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

June 2015

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

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Acronyms

ASME	American Society of Mechanical Engineers
BNI	Bechtel National, Inc.
BOF	Balance of Facilities
CDR	Construction Deficiency Report
CFR	Code of Federal Regulations
CM	Commercial Grade
CRAD	Criteria, Review and Approach Document
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
HLW	High Level Waste
kcmil	area of a circle with a diameter of one thousand mils (one mil=one thousandth of an inch)
LAB	Analytical Laboratory
LAW	Low Activity Waste
MCC	Motor Control Center
NCR	Nonconformance Report
NEC	National Electric Code
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
ORP	Office of River Protection
PDSA	Preliminary Documented Safety Analysis
PICA	Post Installed Concrete Anchor
psi	Pounds per Square Inch
PTF	Pretreatment Facility
Q	Quality Related
QA	Quality Assurance
QAM	Quality Assurance Manual
QC	Quality Control
SSC	Structure, System, and Component
WCD	WTP Construction Oversight and Assurance Division
WED	WTP Engineering Division
WTP	Waste Treatment and Immobilization Plant

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EXECUTIVE SUMMARY

The U.S. Department of Energy Office of Enterprise Assessments (EA) conducted a review of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP) with the on-site portion of the review conducted from March 16–19, 2015. This EA review was performed in the broader context of an ongoing program of quarterly reviews of construction quality at the WTP construction site.

For the scope of this review, EA observed ongoing work activities, reviewed the Bechtel National, Inc. (BNI) program for control nonconforming conditions, examined implementation of selected requirements in the BNI quality assurance program, and followed up on issues identified during previous reviews.

Overall, the construction quality (including pressure testing of piping, electrical cable pulling, and structural concrete and structural steel work activities) at WTP is satisfactory in the reviewed areas. Housekeeping within the construction area shows visible improvement. Tripping hazards due to miscellaneous material and equipment randomly distributed on floor spaces has been greatly reduced. Floors are noticeably cleaner, providing a better work environment for craftsmen. BNI has also developed appropriate corrective actions to resolve specific deficiencies for closed nonconformance reports and construction deficiency reports that EA reviewed.

Progress continues to be slow in addressing identified deficiencies in two areas. First, progress in resolving issues with post installed concrete anchors has been slow; BNI expects to complete remaining corrective actions for the post installed concrete anchors by December 2015. Second, questions regarding certain aspects of electrical construction such as inconsistencies in labeling of some electrical cabinets, possible incorrect sizing of breakers, and the adequacy of cable support between the cable trays and cabinets remain unresolved.

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1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Environment, Safety and Health Assessments, within the independent Office of Enterprise Assessments (EA), conducted a review of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The on-site portion of this review was conducted from March 16-19, 2015, 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 reviews to assess the quality of construction at the WTP construction site. These reviews are performed to ensure construction contractors meet the requirements of 10 Code of Federal Regulations (CFR) 830, Subpart A, *Quality Assurance Requirements*.

2.0 SCOPE

EA conducted this review 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 March 2015. The scope of this quarterly review of construction quality included observations of ongoing work activities, review of the Bechtel National, Inc. (BNI) program for control of nonconforming conditions, examination of implementation of selected requirements in the BNI quality assurance (QA) program, and follow-up on issues identified during previous assessments. Design and procurement programs were not included in this review.

EA conducted several construction site walkthroughs concurrently with the DOE Office of River Protection (ORP) WTP Construction Oversight and Assurance Division (WCD) staff to determine whether work activities were completed in accordance with the appropriate design drawings, specifications, and installation procedures. EA observed two pneumatic pressure tests; inspection of structural steel welds; and installation and termination of electrical cables. EA examined nonconformance reports (NCRs) and construction deficiency reports (CDRs) that BNI identified under its corrective action program, as well as ongoing corrective actions to address deficiencies identified in the installation of post installed concrete anchors (PICAs). EA also reviewed construction quality records documenting the results of quality control (QC) tests performed on samples of concrete placed in the High Level Waste (HLW) Facility, the self-assessment program, and QA and QC surveillance reports.

3.0 BACKGROUND

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 (PDSA) 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 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, primarily the WCD staff, provides oversight of construction activities at the WTP.

The LAW Facility is expected to be essentially complete by the third or fourth quarter of calendar year 2015. 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 of the waste treatment process. In a September 2014 letter, DOE authorized BNI to proceed with design engineering work on the HLW Facility.

4.0 METHODOLOGY

EA conducted this review 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 March 2015. This review considered the requirements of 10 CFR 830, Subpart A, *Quality Assurance Requirement*, and DOE Order 414.1C, *Quality Assurance*, that specify the contractor must use appropriate national consensus standards to implement DOE QA requirements. The national consensus standard and basis for the BNI QA Program is ASME NQA-1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*. 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.

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

- CRAD 64-15, *Construction – Structural Concrete*
- CRAD 45-52, *Construction – Piping and Pipe Supports*
- 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. 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

This section includes a brief description of the activities that EA evaluated during the review and the results of that review. Conclusions are summarized in Section 6 and items for follow-up are discussed in Section 7.

5.1 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)

Post Installed Concrete Anchors (PICAs) are installed in the concrete structure after the concrete has hardened and attained its design strength to provide anchorage for equipment in locations where embedded plates and cast in-place anchor bolts are unavailable. The types of hardware and components that PICAs support include structural steel platforms, pipe supports, instrument racks, transformers, electrical components, and conduit and instrument supports. As reported in the previous EA quarterly construction report, during a review of commercial grade (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 February 28, 2015, BNI field engineers have identified 2292 records related to CM PICA installations. These records do not include PICAs installed in the HLW or PTF, or those installed by sub-contractors in any WTP facility. Field inspections and engineering reviews were completed for PICA installations documented on approximately 85 percent of the 2292 PICA records. The projected completion date to close this issue is December 2015. In January 2015, BNI engineers started to inspect PICAs installed by subcontractors. 18 CDRs were initiated as of early March 2015 to disposition sub-contractor PICA installations that do not comply with BNI installation criteria. CDRs with validation dates 2/10/2015-2/18/2015 address PICAs installed by subcontractor Apollo e.g. 24590-WTP-CDR-CON-15-0048, -0049, 0050, -0054, 0055.

BNI's determination of extent of condition and identification of corrective actions necessary to correct the PICA installation deficiencies was 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.

No deficiencies were identified.

5.2 Corrective Action Program

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

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

conditions at the WTP associated with quality related (Q) and commercial grade (CM) SSCs. NCRs are issued to document and disposition Q nonconforming conditions, while CDRs are used to document and disposition CM nonconforming conditions. 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 42 NCRs that BNI issued between December 17, 2014, and March 18, 2015, and the 130 CDRs that BNI issued between January 5 and March 18, 2015, to evaluate the types of nonconforming issues that were identified, their apparent causes, and subsequent corrective actions. The NCR categories included 9 NCRs related to construction or installation errors, including damage to installed components resulting from construction activities; 28 NCRs for procurement and supplier deficiencies; 3 NCRs for engineering issues; and 2 for materials handling issues.

Of the130 CDRs that EA reviewed, 48 involved BNI construction deficiencies, as well as18 CDRs for procurement and supplier deficiencies, 47 CDRs for deficiencies in work performed by sub-contractors, 8 CDRs for engineering errors, and 9 CDRs for materials identified with expired shelf life. The 48 BNI construction deficiencies included 12 related to PICA installation errors. The 47 sub-contractor CDRs included 18 for incorrect PICA installations and 23 CDRs for work performed by the subcontractor installing insulation blocks for the LAW melters.

Procurement deficiencies documented in CDRs and NCRs continue to challenge the BNI engineering organization, resulting in Design Engineering dedicating a large number of personnel to resolve the identified problems. The BNI engineering organizations have developed appropriate corrective actions to disposition the specific problems identified in the completed NCRs and CDRs that EA reviewed. The corrective action program and implementation is adequate to address and resolve specific construction quality deficiencies.

No deficiencies were identified.

5.3 Pressure Testing of Piping

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

EA observed two piping pressure tests (i.e., a pneumatic test performed on a section of the plant service air system and a hydrostatic test performed on a section of the plant service water system). These CM systems are located in the BOF chiller compressor building. 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,* and the requirements for pneumatic pressure testing are specified in ASME Code B31.3, Paragraph 345.5, *Pneumatic Testing*.

EA attended the pre-test briefings, reviewed drawings and test data sheets, 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 pressurization sequence and verified that the system tested was pressurized to the designated test pressure and held for a minimum of 10 minutes before initiating the system walk down to inspect the piping for leakage. EA observed the walk downs and inspections that BNI Field Engineering personnel performed. BNI Field Engineering personnel identified no leaks during the pneumatic test, and they declared the pressure tests successful. During the hydrostatic test, craft personnel identified a thru-wall leak in a valve body, and BNI Field Engineering personnel suspended the test. BNI Field Engineering personnel initiated a CDR, and the defective valve was replaced. BNI then performed a new hydrostatic test on the system after the valve was replaced, and a WCD site inspector witnessed the test. BNI identified no leaks during the test. EA reviewed the test data sheets from the second test and found no discrepancies.

The implementation of the pressure testing program was satisfactory for the sample that EA reviewed. No deficiencies were identified.

5.4 WCD Welding Inspection Program

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

The WCD staff performs independent inspections of one or more inspection attributes 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.

EA observed a WCD site inspector perform an independent final visual inspection of a completed structural steel Q column to baseplate weld in the HLW, designated as FW-6 on the weld map, drawing number HLW-S1-S15T-00202. Acceptance criteria for visual examination of support and structural steel welds are specified in *Bechtel Nondestructive Examination Standard, Visual Examination VT-AWS D1.1*. 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. EA inspected other structural steel welds in the same area and observed installation of two structural steel beams.

No deficiencies were identified.

5.5 Concrete Placement Records

Criteria: Work, such as concrete construction, shall be performed in accordance with approved procedures, design drawings, and other design basis documents, including applicable codes and standards. The procedures, instructions, and drawings shall include or reference appropriate quantitative or qualitative acceptance criteria for determining that prescribed results have been satisfactorily attained (NQA-1, Criterion 5; Policy Q-5.1 of the WTP QAM; and DOE Order 414.1C). Records shall furnish documentary evidence that items or activities meet specified quality requirements (NQA-1, Requirement 17; Policy Q-17.1 of the WTP QAM; and DOE Order 414.1C).

EA reviewed the results of QC tests performed on concrete samples from the five Q concrete placements (i.e., three walls and two interior floor slabs) completed between December 23, 2014, and February 23, 2015, in the HLW Facility. The tests included slump, temperature, and unit weight testing performed on

the freshly mixed concrete and unconfined compression tests performed on concrete cylinders cured for 7 and 28 days in the concrete laboratory to verify the concrete quality and demonstrate that the concrete met the design strength requirements. The methods for sampling the concrete, casting and curing the cylinders, and performing the unconfined compression tests are specified in American Society for Testing and Materials International standards.

The allowable compressive strength used for structural design of the reinforced concrete structures at WTP is based on the results of unconfined compression tests performed on concrete cylinders that have been cured under controlled conditions for 28 days. Concrete cylinders are tested after being cured in a laboratory for 7 days to provide an early indication on concrete quality. Typically, the concrete compressive strength increases approximately 20 to 25 percent between 7 and 28 days. The unconfined compression tests performed on 15 concrete cylinders from the 5 HLW Facility pours showed that the concrete strength at 7 days varied from 5030 to 5900 pounds per square inch (psi) with an average strength of 5367 psi. Unconfined compression tests performed on 24 concrete cylinders from the 5 HLW Facility pours showed that the concrete strength at 28 days varied in the range of 6740 and 7900 psi with an average strength of 7226 psi.

The required minimum concrete strength used in designing the HLW was 5000 psi. Results of unconfined compression tests on both the 7 and 28 test cylinders exceeded the required design strength of 5000 psi, indicating that the quality of concrete in the HLW Facility was satisfactory. The results of the unconfined compression strength of the concrete at 28 days continues to exceed the specified design strength by at least 1000 psi for all classes of structural concrete at WTP.

No deficiencies were identified.

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), performed a detailed review of a CDR applicable to cable installation, and observed performance of walk down inspections performed as part of the construction turnover process. EA's observations are discussed in more detail below.

Cable Pulling

Most cable pulling activities are performed on the night shift to reduce interference with other craft personnel. EA and the WCD site electrical inspector discussed cable pulling operations with the supervisors and electrical craft and observed re-installation of cables from switchboard LVE-SWBD-20101 on the +3′ elevation of the LAW to LVE-MCC-20001 on the -21′ elevation in the LAW during the night shift. These previously installed cables were the incorrect size (i.e., too small) because the cable ampacity had not been de-rated to account for the fact that the cables passed through fire penetrations. Design Engineering determined that the minimum size cable required was 500 thousand circular mil (kcmil). The electricians removed the smaller, previously installed (350 kcmil) cables; inspected them for damage; and returned the 350 kcmil cables to storage. The installation of the 500 kcmil cables was a complex cable pull activity involving approximately 300 feet of cable in length, spanning two floors and

several rooms that required coordination between electricians at all stages of the cable route. Electricians were posted to feed the cable and to monitor the cable at every intermediate transition point. Several rollers and sheaves were installed to minimize cable tension. A cable tugger with an integral tension meter was used to assist with the cable pull and assist efforts to prevent exceeding allowable stress on the cable during the pull. The job was well planned and executed. The electricians performed the work efficiently and in a good workmanlike manner, observing all safety precautions.

BNI installed (pulled) more than 270 cables since the EA construction quality review in December 2014. EA reviewed a list of these cable pulls and selected a sample of the cable installations for review and inspection. The cable pulls selected for inspection varied in size, length, and complexity. The cable pulls that EA inspected were satisfactory. Based on observation of cable pulling and inspection of completed cable installations, EA concluded cable installation work was adequate.

Review of CDR Concerning Cable Damage

EA performed a detailed review of CDR 24590-WTP-CDR-CON-15-0020 initiated to evaluate how a cable was damaged during installation. Discussions with the electrical foreman disclosed that a plastic bushing installed in the ends of conduits to protect the cables from abrasions during installation and left in the conduit after installation was dislodged during a cable pull, damaging the cable as it was pulled through the conduit. The damage was immediately evident so the cable was removed and replaced. To prevent this from occurring again, BNI electricians now use a plastic sleeve that is inserted during cable installation and removed after installation is complete.

Routing of Cables between Cable Trays and Electrical Cabinets

During the quarterly WTP construction quality review in May 2014, EA identified a concern with the method of routing electrical cables between cable trays and the top of electrical cabinets such as motor control centers (MCCs). The cables are not routed in conduit or vertical cable trays, but rather drop unprotected in the open air. The WCD site electrical inspector, prior to the May 2014 review, also questioned this practice. BNI has issued a formal interpretation of the National Electric Code (NEC), stating that cables can be run in free air, up to 6' between cable trays and/or between cable tray and equipment, and that multiple cables can be bundled together up to 6' in length without de-rating their ampacity.

WCD requested that the ORP WTP Engineering Division (WED) electrical safety system oversight engineer evaluate the BNI Authority Having Jurisdiction ruling. The WED electrical safety system oversight engineer is currently evaluating this issue. In a previous review of WTP construction quality, EA identified an opportunity for improvement (OFI) in the area of cable entry into electrical cabinets. The OFI states, “WTP should re-evaluate the adequacy of support of cables between the cable trays and entrance into equipment cabinets, and the effect of bundled cables on the ampacity of the cables.” This issue remains unresolved. EA did note during building tours that electricians have installed support rails above a few MCCs and tie wrapped the cables to the rails.

EA noted that because cable pulls are scheduled and performed separate from cable terminations, electricians pull the cables and leave them coiled above the cabinets. At a later date the electricians install the cables into the cabinets and make the terminations. This practice is inefficient and delays completion of cable installations.

During this review, EA and WCD identified one deficiency pertaining to the raceway grounding/bonding relating to the conduits associated with motor control center LVE-MCC-20001 and LVE-MCC-20002. In response, WCD opened a priority level 3 Finding S-15-WCD-RPPWTP-003-F01 to document the undersized bonding jumper noncompliance.

Construction Turnover of Equipment to Operations

After construction is completed, systems are transferred from the Construction Division to Operations. EA and the WCD site electrical inspector attended a pre-job briefing and the system walk down performed in preparation for turnover of electrical panels for the high-mast and parking lot lighting. This system turnover package included the switchboard, transformer, breaker panel, and contactor cabinet. During the walk down, the WCD site inspector identified that the contactor cabinet did not have Underwriters Laboratory approval, a requirement of BNI Specification 24590-WTP-DC-E06-001, *Design Criteria for Approval of Electrical Equipment*. The BNI field engineer drafted a CDR to document this deficiency. The WCD inspector also noted that the grounded (neutral) conductors between panel LTE-PNL-87001 and contactor panel LTE-CTR-87001 were not marked with continuous gray or white insulation as required by Section 200-6(a) of the NEC. The field engineer drafted an additional CDR to document this deficiency. A month after this walk down, BNI is still evaluating these draft CDRs prior to assigning them numbers and formally entering them into the BNI CDR tracking system. WCD continues to follow up on these two CDRs and EA will review the progress on these CDRs during the next quarterly review of construction quality.

5.7 Self-Assessment Program

Criteria: Line and support organizations shall perform self-assessments of their performance and the adequacy of their processes. Self-assessments shall be used to evaluate performance at all levels periodically and to determine the effectiveness of policies, requirements, and standards and implementation status. Self-assessment results must be documented in sufficient detail to identify the activity covered, identify the individuals performing the surveillance, and document results and any necessary corrective actions. (Policy Q-02.2 of the WTP QAM; DOE Order 226.1A; DOE Order 226.1B; and DOE Order 414.1C) Note: DOE Order 226.1A was superseded by DOE Order 2261B by Contract Modification 310, dated January 28, 2014.

EA reviewed the BNI self-assessment Report number 24590-WTP-SAR-CON-15-0002, *Electrical Cable Terminations*. The scope of the self-assessment included a review of work performance and practices, inspection, training, and documentation processes for terminations of permanent plant electrical cables performed in November and December 2014. This self-assessment noted similar observations as those observed by EA during the construction quality review conducted in December 2014, such as the phase color inconsistency on LPHPNL00019. OFIs identified during this self-assessment also recommended making all possible cable terminations at once and not beginning terminations until at least 70 percent of them are released by Design Engineering. These recommendations are consistent with the OFI identified by EA during the December 2014 construction quality review. Because of the small self-assessment sample size available, EA will continue to evaluate implementation of the self-assessment program by the BNI Field Engineering organization in subsequent quarterly construction quality reviews.

The performance of self-assessment program was satisfactory for this review.

5.8 Quality Assurance Surveillance Activities

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

items and services shall be controlled to assure conformance with specified requirements. (NQA-1, Requirement 7; Policy Q- 7.1 of the WTP QAM; and DOE Order 414.1C)

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

EA reviewed eleven QC surveillances listed in Appendix B that were completed in January through March 2015 to evaluate civil construction activities. These surveillances covered observations of structural concrete and structural steel work activities and reviews of implementation of the QA programs for the concrete supplier subcontractor. EA also reviewed two QA surveillance reports covering Q level pipe welding in the LAW and the NCR program for the subcontractor installing the LAW melters. The reviewed BNI QC and QA surveillances met the requirements of BNI Procedure 24590-WTP-GPP-QA-601.

6.0 CONCLUSIONS

The construction quality at WTP is adequate in the reviewed areas. BNI has developed appropriate corrective actions to resolve specific deficiencies for closed construction quality NCRs and CDRs that EA reviewed. Approximately 25 percent of the NCRs and CDRs are related to deficiencies in materials and hardware supplied by vendors. BNI continues to implement corrective actions that are necessary to address errors in the installation of PICAs. BNI's approach to determining the extent of condition was adequate, but corrective actions have not been timely to resolve the PICA installation errors that were identified in September 2011. Delays by BNI Design Engineering to evaluate and re-issue PICA installation criteria required re-inspection of CM PICAs previously determined compliant with the installation criteria. BNI recently began field inspections of PICAs installed by sub-contractors. Corrective actions are expected to be completed by December 2015. With exception of the deficiencies identified by EA and WCD, electrical work reviewed was satisfactory.

Issues identified in previous inspections regarding inconsistent labeling of some MCCs in the LAB, incorrect labeling of panels in the Water Treatment building and in the LAW, and incorrect sizing of breakers remain unresolved. WCD inspectors and EA will continue to track these issues to resolution.

7.0 ITEMS FOR FOLLOW-UP

EA will continue to follow up on inspection of welding activities, piping and pipe supports, pressure testing of piping, cable pulling, and installation of electrical and mechanical equipment. EA will continue to review corrective actions to address identified discrepancies in the PICA installation process and will perform additional reviews of self-assessments that BNI Field Engineering conducted. Additionally, EA will review actions taken by BNI to resolve deficiencies in cable termination work and other issues identified by EA during the 2014 quarterly reviews involving equipment labeling inconsistencies, support of electrical cables from the point the cables exit cable trays to where they enter cabinets, and breaker sizing in some systems.

Appendix A
Supplemental Information

Review Dates

On-site portion conducted March 16-19, 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, Director, Office of Nuclear Safety and Environmental Assessments
Patricia Williams, Director, Office of Worker Safety and Health Assessments

Quality Review Board

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

EA Site Lead for Hanford Site

Robert Farrell

EA Team Composition

Robert Farrell – Team Lead
Joseph Lenahan
James Boyd

Appendix B
Documents Reviewed, Interviews, and Observations

Documents Reviewed

- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 10C, Pressure Testing of Piping, Tubing and Components, December 16, 2014
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 4B, Post Installed Concrete Anchors, April 30, 2014
- Specification 24590-WTP-3PS-DB01-T0001, Rev. 8, Engineering Specification for Furnishing and Delivering Ready-Mix Concrete, March 26, 2007
- Specification No. 24590-WTP-3PS-FA02-T0004, Rev. 7, Engineering Specification for Installation and Testing of Post Installed Concrete Anchors and Drilling/Coring of Concrete, April 29, 2014
- Specification No. 24590-WTP-3PS-SS00-T0001, Rev. 7, Engineering Specification for Welding of Structural Carbon Steel, January 30, 2008
- Procedure 24590-WTP-GPP-MGT-044, Rev. 2A, Nonconformance Reporting and Control, February 11, 2015
- Procedure 24590-WTP-GPP-MGT-036, Rev. 4, WTP Self-Assessment and Line Surveillance, November 20, 2014
- Procedure 24590-WTP-GPP-QA-601, Rev. 6C, Quality Assurance Surveillance, May 1, 2013
- Document number 24590-WTP-MN-CON-01-001-10-10, Rev. 6, Bechtel Nondestructive Examination Standard, Visual Examination VT-AWS D1.1, 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-15- 0001 through -0082 and -15-0084 through -0120, and -15- 0122 through -0132. CDR numbers 24590-WTP-CDR-CON-15-0083 and 0121 were not issued.
- Nonconformance Report numbers 24590-WTP-NCR-CON-14-0200 through -0204 and 24590-WTP-NCR-CON-15-0001 through -0037.
- WTP Self-Assessment Report 24590-WTP-SAR -CON-14-0002, Electrical Cable Terminations, Performance Assessment and Opportunities for Improvement, October 15, 2014
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-003, Verification of Non Q (NP Material) Temporary Erection Bolts Painted White or Yellow for the HLW.
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-007, Systemic Approach to Rebar/Backfill Inspection.
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-008, Commercial Grade Dedication on Five Star Fluid Grout 100.
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-009, Central Pre-Mix Nonconforming Reports (NCR).
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-01-, Central Pre-Mix Company Implementing Procedure #17 for Corrective Action.
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-015, Central Pre-Mix Internal Audits.
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-021, Kleinfelder KHP-Tp-1.10 Compressive Strength of Hydraulic Cement Mortars (Using 2 Inch Cube Speciments).
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-022, Check Concrete Vibrators Used During the HLW HCC4022-01 Concrete Placement.
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-028, Verification of Shop and Design Drawing Review Before Installation of Structural Steel.

- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-029, Central Pre-Mix Testing of Sand and Aggregate Moistures.
- Quality Control Surveillance Report number 24590-WTP-SV-QC-15-045, CPM Testing of Metered Water.
- Quality Assurance Surveillance Report number 24590-WTP-SV-QA-15-001, Pipe Welding Activities – LAW Melter Process System Quality Level Q.
- Quality Assurance Surveillance Report number 24590-WTP-SV-QA-15-007, Energy Solutions Non Conformance Reports (NCRs)
- System Pressure Test Document Number 24590-BOF-PPTR-CON-14-0022
- System Pressure Test Document Number 24590-BOF-PPTR-CON-14-0023
- Drawing Number 24590- HLW-SS-S15T-00201, Rev. 2, HLW Vitrification Building, Structural Platform HP 0302, Plans, March 23, 2011
- Drawing Number 24590- HLW-SS-S15T-00202, Rev. 2, HLW Vitrification Building, Structural Platform HP 0302 & 0304, Sections and Details, March 23, 2011
- Specification No. 24590-WTP-3PS-E00X-T0004 Rev. 8, Engineering Specification for Installation of Cables, September 17, 2013
- 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. 2E, Electrical Cable Installation, July 8, 2014
- National Electric Code – NFPA-70-1999
- Drawing Number 24590-LAW-E2-E53T-00142, Rev. 5, LAW Vitrification Building Electrical Cable Tray Plan at El. 3’
- Drawing Number 24590-B87-E8T-LTE-00001, Rev 2, Scoped Lighting 480/277V Panel Schedule LTE-PNL-87001
- Drawing Number 24590-B87-E1T-LVE-00001, Rev D, Scoped Switchgear Building 480V Distribution Panel LVE-PNL-87001 and 87001A/B Single Line Diagram
- Drawing Number 24590-B87-E8T-LVE-00003, Rev 0, Scoped Switchgear Building B87 480V Power Panel Schedule LVE-PNL-87001
- Drawing Number 24590-B87-E6-LTE-00001, Rev 7, LTE-CTR-87001 Lighting Contactor Main Switchgear Building Schematic Diagram
- CDR 24590-WTP-CDR-CON-15-0020, Cables with Excessive Damage Require Replacement

Interviews

- Field Engineering Manager
- Field Engineers
- QC Manager
- QC Inspectors
- Pipe fitters
- Electricians

Observations

- Observed performance of pneumatic pressure test documented in System Pressure Test Package 24590-BOF-PPTR-CON-15-0023 and partial performance of hydrostatic pressure test documented in System Pressure Test Package 24590-BOF-PPTR-CON-14-0022.
- Witnessed a WCD site inspector perform final visual inspection of column to base plate structural steel weld, number FW-06, on drawing number 24590-HLW-SS-S15T-00202.
- Observed system walkdowns for construction turnover of electrical panels for high-mast and parking lot lighting.
- Witnessed installation of cables between switch board LVE-SWBD-20101 on Elevation +3 to LVE-MCC-20001 on Elevation -21 of the LAW.