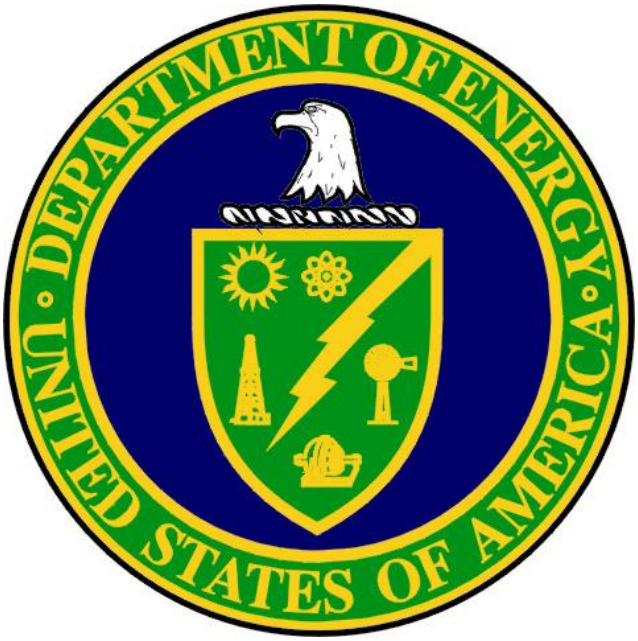
Office of Enterprise Assessments
Review of the Hanford Site
Waste Treatment and Immobilization Plant
Construction Quality



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Office of Nuclear Safety and Environmental Assessments
Office of Environment, Safety and Health Assessments
Office of Enterprise Assessments
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Acronyms

AHJ	Authority Having Jurisdiction
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
FC	Field Change
HLW	High Level Waste
kcmil	Area of a circle with a diameter of one thousand mils (One mil = .001inch)
LAB	Analytical Laboratory
LAW	Low Activity Waste
NCR	Nonconformance Report
NEC	National Electrical Code
NQA	Nuclear Quality Assurance
NRTL	Nationally Recognized Testing Lab
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
UL	Underwriters Laboratory
UPS	Uninterruptable Power Supply
WCD	WTP Construction Oversight and Assurance Division
WTP	Waste Treatment and Immobilization Plant

Office of Enterprise Assessments Review of the Hanford Site
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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 onsite portion of the review conducted from September 14 to 17, 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 of nonconforming conditions, examined implementation of selected requirements in the BNI quality assurance program, and followed up on issues identified during previous reviews.

BNI continues to identify nonconforming conditions involving equipment and hardware with various types of deficiencies. 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. The number and variety of procurement deficiencies has required 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 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. EA identified several deficiencies in the records and reports that document evaluation of the electrical equipment.

EA identified a potential conflict of interest concerning the assignment of BNI as the electrical Authority Having Jurisdiction (AHJ) and also serves as the electrical designer and contractor. BNI's role as the Authority Having Jurisdiction allows BNI to determine if its design and construction methods comply with the National Electrical Code. Similarly, when Underwriter's Laboratory (UL) came on site to review equipment shipped to the site prior to receiving Nationally Recognized Testing Laboratory review, UL came on site as a BNI subcontractor and based their evaluation on data supplied by BNI rather than generating their own data.

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

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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 onsite portion of this review was conducted from September 14 to 17, 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

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.

3.0 BACKGROUND

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

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

The WTP complex consists of 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 WTP Construction Oversight and Assurance Division (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 resume 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. Specifically, EA conducted several construction site walkthroughs concurrently with the ORP WCD staff to determine whether work activities were completed in accordance with the appropriate design drawings, specifications, and installation procedures. EA observed three piping pressure tests; inspection of welds on two sections of non-radioactive liquid waste disposal system (NLD) piping and one NLD pipe support; and installation of electrical cables. EA reviewed nonconformance reports (NCRs) and construction deficiency reports (CDRs) that BNI identified under its corrective action program, records documenting evaluation of electrical equipment, and construction quality records documenting the results of quality control (QC) tests performed on samples of concrete placed in the HLW Facility.

Section 5 of this report 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, an opportunity for improvement (OFI) is described in Section 8, and items for follow-up are discussed in Section 9. 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

5.1 Corrective Action Program

Criterion:
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 58 NCRs that BNI issued between June 23, 2015, and September 15, 2015, and a sample of 20 CDRs that BNI issued in August 2015 to evaluate the types of nonconforming issues, their apparent causes, and subsequent corrective actions. The NCR categories included 14 NCRs related to construction or installation errors, including damage to installed components resulting from construction activities; 39 NCRs for procurement and supplier deficiencies; 2 NCRs for engineering issues; and 3 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, who will determine corrective actions required to resolve the deficiencies. A large backlog of NCRs is open pending completion of review by Design Engineering.

Of the 20 CDRs that EA reviewed, 14 were BNI construction deficiencies, 3 CDRs for procurement and supplier deficiencies, 1 CDR for engineering errors, and 2 CDRs for maintenance issues or for materials identified with expired shelf life. The construction deficiencies included 10 related to post installed concrete anchors.

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 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 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.

EA identified no deficiencies in this review area.

5.2 Piping Pressure Tests

Criterion:
Construction and pre-operational tests, such as pressure testing operations for piping systems, shall be conducted in accordance with methods approved by the design organization. Test procedures shall include test requirements, acceptance criteria, test prerequisites, inspection hold points, and instructions

for recording data. Testing shall be observed by qualified inspection personnel. Test results shall be recorded and evaluated by qualified personnel. (NQA-1, Requirement 11; Policy Q-11.1 of the WTP QAM; and DOE Order 414.1C)

EA observed three piping pressure tests, two pneumatic tests performed on the plant service air system and a hydrostatic test performed on the fire water supply piping. The CM plant service air systems tested were on sections of piping modified by design changes located in the BOF chiller building and the BOF water treatment plant. The section of the fire water supply piping tested involved only a flange that was installed to connect the yard fire water supply piping to the LAW fire protection system. 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 plant air system piping 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. EA witnessed the hydrostatic test pressurization sequence and verified that fire water system piping was pressurized to the designated test pressure and held for the minimum 2 hour test hold time specified in the test procedure. No leaks were identified during the hydrostatic test. All three pressure tests were declared successful.

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

EA identified no deficiencies in this review area.

5.3 WCD Welding Inspection Program

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

The WCD 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 three completed welds on a Non-Radioactive Liquid Waste Disposal System pipe support (number HLW-NLD-H30187 in the HLW, designated as FW-1, FW-2, and FW-3 on the weld map, drawing number HLW-P3-NLD-WT00002004) and a pipe anchor attachment weld on BOF yard Radioactive Liquid Waste Disposal System piping (shown on field welding check list 24590-BOF-FWCL-CON-15-00195). Acceptance criteria for visual examination of the pipe support structural welds are specified in *Bechtel Nondestructive Examination Standard, Visual Examination VT-AWS D1.1*. 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.

EA identified no deficiencies in this review area.

5.4 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 six Q concrete placements (i.e., three wall placements and three interior floor slabs) completed between June 16 and September 3, 2015, in the HLW Facility. During the placement of concrete in one of the wall pours, technical difficulties with the concrete batch plant resulted in stopping the placement. This resulted in formation of an unplanned cold joint in the wall. An NCR, number 24590-WTP-NCR-CON-15-0090, was initiated to document this problem. The unplanned joint was prepared in accordance with Section 3.5.2 of BNI Construction Specification 24590-WTP-3PS-D000-T001, *Engineering Specification for Concrete Work*. The completion of the wall placement was treated as an additional wall placement that was subjected to pre-placement and in-process inspections required for all the concrete pours.

The quality of ready mix concrete for the WTP project is tested prior to placement by using ASTM approved test standards to verify that concrete temperature, slump, and unit weight comply with Specification requirements. In addition, unconfined compression tests are 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 required concrete strength, based on the results of unconfined compression tests, used in designing the HLW is 5000 pounds per square inch (psi). 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.

Unconfined compression tests performed on the concrete cylinders from the 6 HLW Facility pours showed that the concrete strength at 28 days varied from 6590 to 7580 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 1500 psi for all classes of structural concrete at WTP.

EA identified no deficiencies in this review area.

5.5 Electrical Construction Activities

Criterion:
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). Furthermore, EA reviewed the certification for the uninterruptable power supply (UPS) system and the evaluation of the UPS cabinets performed by the Underwriters Laboratory (UL) Field Evaluation Services. 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 observed electricians install a short length of cable between a transformer and a breaker panel on the 28' elevation of the LAW. The cable pull was performed in accordance with specification requirements.

EA and the WCD inspector then observed the electricians preparing to perform a cable pull between a 60 Amp ground fault breaker and a wet electrostatic precipitator (WESP). Although the cable (SETROUTE) card and the design drawings specified installation of a 3 conductor #8 cable, the cable that had been prepared (cut to length), labeled, tagged, and staged for the pull in the work area was a 3 conductor #6 cable. The electricians stopped work to consult with field engineering when they identified the differences between the cable size prepared for the installation and the cable size specified in the documentation. The BNI electrical field engineer consulted with Design Engineering and initiated a field change request to address the apparent discrepancy.

Based on review of the WESP and its current rating, the WCD site inspector correctly concluded the cable size (#8) specified in the installation (design) documents was incorrect. The current rating for the WESP specified on its name plate is 42 Amps. The National Electrical Code (NEC) requires the current rating for the ground fault breaker for the power feed to the WESP unit to be rated a minimum of 125 percent of the 42 Amp WESP name plate current rating, which is 52.5 Amps. The 60 Amp ground fault breaker is the correct size. Since the breaker also protects the cable, the cable must have an ampacity of at least 60 Amps. According to the NEC, a #8 cable is only rated at 50 Amps, whereas a #6 cable is rated at 65 amps. Therefore, the #8 cable specified by the design documents was too small. Although the electricians recognized the cable sizing error prior to installation, the error should have been identified earlier in the construction process.

Certification of Uninterruptable Power Supplies

The WTP site has 15 UPS units manufactured by Gutor Equipment Company, which was acquired by Schneider Electric after the UPS units were fabricated. NEC Articles 110-2 and 90-7 require electrical equipment to be certified by a Nationally Recognized Testing Lab (NRTL). BNI determined during review of the records submitted by the manufacturer for the UPS units that the equipment was not certified by a NRTL, and therefore the equipment was considered to be of indeterminate quality. BNI initiated CDR number 24590-WTP-CDR-CON-09-0217 to resolve this problem. The description of the

equipment location, the construction status regarding completed installation, and whether the equipment is UL approved, is shown in the Table below.

Description/Location	QTY	Status
PTF	6	Not installed
HLW	2	Not installed
LAW	2	Installed, not UL approved
LAB	2	Installed, UL approved
Chiller-Compressor Building (Bldg 82)	1	Installed, UL approved
Main Switchgear Building (Bldg 87)	1	Installed, UL approved
BOF Switchgear Building (Bldg 91)	1	Installed, UL approved

Each UPS system includes the UPS cabinet, batteries, and a breaker or battery disconnect switch. During normal operations the batteries are in the charging mode. When AC power is lost or interrupted, the batteries supply power to the UPS cabinets. The function of the breaker or disconnect switch is to provide overcurrent protection between the batteries and UPS cabinets and to provide a means to isolate the batteries for maintenance. Each equipment item has a unique identifier, equipment identification (i.e., ID) number, e.g., UPE-UPS-20201 for the UPS cabinet; UPE-BATT-20201 for the battery; and UPE-SW-20201 for the disconnect switch. The installed UPS units, listed in the Table above, includes the UPS cabinet and the disconnect switches. The batteries will not be installed until near the end of construction.

The CDR states the 15 Gutor UPS units were shipped to the material handling facility and are on hold awaiting NRTL approval. The equipment IDs are listed for each of the UPS cabinets in the CDR, but the equipment IDs for the disconnect switches are not. BNI Procedure 24590-WTP-GPP-MGT-044 requires: (1) the equipment IDs for each potentially nonconforming equipment item is to be listed in the CDR; (2) a CDR Hold (red) tag to be attached, if practical, to each listed equipment item; and (3) nonconforming equipment, including equipment of indeterminate quality, to be segregated by placing the equipment in a designated hold area. WCD issued a finding to address correction of the CDR (S-15-WCD-RPT-WTP-009-F04)**.**

The five disconnect switches associated with the UPSs installed in the LAB, Chiller-Compressor, Main Switchgear, and BOF Switchgear Buildings were purchased with an existing UL approval, so they need no further evaluation. The disconnect switches installed in the two LAW UPS cabinets, numbers UPE-SW-20201 and UPE-SW-20202, have not been approved by UL. EA and the WCD electrical inspector identified the following concerns for these two switches and the associated enclosures:

- The enclosure housing the disconnect switch is not labeled with any information. It does not have a manufacturer's name, a model number, a UL approval label, or other markings required by NEC Article 110-21.

- Section 380-3 of the NEC, which specifies the requirements for enclosures for switches, applies to the UPS disconnect switches. This Section requires that switches are able to be externally operated and mounted in an enclosure listed for the intended use. The plexiglass enclosures within the two UPS cabinets in which the switches are mounted are not listed for use as breaker enclosures. The switch enclosures meet the definition of externally operable because the operator is not exposed to any live electrical parts when the breaker is properly installed behind a plexiglass panel. However, an evaluation is necessary to verify that the plexiglass panel meets the durability and effectiveness requirements to comply with Section 380-3.

- Article 380-3 also requires a minimum bending space for the conductors. The panel is fed by two sets of three 373 kcmil cables in parallel. The size of these conductors requires at least 14 inches from the terminal to the edge of the cabinet to obtain an adequate bending space. Since there are fewer than 5 inches from the lower buss bar to the bottom edge of the cabinet, and fewer than 7 inches from the upper buss bar to the top edge of the cabinet, the minimum bending space cannot be obtained.

- The disconnect switch/breaker provided for the UPS unit was manufactured by Siemens and is rated for a maximum of 900 Amps and 250 Volts DC. The batteries used in this system are rated at 400 Volts DC, exceeding the rating of the disconnect switch/ breaker.

In order to address these concerns, the WCD site inspector was reviewing the documentation that procured the battery disconnect switches for the LAB UPSs.

UL Field Evaluation Report

The UL Field Evaluation Services unit evaluated the UPS cabinets installed in the LAB and Buildings 82, 87, and 91 and published the results of their evaluations in UL Field Evaluation Services Reports. EA reviewed UL Field Evaluation Services Final Report (24590-CM-HC4-E00Z-00002-17-00047, Rev. 00A), dated July 20, 2015. This UL report documents the results of the evaluation that the UL Field Evaluation Services unit performed for the UPS Cabinet equipment (UPE-UPS-60041) installed in the LAB. EA identified the following discrepancies while reviewing the UL report:

- The Report references testing data that had been gathered previously, but the data was not included as an attachment to the UL Report. Section 7 of the UL Report states that no tests were deemed necessary. However, Section 5.2 of the report states that certain components of the UPS cabinet "may require additional testing during performance testing of the UPS."

- The CDR (24590-WTP-CDR-CON-09-0217) states that UL will perform a test of the UPS units under load as the final field evaluation. This UL report is the final report. UL did not perform any testing or make testing a requirement for final approval.

- Section 5.3 of the UL Report indicates that the unit must be fully connected and available for field testing. The report identified a discrepancy since the unit was not connected to the building power or the batteries. The UL Report stated that the discrepancy was resolved by reviewing previously collected manufacturer's test data that UL did not conduct or witness. The UL evaluation relied on test data that BNI provided and accepted. There is a potential conflict of interest with this evaluation because BNI contracted UL to perform the evaluation of the UPS cabinets, provided the test data used by UL for their evaluation, and BNI also has the Authority Having Jurisdiction (AHJ) for approval of the equipment and its installation. (See **OFI-WTP-1**.)

- CDR 24590-WTP-CDR-CON-09-0217 was revised several times, whenever an equipment item listed in the CDR was released to construction for installation in the plant. However, EA noted that with each iteration and revision of the CDR documenting release of equipment, earlier CDR corrective actions and commitments could be missed or overlooked. For example, the CDR corrective actions originally required UL to test the UPSs cabinets by performing a full load test. The corrective actions were revised to only require performance of a data review. The UL review only considered the UPS cabinets and did not consider the interconnecting equipment (i.e., batteries and disconnect switches).

ORP WCD issued a finding to address deficiencies identified in this review area.

6.0 CONCLUSIONS

The construction quality at WTP is adequate in the areas reviewed. 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 June quarterly review are related to deficiencies in materials and hardware that vendors supplied. Deficiencies in procured equipment continue to challenge the BNI Design Engineering organization requiring Design Engineering to dedicate numerous personnel to resolving identified problems.

A CDR that EA reviewed did not document all the UPS system associated equipment of indeterminate quality associated with the listed UPS cabinets as required by the BNI corrective action program. As a result, WCD identified a finding to address the incomplete CDR. EA identified several deficiencies in the records and reports that document evaluation of the UPS switches and cabinets.

Progress continues to be slow in addressing identified deficiencies 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. EA identified several deficiencies in the records and reports that document evaluation of the electrical equipment.

A potential for a conflict of interest was identified concerning the fact that BNI is the electrical AHJ and also serves as the electrical designer and contractor. BNI's role as AHJ allows BNI to determine if its design and construction methods comply with the NEC. This defeats the intent of the AHJ function.

The AHJ function is provided by the Hanford Site Electrical Safety Committee for all other Hanford Site activities. The Committee consists of representatives from each major Hanford Site contractor except BNI as well as representatives from the ORP and Richland Operations Office. A contractor question on code compliance or interpretation is evaluated by the committee.\

7.0 FINDINGS

None

8.0 OPPORTUNITIES FOR IMPROVEMENT

Opportunities for improvement are suggestions offered in EA appraisal reports that may assist cognizant managers in improving programs and operations. While they may identify potential solutions to findings and deficiencies identified in appraisal reports, they may also address other conditions observed during the appraisal process. Opportunities for improvement are provided only as recommendations for line management consideration; they do not require formal resolution through a corrective action process. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are suggestions 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.

Waste Treatment and Immobilization Plant

OFI-WTP-1: ORP should consider retaining an independent subcontractor, unaffiliated with BNI or the WTP project, to perform the function of the AHJ, to ensure the final decision on what is acceptable electrically is made independent of the designer and contractor.

9.0 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 taken by BNI to resolve deficiencies in cable termination work and other issues that EA identified during the 2014 and 2015 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. EA will also continue to review records documenting evaluation of electrical equipment.

Appendix A
Supplemental Information

Review Dates

Onsite portion conducted September 14-17, 2015

Office of Independent Enterprise Assessments Management

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Quality Review Board

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EA Team Composition

Robert Farrell – Team Lead
Joseph Lenahan
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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-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 24590-WTP-3PS-D000-T001, Rev. 8, Engineering Specification for Concrete Work, August 17, 2012
- 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-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- 0346 through -0365
- Nonconformance Report numbers 24590-WTP-NCR-CON-15-0085 through -0142
- System Pressure Test Document Number 24590-BOF-PPTR-CON-15-0030
- System Pressure Test Document Number 24590-BOF-PPTR-CON-15-0039
- System Pressure Test Document Number 24590-BOF-PPTR-CON-15-0052
- 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
- Document number 24590-CM-HC4-E00Z-00002-17-00047, Rev. 00A, Field Evaluation Services Final Report for Uninterruptable Power Supplies
- Document number 24590-CM-MRA-EU00-00001, Revision 6, Material Requisition for Uninterruptable Power Supplies
- Document number 24590-CM-POA-EU00-00001-04-00014, Rev. 00A, Certificate of Compliance for Gutor UPS
- Drawing number 24590-LAB-E1-UPE-00002, Rev. 4, Analytical Laboratory Non-ITS UPS Single Line Diagram

- Drawing number 24590-LAB-E1-UPE-00001, Rev. 3, Analytical Laboratory Non-ITS UPS Single Line Diagram
- Drawing number 24590-LAW-E1-UPE-00002, Rev. 4, LAW Vitrification Building Uninterruptable Power Supply
- Drawing number 24590-LAW-E1-UPE-00001, Rev. 4, LAW Vitrification Building Uninterruptable Power Supply
- Document number 24590-LAW-EUD-UPE-00006, Rev. 0, Electrical Data Sheet for UPS Battery (UPE-BATT-20201 and 20202)
- Document number 24590-LAW-EUD-UPE-00002, Rev. 3, Electrical Data Sheet for UPS System (UPE-UPS-20201 and 20202)
- CDR number 24590-WTP-CDR-CON-09-0217, NRTL/CSA Certification of UPS systems
- National Electric Code – NFPA-70-1999

Interviews

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

Observations

- Observed performance of one hydrostatic and two pneumatic pressure tests.
- Witnessed a WCD site inspector perform final visual inspection of three 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.