Office of Enterprise Assessments
Assessment of Construction Quality and the Fire Protection Program at the Hanford Site Waste Treatment and Immobilization Plant

April 2016

Office of Nuclear Safety and Environmental Assessments
Office of Environment, Safety and Health Assessments
Office of Enterprise Assessments
U.S. Department of Energy

Table of Contents

Acronyms

AHJ	Authority Having Jurisdiction
amp	Ampere
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWG	American Wire Gauge
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
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
FCU	Fan Coil Unit
FP	Fire Protection
FPP	Fire Protection Program
FR	DOE Facility Representative
FSW	Fire Service Water
HLW	High Level Waste
ICP	Industrial Control Panel
IG	DOE Office of Inspector General
IPIP	Integrated Project Improvement Plan
LAB	Analytical Laboratory
LAW	Low Activity Waste
MIP	Management Improvement Plan
NCR	Nonconformance Report
NEC	National Electrical Code
NFPA	National Fire Protection Association
NLD	Non-radioactive Liquid Waste Drain
NQA	Nuclear Quality Assurance
NRTL	Nationally Recognized Testing Lab
OFI	Opportunity for Improvement
ORP	Office of River Protection
OSHA	Occupational Safety and Health Administration
PICA	Post Installed Concrete Anchor
PIER	Project Issues Evaluation Report
psi	Pounds per Square Inch
PTF	Pretreatment Facility
Q	Quality Related
QA	Quality Assurance
QAM	Quality Assurance Manual
QC	Quality Control
SME	Subject Matter Expert
SSC	Structure, System, and Component
UL	Underwriters Laboratories, Inc.
WCD	Office of River Protection WTP Construction Oversight and Assurance Division
WESP	Wet Electrostatic Precipitator
WTP	Waste Treatment and Immobilization Plant

Office of Enterprise Assessments
Assessment of Construction Quality and the Fire Protection Program at the Hanford Site
Waste Treatment and Immobilization Plant

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an assessment of construction quality and the fire protection program at the Hanford Site Waste Treatment and Immobilization Plant (WTP) from December 14 to 17, 2015. 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 nonconforming conditions, examining the implementation of selected requirements in the BNI quality assurance program, and following up on issues identified during previous assessments. EA assessed the fire protection program to determine if the WTP fire protection program complies with applicable aspects of DOE Order 420.1B, *Facility Safety*, and corresponding National Fire Protection Association codes.

BNI continues to identify nonconforming conditions involving procured equipment and hardware. Much of this equipment was manufactured and delivered to the project between 5 and 10 years ago, and some of this equipment was supplied by vendors or manufacturers who are no longer in business. EA reviewed a number and variety of procurement deficiencies and found that BNI Design Engineering has dedicated a large number of personnel and resources to adequately resolve those nonconforming conditions.

Overall, with the exception of electrical construction problems and a potential conflict of interest (first identified in previous EA reports), the construction quality at WTP is satisfactory in the areas reviewed (pressure testing of piping, electrical cable pulling, structural concrete, and welding inspection activities). EA reviewed closed nonconformance reports and BNI construction deficiency reports, and found that BNI has developed appropriate corrective actions to resolve specific deficiencies.

BNI's corrective action management process performance remains a significant challenge. At the time of this EA review, 1,836 condition reports (CRs) remained open, and approximately 540 nonconformance reports and approximately 660 construction deficiencies remained open. Of the open CRs, 125 were categorized in the two highest significance levels. Progress continues to be slow in addressing EA identified problems with BNI's process to evaluate, document, certify, and label electrical equipment.

EA reviewed and assessed the effectiveness of BNI's fire protection program. The review focused on program implementation in the Low Activity Waste Facility, Analytical Laboratory Facility, Main and Balance of Facilities Switchgear Buildings, Chiller/Compressor Plant, Fire Water Pump House, and the Steam Plant Facility. Many fire protection program elements were adequate, including the fire hazards analyses; fire pre-plans; combustible controls; hot work program; and the installation of safety structures, systems, and components and supporting infrastructure.

Although fire suppression (sprinkler) systems and fire detection systems are complete in some buildings, they are not activated because the necessary support systems (e.g., permanent plant heat) are not completed. Activation of these systems would reduce life safety risk and protect over a billion dollars of completed construction from fire. Barriers to activation of the fire systems have not been effectively addressed.

Office of Enterprise Assessments
Assessment of Construction Quality and the Fire Protection Program at the Hanford Site
Waste Treatment and Immobilization Plant

1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an assessment of construction quality and the fire protection program (FPP) at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The onsite portion of this assessment was conducted from December 14 to 17, 2015. 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 will continue the ongoing program of quarterly assessments of the quality of construction at the WTP construction site. These assessments are performed to ensure construction work meets the requirements of 10 Code of Federal Regulations (CFR) 830, Subpart A, *Quality Assurance Requirements*.

2.0 SCOPE

The scope of this quarterly assessment of construction quality included observing ongoing work activities, reviewing the Bechtel National, Inc. (BNI) program for controlling nonconforming conditions, examining the implementation of selected requirements in the BNI quality assurance (QA) program, specifically improvement of assessment and review effectiveness, and the BNI corrective action program, and following up on issues identified during previous assessments. The WTP fire protection program was also reviewed, but 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 Quality Assurance (NQA) -1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, and DOE Order 414.1C, *Quality Assurance*.

The WTP complex consists of five major components: the Pretreatment Facility (PTF) for separating the waste into low activity and high activity waste, the High Level Waste (HLW) Facility where high level waste will be immobilized in glass, the Low Activity Waste (LAW) Facility where the low level waste will be immobilized in glass, the Analytical Laboratory (LAB) for sample testing, and the balance of facilities (BOF) that will house support functions. Construction work is essentially complete for the LAB and for 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 is slowed in the HLW Facility pending resolution of technical issues involving the waste treatment process. In a September 2014 letter, DOE authorized BNI to resume design engineering work on the HLW Facility.

4.0 METHODOLOGY

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 and Fire Protection Program*, dated December 2015. 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 referenced DOE Order 420.1B, *Facility Safety*, when reviewing the WTP fire protection program for both fire protection during construction and compliance of the fire protection system when construction is complete.

This EA assessment focused on installation and termination of electrical cables, as well as certain portions of the following criteria and review approach documents (CRADs):

- CRAD 45-52, *Construction – Piping and Pipe Supports*
- CRAD 45-34, Rev. 1, *Fire Protection Inspection Criteria, Approach, and Lines of Inquiry*
- 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 walk-downs to observe work activities and inspect WTP components. EA conducted several construction site walkthroughs with WCD staff to determine whether work activities were completed in accordance with the appropriate design drawings, specifications, and installation procedures. EA observed a piping pressure test; inspection of welds on two sections of piping in the LAW Facility; and installation of electrical cables. EA reviewed nonconformance reports (NCRs), construction deficiency reports (CDRs), and condition reports (CRs) that BNI identified under its corrective action program, as well as the BNI Management Improvement Plan (MIP). EA also reviewed corrective actions to resolve deficiencies with post installed concrete anchors (PICAs), corrective actions to address installed electrical cabinets and panels that do not have minimum NED code-required work space to safely perform maintenance work, and certification issues regarding labeling of electrical panels and cabinets. The WTP fire protection program was reviewed to determine whether the construction fire protection and prevention program and the permanently installed fire protection system comply with DOE Order 420.1B.

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. 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. Section 5 of this report includes brief descriptions of the activities that EA evaluated during this assessment, as well as the results of the assessment. No findings deficiencies, or OFIs were identified in this review. Items for follow-up are summarized in Section 8. Supplemental information, including the

members of the EA team, the Quality Review Board, and EA management, is provided in Appendix A. Key documents reviewed, interviews conducted, and work activities observed are listed 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 when in service.

5.1 BNI Corrective Action Programs

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).

Quality Assurance surveillances and other management/independent assessments shall be scheduled in a manner to provide coverage, consistency and co-ordination of ongoing work, shall be performed by knowledgeable personnel, and shall be performance based of sufficient scope and depth to identify issues as soon as practicable. Surveillance/assessment results shall be documented in sufficient detail to identify the activity covered, identify the individual(s) performing the surveillance/assessment, and document results and any necessary compensatory corrective actions. (NQA-1 Requirement 18; Policy Q-02.2 of the WTP QAM; and DOE Order 414.1C).

EA reviewed selected management programs that BNI developed to resolve deficiencies identified by several DOE organizations, the BNI corrective action program, and the BNI self-assessment program. EA's observations are discussed in more detail below.

Management Improvement Plan

Within the last four years, the DOE Office of Inspector General (IG) issued three reports that identified significant problems in design control, procurement, and implementation of the QA program at WTP.

In June 2015, the DOE Office of Enforcement (EA-10) and BNI signed a Consent Order that included a financial penalty and BNI commitments to resolve several systemic weaknesses. The weaknesses involve: misalignment of design documents with the authorization basis, welding deficiencies in fabricated vessels that were accepted by BNI for installation at the WTP complex, and inadequate implementation of the QA and corrective action programs. EA-10 referenced ORP Audit Report number U-13-QAT-RPPWTP-001, *Bechtel National, Inc. Quality Assurance Program Requirements 3, 4, 5, 8, 15, and 16*, dated October 28, 2013, as the basis for identifying the systemic weaknesses in the QA and corrective action programs.

Two commitments in the Consent Order were to 1) improve the QA program by completing Corrective Action: CCN 265649 by September 30, 2015, and 2) improve the corrective action program by completing Corrective Action: CCN 265648 by October 31, 2015. In response to the Consent Order and at ORP's direction, BNI developed a management improvement plan (MIP) to integrate 51 management improvement initiatives. The MIP is described in BNI document number 24590-WTP-PL-MGT-14-0006,

Managed Improvement Plan (MIP).

Prior to development of the MIP, BNI prepared an Integrated Project Improvement Plan (IPIP) in response to ORP Surveillance Report S-12-NSD-RPPWTP-001. The IPIP was described in BNI Document 24590-WTP-PL-MGT-12-0012, Attachment 2 to BNI letter CCN: 236405, dated August 3, 2012. The IPIP was incorporated into the MIP.

The BNI corrective action program documents nonconforming conditions as NCRs, CDRs, or CRs. NCRs are issued to document and disposition non-conformances for quality related (Q) SSCs, while CDRs are used to document and disposition nonconforming conditions involving commercial grade (CM) SSCs. CRs are used to implement the corrective action management processes and for responding to findings identified by internal or external organizations. CRs are initiated for non-hardware issues; for example, to document and manage improvement opportunities, adverse conditions, or deficiencies such as those involving design errors and non-compliant conditions, as well as any situation that an employee determines may warrant management attention. Examples of non-compliant conditions include violations of safety or security policies, and potential environmental issues. To categorize CRs, BNI's corrective action program utilizes four significance levels: Level A (highest significance), B, C, and D (lowest significance). Under the MIP, the CR replaced the project issues evaluation report (PIER) in order to improve the BNI corrective action management program (CAMP). Open PIERs were rolled over into CRs when the change-over in the program occurred.

BNI's Corrective Action Management Program

BNI's Corrective Action Management Program (CAMP) was the subject of one of the two level one findings in the 2013 ORP QA audit of BNI. BNI conducted a status presentation of this Management Improvement Plan Area on September 28, 2015, and indicated that only 36 of 42 corrective actions were completed at that time.

Closure of high-level CRs, Level A and B, remains a concern. Since the beginning of the WTP project, 37 Level A CRs were identified. Of those 37, 24 CRs are closed; the most recent closure occurred in November 2011. A review of the 13 open Level A findings indicate 6 were identified in 2012, 4 in 2013, 1 in 2014, and 2 in 2015. All but the two most recent Level A CRs have established due dates. Currently, 112 Level B CRs are open. The BNI contractor assurance program metric for CAMP timeliness indicates that the time required for resolution and closure of Level A and B CRs increased in 2015. The average age of open Level A CRs is 900 days and open Level B CRs is 690 days.

Since late 2014, BNI has made a concerted effort to encourage all employees to report issues through the BNI CAMP. This effort resulted in the current submission rate of 9.5 issues per day. As of December 15, 2015, there were 1,110 open Level C CRs and 601 open Level D CRs, for a total of 1826 open Level A, B, C, and D CRs. The metric for timely closure currently indicates an adverse trend and a continuing challenge to BNI. The BNI WTP Site Manager and the BNI Deputy Quality Manager acknowledged that the high rate of issue reporting (most at Level C and D) challenges BNI's ability to respond to more significant issues. Additionally, NCRs and CDRs are not categorized or prioritized with a significance level. The number of open CRs, NCRs, and CDRs now exceeds 2400.

Addressing the burgeoning volume of identified issues will require substantial effort by BNI.

Review of Nonconformance and Condition Reports

BNI Procedure 24590-WTP-GPP-MGT-044, *Nonconformance Reporting and Control*, defines the requirements for identifying, documenting, reporting, controlling, and dispositioning nonconforming

conditions associated with Q and CM SSCs at the WTP. According to 24590-WTP-GPP-MGT-044, SSCs designated as Q (previously classified as Quality-List or QL) in the design documents must be constructed or manufactured in accordance with the WTP QA program and the ASME NQA-1 standard. Additionally, 24590-WTP-GPP-MGT-044 requires SSCs designated in the design documents as non-Q (i.e., CM) to 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 85 NCRs that BNI issued between September 21 and December 14, 2015, and the 49 CDRs that BNI issued between October 14 and December 16, 2015, to evaluate the types of nonconforming issues, their apparent causes, and subsequent corrective actions. The NCR categories included 2 NCRs related to construction or installation errors, including damage to installed components resulting from construction activities; 75 NCRs for procurement and supplier deficiencies; 4 NCRs for engineering issues; and 4 for materials handling issues. Most NCRs attributed to supplier deficiencies were initiated for incomplete non-destructive examination records that suppliers submitted for piping and tanks. The NCRs related to procurement and supplier deficiencies are currently being evaluated by Design Engineering, which will determine the corrective actions required to resolve the deficiencies. A large backlog of NCRs is open pending completion of review by Design Engineering.

Of the 49 CDRs that EA reviewed, 19 CDRs were for BNI construction deficiencies, 20 CDRs for procurement and supplier deficiencies, 5 CDRs for engineering errors, 2 CDRs for maintenance issues or for materials identified with expired shelf life, and 3 CDRs were initiated to document deficiencies in subcontractor work.

Procurement deficiencies documented in CDRs and NCRs continue to challenge the BNI Design Engineering organization. Each procurement issue requires an evaluation by Design Engineering on a case-by-case basis. Examples of these deficiencies include fabrication errors, design errors, missing quality records, missing or inadequate certification and qualification records for vendor personnel who performed acceptance inspections, inadequate vendor quality control (QC) inspection programs (some required inspections were not performed), inadequate testing of components, and use of incorrect materials. Much of the equipment and hardware with procurement deficiencies was manufactured and delivered to the project between 5 and 10 years ago. Some equipment with identified deficiencies was supplied by vendors or manufacturers who are no longer in business. The number and variety of procurement deficiencies has required Design Engineering to dedicate a large number of personnel to resolve the identified problems.

The BNI engineering organizations have developed corrective actions to disposition the specific problems identified in the completed and closed NCRs and CDRs that EA reviewed. The corrective action program and implementation address and resolve specific construction quality deficiencies, but is challenged by the large backlog of open items

BNI Self-Assessments/Surveillances

The BNI WTP Field Engineering Manager utilizes the self-assessment process to provide feedback on the performance of field engineers. Self-assessments are selected based on organizational commitments (specifically associated with the MIP), identified problem areas, and evolving conditions. A new performance metric has been developed to monitor the error rate in inspection records. The addition of this metric was prompted by errors in completed records that were identified by WCD site inspectors. EA noted that this new metric does not currently apply weighting factors to different errors since different inspection errors in many cases pose a different level of risk.

EA's review of 2015 self-assessments completed by BNI Field Engineering disclosed that the majority of

completed self-assessments related to the flow down of requirements from higher level documents to working level documents. This issue was the subject of one of the MIP corrective actions. The BNI self-assessments were performed in preparation for a scheduled ORP audit. Only two of the completed self-assessments evaluated field engineering work activities. These were assessments of electrical cable pulling and electrical cable terminations. Although these two self-assessments were comprehensive and resulted in improvements to the work processes examined, several work discipline areas have yet to be assessed or have not been assessed for several years, including instrumentation, cable tray and cable tray supports, electrical conduit and conduit supports, and structural steel construction. A self-assessment of piping and pipe support installation scheduled for late 2015 was canceled due to lack of manpower.

EA reviewed 2015 BNI Level A and B CRs for issues attributed to Field Engineering and found one Level A CR associated with inadequate acceptance of subcontracted work and one Level B CR associated with inadequate implementation of the suspect/counterfeit item program. EA has also documented in previous EA Construction Quality Review reports that BNI field engineers accepted CM PICA installations, all of which required re-inspection after a WCD site inspector questioned whether they were installed in accordance with specification requirements. Electrical construction errors or BNI field engineers' failure to identify defects was identified by the WCD site electrical inspector and EA.

BNI Corrective Action Programs Conclusion

Overall, BNI corrective action programs are adequately implemented; however, the current high rate of issue reporting (most at Level C and D) challenges BNI's ability to respond to more significant issues. NCRs and CDRs are not categorized or prioritized with a significance level. The number of open CRs, NCRs, and CDRs now exceeds 3000. Addressing the burgeoning volume of identified issues will require substantial effort by BNI.

5.2 ORP Contractor Oversight

Overall, ORP's contractor oversight program and BNIs corrective action, QA, and surveillance programs show evidence of being effective in identifying quality issues. ORP utilizes several organizations to monitor and assess contractor performance, including WCD that provides day-to-day oversight, the ORP Quality Assurance Division, and the ORP Performance Assurance Division. These organizations are staffed by experienced subject matter experts (SMEs) who have identified significant weaknesses in procurement, engineering, and construction.

WCD performs oversight of BNI construction activities at WTP by performing construction inspections; performing the owner's inspections of ASME B31.3 piping and pipe supports; reviewing records documenting inspections required by ASME B31.3; monitoring construction costs and schedule; and monitoring BNI compliance with DOE regulations such as those pertaining to worker safety, environmental protection, and protection of Government property. The ORP procedures that control WCD activities are ORP Procedure MGT-PM-DI-04, *WCD Construction Oversight*, and ORP Procedure TRS-OA-IP-01, *Integrated Assessment Process*. In addition to the onsite WCD director, the WCD Federal staff includes a construction manager and Facility Representatives (FRs). To augment the Federal staff, WCD currently employs four contract SME quality inspectors (site inspectors), two civil/mechanical and two electrical. The site inspectors conduct surveillances of BNI work activities by witnessing concrete placements, welding activities, piping pressure test activities, installation and termination of electrical cables, and installation of electrical and mechanical equipment. The site inspectors document the results of their inspections in surveillance reports that are included in monthly summary reports.

WCD FRs and site inspectors are involved in day-to-day oversight of WTP. The onsite WCD staff has

identified many deficiencies in BNI's work activities, including PICA installation deficiencies, installation of electrical cabinets in areas that have insufficient clearances to perform safe maintenance work (discussed in the Electrical Construction Activities section of this report), errors in inspection records, and welding deficiencies. The WCD FRs conduct daily walk-downs of their assigned facilities to observe and assess safety and operational-type performance during construction. They also observe ongoing construction activities and attend contractor meetings as needed to keep apprised of the status of construction. The FRs document their activities and observations in surveillance reports that are included in monthly summary reports. A monthly exit interview is conducted with BNI to discuss the results of surveillances and inspections performed by WCD, including any identified findings. The monthly report is formally transmitted in a letter to BNI. BNI is required to respond in writing to address findings and to provide corrective actions and a schedule for resolving the findings.

ORP performs contractor oversight of construction quality through the WCD and SMEs from the ORP WTP Engineering Division and ORP Technical and Regulatory Support organization.

5.3 Deficiencies in Installation of Post Installed Concrete Anchors

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

PICAs are installed in the concrete structure after the concrete has hardened and attained its design strength in order to provide anchorage for equipment in locations where embedded plates and cast in-place anchor bolts are unavailable. The types of hardware and components that PICAs support include structural steel platforms, pipe supports, instrument racks, transformers, electrical components, and conduit and instrument supports. As reported in previous EA quarterly construction reports, during a review of CM pipe support installation records in September 2011, ORP WCD personnel identified incorrect or missing data in the documentation of installation of CM PICAs. The initial corrective actions to evaluate the questions raised by WCD were to review the PICA records for all anchors installed between July 19, 2010, and May 2012. Upon completing the documentation review in 2012, BNI Field Engineering determined that the PICA installations should be physically inspected. As of December 1, 2015, BNI field engineers have identified 2495 records related to CM PICA installations. This number includes an additional 147 PICA records identified since May 31, 2015. These records do not include PICAs installed in the HLW Facility or PTF. Field inspections and engineering review have been completed for PICA installations documented on approximately 90 percent of the 2495 PICA records. Deficiencies have been identified with one or more PICAs documented on approximately 39 percent of the 2495 records. CDRs were initiated for BNI Design Engineering to evaluate and determine whether any rework is required.

EA reviewed reports documenting inspection of PICAs installed by subcontractors in BOF Buildings 82, 86, 87, and 91 and the BOF steam plant. Some subcontractor PICA installation procedures did not conform to the BNI PICA specification. BNI found the majority of the PICAs installed in Buildings 82, 86, 87, and 91 acceptable. Eight PICAs in Building 82 did not meet the minimum embedment criteria. A few other PICAs were identified in Buildings 82, 86, 87, and 91 that did not comply with the BNI PICA installation criteria. BNI initiated three CDRs to document the PICAs that did not meet the BNI PICA installation acceptance criteria in Buildings 82, 86, 87, and 91. The BNI PICA inspections in the BOF steam plant identified several PICAs that did not comply with BNI installation criteria. Examples

included incorrect diameter PICAs, insufficient PICA embedment, missing washers, loose nuts, and bent or nearly broken off anchors. BNI wrote four CDRs to document, evaluate, and correct the deficient PICA installations in the BOF steam plant.

BNI's determination of extent of condition and identification of corrective actions necessary to correct the PICA installation deficiencies were adequate. However, because of delays in developing PICA installation criteria, significant rework was required to re-inspect and re-evaluate CM PICAs previously inspected and found acceptable. The projected completion date to close this issue has been extended from December 2015 to January 2017.

BNI established and implemented a process to identify, control, document, evaluate, and correct conditions adverse to quality related to Deficiencies in Installation of PICAs.

5.4 Piping Pressure Tests

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

EA observed one piping pressure test, a hydrostatic test that was performed on a non-radioactive liquid waste drain (NLD) line. The WTP site work process for conducting leak testing is specified in Construction Procedure 24590-WTP-GPP-CON-3504, *Pressure Testing of Piping, Tubing and Components*. The requirements for hydrostatic pressure testing are specified in ASME Code B31.3, Paragraph 345.4, *Hydrostatic Testing*.

EA attended the pre-test briefings, reviewed drawings and test data sheets, examined the testing apparatus, and verified that the calibration stickers on the test pressure gauges were current and that whip restraints were installed on pressure hoses. Before the pressure tests, EA examined the sections of the piping system and examined the valve lineup and pressure test tags attached to the valves. EA witnessed the hydrostatic test pressurization sequence and verified that the NLD piping was pressurized to the designated test pressure, 14 pounds per square inch (psi), and held for a minimum of 10 minutes before the BNI field engineers initiated the system walk-down to inspect the piping for leakage. EA observed the walk-downs and inspections that BNI Field Engineering personnel performed. No leaks were identified during the pressure test, and the test was declared successful.

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

5.5 WCD Welding Inspection Program

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

The WCD 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

examine are Q, but the WCD staff also includes some CM welds in their independent sample. The site inspectors also select some welds for examination that have unique configurations or geometry and have some aspect that differs from routine site welding operations.

EA observed a WCD site inspector perform an independent final visual inspection of two completed welds in the LAW Facility. These welds had been pre-selected by the WCD site inspector as DOE designated witness points. The welds examined were a ¾ inch pipe to flange weld (Weld GB001) on field welding check list 24590-LAW-FWCL-CON-15-00769 for the cascade ventilation system piping and an 18 inch pipe to fitting weld (Weld FW001) on field welding check list 24590-LAW-FWCL-CON-15-00270 for the LAW secondary off-gas/vessel vent process system piping. Acceptance criteria for visual examination of the piping welds are specified in *Bechtel Nondestructive Examination Standard, Visual Examination VT-ASME*. The WCD site inspector also reviewed the field welding checklists, weld wire draw slips, and drawings associated with the welds.

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

5.6 Electrical Construction Activities

Criteria:
Electrical equipment that performs a safety function shall be installed in accordance with approved procedures, design drawings, manufacturer's instructions, and other design basis documents, including applicable codes and standards. The procedures, instructions, and drawings shall include or reference appropriate quantitative or qualitative acceptance criteria for determining that prescribed results have been satisfactorily attained. (NQA-1, Requirement 5; Policy Q-5.1 of the WTP QAM; and DOE Order 414.1C)

EA observed cable pulling in the LAW Facility to verify that the work was performed in accordance with design documents (i.e., specifications and drawings). EA also reviewed CDRs initiated to document electrical cabinets installed with insufficient working clearance as specified in the National Electrical Code (NEC), or problems with the certification and labeling of electrical panels and equipment.

Cable Pulling

During the September 2015 EA Construction Quality Review, EA and the WCD site electrical inspector observed the electricians preparing to perform a cable pull between a 60 ampere (amp) ground fault breaker and the melter 2 wet electrostatic precipitator (WESP). EA and the WCD site electrical inspector noted that the cable listed by design engineering was undersized for the load it would be serving. BNI documented the problem on a CDR and initiated evaluation and corrective action.

During the current review, EA and the WCD site electrical inspector witnessed electricians pulling (installing) the correct size cable, #6 AWG, between the 60 amp breaker and the melter 2 WESP. The cable pull went according to plan. The electricians performed all necessary tests on the pulled cable and left it ready for the termination crew to land the leads.

The cable pull was performed in accordance with specification and procedure requirements.

LAW Fan Coil Units - Inadequate Working Clearance

The ambient temperature in the LAW Facility is controlled by multiple fan coil units (FCUs). These units use chilled water for cooling and electric coils for heating. After installation of the FCUs commenced in

early 2007, a WCD site electrical inspector observed that some of the units did not provide the minimum work space clearance required by the NEC. Article 110.26 of the NEC specifies the minimum working clearances for electrical maintenance work on low voltage (less than 600 volts) equipment. Article 110.34 of the NEC addresses minimum working clearances for high voltage equipment. The intent of the adequate work space requirement is to keep electricians safe while they work on electrical equipment. The Occupational Safety and Health Administration (OSHA) and the DOE Worker Safety and Health Program (10 CFR 851) endorse the NEC requirements for the required minimum work clearance for safety of maintenance personnel working on electrical equipment.

Since first identified as a concern in 2007, several CDRs have been written to document insufficient working space around FCUs. A partial list follows:

CDR-07-0235 - C3V-FCU-00014 Access Obstruction
CDR-09-0134 - LAW Maintenance Accessibility Issue on Fan Coil Unit FCU-00093
CDR-09-0218 - LAB Duct Heater Work Clearance (addresses C2V-FCU-00095)
CDR-10-0040 - LAW NEC Space Requirements for C5V-FCU-00002 Not Met
CDR-11-0444 - LAW- C2V Fan Coil Unit Working Clearance Violations
CDR-12-0593 - LAW - C2V-FCU-00095 – NEC Working Space Clearance Violation.

These subsequent CDRs addressing FCUs that have less than the required minimum clearances specified in the NEC indicate that corrective actions were inadequate to resolve the minimum working space issue. Some FCUs were installed in locations where there was inadequate working clearance because other components or equipment had already been installed within the minimum working clearance area. Other FCUs may have been initially installed with adequate working clearance, but then new components were installed within the minimum work space area. Although additional equipment and components are being installed in the proximity of the FCUs, BNI has not placed adequate emphasis on locating the new equipment and components to maintain the minimum clearance envelope.

The proposed resolution of this issue is to relocate the electrical controls from their original enclosures and install the controls in new enclosures in more accessible locations. The controls for some of the FCUs have already been relocated to new enclosures. The original enclosures for the FCU electrical controls were certified by a Nationally Recognized Testing Lab (NRTL), Underwriters Laboratories, Inc. (UL). The new enclosures for the relocated FCU controls will also require NRTL certification to comply with NEC Articles 110-2 and 90-7 that require electrical equipment, including enclosures, be certified by an NRTL. BNI Design Criteria 24590-WTP-DC-E-06-001, *Design Criteria for Approval of Electrical Equipment*, specifies the requirements for approval of the enclosures.

BNI Field Engineering is compiling a list of the FCUs that require relocation of their electrical controls. They intend to use this list to coordinate planning to ensure that all FCUs with inadequate work space are addressed and that all modified control boxes are properly certified. EA will continue to monitor the progress on these panels to verify the quality of the installations.

The electrical disconnect switches for two FCUs in the LAW Facility melter bay area, numbers C3V-FCU-00015 and -00016, are mounted approximately 8 feet off the floor, which exceeds the maximum height of 6 feet 7 inches (2 meters) specified in NEC Article 380.8. The WCD electrical inspectors evaluated placement of the disconnect switches for the equipment (fan motors). The disconnect switches were behind removable covers and the WCD electrical inspectors noted that the 1999 NEC provides an exception to requiring the disconnect switches at no higher than 6 feet 7 inches in Article 380-8(a), *Exception No. 2.*

Heater Control Panel in the LAW Facility

A heater control panel in the LAW Facility primary off-gas process system, number LOP-PNL-00005, is fed by 3 - 2/0 cables. The main breaker for the panel is rated for 100 amps and has a stated maximum wire size of 1/0. The cables have not been terminated yet, so it is possible to use a reducing pin for the 2/0 (0.3648 inch diameter) cable to allow it to fit the breaker sized for a 1/0 (0.3249 inch diameter) cable. EA and the WCD site electrical inspector discussed this issue with BNI Field Engineering.

The WCD site electrical inspector documented this issue in Assessment Follow-up Item S-15-WCD-RPPWTP-012-A01 to monitor this situation to ensure a proper resolution.

Labeling of Electrical Panels and Cabinets

Electrical panels and cabinets are required to be labeled to comply with the NEC and OSHA regulations. The purpose of labeling is to identify the hazards associated with the equipment enclosed in the panels and cabinets. These hazards include risk of fire, risk of electrical shock, and mechanical hazards. The labeling is required to be performed by an NRTL. The labeling can be completed after manufacture, prior to shipment to the project, or in the field by an NRTL.

An ongoing issue at WTP is the installation of cabinets and panels that have not been labeled. Several CDRs have been initiated to document and disposition the various panels that have not been labeled. BNI Procedure 24590-WTP-DC-E-06-001 describes the approval process for equipment that does not have an NRTL label, including seven different methods of approving equipment for use in the facility. The preferred method is to have electrical equipment NRTL approved and labeled prior to receiving the equipment on site. The other methods involve approving the equipment after it is on site and installed, by having an NRTL come on site and evaluate the equipment.

The BNI site organization has been certified by UL to be a UL 508A Industrial Control Panel (ICP) shop, authorized by UL to build, modify, and/or evaluate ICPs to UL Standard 508A and place its own UL "ICP" label on these types of panels.

The EA September 2015 Construction Quality review report discussed that there is potential conflict of interest for BNI to have the Authority Having Jurisdiction (AHJ) for approval of the equipment and its installation, and also be the designer and general contractor. The ability of BNI to provide AHJ approval in lieu of NRTL certification is another example of a conflict of interest, since all installed electrical equipment is not inspected by an impartial third party.

BNI adequately performed most observed electrical construction activities in accordance with approved procedures, design drawings, manufacturer's instructions, and other design basis documents, including applicable codes and standards. EA will continue to review the resolution of issues associated with items discussed above.

5.7 Fire Protection Program

Fire Protection Program Documentation

Criterion:
A documented fire safety program exists as required by applicable orders, standards, and the Bechtel National, Inc. contract. (DOE Order 420.1B; DOE-STD-1066-97; NFPA 801 (2003))

BNI has developed and issued a Fire Protection Program (FPP) Plan in document number 24590-WTP-

PL-ESH-02-004 that delineates programmatic requirements for the design, construction, and operation of fire protection systems at the WTP site. The plan identifies key responsibilities and requirements for the implementation of the FPP for buildings during construction and operations. To support the FPP Plan, BNI has a Fire Prevention and Protection Procedure, 24590-WTP-GPP-SIND-026, that establishes fire protection guidelines and requirements to protect workers and property at WTP. System description 24590-WTP-3YD-FSW-00001, *System Description for the Fire Service Water (FSW), Fire Protection Water, and the Fire Detection and Alarm Systems*, establishes system requirements, operations requirements, systems maintenance, interfacing systems, and documents applicable to the described systems. Fire Protection Policy Statement (BNI document number 24590-WTP-G63-MGT-007) describes the commitments for BNI and WTP Project Management to provide a high level of fire protection capability at WTP throughout the life of the project.

EA determined that WTP has a documented FPP meeting the intent of DOE Order 420.1B; DOE-STD-1066-97, *Fire Protection Design Criteria*; and National Fire Protection Association (NFPA) 801, *Standard for Facilities Handling Radioactive Materials*.

Pre-Incident Fire Plans

The Hanford Site fire department has established fire pre-plans for the LAW, LAB, and BOF facilities, and these pre-plans are updated periodically to ensure that facility information remains current. The BNI and ORP fire safety groups provide input to the site fire department for the fire pre-plans. The fire pre-plans show the locations of the fire hydrants connected to the Hanford Site raw water supply. The fire pre-plans for the WTP - Laboratory, main BNI office building on site (referred to as T1), and support buildings state that automatic sprinkler systems are not in service in these buildings, and indicate that the Hanford Site fire department can connect to each building's fire department connections (FDCs), the large hose connections that allow water to be supplied via fire hose to charge fire sprinkler systems in the event of a fire. The fire pre-plans show information that is specific to each building to assist responding personnel in effectively managing emergencies for the protection of occupants, responding personnel, and the environment.

The fire pre-plans for the LAW, LAB, and BOF facilities reviewed are adequate and consistent with the requirements of DOE Order 420.1B and the guidance provided in NFPA 1620 (2010), *Standard for Pre-Incident Planning*.

Control of Combustibles

BNI Procedure 24590-WTP-GPP-SIND-026, *Fire Prevention and Protection*, establishes the WTP program for controlling flammable and combustible materials. The program requirements are consistent with Title 29, CFR 1926, Sections 151 and 152. Section 4 of BNI Procedure 24590-WTP-GPP-SIND-073, *General Housekeeping*, defines the responsibilities and requirements for fire protection and prevention to minimize flammables, combustibles, and the accumulation of waste in all areas within the WTP construction boundary and site support areas. These requirements are consistent with NFPA 241, Chapters 4, 5, and 8. Construction superintendents are required to perform daily, weekly, and monthly walk-downs in construction areas. In addition, the area construction superintendent, lead safety assurance representative, and an area field engineer are required to perform bi-annual walk-downs. EA evaluated the implementation of the combustible control program during walk-downs in the LAW Facility, LAB, and the following BOF buildings: two electrical distribution facilities, the steam plant, compressor building, and fire water pump houses. The BNI combustible control program is satisfactory.

As part of the WTP fire safety program, the fire safety group performs daily/weekly walk-downs of the facilities under construction, and the major occupied buildings that support construction activities at the

WTP construction site, Material Handling Facility, and Yakima warehouse for compliance with NFPA 241, other NFPA codes and standards, and applicable building codes.

EA concluded that flammables, combustibles, and accumulation of wastes are being adequately controlled as required by DOE 420.1B, 29 CFR 1926, and NFPA codes and standards.

Hot Work

The WTP fire protection program includes controls for hot work (welding, cutting, and grinding). These controls are specified in BNI Procedure 24590-WTP-GPP-SIND-035, *Welding and Cutting Safety*, and BNI Procedure 24590-WTP-GPP-SIND-013, *Hot Work Permit*. The requirements in these procedures are consistent with NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*; 29 CFR 1926, Subpart J, *Welding and Cutting*; and American National Standards Institute (ANSI) Z49.1, *Safety In Welding, Cutting, and Allied Processes*.

Section 4.5 of BNI Procedure 24590-WTP-GPP-SIND-013 requires the Permit Authorizing Supervisor to identify permit conditions, including the need for a fire watch. Section 5.3.3 (a) and (b) of BNI Procedure 24590-WTP-GPP-SIND-035 requires protective clothing for hot work operators to minimize the potential for fire ignition, burning, trapping hot sparks, and electrical shock consistent with ANSI Z49.1.4.3 and E4.3. ANSI Z49.1.4.3, Section 7, requires appropriate protective (flame-retardant) clothing for any welding operation and specifies that cotton clothing, if used, should be chemically treated to reduce its combustibility.

On December 15, 2015, EA observed three hot work activities in the LAW building. Two of the observed activities were conducted in accordance with requirements:

- In Activity 1, EA observed a welder standing and welding at a round table. Consistent with the requirements of ANSI Z49.1.4.3, a fire watch was required and present. The welder wore personnel protective clothing consisting of a green fire resistive welder's jacket and welding apron.
- In Activity 2, EA observed two welders within the boundaries of a confined space, welding in a seated position. Two fire watch persons were assigned to the activity, one immediately above the confined space opening and a second at ground level. Both welders wore personnel protective clothing consisting of green fire resistive welders' jackets and leather leggings/chaps.
- In Activity 3, the welder was welding in a standing position at a work table. EA reviewed the welding permit at the work location. The section of the permit for determining whether a fire watch is required had responses to all questions checked "NO," including: (1) Will hot work be performed in an area where a fire might develop, and (2) Are there combustibles that cannot be protected or relocated outside the 35 feet boundary (or other established distance) located within the hot work area? The permit, completed by the Permit Authorizing Supervisor on the same day as the activity (December 12, 2015), did not require a fire watch, and a fire watch was not present. However, combustible materials (wood) were located within the 35 feet boundary and were not covered with protective coverings. Appendix F of 24590-WTP-GPP-SIND-013 provides two illustrations of the 35 feet rule that show locations where an assigned fire watch should be positioned.

Overall, BNI has adequately developed and implemented controls for hot work.

Fire Prevention and Protection

Criteria:
A reliable and adequate water supply and distribution system must be provided for fire suppression, as documented through appropriate analysis. (DOE Order 420.1B; DOE STD-1066-97, Building Codes; NFPA Codes and Standards)

A process exists to assure that all fire prevention and protection features are reviewed and approved by a qualified fire protection engineer. (DOE Order 420.1B; DOE-STD-1066-97, Building Codes; NFPA Codes and Standards)

Water Supply

The WTP fire water distribution system is described in System Description 24590-WTP-3YD-FSW-00001, *System Description for the Fire Service Water, Fire Protection Water, and the Fire Detection and Alarm*, issued February 27, 2012. This document states that the installed underground fire water distribution system will be supplied by the FSW system that will store and deliver fire water throughout the WTP complex to fire hydrants and buildings equipped with fire sprinkler systems and standpipes. The FSW system consists of two fire pump houses, two fire water storage tanks, underground yard mains, and fire hydrants.

In early 2000, the newly installed WTP underground water mains were connected to the Hanford Site raw water supply as a temporary source of water for underground water mains and fire hydrants while components and piping for the FSW system were installed, pressure tested, fully flushed, and placed in service. All of the FSW underground water mains and fire hydrants have been installed and pressure tested to provide a source of water for fire protection during construction as required by NFPA 241 (2000), *Safeguarding Construction, Alteration, and Demolition Operations*, Section 8.7.2.1, 8.7.2.2, and 8.7.2.3.

Regarding the FSW that will supply water to building sprinkler systems, BNI fire protection engineers indicated that this system has not been declared in service because flushing meeting NFPA 24 requirements for minimum flow and velocity have not been performed on all portions of the system. Fire protection engineers and the construction manager indicated NFPA 24 flushing requirements will be completed prior to the system being turned over from construction to the startup organization. The LAB and BOF fire sprinkler systems are tentatively scheduled to go in service in 2016.

Sprinkler Systems

EA evaluated completed fire sprinkler systems installed in the LAB, Switchgear Buildings, Chiller/Compressor Plant, and Steam Plant. These systems were installed, completed, and hydrostatically tested prior to 2006. However, these systems are not in service. There is no water in these systems, as they await further acceptance testing.

Placing these systems in operation requires completion of the FSW system. However, the DOE Hanford Site raw water supply does not have the minimum flow and velocity required, as specified in NFPA 13 (1999), Section 10.10, for flushing. Also impairing immediate sprinkler system operation is the lack of permanent heat to the buildings, which could result in sprinkler systems freezing.

Facility support utilities and sprinkler systems not being in service is an ongoing issue at WTP. EA reviewed a sample of completed ORP fire protection engineer assessments of the WTP FPP. Since 2006, ORP Assessment Reports have documented that completed fire sprinkler systems are not in service.

Examples include:

- Report A-06-ESQ-RPPWTP-001, performed in February 2006, stated that completed installations of fire systems in the steam plant, fire water pump houses, and BOF switchgear facilities have not been put into service and that BNI lacks clear strategy and identification for which system will go in lay-up or operational modes.
- Report A-13-TSR-RPPWTP-001 was performed in March 2013 for the LAW, LAB, and Switchgear Building. The assessment team noted in this report that NFPA 241, Section 8.7.3, states: if suppression systems are to be provided, the installation "shall be in service as soon as practically possible." The 2013 assessment team observed that installed fire protection systems were not put in service, and a plan to evaluate the system in use did not exist.
- The Facility Fire Protection Assessment report for Building 60 (LAB), dated September 2 to December 9, 2014, states in Section C: "while the fire sprinkler system has physically been connected to the fire service water (FSW) underground, it has not been placed in-service."

Activation of these water supply and sprinkler systems will reduce life safety risk and protect the existing property valued in excess of a billion dollars from fire. Barriers to activation of the fire systems have not been effectively addressed.

Reviews and Approvals

BNI Procedure 24590-WTP-PL-ESH-02-004, *WTP Fire Protection Program*, and BNI Procedure 24590-WTP-3DP-G04T-00913, *Review of Engineering Documents*, requires a qualified fire protection engineer to perform reviews and approvals of all fire prevention and protection features. EA reviewed the following documents: (1) LAW Facility hot cell fire suppression system design and drawing; (2) seismic calculations for sprinkler piping hangers and braces installed in the LAB Facility; (3) underground piping layouts; and (4) fire pump installations and acceptance tests. These documents were reviewed and approved by a qualified fire protection engineer.

EA also reviewed ORP surveillance report S-12-ESD-RPPWTP-001, *LAB Fire Sprinkler Design and Installation*. This surveillance was performed by the ORP fire protection engineer to evaluate the BNI fire protection review process for the LAB fire sprinkler system design and installation.

EA concluded that BNI has a process that ensures that all fire prevention and protection features are reviewed and approved by a qualified fire protection engineer, as required by DOE Order 420.1B and DOE-STD-1066-97. Further, the ORP fire protection engineer's oversight and surveillance of WTP fire protection system design and installation, as well as his oversight of fire protection during construction, is comprehensive and thorough.

The design and construction of fire detection and protection systems at the WTP are satisfactory. However as noted above these systems should be activated on a priority basis to reduce personnel risk from fire and protect the portions of the WTP already constructed which exceed a billion dollars in value.

6.0 FINDINGS

EA identified no findings or deficiencies during this assessment.

7.0 OPPORTUNITIES FOR IMPROVEMENT

None.

8.0 ITEMS FOR FOLLOW-UP

EA will perform additional reviews of the BNI self-assessment process; resolution of open CRs, NCRs, and CDRs including BNI efforts to reduce the backlog of unresolved issues; and implementation of the MIP. EA will 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. EA will review use and effectiveness of a new performance metric developed to monitor the error rate in field engineer inspection records. In addition, EA will continue to review corrective actions taken by BNI to resolve PICA installation deficiencies, issues with adequate work space to safely perform maintenance on FCUs, and cable termination work errors. EA will also follow BNI and ORP efforts to complete, test, and place fire detection and protection systems into service.

Appendix A
Supplemental Information

Review Dates

Onsite portion conducted December 14-17, 2015

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
Karen L. Boardman
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
James M. Boyd
Michael A. Marelli
Barry L. Snook

Appendix B
Documents Reviewed, Interviews, and Observations

Documents Reviewed

- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 11, Pressure Testing of Piping, Tubing and Components, December 8, 2015
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 4B, Post Installed Concrete Anchors, April 30, 2014
- Specification No. 24590-WTP-3PS-FA02-T0004, Rev. 7, Engineering Specification for Installation and Testing of Post Installed Concrete Anchors and Drilling/Coring of Concrete, April 29, 2014
- Procedure 24590-WTP-GPP-MGT-044, Rev. 3, Nonconformance Reporting and Control, October 13, 2015
- Procedure 24590-WTP-GPP- MGT-036, WTP Self-Assessment and Line Surveillance, Rev. 5, March 31, 2015
- 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-QAM-QA-06-001, Rev. 16, Quality Assurance Manual, December 22, 2014
- Construction Deficiency Report numbers 24590-WTP-CDR-CON-15-0442 through -0492. CDR number -0445 was not issued
- Nonconformance Report numbers 24590-WTP-NCR-CON-15-0147 through -0231
- BNI Report titled “Subcontractor PICA Action for Building 82, 86, 87, and 91.”
- BNI Report titled “PIER Subcontractor PICA Evaluation Response Wording for BOF Steam Plant.”
- Specification No. 24590-WTP-3PS-E00X-T0004, Rev. 10, Engineering Specification for Installation of Cables, January, 2015
- Specification No. 24590-WTP-3PS-EW00-T0001 Rev. 3, Engineering Specification for Power, Control, and Instrumentation Cable, Medium Voltage Power Cable and Fiber Optic Cable (Safety), July 1, 2011
- Specification 24590-WTP-DC-E06-001, Rev. 4, Design Criteria for Approval of Electrical Equipment
- Construction Procedure 24950-WTP-GPP-CON-3304, Rev. 4, Electrical Cable Installation, November 24, 2015
- Design Criteria 24590-WTP-DC-E-06-001, Rev. 4, Design Criteria for Approval of Electrical Equipment
- CDR 24590-WTP-CDR-CON-12-0593, LAW-C2V-FCU-00095 – NEC Working Space Clearance Violation
- CDR 24590-WTP-CDR-CON-15-0419, LVEPSUP20201H01 and LVEPSUP20202H01 over current protection and cable sizing
- Drawing number 24590-WTP-E9-E51T-00015, Rev. 0, FCU Heater Control Panel Layout
- Sub-Tier Assessment Report, S-15-RPPWTP-012-14, December 16, 2015, Feeder Cable to LOP-PNL-00005 Control Panel is Oversized for the Main Breaker Lug Rating
- Drawing number 24590-WTP-E9-E51T-00015, Rev. 1, FCU Heater Control Panel
- Drawing Change Notice, 24590-LAW-VDCN-E-15-00065, Update LVESUP20201 & LVEPSUP20202 Breaker Supply Cable Size
- Drawing Change Notice, 24590-LAW-VDCN-E-15-00073, Update LVESUP20201 & LVEPSUP20202 Breaker Supply Cable Size
- DOE IG Report number DOE/IG-0863, The Department of Energy’s $12.2 Billion Waste Treatment and Immobilization Plant – Quality Assurance Issues – Black Cell Vessel. April 2012

- DOE IG Report number DOE/IG-0894. Department of Energy Quality Assurance: Design Control for the Waste Treatment and Immobilization Plant at the Hanford Site, September 2013
- DOE IG Report number DOE-OIG-16-03. Procurement of Parts and Materials for the Waste Treatment and Immobilization Plant at the Hanford Site, November 2015
- Document BNI 24590-WTP-PL-MGT-14-0006, Managed Improvement Plan (MIP), Rev. 1, August 28, 2014
- DOE/ORP U-13-QAT-RPPWTP-001, Bechtel National, Inc. Quality Assurance Program Requirements 3, 4, 5, 8, 15, and 16, October 28, 2013
- BNI 2015 QC Surveillance of Sub Contractor and Construction Operations Schedule
- DOE/ORP TRS-OA-IP-01, Integrated Assessment Process, Rev. 8, February 5, 2014
- BNI 24590-WTP-CMCA-MGT-13-0003, Common Cause Analysis of Inadequate Implementation of the WTP Corrective Action Program
- BNI Managed Improvement Plan Area Review presentation, September 28, 2015
- BNI 24590-WTP-GPP-RACA-CR-0116, Performance Improvement Review Boards, Rev. 2, October 22, 2015
- EXCEL Spread Sheet listing Level A and B Condition Report
- Document 24590-WTP-PL-ESH-02-004, WTP Fire Protection Program, Rev. 8C, January 25, 2015
- Document 24590-WTP-PSAR-ESH-01-002-01, Preliminary Documented Safety Analysis to Support Construction Authorization; General Information, Rev. 5e, July 10, 2015
- Document 24590-WTP-GPG-SRAD-0003, Fire Protection Glossary of Terms, Rev. 1, August 26, 2015
- Document 24590-WTP-RPT-CON-05-007, List of Applicable NFPA Codes and Standards to Construction Activities Involving Non-Permanent Plant Installation and Maintenance, Rev. 3, January 31, 2012
- Document 24590-WTP-RPT-ENS-03-010, Fire Protection Equivalency Request (Structural Steel Fireproofing), Rev. 0, November 19, 2003
- Document 24590-WTP-RPT-FP-04-0002, List of Applicable NFPA Codes and Standards to Design, Rev. 2, July 23, 2007
- Document 24590-LAB-FHA-RAFP-FP-0001, Fire Hazards Analysis for the Analytical Laboratory Facility, Rev. 1, April 14, 2015
- Document 24590-LAW-FHA-RAFP-FP-0001, Fire Hazards Analysis (FHA) for the Low-Activity Waste Facility, Rev. 1, April 9, 2015
- Document 24590-WTP-FHA-RAFP-FP-0001, Fire Hazards Analysis (FHA) for the General/Balance of Facilities, Rev. 1, June 4, 2015
- Document 24590-WTP-3DP-G04T-00916, Design Completion for Turnover to Startup or Plant Operations, Rev. 6, February 18, 2015
- Document 24590-WTP-3YD-FSW-00001, System Description for the Fire Service Water (FSW), Fire Protection Water (FPW), and the Fire Detection and Alarm (FDE) Systems, Rev. 1, February 27, 2012
- BNI Procedure 24590-WTP-GPP-SIND-009, Safety Watches, Rev. 5C, August 24, 2012
- BNI Procedure 24590-WTP-GPP-SIND-019, Emergency Management Program, Rev. 11, June 16, 2015
- BNI Procedure 24590-WTP-GPP-SIND-013, Hot Work Permit, Rev. 8C, June 3, 2013
- BNI Procedure 24590-WTP-GPP-SIND-026, Fire Prevention and Protection, Rev. 6, March 14, 2015
- BNI Procedure 24590-WTP-GPP-SIND-035, Welding and Cutting Safety, Rev. 5C, November 21, 2013
- BNI Procedure 24590-WTP-GPP-SIND-073, General Housekeeping, Rev. 2, July 10, 2015
- BNI Procedure 24590-WTP-GPP-SRAD-042, Control of Combustibles, Rev. 1a, June 2, 2014
- BNI Procedure 24590-WTP-GPP-SRAD-058, Compressed Gas Cylinders, Rev. 1, May 20, 2011

- BNI Procedure 24590-WTP-GPP-SRAD-059, Fire Prevention, Rev. 1, May 20, 2011
- BNI Procedure 24590-WTP-GPP-SRAD-063, Inspection, Testing, and Maintenance of Fire Doors, Fire Dampers, and Combination Fire/Smoke Dampers, Rev. 1a, June 2, 2014
- BNI Procedure 24590-WTP-GPP-SRAD-064, Inspection of Fire Walls, Ceilings, Floors, and Fire Penetrations, Rev. 1a, June 2, 2014
- BNI Procedure 24590-WTP-GPP-SRAD-065, Preparing a Fire Hazards Analysis, Rev. 4, September 8, 2014
- BNI Procedure 24590-WTP-GPP-SRAD-069, Fire Protection System Impairments, Rev. 5, September 22, 2015
- BNI Procedure 24590-WTP-GPP-SRAD-0004, Guide: Preparing a Fire Hazards Analysis, Rev. 2, September 8, 2014
- BNI Procedure 24590-WTP-PL-ENS-06-0002, Fire Protection Facility Assessments – Management Assessment Plan, Rev. 4 and 4A, June 2, 2014
- Document number 24590-WTP-PL-MGT-07-0003, Plan to Place WTP Permanent Plant Fire Protection Systems in Service, Rev. 1, September 16, 2010
- Document 24590-WTP-PL-RAFP-FP-0001, Fire Safety Management Assessment Plan, Rev. 1, September 17, 2014
- Document 24590-WTP-SAR-FP-14-0004, 2014 Fire Protection Facility Assessment LAW Buildings 20 and 24, Rev. 0, October 6, 2014
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0014, 2014 Fire Protection Facility Assessment – Building 86, Rev. 0, January 15, 2014
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0015, 2014 Fire Protection Facility Assessment – Building 10, Rev. 0, February 18, 2014
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0016, 2014 Fire Protection Facility Assessment – Building 83 and 83S, Rev. 0, March 20, 2014
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0017, 2014 Fire Protection Facility Assessment – Satellite Accumulation Facility Areas, Rev. 0, July 24, 2015
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0019, 2014 Fire Protection Facility Assessment – T52, T54, and T54A, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0020, 2014 Fire Protection Facility Assessment – Building 60, Rev. 0, September 2, 2014
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0021, 2014 Fire Protection Facility Assessment –HLW, Rev. 0, November 26, 2014
- Self Assessment Report number 24590-WTP-UPIR-CON-03-048, Underground Pipe Inspection Record, dated January 23, 2008
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0002, February 2014 Assessment of the WTP Fire Protection Program, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0003, March 2014 Assessment of the WTP Fire Protection Program, Rev. 1
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0005, May 2014 Assessment of the WTP Fire Protection Program, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0006, June 2014 Assessment of the WTP Fire Protection Program, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0007, July 2014 Assessment of the WTP Fire Protection Program, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0008, August 2014 Assessment of the WTP Fire Protection Program, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-ENS-14-0009, September 2014 Assessment of the WTP Fire Protection Program, Rev. 0

- Self Assessment Report number 24590-WTP-SAR-FP-14-0001, October 2014 Assessment of the WTP Fire Protection Program – LOIs 138-142, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-FP-14-0002, November 2014 Assessment of the WTP Fire Protection Program – LOIs 143-148, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-FP-15-0010, January 2015 Assessment of the Fire Protection Program – LOIs 154 through 159, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-FP-15-0011, February 2015 Assessment of the Fire Protection Program – LOIs 160 through 164, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-FP-15-0012, March 2015 Assessment of the Fire Protection Program – LOIs 165 through 171, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-FP-15-0013, April 2015 Assessment of the Fire Protection Program – LOIs 172 through 175, Rev. 0
- Self Assessment Report number 24590-WTP-SAR-FP-15-0014, May 2015 Assessment of the Fire Protection Program – LOIs 176 through 178, Rev. 0
- Letter 06-ESQ-033 from R. J. Schepens to J. P. Henschel, Assessment Report A-06-ESQ-RPPWTP-001 Fire Protection Program Implementation, February 6 through 17, 2006, April 17, 2006
- Letter 07-ESQ-044 from J. R. Eschenberg to C. M. Albert, Assessment Report A-07-ESQ-RPPWTP-001 Fire Protection Program Implementation One Year Follow Up, February 5 Through 16, 2007, March 28, 2007
- Letter 10-ESD-008 from G. A. Girard to R. W. Bradford, Assessment Report A-10-ESD-RPPWTP-001 – Fire Protection Program Implementation of Bechtel National, Inc. (BNI) Waste Treatment and Immobilization Plant (WTP) Facilities, April 19, 2010
- Letter 12-ESD-0003 from D. L. Noyes to R. W. Bradford, Surveillance Report S-12-ESD-RPPWTP-001 – Bechtel National, Inc. Facility Fire Sprinkler System Design and Installation at the Analytical Laboratory (LAB) Facility Waste Treatment and Immobilization Plant, February 23, 2012
- Letter 12-TSR-0025 from D. L. Noyes to R. W. Bradford, Surveillance Report S-12-TSR-RPPWTP-001 – Bechtel National, Inc. (BNI) Waste Treatment and Immobilization Plant (WTP) Fire Sprinkler Design and Installation Process, 7/16/2012
- Letter 13-TSR-0029 from W. F. Hamel to J. M. St. Julian, Transmittal of the U.S. Department of Energy (DOE), Office of River Protection (ORP) Assessment Report A-13-TSR-RPPWTP-001, Bechtel National, Inc. (BNI) Waste Treatment and Immobilization Plant (WTP) Facilities Fire Protection Program Implementation, July 26, 2013
- Letter 15-WTP-0102 from W. F. Hamel to J. M. St. Julian, Actions to Implement NFPA 241 and Fire Sprinkler Design/Installation Process at the Waste Treatment and Immobilization Plant, September 2, 2015
- Construction Deficiency Report 24590-WTP-CDR-CON-15-0457 LAB Roof Failed to Meet ASTM Requirements
- Hot Work Permit issued in the LAW facility for Work Package LP1-2100, December 15, 2015
- Drawing 24590-BOF-M6-FSW-00001, P&ID Fire Protection System Fire Water Main Loop System FWS, Rev. 10, October 26, 2015
- Drawing 24590-LAB-U1-60-00006, Analytical Laboratory Fire Barrier Drawing Plan at Elevation 17’0”, Rev. 1, May 20, 2014
- ORP Procedure MGT-PM-DI-04, WCD Construction Oversight, Rev. 1, November 28, 2012
- ORP Procedure TRS-OA-IP-01, Integrated Assessment Process, Rev. 8, February 5, 2014

Interviews

- BNI WTP Site Manager
- BNI Field Engineering Manager
- BNI Area Construction Superintendents
- BNI Field Engineers
- BNI Welding Engineers
- BNI QC Manager
- BNI QC Inspectors
- BNI Electricians
- DOE/ROP Fire Protection Engineer
- BNI Fire Safety Coordinator
- BNI Project FPE/AHJ
- BNI Project Manager
- BNI WTP Engineering Oversight Manager
- BNI Fire Protection Engineer/System Technical Representative for Fire Alarm Systems
- BNI Lead Fire Protection Engineer for LAW and BOF
- BNI Fire Safety Manager
- BNI CAS Assessment SME
- BNI Senior Contractor Assurance Specialists

Observations

- Observed performance of one hydrostatic pressure test.
- Witnessed a WCD site inspector perform final visual inspection of two welds on an NLD system pipe support in the HLW and two piping welds on BOF NLD piping.
- Observed cable pulling activities in the LAW.
- Performed detailed review of UL Field Evaluation Reports on UPS Cabinets.
- Observed construction hot work activities (welding) at 3 locations in the LAW.
- Examined control of combustibles in the LAB, LAW, and several BOF buildings.
- Examined the following completed fire protection features: fire sprinklers, standpipes, fire alarms, fire rated walls/barriers, fire doors and frames, spray-on fire proofing, fire pumps, fire water storage tanks, and installed life safety systems (exit signs, emergency lighting, stairwells).

Examined sectional valves, fire hydrants installed for underground fire water distribution system