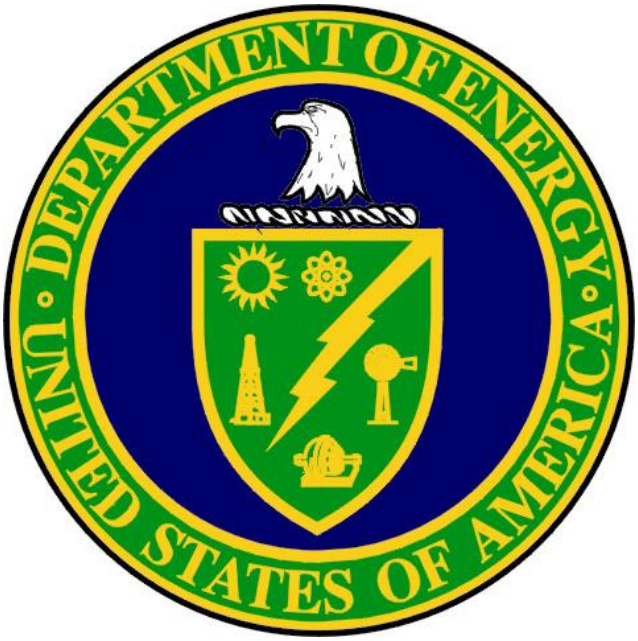
Office of Enterprise Assessments
Review of the Hanford Site
Waste Treatment and Immobilization Plant
Construction Quality



October 2015

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

Draft

Table of Contents

Acronyms

ASME	American Society of Mechanical Engineers
AWG	American Wire Gauge
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
FC	Field Change
HLW	High Level Waste
LAB	Analytical Laboratory
LAW	Low Activity Waste
MCC	Motor Control Center
NCR	Nonconformance Report
NQA	Nuclear Quality Assurance
ORP	Office of River Protection
PDSA	Preliminary Documented Safety Analysis
PICA	Post Installed Concrete Anchor
psi	Pounds per Square Inch
PTF	Pretreatment Facility
PTJ	Process and Mechanical Handling CCTV System
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
WTP	Waste Treatment and Immobilization Plant

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

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 June 8 to 11, 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 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, installed crane testing, and structural concrete and structural steel work activities) at WTP is satisfactory in the reviewed areas. BNI has also developed appropriate corrective actions to resolve specific deficiencies for closed nonconformance reports and construction deficiency reports that EA reviewed.

BNI continues to identify nonconforming conditions involving equipment and hardware with various types of potential deficiencies. Much of this equipment was manufactured and delivered to the project between 8 and 10 years ago and some of this equipment was supplied by vendors or manufacturers who are no longer in business. The number and variety of procurement deficiencies has required BNI Design Engineering to dedicate a large number of personnel and resources to resolve the identified problems.

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 remain unresolved 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.

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1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Environment, Safety and Health Assessments, within the 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 June8 to 11, 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 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 June 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 one hydrostatic test; one pneumatic pressure test; one crane functional test; 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.

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 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, primarily the WCD staff, provides 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 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 June 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 64-15, *Construction – Structural*
- CRAD 45-52, *Construction – Piping and Pipe Supports*

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)

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 previous EA quarterly construction reports, 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 May 31, 2015, BNI field engineers have identified 2348 records related to CM PICA installations. 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 2348 PICA records. Deficiencies have been identified with one or more PICAs documented on 40.6 percent of the 2348 records. CDRs were initiated for BNI Design Engineering to evaluate and determine if any rework is required. The projected completion date to close this issue is December 2015.

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 50 NCRs that BNI issued between March 17, 2015, and June 10, 2015, and the 123 CDRs that BNI issued between March 23 and June 11, 2015, to evaluate the types of nonconforming issues, their apparent causes, and subsequent corrective actions. The NCR categories included 5 NCRs related to construction or installation errors, including damage to installed components resulting from construction activities; 34 NCRs for procurement and supplier deficiencies; 7 NCRs for engineering issues; 3 for materials handling issues and 1 related to a subcontractor deficiency. Eight of the NCRs attributed to supplier deficiencies were related to design activities performed by vendor engineering organizations or vendor engineering contractors using computer software that had not been validated and verified in accordance with the requirements of DOE QA requirements to design Q equipment. These NCRs apply to several vessels and other Q equipment that had been delivered to the project in 2004 and 2005.

Corrective actions have been completed and the NCRs closed for 10 of the 50 NCRs that were initiated since March 17. The majority of the remaining 40 NCRs are currently being evaluated by Design Engineering who will determine corrective actions required to resolve the deficiencies. Currently there is a large backlog of NCRs issued prior to March 17 that are open pending completion of review by Design Engineering.

Of the123 CDRs that EA reviewed, 50 involved BNI construction deficiencies, as well as 45 CDRs for procurement and supplier deficiencies, 14 CDRs for deficiencies in work performed by sub-contractors, 4 CDRs for engineering errors, and 10 CDRs for maintenance issues or for materials identified with expired shelf life. The 45 BNI construction deficiencies included 25 related to PICA installation errors. Only 14 of the 123 CDRs issued since March 23 have been closed. The majority of the open CDRs are being evaluated by Design Engineering.

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 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 8 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 appropriate 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 is adequate to address and resolve specific construction quality deficiencies.

No deficiencies were identified.

5.3 Installed Equipment Testing

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)

5.3.1 Piping Pressure Tests

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 BOF non-radioactive liquid waste disposal (NLD) system. The section of the CM plant service air system tested was located in the LAW. The section of the NLD system tested was adjacent to the BOF NLD tanks and NLD pump house. 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. One minor leak at an instrument line fitting was identified by the craft during the pneumatic test that the craft repaired by tightening the fitting in accordance with the Construction Procedure. BNI Field Engineering personnel identified no leaks during the pneumatic test. No leaks were identified during the BOF non-radioactive liquid waste disposal hydrostatic test. Both pressure tests were declared successful.

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

No deficiencies were identified.

5.3.2 Crane Functional Test

EA and ORP WCD observed the functional test of a pair of 25 ton overhead gantry construction cranes (JO-14-044 and JO-14-045) in the LAW. The cranes are installed to lift and invert the LAW melter lid after the lid is assembled in place. The melter lid is assembled in place and filled with refractory which sets and solidifies after filling the lid. The entire assembly must then be lifted clear of the floor and inverted and placed over the melter for permanent attachment to the melter with the refractory surface facing down over the process area of the melter. To accomplish this lift and allow for inverting the lid by having the square lid supported from separate cranes allowing lifting on one side of the lid while lowering the opposite side, two separate cranes are operated in tandem. The functional test witnessed by EA and ORP WCD was done with Rigging Plan 24590-LAW-RIG-CON-15-006, *Lift 4 Demag Counterweights with 25 Ton Construction Cranes (JO-14-044 & JO-14-045).* The rigging plan was approved by the BNI Field Engineering Manager.

During performance of the test, lifting 4 large test weight blocks simultaneously and moving the entire assembly laterally as a unit (total test weight 46,885 pounds), numerous BNI construction management personnel were present, as were BNI engineers responsible for the equipment, and BNI occupational safety personnel assuring that observers stayed a safe distance back from the hoisted load including allowance for a failed sling.

The test was successfully completed in accordance with the approved rigging plan and in compliance with occupational safety requirements.

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 completed welds in the HLW Facility, designated as FW-3 on the weld map, drawing number HLW-DD-S13T-00166, for attachment of joggle shielding plate to the structural steel beams, top of steel elevation 54'-00" at Column Lines 8 and G-H. 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.

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 four Q concrete placements (i.e., three wall placements and one interior floor slab) completed between February 26 and May 5, 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 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. Unconfined compression tests performed on the 18 concrete cylinders from the 4 HLW Facility pours showed that the concrete strength at 28 days varied in the range of 6050 and 7210 psi with an average strength of 6602 psi.

The required minimum concrete strength used in designing the HLW was 5000 psi. Results of unconfined compression tests on the 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.

EA examined the concrete surfaces on the accessible sections of the HLW Facility walls in the three wall placements completed since April 7, 2015. No structural cracks were observed nor were other types of defects such as honeycomb or voids (resulting from improper concrete consolidation) or rock pockets caused by loss of mortar from concrete form leaks. A few very minor surfaces defects were noted, but overall the concrete surfaces are in good condition.

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 reviewed the cable installation specification, inspected the completed installation of an emergency trip switch, and 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's observations are discussed in more detail below.

Review of Engineering Specification for Cable Installation

EA reviewed Specification 24590-WTP-3PS-E00X-T0004, Revision 10 of *Engineering Specification for Installation of Cables*, January 2015. Revision 10 changed some of the requirements for Category 6 and 6A cable installations. EA identified an apparent inconsistency regarding the allowance of cable pull-bys for Category 6 communications cables. Paragraph 1.3 of the Specification defines a pull-by as a term used to describe the practice of installing cables in conduits that contain previously installed cables. Paragraph 4.13 of the Specification addresses cable pull-bys, for power cables and communications cables, and states the criteria when pull-bys are permitted. Section 5.6.1 of the Specification states that all communication cables shall be pulled together (no pull-bys) and later tested together. There appears to be a contradiction between Paragraphs 4.13 and 5.6.1 of the Specification, giving guidelines for pull-bys and then stating that pull-bys are not permitted.

The requirement for a radius drop out when cables transition from the bottom of one cable tray into another was added in Paragraph 4.15.2 of Revision 10. The Specification indicates the requirement for the radius drop out is not retroactive and thus does not apply to cables that were previously installed. However, when EA and the WCD site electrical inspector discussed the new requirement for the radius drop out with electrical personnel, some stated that they were not aware of this Specification change. Changes to specifications and construction procedures were not clearly communicated to craft personnel and other site personnel who perform work activities affected by specification and procedure changes. (See **OFI-WTP-1**.)

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 observed electricians pulling new cables during the June 10 nightshift for the Process and Mechanical Handling CCTV system (PTJ) in the Melter Bay area of the LAW. The electricians coordinated the work in order to pull several cables from a panelboard in the hallway to different junction boxes in the Melter Bay. The installation of all the cables during one simultaneous pull was more efficient than pulling them one at a time.

While installing other new cables in the LAW during a pull on the June 9 nightshift, a previously installed cable was damaged. When the electricians were pulling in the new cables, the pull rope rubbed through the outer jacket insulation of a previously installed cable. The damaged cable ran perpendicular to and above the cable tray that the new cables were being pulled through, but the pull rope raised up when it was tightened, made contact with the existing cable, and damaged the insulation on the existing cable to the extent that bare copper wire was visible. When the electricians realized the previously installed cable was damaged, they immediately stopped work and inspected the damaged cable. The existing cable had three size 12 American Wire Gauge (AWG) conductors plus a bare copper ground. Visual inspection of the cable indicated that it was only the ground conductor that was exposed. To verify that the insulation on none of the three conductors was damaged, the electricians performed insulation and continuity checks on the three conductors in the cable and confirmed that only the ground wire conductor was exposed. The electricians initiated CDR number 24590-WTP-CON-15-0271 to document the condition and to receive guidance from BNI field engineering for disposition of the issue.

After stopping work to refocus on safety and quality, the electricians and their supervisors reviewed the event to determine what occurred and what actions would prevent a similar situation from occurring in the future. They reviewed the extent of condition by inspecting many of the completed cable pulls throughout the LAW and found no other similar occurrences.

Specification 24590-WTP-3PS-E00X-T0004 also addresses the inspection and testing requirements for cables prior to installation, during installation, and prior to being energized. EA observed electricians performing a continuity check and an insulation resistance test (Megger test) on cables C2VUH000061H01 and C2VFCU00032H01in the LAW. These cables both have three size12 AWG conductors with ground. Electricians checked the insulation resistance between each combination of conductors and recorded the results on the cable SETROUTE card. The results of the megger tests were satisfactory.

Review of Emergency Trip Switch Installation

EA examined a recently installed electrical shutdown pushbutton (emergency trip switch) that was installed in Control Room A-117 in the LAB to isolate power to two electrical panels in Room A-117 and the Room A-117 HVAC unit that is powered from Motor Control Center (MCC) 60002 in an adjacent room. Field Change (FC) number 24590-WTP-FC-E-15-0058 was issued to install the emergency trip switch and its associated wiring. EA and the WCD site electrical inspector reviewed the field change and identified the following discrepancies:

(1) The FC included a drawing and a wiring schedule that did not agree. EA noted that the wiring connections for the new emergency trip switch and MCC were installed in accordance with the wiring schedule, not the drawing; and,

(2) The FC drawing for MCC-60002 cubicle 7K did not correctly show the wiring for the MCC. In addition to the new emergency trip switch the HVAC unit can be tripped by a ground fault relay in the MCC cubicle. The wiring details for the ground-fault relay were not illustrated in the FC.

EA and the WCD site electrical inspector inspected the installed ground fault relay in the MCC cubicle. The gauge of the MCC cubicle wire terminal connections are classified for 14 AWG to 20 AWG wires.

However, number 12 AWG wires were installed to connect the ground fault relay to the new emergency trip switch. Additionally, the leads from the shunt trip coil in the MCC are also connected to the same terminals, further exceeding the acceptable conductor size limit for these terminals.

The installation records (SETROUTE Cards) for the wiring of the emergency trip switch were not available for review by the EA and the WCD site electrical inspector during the onsite June 8-11 construction quality assessment. These discrepancies, the drawing errors and installation of oversized wires on the ground fault relay, were discussed with BNI Field Engineers who agreed to initiate a CDR to document the errors. After reviewing the SETROUTE Cards in July, 2015, BNI Field Engineering determined that the wiring for the emergency trip switch had been approved by the responsible BNI field engineer who failed to identify the drawing errors and observe that oversized wires were installed on the ground fault relay. Corrective actions will include correcting the drawing and re-issuing the FC. BNI issued CDR number 24590-WTP-CDR-CON-15-0336 on July 27, 2015 to document and disposition this issue. The WCD issued a finding to address correction of these discrepancies (**S-15-WCD-RPPWTP-006-F03)**.

Overview of Housekeeping and Electrical Work Activities

EA and the WCD site electrical inspector walked through the LAB, LAW Facility, HLW Facility, and BOF Glass Former and Chiller/Compressor Buildings. The areas were well kept and neat. The LAW Facility was the most active with electrical work. The other buildings had minimal electrical crews working on punch list items and most of the electrical cabinets were closed and inaccessible. During a walkthrough of the LAB, EA noted that the workmanship of cable installations and terminations appeared to be improving. Connections in panel boards were neater and the labeling of unscheduled cables was clearer and more consistent than observed during past quarterly reviews. However, there is room for improving the efficiency of electrical work activities. EA observed the day shift electricians performing cable checks on some cables in panelboards and MCCs while leaving other cables untested, rather performing all of the cable checks in one area before moving on to another area. A similar issue was identified during the March 2015 quarterly review.

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 70 percent of the NCRs and 35 percent of the CDRs initiated since the March quarterly review are related to deficiencies in materials and hardware supplied by vendors. Procurement deficiencies continue to challenge the BNI Design Engineering organization requiring Design Engineering to dedicate numerous personnel to resolving identified problems.

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. Corrective actions are expected to be completed by December 2015. With exception of the minor 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 Facility, 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 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.

8.0 OPPORTUNITIES FOR IMPROVEMENT

This EA review identified one OFI. This potential enhancement is not intended to be prescriptive or mandatory. Rather, it is a suggestion offered by the EA review team that may assist site management in implementing best practices, or provide potential solutions to minor issues identified during the conduct of the review. In some cases, OFIs address areas where program or process improvements can be achieved through minimal effort. It is expected that the responsible line management organizations will evaluate this OFI and accept, reject, or modify it as appropriate, in accordance with site-specific program objectives and priorities.

OFI-WTP-1: WTP/BNI should consider reviewing their program for communicating changes to Specifications, Procedures, and other program requirements such as design criteria or the PDSA to affected project personnel, including craft personnel, design engineers and procurement personnel.

Appendix A
Supplemental Information

Review Dates

On-site portion conducted June 8-11, 2015

Office of Independent Enterprise Assessments Management

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Quality Review Board

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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
- Construction Procedure 24590-WTP-GPP-CON-3206, Rev. 5B, Structural Steel Installation and On-Site Fabrication, August 21, 2014
- Specification 24590-WTP-3PS-SS02-T0001, Rev. 3, Engineering Specification for Structural Steel Erection, December 1, 2008
- Specification 24590-WTP-3PS-SS00-T0001, Rev. 7, Engineering Specification for Welding Carbon Steel, January 30, 2008
- 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
- 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- 0133 through -0142, -15-0144 through -01176, 178 through 210, 213 through 246, and -15- 0248 through -02261. CDR numbers 24590-WTP-CDR-CON-15-0143, 177, 211, 212, and 0247 were not issued
- Nonconformance Report numbers 24590-WTP-NCR-CON-15-0034 through -0083
- System Pressure Test Document Number 24590-BOF-PPTR-CON-14-0045
- System Pressure Test Document Number 24590-LAW-PPTR-CON-14-0076
- Drawing Number 24590- HLW-SS-S15T-00003, Rev. 8, HLW Vitrification Building, Structural Steel Notes, August3, 2009Drawing Number 24590- HLW-DD-S13T-00166, HLW Vitrification Building, Structural Joggle Shielding Plates, Plan TOS EL 54’-00”, Sheet 1
- Drawing Number 24590- HLW-DD-S13T-00169, HLW Vitrification Building, Structural Joggle Shielding Plates, Details, Sheet 3
- Field Change Notice DDN-S13T-00121, Weld details, March 15, 2011
- 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. 2E, Electrical Cable Installation, July 8, 2014
- Procedure 24590-WTP-GPP-CON-3317, Rev. 0E, DC High Potential, Meggar and Continuity Testing

- Rigging Plan 24590-LAW-RIG-CON-15-006, *Lift 4 Demag Counterweights with 25 Ton Construction Cranes (JO-14-044 & JO-14-045)*
- National Electric Code – NFPA-70-1999
- Field Change 24590-WTP-FC-E-15-0058, Part A & Part B
- Field Change 24590-WTP-FC-E-14-0720, Part B
- Field Change 24590-WTP-FC-E-15-0187, Part B

Interviews

- Field Engineering Manager
- Area Construction Superintendents
- Design Engineers
- Field Engineers
- QC Manager
- QC Inspectors
- Pipe fitters
- Electricians

Observations

- Observed performance of pneumatic pressure test documented in System Pressure Test Package 24590-LAW-PPTR-CON-15-0076 and performance of hydrostatic pressure test documented in System Pressure Test Package 24590-BOF-PPTR-CON-14-0045.
- Witnessed a WCD site inspector perform final visual inspection of structural steel welds for securing a joggle shielding plate to structural steel beams in the HLW, weld number FW-03, on drawing number 24590-HLW-DD-S13T-00166.
- Examined completed concrete placements in HLW walls placed since February 23, 2015.
- Examined completed emergency trip switch installation in Room A-117 in the LAB.
- Observed installation of cables between for the Process and Mechanical Handling CCTV system in the Melter Bay area of the LAW.
- Observed performance of Megger tests on cables C2VUH000061H01 and C2VFCU00032H01 in the LAW.