Independent Oversight Review of the Hanford Site Waste Treatment and Immobilization Plant Construction Quality

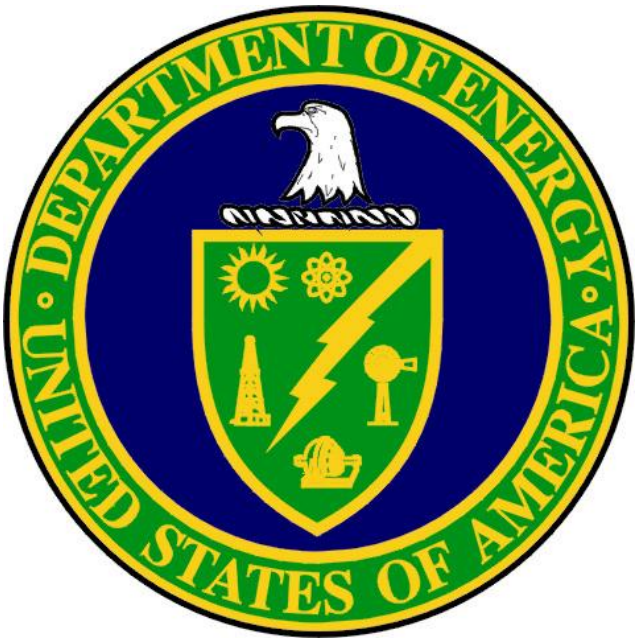

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Table of Contents

Acronyms

AISC	American Institute of Steel Construction
ASME	American Society of Mechanical Engineers
ASTM	ASTM International
BNI	Bechtel National, Inc.
BOF	Balance of Facilities
CDR	Construction Deficiency Report
CM	Commercial Grade
CRAD	Criteria, Review and Approach Document
DOE	U.S. Department of Energy
FSW	Fire Service Water
HLW	High-Level Waste Facility
HSS	Office of Health, Safety and Security
LAB	Analytical Laboratory
LAW	Low-Activity Waste Facility
NCR	Nonconformance Report
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
ORP	Office of River Protection
P&ID	Piping and Instrumentation Diagram
PICA	Post Installed Concrete Anchor
PIER	Project Issues Evaluation Report
POC	Point of Contact
psi	Pounds per Square Inch
PTF	Pretreatment Facility
Q	Quality Related
QA	Quality Assurance
QC	Quality Control
SSC	Structures, Systems, and Components
WCD	WTP Construction Oversight and Assurance Division
WES	Western Electrical Services, Inc.
WTP	Waste Treatment and Immobilization Plant

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1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Enforcement and Oversight (Independent Oversight) within the Office of Health, Safety and Security (HSS) conducted an independent review of selected aspects of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The review, which was performed November 12-15, 2013, was the latest in a series of ongoing quarterly assessments of construction quality performed by Independent Oversight at the WTP construction site.

2.0 SCOPE

The scope of this quarterly assessment of construction quality review included observations of ongoing work activities, review of the Bechtel National, Inc. (BNI) corrective action program, examination of implementation of selected requirements in the BNI quality assurance (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 design concerns that may result in redesign of some systems and/or structures and reductions in construction craft staffing.

Work activities observed during Independent Oversight's November 2013 review included observation of a pneumatic pressure test, structural steel bolting in the High-Level Waste Facility (HLW), and review of the results of quality control (QC) tests performed on samples of concrete placed in the HLW. Independent Oversight examined nonconformance reports (NCRs) and construction deficiency reports (CDRs) identified by BNI under its corrective action program, as well as corrective actions to address deficiencies identified in installation of post installed concrete anchors (PICAs). Independent Oversight also reviewed the BNI construction organization's self-assessment program, as well as BNI QA surveillance reports.

Independent Oversight reviewed various construction quality documents and conducted several construction site walkthroughs, concurrent with DOE Office of River Protection (ORP) staff. During the walkthroughs, Independent Oversight observed pressure testing of piping in the carbon dioxide system in the Low-Activity Waste Facility (LAW) and tightening of structural steel bolting in the HLW. Independent Oversight also examined specifications and procedures that control installation of PICAs, erection of structural steel, and pressure testing of piping and instrument tubing.

3.0 BACKGROUND

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 HLW and 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 BNI under contract to ORP. 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, Independent Oversight has scheduled quarterly reviews to assess the quality of ongoing construction.

4.0 METHODOLOGY

This independent review of the WTP construction project was conducted in accordance with applicable sections of HSS nuclear facility construction criteria, review and approach documents (CRADs) HSS-CRAD-45-52, *Piping and Pipe Supports*; HSS-CRAD-64-15, *Construction - Structural Concrete*; HSS-CRAD-64-16, *Construction - Structural Steel*; and HSS-CRAD-64-20, *Feedback and Continuous Improvement Inspection Criteria and Approach - Contractor*.

5.0 RESULTS

Activities examined by Independent Oversight during the review are discussed below. Each activity is briefly described, followed by a discussion of the review performed by Independent Oversight. Conclusions are summarized in Section 6, and items for follow-up are discussed in Section 7.

NCRs and CDRs

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 (Q) and commercial grade (CM) structures, systems, and components (SSC). NCRs are issued to document and disposition Q nonconforming conditions, while CDRs are used to document and disposition CM nonconforming conditions. SSC designated as Q (previously classified as QL) in the design documents are required to be constructed or manufactured in accordance with the WTP QA program and the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1 standard. SSC 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 as CM suppliers.

Independent Oversight reviewed the 47 NCRs issued by BNI between September 17 and November 15, 2013, and a sample of 19 CDRs issued by BNI between October 1 and 16, 2013, to evaluate the types of nonconforming issues that were identified, their apparent causes, and subsequent corrective actions.

Approximately 20 percent of the NCRs were initiated to document construction or installation errors, or damage to installed components resulting from construction activities. NCRs issued to document and disposition equipment and hardware problems resulting from procurement issues accounted for 40 percent of the NCRs. These 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 transit. Maintenance and material handling issues, such as outdated materials or inadequate preventive maintenance on installed or stored equipment, accounted for another 20 percent of the NCRs. Design/engineering issues, such as drawing or design errors or failure to perform independent quality verification on equipment delivered to the WTP project, accounted for the remaining 20 percent of the NCRs. The CDRs that Independent Oversight reviewed were issued to document and disposition construction errors, design engineering issues, and procurement discrepancies.

The BNI engineering organizations have developed appropriate corrective actions to disposition the problems identified in the completed NCRs/CDRs that Independent Oversight reviewed. The NCR/CDR process and implementation appear adequate to address and resolve construction quality deficiencies.

Deficiencies in Installation of PICAs

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 not available. 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. BNI Specification No. 24590-WTP-3PS-FA02-T0004, *Engineering Specification for Installation and Testing Post Installed Concrete Anchors and Drilling/Coring of Concrete*, and BNI Construction Procedure 24590-WTP-GPP-CON-3205, *Post Installed Concrete Anchors*, contain the requirements for installation, inspection, and testing of PICAs.

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) Number 24590-WTP-PIER-MGT-11-0918-C, *Post Installed Concrete Anchor (PICA) Documentation*. 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 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 Number 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.

Independent Oversight reviewed the status of the CM PICA re-inspection program and found that as of October 31, 2013, BNI Field Engineering had identified 1937 records documenting installation of CM PICAs in the LAW (1158), the LAB (303) and BOF (476). 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 1871 records in the LAW (1112), LAB (300) and BOF (459) identified installation errors on one or more PICAs documented on 671 of these records. BNI initiated 671 CDRs (one for each record that had an installation error) related to PICA deficiencies since September 2011 to disposition the discrepancies. BNI Design Engineering has completed evaluation of more than half of 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. The apparent causes of the installation deficiencies were inadequate installation instructions in the BNI PICA Construction procedure and specification, and inadequate oversight of PICA installations by BNI Field Engineering. 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 installation method for all Q PICAs. QC inspectors do not inspect CM PICAs.

The specification lists two classes of anchors (PICAs) designated for use at WTP: structural and non-structural. Non-structural anchors are defined as: (1) those that support components or equipment weighing less than 400 pounds, are mounted on a floor or wall such that the center of gravity is not more than 4 feet above the floor or platform level, and do not have anchor diameter and embedment requirements listed on design drawings; and (2) attachments to walls or ceiling-mounted components that

weigh 20 pounds or less. For linear type components, such as electrical conduits or instrument tubing, the load per anchor must be less than 20 pounds and the anchor and embedment requirements are not specified on the design drawings. All other anchors that do not meet the definition of non-structural anchors are defined as structural anchors (CM or Q). The BNI specification states that BNI Design Engineering shall provide the anchor bolt type, material, diameter, and embedment depth on a design drawing, and refers the reader to specification Section 3.16 and Appendix C for all structural anchors not listed on design drawings.

For CM PICAs, BNI field engineers are responsible for ensuring that installation of CM PICAs classified as structural anchors complies with project design documents. The specification states that structural CM PICAs are designed and specified by BNI Design Engineering. For non-structural anchors, construction craft personnel are responsible for locating and installing CM non-structural anchors in accordance with Construction Procedure24590-WTP-GPP-CON-3205. Revision 3D of BNI Construction Procedure 24590-WTP-GPP-CON-3205, which was issued on August 21, 2013, added a new requirement for field engineers to inspect non-structural CM PICAs to verify that the minimum spacing between new PICAs and existing PICAs or embedded plates, and the minimum edge distances, comply with procedure requirements; previously, field engineers generally were not required to inspect installation of non-structural anchors (PICAs).

BNI Specification No. 24590-WTP-3PS-FA02-T0004, *Engineering Specification for Installation and Testing of Post Installed Concrete Anchors and Drilling/Coring of Concrete*, and BNI Construction Procedure 24590-WTP-GPP-CON-3205, *Post Installed Concrete Anchors*, were revised in October 2013 to address actions required by PIER Numbers 24590-WTP-PIER-MGT-11-0918-C and 24590-WTP-PIER-MGT-12-1246-B to clarify installation and inspection requirements for the PICAs. As of November 15, 2013, Revision 6 was the current revision of BNI Specification No. 24590-WTP-3PS-FA02-T0004 and Revision 4 was the current revision of BNI Construction Procedure 24590-WTP-GPP-CON-3205. In Section 3.16 and Appendix C of Revision 6 of the specification, the minimum spacing requirements between adjacent CM PICAs, between CM PICAs and Q PICAs, and between CM PICAs and embed plates are more conservative than those cited in previous revisions of the specification, and these requirements are retroactive (see Revision History for Revision 6, page ii of Specification No. 24590-WTP-3PS-FA02-T0004). In discussions with Independent Oversight on the impact of the retroactive changes to the spacing requirements, the Lead Civil Field Engineer indicated that since Revision 6 of the specification increases the minimum spacing between adjacent PICAs, another re-inspection program may be required for the PICAs installed to date. BNI Design Engineering is reviewing the need for such a re-inspection program.

After reviewing the revised specification and Construction procedure, Independent Oversight concluded that controls for installing and inspecting PICAs for PICAs classified as non-structural and for some CM structural anchors are not sufficiently clear to preclude future PICA installation errors. Details for installation of structural PICAs may or may not be shown on design drawings. Construction craft personnel are responsible for locating and installing non-structural anchors in accordance with the specification and Construction procedure, but they may not have a drawing or sketch to use to perform the installation. Independent Oversight observed that:

- Paragraph 2.0 of the Construction procedure, titled Scope, states that the procedure for PICA installation applies only to WTP direct-hire employees. Discussions with site personnel disclosed that subcontractors use their own specifications and procedures for installing PICAs. Although the subcontractor PICA specifications and installation procedures are approved by BNI Design Engineering, the BNI processes do not have clear mechanisms: (1) to incorporate lessons learned from the PICA installation errors disclosed by the ongoing BNI PICA re-inspection process into

subcontractor procedures; and (2) ensure that subcontractors submit as-built details to BNI showing PICAs they installed.

- Seven types of anchors of various sizes (diameter and length) are used at WTP, each one with a different method of installation, different load carrying capacity, and different installation requirements (e.g., distance between adjacent PICAs, embedment depth, edge distance). The specification and Construction procedure are difficult to follow because they cover a variety of technical and installation requirements (for Q PICAs, CM structural PICAs, and non-structural CM PICAs), and they lack clarity regarding design drawings.

- Paragraph 3.16 of the Construction procedure references Appendix C of the specification for CM PICA installation requirements. Appendix C contains seven tables covering a variety of installation criteria. For non-structural anchors, paragraph 3.16 states that: "For adjacent non-structural anchors use the ICBO ES Reports (Appendix A) {International Council of Business Officials Evaluation Services} for requirements, exceptions do not require engineering approval." Appendix A contains the ICBO ES report numbers and references a site document where the reports can be located. The statement "exceptions do not require engineering approval" implies that construction craft are permitted to amend the installation criteria specified in ICBO ES Reports (Appendix A), possibly resulting in an unapproved design change. The non-structural anchor selection and installation process places the burden on construction craft supervision to ensure that the non-structural anchors they approve for installation meet the specification requirements. Instead of being able to use a simple series of tables to determine the correct type, size, location, and spacing for a PICA, craft personnel are required to consult several referenced reports and Appendix C of the specification.

- As noted, the specification and Construction procedure apply to both structural and non-structural anchors and are not clear about the design requirements for various types of PICAs. For Q PICAs, the requirements are clear; the location and size for all Q anchors are shown on the design drawings, and all Q PICAs are the maxibolt (undercut) type of anchor. For CM anchors, the "design" requirements are not clear since the location, type, and size of structural CM PICAs may or may not be shown on design drawings. If the size and type of structural CM anchors are not shown on the design drawings, field engineers are required to select the structural CM PICA size and type in accordance with the design documents. Paragraph 1.4.1 of the specification states that for non-structural anchors, the field engineer may choose any type of approved anchor listed in Appendix A of the specification. The selection of CM structural PICA type by the field engineers may be considered an engineering design function that requires an independent design check under the BNI QA program.

- Although the specification and the Construction procedure indicate that field engineers are involved in selecting the type of non-structural anchors, in practice the construction craft supervisors appear to make most of the decisions regarding selection and installation of non-structural PICAs.

- Paragraph 5.3.8 of the Construction procedure states that adhesive anchors are to be used only where specified by Design Engineering, but also permits construction craft to use adhesive anchors as non-structural anchors. Paragraph 10.1 of the specification prohibits the use of adhesive anchors subjected to sustained loads and references Appendix A, Figure A-1 for examples. However, Appendix A is titled Anchors Approved for use on WTP for CM applications; the correct reference should be Appendix B, Figure E-1. Appendix B of the specification shows examples where adhesive anchors cannot be used, but there are no clear criteria stating where adhesive anchors can be used.

- Paragraph 2 of the Construction procedure states that construction supervisors and field engineers select materials and ensure that parts from one manufacturer are not intermixed with those from another. Under Paragraph 5.4.3, there is a statement that anchor assemblies are kept together for purposes of material control. However, when touring the LAW and LAB, Independent Oversight noted that CM wedge anchors, drop-ins, screw anchors, etc., were stored on shelves in various areas in the buildings. The storage areas were not controlled, and the issuance of anchors to craft personnel appeared to be on a self-service basis. Additionally, various sizes of anchors in the storage areas were mixed together (e.g., a half-inch diameter wedge anchor may be in a box with one-inch wedge anchors), and hardware, such as washers or nuts, was missing from some anchor assemblies. In discussions on WTP's methods for issuing Q PICAs to the construction craft in the field for installation, Independent Oversight found that for Q PICA installations, the materials are controlled and issued from the warehouse as needed. The adhesive materials used for installing CM adhesive anchors are also issued by the warehouse in order to control the shelf life of the adhesive.

- There is a typographical error in the sentence in paragraph 3.16 of the specification where minimum spacing for maxibolts is discussed. The "I.5" should read "1.5" times the embedment depth.

All construction craft personnel who install PICAs are required to attend training to keep current with PICA installation requirements as changes are made to the specification and construction procedure. BNI field engineers are also required to attend training. Independent Oversight observed a training program conducted by BNI field engineers for craft personnel who install PICAs. The training explained the changes in the specification and construction procedure; used visual aids, including sketches and drawings that showed how to determine the minimum spacing requirements between PICAs, PICAs and embedded items, and edge distance; and included a demonstration of a tension load test.

BNI construction management has restricted installation of CM PICAs until the construction procedure and engineering specification are revised and BNI field engineers and craft personnel receive training on the revised PICA installation and inspection instructions. BNI is performing a causal analysis to determine the factors underlying the deficiencies in the installation of the PICAs. Independent Oversight determined that BNI's approach to determining the extent of condition was adequate.

Pressure Testing of Piping

Independent Oversight observed a pneumatic pressure test on piping for the LAW carbon dioxide system. This system produces dry ice pellets that are used to decontaminate casks after they are filled with low activity glass from the LAW melters. The WTP site work process for conducting leak testing is specified in Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 9B, *Pressure Testing of Piping, Tubing and Components*. The requirements for pneumatic pressure testing are specified in ASME Code B31.3, Paragraph 345.5, Pneumatic Testing.

Independent Oversight 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 walkdown 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 pneumatic pressure tests of the LAW carbon dioxide system observed by Independent Oversight were specified in System Pressure Test Package Number 24590-LAW-PPTR-CON-13-0042, -0052, -0053, -0079- -0080, -0083, -0084, -0142, and -0143, Carbon Dioxide Gas System, LAW. This test package included the test data sheets, test information, test requirements, valve lineup

sheets, and marked-up piping and instrumentation diagrams (P&IDs) for the pressure test performed on instrument lines (tubing). 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 test, a WCD Facilities Representative and Independent Oversight walked down portions of the piping system 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, indicate the test position of the component (open, closed, or N/A), and state that operation of the component is restricted to authorized test personnel. It was noted that the tags attached to four valves did not reflect the actual valve position (the tags indicated closed, but the valves were open) and tags were missing from five other valves within the test boundary. When asked about these apparent discrepancies, the BNI field engineers postponed the start of the test and reexamined all valves and components within the test boundary to determine whether the valves were in the correct position and whether the tags indicated the correct valve position for the test configuration. They identified the following discrepancies: (1) Tags on four valves indicated the valve position as closed, but the valves were actually open, which was the correct position for the test. The tags were corrected. (2) Tags indicating valve position were missing from six valves. The valves were in correct position (open) for the test, and tags were then attached to the valves. A tag was also added to one test blank. (3) Block and bleed components are installed adjacent to instruments. These components have two valves, designated "X" and "Y." On two components, the "Y" valves were in the correct test position, but the "X" valves were in the incorrect position. The position of the "X" valves was changed prior to test pressurization, and the tags were changed to indicate the correct position. (4) The six three-way valves within the test boundary have handles with position indications "closed" or "open." The handles on four of the valves were in the "closed" position, while the handles on the remaining two valves were in the "open" position. The test data sheets and tags indicated that all six valves were open. The position indication handle on the "closed" valves was changed to "open." To summarize, within the pressure test boundary, seven tags were missing, six tags indicated the incorrect position for the valves for the pressure test, the position indication handles on four three-way valves were in the incorrect position, and valves on two block and bleed components were in the incorrect position. BNI initiated PIER Number 24590-WTP-PIER-MGT-13-1428-D to address the tagging discrepancies. After the tagging discrepancies were corrected, the pressure test was completed in accordance with the requirements of Construction Procedure 24590-WTP-GPP-CON-3504, 9B.

Discussions with the system engineers indicated that the pressure test for the carbon dioxide system was originally scheduled to be performed as nine separate tests, but a decision was made to combine the nine separate tests into one. Combining the test data sheets may have contributed to the discrepancies in tagging components. The decision to combine the nine individual test packages into one test also affected the free air volume in the piping, which is used to calculate the stored energy in the system being tested, which in turn is used to establish limited access safety boundaries. Independent Oversight reviewed the calculation of the stored energy for the combined system in the pressure test and verified that the stored energies in the nine separate piping sections were added to calculate the total stored energy for the combined system test. The locations of limited access/safety barriers were established in accordance with the test procedure.

The minimum test pressure was 247.5 pounds per square inch (psi), with a specified hold time of 10 minutes. Independent Oversight verified that the calibration stickers on the test pressure gauges were current and that whip restraints were installed on pressure hoses. The systems were pressurized to approximately 250 psi and held for 11 minutes, slightly in excess of the pressure test requirements. Walkdowns and inspections of the piping, valves, and other components were performed by BNI field engineering personnel. Independent Oversight witnessed the walkdowns and inspections and observed the leak tests performed on the welds in the piping and in any fittings used at joints between instrument tubing sections and the piping. Minor leaks were identified in two three-way valves and one pipe cap that

could not be corrected by tightening the fittings in accordance with the test procedure. It appeared that the leaks were between the valve body and O-rings. CDR number 24590-WTP-CDR-CON-13-0900 was initiated to document the leaks in the three-way valves. The valves will be retested after repairs are completed.

Structural Steel Activities

Independent Oversight observed pre-tensioning (tightening) of 14 high strength structural steel bolts at Connection number 42, Elevation 72'-0", Column lines 6 and R-2 in the HLW. The requirements for installation, tightening, and inspection of bolts are specified in BNI Construction Procedure 24590-WTP-GPP-CON-3206, Rev. 5A, *Structural Steel Installation and On-Site Fabrication.* High strength bolts meeting the requirements of ASTM International (ASTM) A490 were installed in the joints. Due to the joint configuration and geometry, it was necessary to use fastener assemblies that could be pre-tensioned using the turn-of-nut method in bolt holes where the tool used to pre-tension the twist-off bolts could not be used because of interference with other structural steel members. Prior to final pre-tensioning, the bolts were installed in the connection and snug tightened in accordance with the bolt installation requirements specified in American Institute of Steel Construction (AISC) 348, *Specification for Structural Joints Using ASTM A325 or A490 Bolts*. Before pre-tensioning, a BNI QC inspector marked each nut to indicate the required rotation for the fastener assemblies pre-tensioned by the turn-of-nut method (1/3 turn). The QC inspector witnessed the bolting crew apply tensioning force and verified that the nut was rotated as required. Eight fastener assemblies were pre-tensioned using this method, two of which had to be removed and replaced because it was necessary to loosen two nuts after the pre-tensioning force was applied; AISC 348 does not permit re-installation of high strength ASTM 490 bolts after they are initially pre-tensioned. The six twist-off type fastener assemblies were pre-tensioned by severing the splined end of the fastener assembly using the air operated tool designed for this task. The bolting activities were performed in accordance with procedure requirements.

Concrete Placement Records

Concrete placement activities have been deferred in the PTF due to design and process questions. Concrete placements continue in the HLW, but at a slow pace due to reductions in construction craft staffing. Independent Oversight reviewed the results of QC tests performed on concrete samples from the five Q concrete placements in the HLW facility completed between August 8 and October 30, 2013. 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 for 7 to 28 days. The concrete design strength is based on the unconfined compression strength of concrete cylinders, which are either 4 inches in diameter and 8 inches high or 6 inches in diameter and 12 inches high. The concrete strength is determined by casting samples of concrete in cylindrical molds, moist curing them in a field laboratory for a specified period, and then subjecting them to an unconfined compression test. The results of the unconfined compression tests are used to verify the concrete quality and demonstrate that the concrete meets the design strength requirements. The methods for sampling the concrete, casting and curing the cylinders, and performing the unconfined compression tests are specified in ASTM standards. Typically, the design strength at WTP is based on concrete test cylinders cured in the laboratory for 28 days, and the unconfined compression strength of the concrete at 28 days generally exceeds the specified design strength by 1000 psi or more for all classes of structural concrete. The unconfined compression tests performed on 20 concrete cylinders from four of the five concrete wall placements reviewed showed that the concrete strength at an age of 28 days in these placements ranged between 5830 and 7160 psi. The average strength for the 20 test cylinders was 6322 psi. The required (design) strength for the concrete is 5000 psi. The concrete placed on October 30 had not attained an age of 28 days during this review. The results of unconfined compression tests performed on the concrete

cylinders from the October 30 placement at an age of 7 days ranged from 4950 to 5250 psi. The quality of concrete at the WTP plant has been good.

Management Self-Assessment Program

In the May 2013 construction quality quarterly report issued on May 22, 2013, Independent Oversight identified an opportunity for improvement (OFI) in 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 initiated PIER 24590-WTP-PIER-MGT-13-0743-D to address this OFI in June 2013. Independent Oversight 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, DOE Order 226.1A, Attachment 1, Appendix A, 2.a.(5) and Paragraph 2.2.2.2.3 of BNI Quality Assurance Manual Policy Q-02.2 state that self-assessment results are to be documented commensurate with the significance of risks associated with the activities being evaluated.

BNI Construction Procedure 24590-WTP-GPP-MGT-036, *WTP Self-assessment,* is the implementing procedure that WTP personnel use to perform the self-assessments necessary to comply with the BNI QA program and DOE QA requirements. This procedure describes a process for managers and employees to use when performing self-critical evaluations of their work processes and activities to ensure that work is performed as expected and to monitor work results to ensure that completed work meets project requirements. The procedure describes compliance-based and performance-based self-assessments as the processes for evaluating performance at all levels to identify problems with work processes and completed work activities. A compliance-based assessment is 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 includes 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 is defined as one that 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.

The last paragraph in the Overview section of the procedure states that: (1) typically, a self-assessment combines performance- and compliance-based activities; (2) while both elements are essential, WTP places a high degree of importance on performance-based assessments; and (3) a performance-based assessment is an excellent means of positively affecting the products or services resulting from a process. The procedure recommends developing lines of inquiry related to the scope of the self-assessment.

Between January 1 and August 1, 2013, the BNI Field Engineering organization performed 21 compliance-based self-assessments that were limited to reviewing completed construction records to determine whether the records were complete and accurate. No additional compliance-based self-assessments were completed between August 1 and November 15, 2013, by this organization, nor did this organization complete any performance-based self-assessments in 2013 to observe ongoing work activities and evaluate performance in construction activities, such as piping and pipe support installation, instrument tubing and support installation, and electrical cable and component installation. Performance-based self-assessments had been scheduled to observe structural steel erection and pressure testing of piping in October 2013, the former in response to DOE and BNI quality issues identified in 2008 through 2011. However, these two self-assessments have been deferred until 2014.

The BNI Field Engineering organization's activities are critical to the successful operation of the WTP. Field engineers are responsible for inspection (quality verification) of CM construction activities and installation of CM components to determine whether these activities are being performed in accordance with design requirements. Approximately 25 percent of the piping and vessels installed in the black cells and hard-to-reach areas are classified as CM, and field engineers are responsible for performing quality verification activities for these components. (See the Independent Oversight construction quality report for November 14-17, 2011, issued in March 2012.) Although CM components are not required for accident mitigation, operation of the CM components is necessary for treatment and disposal of the 56 million gallons of waste stored in the Tank Farm. The construction field organization has not fully implemented a self-assessment program that includes both performance- and compliance-based assessments to evaluate work processes and work in progress as required by DOE Order 226.1A. BNI provided Independent Oversight with a tentative self-assessment schedule indicating that nine performance-based self-assessments are planned for 2014, covering several work activities including cable installation and terminations, structural steel erection, pressure testing, alignment of pumps, and nondestructive examination of welding.

Quality Assurance Surveillances

BNI Procedure 24590-WTP-GPP-QA-601, *Quality Assurance Surveillance*, describes the process used to plan, conduct, and document QA surveillances of work activities at WTP. The onsite QA staff conducts these surveillances, which generally focus on observations of work activities to determine whether procedures are being followed. Independent Oversight reviewed four QA surveillances completed in August and October 2013:

- QA/QC Surveillance Report Number 24590-WTP-SV-QA-13-086, External Lessons Learned Organizational POC Flowdown of Information. The scope of this surveillance was to determine whether external lessons learned and operating experience documents are reviewed and processed by assigned point of contact (POC) coordinators in various WTP organizations and whether the POC reviewers are disseminating the lessons learned data to their organizations as specified in Procedure 24590-WTP-GPP-MGT-017, *WTP Lessons Learned*. The QA surveillance identified several issues regarding inadequate training of POC coordinators that resulted in some POC coordinators failing to perform lessons learned reviews in compliance with the procedure. A number of administrative issues were identified that also limit the effectiveness of the lessons learned program at WTP. PIER Number 24590-WTP-PIER-MGT-13-1021-C was initiated to address the QA surveillance findings. The surveillance was classified as unsatisfactory.

- QA/QC Surveillance Report Number 24590-WTP-SV-QA-13-096, Pressure Testing Fire Service Water (FSW) System for the Standby Diesel Generator. The scope of this surveillance was to observe hydrostatic testing of a portion of the piping for the FSW system (a CM system) for the standby diesel generator. The surveillance included the following activities: review of the test package, attendance at the pre-job briefing, verification that calibration of pressure gauges was current, review of system tagging, observation of system pressurization, observation of system walkdown and leak checks, and review of test data. No leaks were identified during the test, and the test was determined to be successful. A review of the test data package after the test identified that the P&ID that was used in the test was not current; a design change to the P&ID had added two line numbers that were part of the pressure test. BNI Field Engineering initiated PIER Number 24590-WTP-PIER-MGT-13-1213-C to address this discrepancy, which is similar to Independent Oversight's observations discussed above under Pressure Testing of Piping. The surveillance was classified as unsatisfactory.

- QA/QC Surveillance Report Number 24590-WTP-SV-QA-13-097, Western Electrical Services (WES), Inc. Electrical Testing in Switchgear Building 91. The scope of this surveillance was to determine whether WES is performing testing of the medium voltage electrical system in Building 91 in accordance with WTP work control and subcontract requirements. The work observed is CM and was performed in a BOF building. Overall, the tests observed during the surveillance were acceptable. However, two PIERs were initiated: PIER Number 24590-WTP-PIER-MGT-13-1245-C, documenting that the WES onsite crew leader did not hold current certification in electrical testing; and PIER Number 24590-WTP-PIER-MGT-13-1293-C, documenting that electricians failed to record lifted leads as required by test procedures. The surveillance was classified as unsatisfactory.

- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-101, Performance Qualification Testing Craft Personnel Bonding of Joints in Nonmetallic Materials. The scope of this surveillance was to observe testing to qualify craft personnel to bond nonmetallic materials (PVC piping) using solvent cement in accordance with ASME B31.3 requirements. Although the pressure test was classified as a failure, no findings were identified. The initial test failed at a threaded coupling connection. During a retest, a coupling fractured. The following activities were observed during the surveillance and deemed to be satisfactory: documentation in work package, pre-job briefings, joint preparation, fit-up, and assembly, establishment of safety boundaries, conduct of test, and documentation of failures. The surveillance was classified as satisfactory.

The BNI QA surveillance program was found to be satisfactory for the sample reviewed by Independent Oversight. QA surveillances are performed to observe the full range of ongoing work activities. Independent Oversight also reviewed 14 QC surveillance reports that documented surveillance activities performed by QC inspection personnel in September and October 2013. The activities included verification of proper application of hold tags, various civil/structural construction and testing activities, surveillance of subcontractors, and cable pulling. The 14 QC surveillance reports reviewed were classified as satisfactory. Independent Oversight concluded that the BNI QC surveillance program is acceptable.

6.0 CONCLUSIONS

It is emphasized that design and procurement programs are not included in the scope of this quarterly construction quality review. Independent Oversight determined that construction quality at WTP is adequate in the areas that were reviewed. BNI Engineering has developed appropriate corrective actions to resolve construction quality NCRs and CDRs, and BNI continues to implement corrective actions necessary to address errors in installation of PICAs. However, the BNI specification and Construction procedure that cover installation of CM PICAs should be revised to provide clearer direction to field engineers and construction craft personnel for PICA installations that are not shown on a design drawing or sketch.

The self-assessment program in the BNI construction Field Engineering organization still consists of mostly compliance-based assessments, and does not regularly include performance-based assessments. Almost all self-assessments conducted by this organization since 2011 have focused on determining the completeness and accuracy of completed construction records. BNI Field Engineering conducted no performance-based self-assessments of work in progress during the first ten months of 2013, and only three performance-based self-assessments in 2011 and 2012. The self-assessment program implemented in the BNI Field Engineering organization still needs improvement, as identified in the May 2013 Independent Oversight review of WTP construction quality.

7.0 ITEMS FOR FOLLOW-UP

Independent Oversight will continue to follow up on inspection of welding activities, piping and pipe supports, pressure testing of piping, cable pulling, and cable terminations. Independent Oversight 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.

Appendix A
Supplemental Information

Review Dates

November 12-15, 2013

Office of Health, Safety and Security Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
William A. Eckroade, Principal Deputy Chief for Mission Support Operations
John S. Boulden III, Director, Office of Enforcement and Oversight
Thomas R. Staker, Deputy Director for Oversight
William E. Miller, Deputy Director, Office of Safety and Emergency Management Evaluations

Quality Review Board

William A. Eckroade
John S. Boulden III
Thomas R. Staker
William E. Miller
Michael A. Kilpatrick

Independent Oversight Site Lead for Hanford Site

Robert Farrell

Independent Oversight Team Composition

Joseph Lenahan

Appendix B
Documents Reviewed

- Construction Procedure 24590-WTP-GPP-CON-3503, Rev. 6C, Aboveground Piping Installation, August 29, 2013
- Construction Procedure 24590-WTP-GPP-CON-3509, Rev. 3, Pipe Support Installation, September 10, 2013
- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 9B, Pressure Testing of Piping, Tubing and Components, September 10, 2013
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 4, Post Installed Concrete Anchors, October 8, 2013
- Construction Procedure 24590-WTP-GPP-CON-3206, Rev. 5A, Structural Steel Installation and On-Site Fabrication, February 14, 2013
- Specification No. 24590-WTP-3PS-FA02-T0004, Rev. 6, Engineering Specification for Installation and Testing of Post Installed Concrete Anchors and Drilling/Coring of Concrete, October 7, 2013
- Construction Procedure 24590-WTP-GPP-MGT-043, Rev. 5A, Corrective Action Management, September 20, 2013
- Construction Procedure 24590-WTP-GPP-MGT-044, Rev. 1D, Nonconformance Reporting and Control, July 29, 2013
- Construction Procedure 24590-WTP-GPP-MGT-036, Rev. 2A, WTP Self Assessment, October 8 , 2012
- Construction Procedure 24590-WTP-GPP-QA-601, Rev. 6C, Quality Assurance Surveillance, May 1, 2013
- Procedure Number 24590-WTP-MN-CON-01-001-10-10. Rev. 6, Bechtel Nondestructive Examination Standard Visual Examination VT-AWS D1.1
- Document No. 24590-WTP-QAM-QA-06-001, Rev. 13, Quality Assurance Manual, September 20 , 2013
- Construction Deficiency Report numbers 24590-WTP-CDR-CON-13-0793 through 13-0812
- Nonconformance Report numbers 24590-WTP-NCR-CON-13-0137 through -0183
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-086, External Lessons Learned Organizational POC Flowdown of Information
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-096, Pressure Testing Fire Service Water (FSW) System for the Standby Diesel Generator
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-097, Western Electrical Services, Inc. Electrical Testing in Switchgear Building 91
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-101, Performance Qualification Testing Craft Personnel Bonding of Joints in Nonmetallic Materials
- QA/QC Surveillance Report Numbers 24590-WTP-SV -QC-13-102 through 106, 108 through 110, 112 through 115, 120 and 122
- Drawing Number 24590-HLW-SS-S15T-00067, Rev. 1, HLW Vitrification Building Structural Steel Framing Partial Plan EL 72’0” (Area 7)
- Drawing Number 24590-HLW-SS-S15T-00207, Rev. 2, HLW Vitrification Building Structural Steel Framing Elevation COL Line R.2 Sheet 1
- Drawing Number 24590-HLW-SS-S15T-00264, Rev. 5, HLW Vitrification Building Structural Vertical Bracing Details Sheet 1 of 2
- Drawing Number 24590-HLW-SS-S15T-00326, Rev. 0, HLW Vitrification Building Structural BM to COL & BM to BM Typical Connection Details

- System Pressure Test Document No. 24590-LAW-PPTR-CON-13-0042, -0052, -0053, -0079- -0080, -0083, -0084, -0142, and -0143, Carbon Dioxide Gas System, LAW
- Drawing Number 24590-LAW-M6-CDG-00001001, Rev. 0, Carbon Dioxide Gas System CDG-VSL-0001
- Drawing Number 24590-LAW-M6-CDG-00001002, Rev. 0, Carbon Dioxide Gas System CDG-PMP-00001A/B-00002A/B
- Drawing Number 24590-LAW-M6-CDG-00002002, Rev. 0, Carbon Dioxide Gas System CDG-SKID-00004B & 00005B
- Drawing Number 24590-LAW-M6-CDG-00002001, Rev. 0, Carbon Dioxide Gas System CDG-SKID-00004A & 00005A