

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



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Acronyms

ASME	American Society of Mechanical Engineers
BNI	Bechtel National, Inc.
BOF	Balance of Facilities
CAMP	Corrective Action Management Program
CDR	Construction Deficiency Report
CFR	Code of Federal Regulations
CM	Commercial Grade
CR	Condition Report
CRAD	Criteria and Review Approach Document
CRD	Contractor Requirements Document
CS	Construction Subcontractor
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EMF	Effluent Management Facility
FSW	Fire Service Water
FY	Fiscal Year
HLW	High-Level Waste
HVAC	Heating, Ventilation, and Air Conditioning
ITP	Inspection and Test Plan
LAB	Analytical Laboratory
LAW	Low-Activity Waste
NCR	Nonconformance Report
NFPA	National Fire Protection Association
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
ORP	Office of River Protection
psi	Pounds per Square Inch
PTF	Pretreatment Facility
Q	Quality Related
QA	Quality Assurance
QAM	Quality Assurance Manual
QC	Quality Control
SC	Subcontract Coordinator
SSC	Structure, System, or Component
WCD	ORP Construction Oversight and Assurance Division
WTP	Waste Treatment and Immobilization Plant

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of construction quality and the implementation of the quality assurance program at the Hanford Site Waste Treatment and Immobilization Plant (WTP) from June 20 to 23, 2016. EA performed this assessment in the broader context of an ongoing program of quarterly assessments of construction quality at the WTP construction site.

The scope of this EA assessment included observing ongoing work activities, reviewing the Bechtel National, Inc. (BNI) program for controlling non-conforming conditions, examining the implementation of selected requirements in the BNI quality assurance program, and following up on issues identified during previous assessments.

BNI continues to identify non-conforming conditions involving procured equipment and hardware. Much of this equipment was manufactured and delivered to the project between five and ten years ago, and the vendors or manufacturers who supplied some of this equipment are no longer in business. EA's review indicated that BNI Design Engineering has found it necessary to dedicate a large number of personnel and resources to adequately resolve those non-conforming conditions, thereby adversely impacting the construction schedule.

EA identified one deficiency in that inspection and test plans used by subcontractors lack rigor and do not conform to BNI procedure requirements for inspection and quality verification requirements. EA also identified a concern with the quality of subcontractor surveillances.

Overall, construction quality at WTP is satisfactory in the other areas reviewed (pressure testing of piping, structural concrete, and welding inspection activities). EA also reviewed closed non-conformance reports and BNI construction deficiency reports and found that BNI has developed appropriate corrective actions to resolve specific deficiencies.

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1.0 PURPOSE

The U.S. Department of Energy (DOE) independent Office of Enterprise Assessments (EA) conducted an assessment of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The onsite portion of this assessment was conducted June 20-23, 2016. This EA assessment was performed within the broader context of an ongoing program of assessments of construction quality at DOE major construction projects. Because of the safety significance of WTP facilities, EA plans to continue these ongoing quarterly assessments at the WTP construction site to ensure that construction contractors meet the requirements of 10 CFR 830, Subpart A, *Quality Assurance Requirements*.

2.0 SCOPE

This quarterly assessment evaluated construction quality by observing ongoing work activities, reviewing the Bechtel National, Inc. (BNI) program for controlling non-conforming conditions, and examining the implementation of selected requirements in the BNI quality assurance (QA) program, the BNI corrective action program, and the BNI program for oversight of subcontractors. Design and procurement programs were not included in this assessment.

3.0 BACKGROUND

The DOE Office of River Protection (ORP) manages the 56 million gallons of liquid or semi-solid radioactive and chemical waste stored in 177 underground tanks at the Hanford Site and the WTP, an industrial complex for separating and vitrifying the radioactive and chemical waste in the underground tanks. The WTP is in the design and construction phase.

BNI manages design and construction activities at WTP under contract to ORP. The QA program requirements for design and construction of the WTP referenced in the preliminary documented safety analysis and cited in the BNI contract are American Society of Mechanical Engineers (ASME) Nuclear QA (NQA) -1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, and DOE Order 414.1C, *Quality Assurance*.

The WTP complex consists of the Pretreatment Facility (PTF) for separating the waste into low-activity waste (LAW) and high-activity waste (HLW); the HLW Facility, where HLW will be immobilized in glass; the LAW Facility, where LAW will be immobilized in glass; the Analytical Laboratory (LAB) for sample testing; and the balance of facilities (BOF) that will house support functions. Construction work is essentially complete for the LAB and most BOF buildings. ORP staff members, primarily the WTP Construction Oversight and Assurance Division (WCD) staff, provide oversight of construction activities at the WTP.

Construction work activities are deferred in the PTF pending satisfactory resolution of technical questions regarding separation and processing of the waste and the design life of PTF equipment. Construction has slowed in the HLW Facility pending resolution of technical issues involving the waste treatment process.

ORP currently plans to commission the LAW Facility to start processing LAW in 2022, before completion of the HLW Facility and the PTF. An additional facility, the Effluent Management Facility (EMF), will be constructed to process the non-radioactive liquid byproducts resulting from the LAW processed in the LAW Facility. Initial design of the EMF is completed and some preliminary construction work is in progress, such as relocating fire service water (FSW) piping, isolating systems necessary to facilitate operation of the LAW Facility prior to completion of the HLW and PTF, placing reinforcing steel for the EMF foundation, and preparing for procurement of equipment. Concrete placement is on hold pending approval of the EMF design by the State of Washington Department of Ecology.

4.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*. EA implements the independent oversight program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. Organizations and programs within DOE use varying terms to document specific assessment results. In this report, EA uses the terms “deficiencies, findings, and opportunities for improvement [OFIs]” as defined in DOE Order 227.1A. In accordance with DOE Order 227.1A, DOE line management and/or contractor organizations must develop and implement corrective action plans for the deficiencies identified as findings. Other important deficiencies not meeting the criteria for a finding are also highlighted in the report and summarized in Appendix C. These deficiencies should be addressed consistent with site-specific issues management procedures.

EA conducted this assessment of WTP construction quality processes in accordance with the *Plan for the Office of Enterprise Assessments Review of the Hanford Site Waste Treatment and Immobilization Plant Construction Quality*, dated June 2016. This assessment considered the requirements of 10 CFR 830, Subpart A, and DOE Order 414.1C, which specify that the contractor must use appropriate national consensus standards to implement DOE QA requirements.

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

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

EA reviewed procedures, specifications, drawings, and records; interviewed key personnel responsible for construction and inspection work activities; and conducted site walkdowns to observe work activities and inspect WTP components. EA conducted several construction site walkthroughs with the WCD staff to determine whether work activities were completed in accordance with the appropriate design drawings, specifications, and installation procedures. EA observed portions of two piping pressure tests; inspection of welds on a PTF vessel and on piping in the LAW Facility and BOF; and a commercial grade concrete placement. EA also examined the concrete batch plant and construction materials testing laboratory. EA reviewed assessments performed by BNI and the BNI program for oversight of subcontractors and reviewed non-conformance reports (NCRs), construction deficiency reports (CDRs), and condition reports (CRs) that BNI identified under its corrective action program.

The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. A detailed list of the documents reviewed, personnel

interviewed, and observations made during this assessment, relevant to the findings and conclusions of this report, is provided in Appendix B.

5.0 RESULTS

The national consensus standard and basis for the BNI QA program is ASME NQA-1-2000. BNI Document 245909-WTP-QAM-QA-06-001, *Quality Assurance Manual*, provides a detailed description of the application of the 18 NQA-1-2000 requirements to the WTP. The QA Manual (QAM) establishes a management system of planned and systematic actions necessary to ensure that structures, systems, and components (SSCs) perform satisfactorily in service.

5.1 BNI 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)

Identified conditions adverse to quality shall be documented, evaluated, and corrected in a timely manner. Objective evidence shall demonstrate satisfactory implementation of corrective actions and performance improvement. (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*, adequately defines the requirements for identifying, documenting, reporting, controlling, and dispositioning non-conforming conditions associated with Q (previously classified as Quality-List or QL) and commercial grade (CM) SSCs at the WTP. It requires NCRs to be issued to document and disposition non-conforming conditions associated with Q SSCs, while CDRs are required to document and disposition such conditions associated with CM SSCs. SSCs designated as Q in the design documents must be constructed or manufactured in accordance with the WTP QA program and the ASME NQA-1 standard. SSCs designated in the design documents as non-Q (i.e., CM) be constructed in accordance with CM standards, such as the Uniform Building Code, or purchased as CM items from vendors who are qualified CM suppliers.

EA reviewed the 141 NCRs that BNI issued between March 18 and June 23, 2016, and the 67 CDRs that BNI issued between May 3 and June 23, 2016, to evaluate the types of non-conforming issues, as well as their apparent causes. The NCRs included 7 related to construction or installation errors, including damage to installed components resulting from construction activities; 5 related to work performed by subcontractors; 23 for engineering design deficiencies; 2 for materials handling issues, such as expired shelf life; 1 for a maintenance issue; and 103 for procurement and supplier deficiencies. Approximately half of the 103 procurement and supplier NCRs concern documentation deficiencies with various components for the two LAW Facility melters.

Most of the NCRs concerning engineering design deficiencies were initiated for design calculations that did not comply with project quality requirements. BNI Design Engineering is evaluating the NCRs related to procurement and supplier deficiencies to determine the corrective actions required to resolve the deficiencies. Most of the NCRs that remain open require review by Design Engineering.

BNI categorized the 67 CDRs as follows: 31 for BNI construction deficiencies, 14 for procurement and supplier deficiencies, 8 for engineering errors, 3 for maintenance issues or for materials identified with expired shelf life, and 11 for deficiencies in subcontractor work. Ten of the construction CDRs were initiated to document errors in the installation of post installed concrete anchors. Nine of the CDRs were initiated for errors in installation of electrical items.

For closed NCRs and CDRs EA determined that the records document the completed corrective actions and provide evidence that corrective actions were satisfactorily implemented. However, as noted in previous EA assessments, corrective actions necessary to disposition open NCRs and CDRs have not always been timely, resulting in a significant backlog of open CDRs and NCRs.

As EA previously noted, procurement deficiencies continue to challenge the BNI Design Engineering organization. Each procurement issue requires an evaluation by Design Engineering on a case-by-case basis. Many of these issues involve equipment delivered several years ago. Some deficient equipment was supplied by vendors or manufacturers who are no longer in business. Examples of the deficiencies include missing or incomplete documentation, incomplete inspections, improper fabrication, or manufacturing defects. The number and variety of procurement deficiencies has required Design Engineering to dedicate a large number of personnel to resolve the identified problems, adversely impacting the construction schedule. For example, additional engineers were hired to resolve design and procurement deficiencies resulting in a reduction of the construction workforce due to budget limitations. Furthermore, some field engineers and QC inspectors have been assigned to inspect installed components and hardware to determine whether the equipment furnished by the vendor complies with the design drawings and specifications.

5.2 Piping Pressure Tests

Criterion:

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

EA observed portions of two hydrostatic piping pressure tests that were performed on the FSW piping, a section of a fire service loop main yard piping that was relocated in preparation for construction of the EMF, and a FSW system drain line in FSW pump building 84A. 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 procedure includes test requirements, test prerequisites, hold points, inspection requirements, the test sequence, instructions for recording and evaluating data and acceptance criteria. The procedure references the appropriate Codes and documents approved by BNI Design Engineering for conduct of pressure testing. The procedure was adequate.

Construction Procedure 24590-WTP-GPP-CON-3504 references the National Fire Protection Association (NFPA) Code for the hydrostatic pressure testing criteria for the FSW system, NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances, Section 10.10.2.2, Hydrostatic Test* contains the hydrostatic criteria for FSW main piping. NFPA specifies to minimum test pressure of 200 pounds per square inch (psi) or 50 psi above the normal system working pressure, whichever is greater, for a minimum of two hours. The acceptance criterion specified in the NFPA Code is no visible leakage. The NFPA Code permits water to be added to the system to maintain test pressure, up to a maximum

volume specified in the NFPA Code under the hydrostatic testing allowance values that are based on piping diameters and lengths within the test boundary.

After the hydrostatic test on the FSW system drain line, EA examined the sections of the piping system within the test boundary and the valve lineup and pressure test tags attached to the valves, reviewed drawings and test data sheets, examined the testing apparatus, and verified that the calibration stickers on the instruments used during the pressure test (pressure gauges) were current and that whip restraints were installed on pressure hoses. Since the normal system working pressure is 175 psi, a minimum test pressure of 225 psi was specified (50 psi above the normal system working pressure). No leaks were observed, and the test results were satisfactory.

EA attended the pre-test briefing for the FSW fire main piping test, reviewed drawings and test data sheets, examined the testing apparatus, and verified that the calibration stickers on the instruments used during the pressure test (pressure gauges) were current and that whip restraints were installed on pressure hoses. EA examined the sections of the piping system and examined the valve lineup and pressure test tags attached to the valves. Since the normal system working pressure is 175 psi, a minimum test pressure of 225 psi was specified (50 psi above the normal system working pressure). EA witnessed initial system pressurization and system walk downs performed by the test (field) engineer to check for leakage prior to start of the test hold time. The test engineer verified that the pipe joints were visible and accessible for inspection after the test hold time. Before the test pressure was attained, the test engineer observed a leak at a pipe joint. The test was discontinued, the system was depressurized, and the joint was repaired during the week following this EA review. After repairs were completed, this section of FSW fire main piping was re-tested. A WCD site inspector reviewed the records documenting the results of the hydrostatic test and found that the test was satisfactory.

The implementation of the pressure testing program was satisfactory for the sample that EA reviewed.

5.3 Manufacture and Placement of Concrete

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 performed a walk down of the concrete batch plant and concrete and materials testing laboratory. EA examined storage of fine and coarse aggregate, admixtures, cement, and fly ash at the batch plant. In the concrete and materials laboratory, EA examined the concrete test cylinder curing room and the condition of the laboratory testing equipment. The temperature of the curing is monitored using a continuous temperature recorder to verify that the temperature is maintained within the range specified in ASTM International standards. A continuous water spray from fog nozzles is used to maintain the required 100 percent humidity for curing the concrete test cylinders. The laboratory testing equipment was in excellent condition, and all equipment examined had labels attached showing the dates of the last calibration and the next re-calibration. EA identified no deficiencies..

EA also observed a CM concrete placement for an electrical junction box adjacent to the LAB. Activities observed were testing of the freshly mixed concrete to verify it met specification requirements, and placement and consolidation of the concrete in the forms. The BNI subcontract materials and concrete testing organization tested the concrete, and BNI QC inspectors continuously observed the concrete placement activities. No deficiencies were observed by EA.

EA reviewed the results of QC tests performed on concrete samples from the four Q concrete placements in the HLW Facility between April 5 and May 11, 2016. Test acceptance criteria are specified in BNI Specification No. 24590-WTP-3PS-DB01-T0001, *Engineering Specification for Furnishing and Delivery of Ready Mixed Concrete*. The tests included slump, temperature, and unit weight testing of the freshly mixed concrete and unconfined compression testing of concrete cylinders that were moist cured in the concrete laboratory. Unconfined compression tests are used to determine if the strength of the concrete meets the specified design strength, which is the test acceptance criteria. In addition to unconfined compression tests (for concrete strength) on two concrete test cylinders that are moist cured in the concrete field laboratory for 28 days, one concrete cylinder is also tested at 7 days to provide an early indication of the 28-day concrete strength and show that the concrete that was placed can be expected to meet design requirements. The methods for sampling the concrete, casting and curing the cylinders, and performing the unconfined compression tests are specified in ASTM International standards.

The unconfined compression tests performed on ten sets of concrete cylinders from the four HLW Facility pours showed that the concrete strength at 28 days in these placements ranged between 6,380 and 7,350 psi. The average 28-day strength for these test cylinders was 6,885 psi, well in excess of the 5,000 psi design strength.

The concrete testing records demonstrated that the concrete meets the requirements specified in BNI Specification No. 24590-WTP-3PS-DB01-T0001 and exceeds the design strength.

5.4 WCD Welding Inspection Program

Criterion:

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

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

EA observed a WCD site inspector performing an independent visual inspection of one final pipe weld on a section of the C2 ventilation piping in the LAW Facility and a final weld on a section of BOF piping associated with isolation of the plant cooling water system to permit independent operation of the LAW Facility prior to startup of the HLW and PTF facilities. The WCD site inspector had pre-selected these welds (listed in Appendix B) as DOE designated witness points. The WCD site inspector verified that the acceptance criteria for visual examination of the piping welds specified in *Bechtel Nondestructive Examination Standard, Visual Examination VT-ASME* were met; reviewed the field welding checklists, weld wire draw slips, and drawings associated with the welds inspected; and verified that the correct filler materials and weld processes were used to complete the welds and that the size and type of welds

matched the construction drawings. Welding procedures and welder qualification records were reviewed during previous EA Assessments.

EA and a WCD site inspector also observed BNI QC inspectors and a BNI welding engineer performing visual inspection of external seam welds and nozzle welds on PWD-VSL-00016, a quality level tank (vessel) in a PTF black cell, Module PA 7. These inspections were performed to resolve questions concerning missing vendor fabrication records for the vessel. BNI had previously opened an NCR to document the fact that some fabrication records were missing or incomplete. The welding engineers and QC inspectors examined the welds to determine whether they were the size and type specified on the design drawing, and met the specification quality requirements. Welds that did not appear to meet design requirements were documented for evaluation to determine corrective actions.

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

5.5 Self-Assessment of WTP Onsite and Offsite Level C Storage Areas

Criterion:

Line and support organizations shall perform self-assessments of their performance and the adequacy of their processes. 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 226.1B, and DOE Order 414.1C)

In April 2015, the Defense Nuclear Facilities Safety Board (DNFSB) conducted a review of warehouse facilities at the WTP site and two offsite facilities in Washington State: the Material Handling Facility in Richland, and the Yakima warehouse that stores hardware, materials, and components for the WTP. The DNFSB identified 11 deficiencies pertaining to storage, material control, and the material control program. The results of the DNFSB review that was performed in April, 2015 are documented in a Staff Issue report dated February 18, 2016, Subject: *Waste Treatment and Immobilization Plant Quality Assurance Review*. In response to the DNFSB findings, BNI performed a reactive self-assessment September 1-15, 2015, follow-up on the DNFSB review by examining the 44 Level C storage facilities (covered, but no temperature controls) at the WTP site. These storage facilities consisted of tents and/or tarps covering equipment and hardware that required protection from the weather, including sand and debris blown by high winds that are prevalent at the WTP site. EA reviewed BNI Self-Assessment Report 24590-SAR-CON-15-0028, *Construction Level C Storage*, which documented BNI's findings. Twenty-six facilities were acceptable, 8 required normal maintenance, and 10 required repairs. Of the ten facilities requiring repair, two have been repaired, and the stored materials from the other eight facilities have been relocated.

The self-assessment was adequate and documented in sufficient detail to identify the activity assessed, the individuals who performed the self-assessment, and the results and corrective actions.

5.6 BNI Programs for Oversight of Subcontractors

Criterion:

Assessment programs must be risk-informed and appropriately cover potentially high consequence activities. (DOE Order 226.1B, Contractor Requirements Document (CRD) 2.b.(2))

EA examined the BNI Construction Subcontracts (CS) and QC organizations' oversight of equipment and service vendors supplying both Q and CM equipment and services. EA evaluated recently revised

procedures, selection and prioritization of surveillance and assessment topics, the fiscal year (FY) 2016 surveillance and assessment schedules, and a sample of surveillance and assessment reports. EA also observed the performance of a BNI review of the subcontractor that applies protective coatings to concrete and metallic surfaces and a BNI QC surveillance of the subcontractor that supplies concrete for the WTP project.

BNI Subcontractor Oversight Processes

EA reviewed two recently revised subcontractor oversight procedures: the CS organization's implementing procedure, BNI Procedure 24590-WTP-GPP-CON-4103, *Subcontract Surveillance, Inspection, and Quality Verification*, and the QC organization's implementing procedure, BNI Procedure 24590-WTP-GPP-CON-7101, *Construction Quality Control Program*. Each procedure adequately addresses the topics of surveillances (focusing on QA requirements) and inspection/testing (focusing on technical requirements and acceptance criteria). Subcontract surveillances and inspection/testing are led by the assigned CS Subcontract Coordinator (SC), with support from the QC organization and field engineers as needed.

Overall, the revised procedures communicate an effective approach to subcontractor oversight planning and execution. However, EA noted that Procedure 24590-WTP-GPP-CON-4103 does not require scheduling of subcontractor surveillances similar to CON-7101 and that Procedure 24590-WTP-GPP-CON-4103, Subsection 5.1.5, *Surveillance Assessments*, has no supporting text.

QC Surveillance Planning and Scheduling

The QC organization maintains an annual plan of QC surveillances of direct hire work and subcontracted work to support the CS organization. EA's review of the FY 2016 planned QC surveillance schedule documented in BNI document *QC Surveillances of Subcontractors and Const Opns 2015* indicates adequate coverage of subcontracted construction work, with priority attention to the QA areas of significant risk. A sample of completed QC surveillance reports indicates good adherence to the schedule. However, QC has not identified any planned QC surveillances of the fire protection penetration and joint seals subcontractor; the FY 2016 planned QC surveillance schedule indicates "TBD" (To Be Determined). The QC subcontractor oversight schedule is adequate except for the lack of surveillance of the fire protection penetration and joint seals subcontractor.

Observed Walk down and Surveillances

EA observed the BNI SC for the field surface preparation and coating subcontractor performing a walkdown of surface coating operations in the LAW Facility. The SC was familiar with the implementing procedures for subcontractor monitoring specified in BNI procedures 24590-WTP-GPP-CON-7101 and 24590-WTP-GPP-CON-4103 and the technical requirements of the contract. The SC inspected the work environment for safety considerations (ventilation, fire protection, tripping hazards, and the workers' personal protective equipment). The SC verified that the proper product was being used and that information on the mixing ratios, thinner percent, induction time, and pot life was posted as an operator aid on the wall of the temporary mixing room. The SC ensured that the work was in accordance with the subcontract Inspection and Test Plan (ITP), Procedure #16, *Field Surface Preparation and Coating Work Procedure*.

EA observed a BNI QC inspector performing a surveillance of the concrete supplier subcontractor that encompassed the three subcontractor surveillances identified on the 2016 planned QC surveillance schedule for June: Controlled Documents, Quality Assurance Records, and Hot Weather Concrete. The BNI QC inspector verified that each step in the subcontractor's Controlled Documents and Quality

Assurance Records procedure was being implemented. The QC inspector walked down the Hot Weather Concrete procedure and verified the procedural specifications for mixing water temperature, coarse aggregate placement in a cooling pond, the availability of ice production, the light color of the mixing drums, and the fine aggregate distribution in stockpiles. The QC inspector informed the subcontractor that he had not identified any issues.

Overall, the observed field surface preparation and coating subcontractor walk down and the concrete supplier subcontractor QC surveillance were adequate.

BNI Subcontract Surveillances

EA observed the BNI QC and CS organizations working collaboratively to conduct surveillances of subcontracted work. While CS is the lead organization for subcontract oversight, it does not possess all the requisite staff expertise to properly evaluate all construction subcontractors. In such cases, QC performs the more technical surveillances. In the past 12 months, CS conducted about 159 subcontractor surveillances and QC conducted about 42.

However, when documenting subcontract surveillances, the QC organization does not implement the reporting and record formats specified in BNI Procedure 24590-WTP-GPP-CON-4103. Procedure 24590-WTP-GPP-CON-7101 states, "Monitoring of subcontractor quality is controlled in accordance with 24590-WTP-GPP-CON-4103, Subcontract Surveillance, Acceptance, and Closeout." BNI QA engineers identified this issue during QA audit IRA-QA-14-008, *Control of Items and Services*. This issue was documented in CR 15-00365. The issue action history for CR 15-00365 shows that the corrective actions for this issue were to be included in CR 15-00077. However, the issue was not addressed in the CR 15-00077 corrective actions section as required in Section 6.4.1 of Procedure 24590-WTP-GPP-RACA-CR-0112, *Condition Report Evaluation and Action Plan Development*. **(Deficiency)** After the EA review team left the site, BNI advised EA that the BNI WTP QA department documented the corrective actions in CR 15-01434 on August 26, 2015, and that this CR was rolled back to add an action to identify missing actions and add them to CR 15-00077.

In addition, Procedure 24590-WTP-GPP-CON-7101 has no requirement to include the BNI CS manager on distribution of QC surveillances of subcontractors to ensure communication of results that may impact subcontract administration. Discussions with the BNI QC manager indicated his acceptance of EA's observations and his intention to revise the procedures appropriately.

EA's review of QC subcontractor surveillances indicates inadequacies in depth, rigor, and effective communication needed to provide confidence in subcontractor work performance. A sample of 49 subcontractor surveillance reports and 68 QC subcontractor surveillance reports identified some discrepancies:

- Some surveillance reports noted comments without any discussion of tracking or follow-up. For example, one comment in 24590-WTP-SV-QC-15-163 indicated that "stud spacing exceeded the 16 inch maximum spacing."
- Some reports are unclear, shallow, and of questionable value. For example, a basis for accepting the surveillance criterion, "Verified by interviewing the QC Manager...that all of the ASTM Standards associated with the testing are being followed," does not engender confidence in the surveillance result. Several surveillance reports were simply status reports.
- Several surveillance reports did not communicate whether the assessor verified field conditions or just reviewed documentation as required by BNI Procedure 24590-WTP-GPP-CON-4103, which

states, “Identify details regarding the scope of surveillance and/or characteristics under surveillance.”

- Several surveillance reports indicated that QC inspectors were to confirm that recorded data is consistent with specified procedures, without further field verification of the recorded data. In other cases, field data was collected without tracing back to documentation (e.g., drawings or procurement documents).
- None of the recent subcontract surveillances identified any issues. The last subcontract surveillance that identified an issue was in October 2014 regarding housekeeping (Reference: BNI Surveillance report SUV-SCA-15-072). Yet in contrast, BNI has identified significant problems with subcontractor oversight, resulting in a self-identified Level A finding (CR 15-00077 – see Section 5.7 of this report), and external reviews have expressed concerns about subcontract oversight.

BNI’s CR 15-00077 corrective action 39 states, “Perform Sponsored assessment of subcontractor oversight for effectiveness and compliance with applicable procedures.” Several lines of inquiry are listed but omit evaluation of such subcontractor surveillance report attributes as depth, rigor, and ability to effectively communicate. This sponsored (independent) assessment was due June 16, 2016, but was delayed until August, 2016. **(OFI-WTP-01)**

BNI Construction Assessments of Subcontractor Oversight

EA reviewed BNI construction assessment planning with respect to subcontract oversight. The BNI QAM, Section 1.3.1, specifies that “Managers, at every level, participate in management assessments to periodically assess their organizations and functions to determine how well they use resources and meet their objectives, identify strengths or improvement opportunities, and correct problems.” EA reviewed BNI’s *WTP Integrated Assessment Schedule* for FY 2015 and 2016. In FY 2015, the BNI Construction organization identified eight planned self -assessments, none of which were associated with subcontract work. In FY 2016, BNI Construction planned 13 self-assessments. Only one CS self-assessment is related to subcontract surveillances, scheduled for completion in August 2016, in response to a BNI assessment finding (CR 15-00077). During interviews with the CS manager, another draft CS self-assessment plan to examine “Daily Subcontract Reports” was provided as an attachment to an internal email dated May 9, 2016. This recently identified self -assessment was in the process of being submitted for inclusion in the next revised 2016 *WTP Integrated Assessment Schedule*, demonstrating the BNI Construction organization’s effort to self-initiate review of internal subcontract processes for potential improvement. The more recent efforts to complete self-assessments related to BNI subcontract oversight is adequate.

BNI QA Oversight of BNI QC Inspector Performance

The BNI QA oversight of construction quality has been fairly extensive but has not recently focused on QC oversight. The last QA assessment of the BNI QC performance related to BNI inspection, test, and operating status was conducted in 2007 (Ref., 24590-WTP-IAR-QA-07-0008). The BNI QAM, Policy Q-18.1, Audit (Independent Assessment), states that “Audits are used to verify compliance with and to determine the effectiveness of the quality assurance program implementation and maintenance, and to identify continuous improvement opportunities.” Over the past 12 months, BNI QA completed 78 surveillances of important quality construction topics, including, piping inspections, weld verifications, concrete placement, work suspension, non-destructive examination, and construction work packages. None were related to QC inspector performance.

A self-assessment (24590-WTP-SAR-MGT-15-0003) in early 2015 recommended, “B-6: Establish a program for periodic sampling of each QC inspector’s work.” This recommendation was documented in the BNI corrective action management program (CAMP) in CR 15-00982, dated June 23, 2015. The issue was closed with the statement “no action required” and no justification for that response. QA Self-Assessment Report number 24590-WTP-SAR-QA-15-0014 included an attached sponsored assessment conducted by independent consultants dated October, 26, 2015. This report, in part, addressed BNI QA. Some general conclusions included the need for more performance-based assessments; using QC trends and findings to identify troubled/challenged areas; and sampling of QC inspectors’ work. The report specifically recommended that BNI:

- Revisit the decision and (or) justification for “No action required,” in response to evaluation of need for additional oversight program for QC.
- Revisit the decision and (or) justification for “no action required,” in response to the recommendation to establish guidance for control of vendor work on site.

BNI initiated CR 15-02081 to address these issues. Closure is pending. EA will follow-up on closure actions to evaluate conformance with the BNI QAM, Policy Q-18.1.

Summary

The BNI CS and QC organizations are making efforts to improve subcontractor oversight in response to BNI’s self-identified significant problems in subcontractor oversight (CR 15-00077). The revised BNI construction organization subcontractor oversight processes are adequate, with the exception of one deficiency related to the QC organization’s surveillance reporting and record format. With the exception of the fire penetration and joint seal subcontractor, the 2016 planned QC surveillance schedule adequately addresses QC surveillances of subcontracted work. However, EA’s review of 117 CS and QC construction subcontractor surveillances indicated that many BNI subcontractor surveillance reports do not exhibit sufficient depth, rigor, and/or effective communication. EA recognizes: 1) the CS’s effort to use self-assessments to continuously improve; and, 2) BNI’s use of sponsored (independent) assessments to self-identify needed oversight of QC. These efforts demonstrate that BNI is driving improvements in its subcontractor oversight program, the results of which have not yet been fully realized.

5.7 BNI Management’s Use of Feedback

Criterion:

Continuous Feedback and improvement processes identify and address program and performance deficiencies and opportunities for improvement. (EA CRAD 64-20)

BNI’s review of item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement is effective. The BNI QA organization has conducted several oversight assessments over the past few years that have included BNI subcontracting performance and identified a number of issues. BNI’s investigation of CR 14-0438-C resulted in CR 15-00077 in January 2015, which states that “WTP’s oversight of subcontractor’s work may not be adequate to ensure that the work being performed is meeting the design requirements.” This CR was given a significance level A, the highest level of significance in the BNI CAMP. Only 37 issues have received this level of significance since the WTP project’s inception. A root cause analysis, 24590-WTP-RCA-MGT-15-00077, was completed and corrective actions are under way (18 of 40 corrective actions have been completed). CR 15-00077 and its associated corrective actions have stimulated changes in CS leadership, revised procedures, and enhanced attention to subcontract oversight. BNI has placed

significant attention on developing and improving subcontractor ITPs and the BNI construction subcontract surveillance program. This is a good example of BNI's use of assessment feedback and analysis to drive improvement initiatives.

EA examined BNI's efforts to improve BNI subcontract ITPs, CR 15-00077 corrective action number six. Subcontractor ITPs are required subcontract submissions. BNI Procedure 24590-WTP-GPP-CON-4103, Section 5.2.1.1, states that "The intent of ITPs is to monitor subcontractor performance to verify that the Subcontractor is following their own quality program, and verify installations are in accordance with design criteria." Section 5.2.3.1 states that "ITPs identify the items, materials and work to be inspected or tested; by whom, and at what stage or frequency; as well as 'Hold' and 'Witness' points, and references to relevant standards, acceptance criteria, and level of documentation to be recorded to comply with the subcontract as defined during ITP formation." EA reviewed four ITPs and found them generally adequate. Overall, BNI is using the feedback information derived from self- and independent assessment results to improve processes and performance.

5.8 ORP Oversight of BNI Subcontractors

Criterion:

DOE field element line management has established and implemented oversight processes that evaluate contractor and DOE programs and management systems, including site assurance systems, for effectiveness of performance (including compliance with requirements). (DOE Order 226.1B, 4b(1))

EA had previously examined ORP oversight procedures MGT-PM-DI-04, *WCD Construction Oversight*, and TRS-OA-IP-01, *Integrated Assessment Process*, and found them satisfactory. WCD maintains a documented and approved oversight schedule that reflects a reasonable balance of oversight activities and includes assessments of BNI subcontractors. EA examined the WCD oversight assessments of BNI subcontracted work over the past five years. Eight WCD oversight assessments included heating, ventilation, and air conditioning (HVAC) fabrication and installation; special protective coatings; LAW Facility and LAB penetration seals; HLW Facility liner plate; and HLW Facility vacuum box testing. These WCD assessments were mostly well documented, performance-based assessments of five BNI subcontractors, focusing on compliance with specified requirements. One of the WCD assessment reports examined BNI's oversight of BNI's subcontractors. The WCD assessments were conducted by experienced and well qualified ORP site inspectors. Overall, WCD's sampling of subcontractor performance is adequate.

WCD assessments of BNI subcontractor performance are adequate, and WCD uses well-qualified contract site inspectors to provide BNI oversight support. WCD subcontractor oversight assessments conducted over the past five years are well documented and performance-based.

6.0 FINDINGS

EA identified no findings during this assessment. Deficiencies that did not meet the criteria for a finding are listed in Appendix C of this report, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

7.0 OPPORTUNITIES FOR IMPROVEMENT

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

OFI-WTP-1: ORP and BNI should consider improving the quality of subcontractor surveillances by revisiting such attributes as depth, rigor, and ability to effectively communicate.

8.0 ITEMS FOR FOLLOW-UP

EA previously identified that the Authority Having Jurisdiction in the electrical area was delegated to BNI by prior ORP management around 2004, and identified this situation as a conflict of interest. ORP staff reviewed the issue and made recommendations to ORP management. At the time of this EA review, those recommendations were under ORP management review. EA will continue to follow ORP's resolution of this issue in subsequent reviews of WTP construction quality.

EA will perform additional reviews of the BNI subcontractor oversight program and will review resolution of open CRs, NCRs, and CDRs. EA will continue to monitor BNI's progress in addressing identified issues and its efforts to reduce the backlog of unresolved issues. EA will also continue to follow-up on inspection of welding activities, piping and pipe supports, pressure testing of piping, cable pulling, and installation of electrical and mechanical equipment. Additionally, EA will review the program for preservation and maintenance of plant equipment and will examine storage of hardware, components, and materials at the WTP site.

Appendix A Supplemental Information

Review Dates

Onsite visit: June 20-23, 2016

Office of Independent 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, Deputy Director, Office of Environment, Safety and Health Assessments
Patricia Williams, Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

Quality Review Board

William A. Eckroade
John S. Boulden III
Thomas R. Staker
William E. Miller
Patricia Williams
Gerald M. McAteer
Michael A. Kilpatrick

EA Site Lead for Hanford Site

Robert E. Farrell

EA Team Composition

Robert E. Farrell – Team Lead
Joseph J. Lenahan
Michael A. Marelli

Appendix B
Documents Reviewed, Interviews, and Observations

Documents Reviewed

- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 13, Pressure Testing of Piping, Tubing and Components, February 25, 2016
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 5, Post Installed Concrete Anchors, January 28, 2016
- Construction Procedure 24590-WTP-GPP-CON-3203, Rev. 10, Concrete Operations (Including Supply), August 20, 2015
- Specification No. 24590-WTP-3PS-FA02-T0004, Rev. 7, Engineering Specification for Installation and Testing of Post Installed Concrete Anchors and Drilling/Coring of Concrete, April 29, 2014
- Specification No. 24590-WTP-3PS-DB01-T0001, Rev. 8, Engineering Specification for Furnishing and Delivery of Ready Mixed Concrete, March 26, 2007
- Procedure 24590-WTP-GPP-MGT-044, Rev. 5, Nonconformance Reporting and Control, February 25, 2016
- Procedure 24590-WTP-GPP- MGT-036, WTP Self-Assessment and Line Surveillance, Rev. 5, March 31, 2015
- Procedure 24590-WTP-GPP-RACA-CR-0112, Rev 4, Condition Report Evaluation and Action Plan Development
- Document number 24590-WTP-MN-CON-01-001-10-09, Rev. 8, Bechtel Nondestructive Examination Standard, Visual Examination VT-ASME, August 8, 2013
- Document number 24590-WTP-MN-CON-01-001-10-10, Rev. 6, Bechtel Nondestructive Examination Standard, VT-AWS D1.1 Visual Examination, August 15, 2006
- Document number 24590-WTP-QAM-QA-06-001, Rev. 16, Quality Assurance Manual, December 22, 2014
- Construction Deficiency Report numbers 24590-WTP-CDR-CON-16-0105 through -0171.
- Nonconformance Report numbers 24590-WTP-NCR-CON-16-0048 through -00188
- Construction Procedure 24590-WTP-GPP-CON-7101, Rev 11 Construction Quality Control Program
- Construction Procedure 24590=WTP-GPP-CON-4103 Rev 9, Subcontract Surveillance, Inspection, and Quality Verification dated May 11, 2016
- Construction Procedure 24590-WTP-GPP-MGT-057, WTP Integrated Assessment Planning and Scheduling
- BNI-WTP QC Surveillances of Subcontractors and Construction Operations 2015
- QC Surveillance Report 24590-WTP-SV-QC-15-163, “Q” Fire Rated Wall for the LAW Room No. L-0304F dated December 20, 2015
- Q C Surveillance Report 24590-WTP-SV-QC-16-027, *NWII* Qualification and Certification of NDE Personnel dated February 23, 2016
- BNI Independent QA Audit IRA-QA-14-008, Control of Items and Services dated March 26, 2015
- BNI Independent QA Audit 24590-WTP-IAR-QA-07-0008, Inspection, Test, and Operating Status dated November 12, 2007t
- BNI Self-Assessment 24590-WTP-SAR-MGT-15-0003, EPC Process Benchmarking dated June 26, 2015
- BNI Self-Assessment 24590-WTP-SAR-QA-15-0014, Quality Assurance Program Implementation Sponsored Assessment, June 26, 2016
- BNI Self-Assessment 24590-WTP-SAR-CON-15-0028, Construction Level C Storage, September 15, 2015

- BNI Root Cause Analysis 24590-WTP-RCA-MGT-15-00077, Subcontract Root Cause Analysis dated May 10, 2016
- ITP 25490-CM-FC3-AFPH-00001-08-00001, BNI Field Surface Preparation and Coatings, Subcontractor Inspection and Test Plan dated June 20, 2012
- ITP 25490-CM-FC1-AY00-00001-30-00001, BNI Welding Subcontractor Inspection and Test Plan dated December 12, 2012
- ITP 25490-QL-SRA-MDHM-00001-22-01, BNI Heating Ventilation and Air Conditioning (HVAC), Subcontractor Inspection and Test Plan dated March 14, 2016
- ITP 25490-CM-FC1-AYFP-00001-33-00001, BNI Penetrations and Joint Seals, Subcontractor Inspection and Test Plan dated March 30, 2016
- ORP Procedure MGT-PM-DI-04, WCD Construction Oversight
- ORP Procedure TRS-OA-IP-01, Integrated Assessment Process
- WCD Surveillance Report S-12-WCD-RPPWTP-006-03, HVAC Fabrication and Installation dated June 28, 2012
- WCD Surveillance Report S-12-WCD-RPPWTP-08-03, Construction Programs-Special Protective Coatings dated August 1, 2012
- WCD Surveillance Report S-14-WCD-RPPWTP-002-04, Fire Protection – LAW and LAB Penetration Seal dated February 4, 2014
- WCD Surveillance Report S-14-WCD-RPPWTP-012-13, High-Level Waste Facility Liner Plate dated December 22, 2014
- WCD Surveillance Report S-15-WCD-RPPWTP-002-13, Construction Program - HVAC Installation dated February 25, 2015
- WCD Surveillance Report S-15-WCD-RPPWTP-006-10, High-Level Waste Facility Liner Plate dated June 8, 2015
- WCD Surveillance Report S-15-WCD-RPPWTP-011-10, High-Level Waste Facility Vacuum Box Testing dated November 16, 2015
- WCD Surveillance Report S-15-WCD-RPPWTP-012-11, High-Level Waste Facility Liner Plate dated December 9, 2015
- WCD Surveillance Report S-15-WCD-RPPWTP-006-10, High-Level Waste Facility Liner Plate dated June 8, 2015
- BNI Document SUV-SCA-15-072 Rev0, 2015 Quarterly Safety Surveillance dated June 20, 2015
- BNI Document SC-OE-15-002, Fiscal Year 2016 WTP Integrated Assessment Schedule, Rev 0 dated December 23, 2015
- BNI Document SC-OE-16-001, Fiscal Year 2016 WTP Integrated Assessment Schedule, Rev 0

Interviews

- BNI WTP Site Manager
- BNI Field Engineering Manager
- BNI Field Engineers
- BNI Welding Engineers
- BNI QA Manager
- BNI QC Manager
- BNI QC Inspectors
- BNI Construction Subcontracts Manager
- BNI Subcontract Coordinators

Observations

- Observed performance of portions of two hydrostatic pressure tests performed on FSW piping, recorded on document numbers 24590-BOF-PPTR-CON-15-0076 and 24590-BOF-PPTR-CON-15-0080.
- Witnessed a WCD site inspector performing final visual inspections of two piping welds: weld GB00007 on FWCL 24590-LAW-FWCL-CON-16-00740, and weld FA-006 on FWCL 24590-BOF-FWCL-CON-16-00095.
- Observed a non-Q concrete placement for a BOF electrical junction box adjacent to the LAB.
- Examined the concrete batch plant and the concrete and materials testing laboratory.
- Observed QC inspectors and welding engineers performing visual inspections of welds on a Q vessel in the PTF to obtain data to resolve an NCR.
- Observed the BNI Subcontract Coordinator's walkdown of surface coating operations in the LAW Facility.
- Observed the BNI QC inspector's surveillance of the concrete supplier subcontractor.

Appendix C Deficiencies

Deficiencies that did not meet the criteria for a finding are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

- When performing subcontractor surveillances, the QC organization does not implement the reporting and record formats specified in BNI Procedure 24590-WTP-GPP-CON-4103. This issue was documented as CR 15-00365. The issue action history for CR 15-00365 shows that the corrective actions for this issue were to be included in CR 15-00077. However, the issue was not addressed in the CR 15-00077 corrective actions as required in Section 6.4.1 of Procedure 24590-WTP-GPP-RACA-CR-0112, Rev. 4, *Condition Report Evaluation and Action Plan Development*.