

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



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**Office of Nuclear Safety and Environmental 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
CGD	Commercial Grade Dedication
CFR	Code of Federal Regulations
CM	Commercial Grade
CMMS	Computerized Maintenance Management System
CON	BNI Construction
CRAD	Criteria and Review Approach Document
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EMF	Effluent Management Facility
HLW	High-Level Waste Facility
ID	Identification Number
LAB	Analytical Laboratory
LAW	Low-Activity Waste Facility
NCR	Non-Conformance Report
NEC	National Electrical Code
NQA	Nuclear Quality Assurance
ORP	Office of River Protection
PDSA	Preliminary Documented Safety Analysis
PM	Preventive Maintenance
PMTF	Periodic Maintenance and Surveillance Task Form
psi	Pounds per Square Inch
PTF	Pretreatment Facility
PvM	Preservation Maintenance
Q	Quality Related
QA	Quality Assurance
QAM	Quality Assurance Manual
SSC	Structures, Systems, and Components
UL	Underwriters Laboratories
WCD	ORP WTP Construction Oversight and Assurance Division
WED	ORP WTP Engineering Division
WTP	Waste Treatment and Immobilization Plant

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**EXECUTIVE SUMMARY**

The U.S. Department of Energy Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of construction quality and the implementation of the quality assurance program at the Hanford Site Waste Treatment and Immobilization Plant from December 12 to 14, 2016. EA performed this assessment in the broader context of an ongoing program of quarterly assessments of construction quality at the Waste Treatment and Immobilization Plant construction site.

The scope of this EA assessment included observing ongoing work activities, reviewing the Bechtel National, Inc. (BNI) program for controlling non-conforming conditions, examining the implementation of certain requirements in the BNI quality assurance program, and following up on issues identified during previous assessments. EA also evaluated the AECOM preventive maintenance program for stored and installed equipment. AECOM is the Operations contractor responsible for preservation maintenance (PvM) for equipment and systems completed by Construction and turned over to the Operations contractor.

Two issues regarding electrical construction identified in previous EA Construction Quality reports remain unresolved. The first is BNI's technique for transitioning electrical cables from cable trays to cabinets or equipment. The Office of River Protection (ORP) and EA both agree that BNI is using the wrong method, but ORP has not given a definitive resolution to BNI and the issue has languished. The wiring method currently used by BNI offers less protection to the cables, increasing the potential for an electrical fault which could result in personal injury or equipment damage.

Additionally, resolution is hindered by the second issue, which EA identified and documented over two years ago. That is, ORP delegated BNI very limited electrical Authority Having Jurisdiction (AHJ) in 2004. Over time, BNI has incrementally expanded that limited delegation to effectively exercise total electrical AHJ, resulting in a conflict of interest with minimal opposition from ORP. EA has identified the delay in resolving this conflict of interest as a deficiency in this assessment.

Despite the conflict of interest in the electrical AHJ, construction quality is satisfactory in the areas of pressure testing of piping and the work processes for installation of piping and pipe supports, electrical cable pulling, cable termination, and most areas of equipment installation, with the exception of cable transitions between raceways and equipment.

AECOM procedures and work processes are adequate for PvM of installed equipment and systems following construction completion and turnover to Operations. Based on the limited sample reviewed, scheduling and performance of PvM activities is adequate.

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## **1.0 PURPOSE**

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The onsite portion of this assessment was conducted from December 12 to 14, 2016. The assessment was completed a day earlier than scheduled due to inclement weather that resulted in closure of the WTP site on December 15. This EA assessment was performed within the broader context of an ongoing program of assessments of construction quality at DOE major construction projects. Because of the safety significance of WTP facilities, EA plans to continue these ongoing quarterly assessments at the WTP construction site to ensure that construction contractors meet the requirements of 10 CFR 830, Subpart A, *Quality Assurance Requirements*.

## **2.0 SCOPE**

This quarterly assessment evaluated construction quality by observing ongoing work activities; reviewing the Bechtel National, Inc. (BNI), program for controlling non-conforming conditions; and, examining the implementation of certain requirements in the BNI quality assurance (QA) program and the BNI corrective action program. This assessment also evaluated the conduct of preservation maintenance (PvM) activities performed on installed equipment and systems by AECOM, the WTP Operations contractor. Design and procurement programs were not included in this assessment.

## **3.0 BACKGROUND**

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

BNI manages design and construction activities at WTP under contract to ORP. The QA program requirements for design and construction of the WTP referenced in the preliminary documented safety analysis (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*. 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 WTP QA Manual (QAM) establishes a management system of planned and systematic actions necessary to ensure that SSCs perform satisfactorily in service.

The WTP complex consists of the Pretreatment Facility (PTF) for separating the waste into low-activity waste and high-activity waste; the High-Level Waste Facility (HLW), where the high-level waste will be immobilized in glass; the Low-Activity Waste Facility (LAW), where the low-activity 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 most BOF buildings. The BOF Electrical Distribution Building was recently turned over from BNI Construction (CON) to Operations. AECOM, the WTP operations contractor, is responsible for maintaining structures, systems, and components (SSCs) once construction is completed and the SSCs are turned over to Operations from CON. ORP staff members, primarily WTP Construction Oversight and Assurance Division (WCD) staff, provide oversight of construction activities at the WTP.

Construction work activities are deferred in the PTF pending satisfactory resolution of technical questions regarding separation and processing of the waste and the design life of PTF equipment. Construction had been slowed in the HLW through late 2016 pending resolution of technical issues involving the waste treatment process. However, DOE has recently decided to curtail construction of the HLW and concentrate on completing the LAW and the Effluent Management Facility (EMF) to start processing low-activity waste in 2022.

The EMF is an additional facility being constructed to process the non-radioactive liquid byproducts resulting from the low-activity waste processed in the LAW. Any radioactive byproducts remaining after processing of low-activity waste will be transferred via a designated piping system back to the tank farm. Initial design of the EMF is completed, and some preliminary construction work is in progress, such as relocating fire service water piping, isolating systems necessary to facilitate operation of the LAW prior to completion of the HLW and PTF, placing reinforcing steel for the EMF foundation, and preparing for procurement of equipment. At the time of this review, concrete placement was on hold pending approval of the EMF design by the State of Washington Department of Ecology.

#### **4.0 METHODOLOGY**

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

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

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

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

EA reviewed procedures, specifications, drawings, and records; interviewed key personnel responsible for equipment preservation, construction, and inspection work activities; and conducted site walk downs to observe work activities and inspect WTP components. EA conducted several walk downs at the WTP construction site with BNI and the WCD staff to determine whether work activities were completed in accordance with the appropriate design drawings, specifications, and procedures. EA observed three pressure tests; inspected installed electrical equipment in the LAW, and reviewed the AECOM equipment PvM program. EA examined non-conformance reports (NCRs) and construction deficiency reports (CDRs) that BNI identified under its corrective action program. EA also reviewed ORP's progress in resolving the issue concerning the appropriate method to transition electrical cables from cable trays to cabinets and equipment. ORP management is continuing to review the issue concerning the conflict of interest regarding the delegation of the Authority Having Jurisdiction (AHJ) to BNI.

The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. A detailed list of the documents reviewed, personnel interviewed, and observations made during this assessment, relevant to the findings and conclusions of this report, is provided in Appendix B. The deficiencies identified during this assessment are listed in Appendix C.

## **5.0 RESULTS**

### **5.1 BNI Corrective Action Program**

*Criteria:*

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

*Identified conditions adverse to quality shall be documented, evaluated, and corrected in a timely manner. Objective evidence shall demonstrate satisfactory implementation of corrective actions and performance improvement. (NQ A-1, Requirement 16; Policy Q-16.1 of the WTP QAM; and DOE Order 414.1C)*

BNI Procedure 24590-WTP-GPP-MGT-044, *Nonconformance Reporting and Control*, adequately defines the requirements for identifying, documenting, reporting, controlling, and dispositioning non-conforming conditions associated with Q (previously classified as Quality-List or QL) and commercial grade (CM) SSCs at the WTP. This procedure requires NCRs to be issued to document and disposition non-conforming conditions associated with Q SSCs, while CDRs are required to document and disposition non-conforming conditions associated with CM SSCs.

The process for determining quality levels is specified in BNI Procedure 24590-WTP-3DP-G04T-00905, *Determination of Quality Levels*. This procedure references other supporting, interfacing project documents regarding identification of items/services subject to the QA program and procurement requirements. SSCs designated as Q in the design documents must be constructed or manufactured in accordance with the WTP QA program and the ASME NQA-1 standard. SSCs designated in the design documents as non-Q (i.e., CM) are 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 41 NCRs that BNI issued between September 26 and December 8, 2016, and a sample of 21 CDRs that BNI issued in November 2016, to evaluate the types of non-conforming issues and their apparent causes. Most of these NCRs and CDRs were still open and being evaluated by BNI Design Engineering.

The NCRs included 4 related to construction or installation errors, including damage to installed components resulting from construction activities; 2 for engineering design deficiencies; 8 for failure of procurement engineering to properly document evaluation of commercial grade dedication (CGD) for quality-level hardware or equipment; 4 for materials handling issues, such as expired shelf life or storage deficiencies; and 23 for procurement and supplier deficiencies. BNI categorized the 21 CDRs as follows: 6 for BNI construction deficiencies, 5 for procurement and supplier deficiencies, 1 for an engineering design error, 6 for material handling issues (expired shelf life), and 3 for deficiencies in subcontractor work.

For closed NCRs and CDRs, the records document the completed corrective actions and provide evidence that corrective actions were satisfactorily implemented. However, as noted in previous EA assessments, corrective actions necessary to disposition open NCRs and CDRs have not always been timely, resulting in a significant backlog of open CDRs and NCRs. Failure to properly document CGD evaluations continues to challenge the BNI Design Engineering organization.

## 5.2 Pressure Testing Program

*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 one hydrostatic pressure test and two pneumatic pressure tests. BNI Construction Procedure 24590-WTP-GPP-CON-3504, *Pressure Testing of Piping, Tubing and Components*, specifies the generic work process and quality requirements for pressure testing, including the test requirements, test prerequisites, hold points, inspection requirements, test sequence, instructions for recording and evaluating data, and acceptance criteria. This procedure references the appropriate codes and documents approved by BNI Design Engineering for conduct of pressure testing. The procedure is adequate.

Tests observed included:

- Pneumatic pressure test performed on Q instrument air piping, LAW secondary offgas/vessel vent process system, recorded on document number 24590-LAW-PPTR-CON-16-0064. Required test pressure 148.5 pounds per square inch (psi), 10 minute hold. Code requirements are specified in ASME Code B31.3, Paragraph 345.5, *Pneumatic Testing*.
- Hydrostatic pressure test performed on CM chilled water system piping in BOF chiller compressor plant, recorded on document number 24590-BOF-PPTR-CON-16-0041. Required test pressure 264 psi, 10 minute hold. Code requirements are specified in ASME Code B31.3, Paragraph 345.4, *Hydrostatic Testing*.



- Pneumatic pressure test performed on CM potable water system piping (spool piece with attached pressure gauge) for the LAW domestic water system, recorded on document number 24590-LAW-PPTR-CON-15-0058. Required test pressure 50 psi, acceptance criteria zero pressure drop after 15 minutes of hold time at test pressure. Code requirements for pressure testing domestic water piping are specified in the Uniform Plumbing Code, Section 312.

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 test pressurization sequence during each pressure test, verified that the piping systems were pressurized to the designated test pressures, and verified that the required test pressures were maintained for the required hold times before the BNI field engineers initiated the system walk down to inspect the piping for leakage, and verified that pressure was maintained during the walk downs.

EA observed the walk downs and inspections that BNI Field Engineering personnel performed. During the pneumatic pressure test on the Q LAW instrument air piping, EA identified four fittings on adjacent piping that were incorrectly tagged as being within the test boundary, and four fittings in the test boundary that had not been designated to be examined for leakage. The BNI field engineers paused the pressure test and performed a review of the piping system. They determined that the fittings on the adjacent piping had been incorrectly tagged during the pre-test walk downs, and changed the tags in the test boundary to the correct fitting before testing for leakage that were then examined for leakage.

No leaks were identified during the pressure tests on the instrument air and chilled water piping, and no pressure drop occurred during the test on the domestic water piping. EA reviewed the test records and verified that qualified personnel had recorded and evaluated the test results. Overall, the pressure tests were successful.

Excluding the four incorrectly identified fittings on the LAW instrument air piping system, implementation of the pressure testing program was satisfactory for the sample that EA reviewed.

### **5.3 Piping and Pipe Supports**

*Criterion:*

*Piping systems that perform 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 BNI construction procedure and two BNI specifications that define the requirements for installation of piping and instrument tubing and supports for piping and instrument tubing. Documents reviewed included:

- Construction Procedure 24590-WTP-GPP-CON-3503, *Above Ground Piping Installation*
- Specification No. 24590-WTP-3PS-PS02-T0003, *Engineering Specification for Field Fabrication and Installation of Piping*
- Specification No. 24590-WTP-3PS-PH01-T0002, *Engineering Specification for Installation of Pipe Supports*.

The piping specification references applicable codes, design documents, and drawings, and specifies: (1) piping material requirements, including piping material traceability; (2) receiving, handling, and storage requirements; (3) installation details, requirements, and tolerances; (4) welding requirements, including workmanship and inspection; (5) instructions for installation of flanged connections, gaskets, valves, and other specialty items, such as expansion joints and strainers; and (6) examination, test, and inspection requirements. The piping specification also contains additional requirements for installation of piping in areas that will be inaccessible, black cells, and hard-to-reach area piping. This specification also applies to instrument tubing designed in accordance with ASME B31.3.

The construction procedure describes the process for installation and quality verification for piping and instrument tubing activities. Appendices to the construction procedure describe the required inspection activities and provide forms to document required quality inspections.

The pipe support specification, which also applies to instrument tubing supports, references applicable codes, design documents, and drawings, and specifies: (1) material requirements, including traceability and material substitutions; (2) engineering requirements for supports, including welding, bolting, tolerances, and installation; (3) painting; and (4) inspection attributes.

The specification and procedure for fabrication and installation of piping and the specification for fabrication and installation of pipe supports are adequate and reference appropriate acceptance criteria.

#### **5.4 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)*

#### **Transition of Cables from Cable Trays to Electrical Components**

EA met with ORP electrical personnel from the WTP Engineering Division (WED) and the WCD site electrical inspectors to discuss the ongoing issues with the method used to transition cables from the cable trays into various equipment, enclosures, and cabinets. EA and ORP agree on the appropriate methodology cited in the National Electrical Code (NEC), but BNI references a different portion of the code, a reference that EA and ORP believe is incorrect. This issue has been under discussion for more than two years and is still awaiting final resolution. At the request of BNI, the Underwriters Laboratories (UL) prepared a report to address the methods of routing cables between cable tray and other cabinets and enclosures. Note: Although normally an independent testing entity, UL, in this case, is a subcontractor to BNI rather than an independent testing company. During this review, EA attended a meeting with ORP, BNI, and UL to review the report and discuss the details.

Article 300 of the NEC addresses wiring methods in general. Other articles in Chapter 3 of the NEC cite specific details for different wiring methods. NEC Article 318 specifies the requirements for cable trays. The requirements for power and control tray cables (cables installed in cable trays) are specified in NEC Article 340, and NEC Article 346 details the requirements for rigid metal conduits.

NEC Article 318 describes the requirements for transitioning cables between cable trays and the associated electrical components. Article 318 states that cables are permitted to pass (transition) between two different cable trays, between a cable tray and a raceway, or between a cable tray and equipment for an unsupported distance not to exceed 6 feet, provided the cables are protected from physical damage.

NEC Article 340 details the use of tray cable (i.e., cable installed in cable trays). Tray cable is defined in the NEC as a factory assembly of two or more insulated conductors for installation in cable trays or raceways. That is, tray cable is permitted to be installed in raceway, such as rigid metal conduit, and in cable trays. Article 340 permits tray cables to be run in “free-air,” not protected, up to 50 feet provided that the tray cables comply with NEC crush and impact requirements and are protected from physical damage. Article 340 does not specifically describe the method for securing the tray cable when entering a box or enclosure. However, Section 7.8 of standard UL-514B, *Standard for Safety for Conduit, Tubing, and Cable Fittings*, does describe the requirements for tray cable fittings.

NEC Article 346 describes the use of rigid metal conduit. This Article specifies the requirements for supporting the conduit and requires bushings to protect conductors where they enter an enclosure.

The UL and BNI electrical engineers maintain that two wiring methods are utilized: cable tray and raceway. However, ORP’s (WED and WCD) position is that the wiring method is tray cable. This distinction is important because it determines the acceptable transition method between cable trays and cabinets. BNI has been installing a “hub-nipple-bushing” assembly on the top of cabinets, asserting that the nipple is a very short raceway and, therefore, section 346 applies and no further attachment method is necessary. However, if the wiring method is tray cable, then article 340 applies and, in absence of further guidance from the NEC, UL-514B would also apply, requiring listed fittings for cables entering cabinets and enclosures. Currently, installed cable does not follow the UL-514B standard. Use of a longer section of conduit from the top of cabinets to nearer to the cable tray would provide better protection for the cables over the life of the facility and meet the NEC requirements. During the construction process, previously installed cables are subject to physical damage due to scaffolding erection and removal and other craft personnel working in the vicinity. The picture below shows a prime example of this situation.



While these cables are not yet energized, they could be damaged and then have a catastrophic failure

when they are energized. Article 430-74 of the NEC states that conductors for motor control circuits need to be mechanically protected from physical damage. Article 373-5(c) states that cables must be secured to a cabinet unless they enter through a conduit that is at least 18” long. The current installation being used by BNI does not fasten the cables to the cabinet nor does it meet the alternative of 18” conduit.

ORP/WED are solely responsible for determining which requirements apply. Installation of electrical equipment and cables has been delayed because ORP has not resolved this issue. This issue also prevents craft electrical personnel from installing electrical cables into cabinets, enclosures, or equipment and from terminating the electrical cables.

As noted in previous construction quality reviews, BNI maintains the AHJ at the WTP site. The AHJ is able to interpret the code in areas that are unclear or provide exceptions when a requirement cannot be met. There is a clear conflict of interest when the design and construction contractor also acts as the AHJ. The disagreement described above regarding the correct methodology for transitioning cables from cable trays to cabinets and equipment is an example of the questions resolved by the AHJ. ORP’s delay in resolving this conflict of interest in a timely manner is contrary to the requirements of DOE Order 414.1C (**Deficiency**).

**Installation of Permanent Electrical Receptacles**

Permanent electrical receptacles are being installed in several WTP buildings to provide power for large, portable loads, such as welding machines. EA and WCD inspected receptacle numbers LVE-RCPT-20202, -20203, and -20204 on the +28’ level of the LAW. These receptacles are fed from Motor Control Center LVE-MCC-20202 via junction box LVE-JB-20203, also located on the +28’ level of the LAW. The circuits feeding these receptacles are protected with 80-Amp breakers. BNI Drawing numbers 24590-LAW-E2-53T-00230 and -00231 show the locations of the receptacles and references two installation detail drawings. Detail 21 on BNI Drawing number 24590-WTP-E9-50-00185, *Electrical Standards Raceway*, shows the installation details for receptacle LVE-RCPT-20204. Detail 35 on BNI Drawing number 24590-WTP-E9-50-00215, *Electrical Standards Raceway*, shows the installation details for receptacles LVE-RCPT-20202 and -20203. Detail 35 on Drawing number 24590-WTP-E9-50-00215 shows that receptacles LVE-RCPT-20202 and -20203 were manufactured by Appleton and are 600-volt, 60-Amp, and fused. Detail 21 on drawing number 24590-WTP-E9-50-00185 indicates that receptacle LVE-RCPT-20204 was also manufactured by Appleton and is identical to the other receptacles except it is not fused.

Table 1 below gives a summary of the NEC requirements, installation requirement specified on design documents (drawings), and as-built configurations.

Receptacle	NEC Requirements	Design Documents	As-Built Configuration
LVE-RCPT-20202	60 A, fused	60 A, fused	60 A, non-fused
LVE-RCPT-20203	60 A, fused	60 A, fused	60 A, fused
LVE-RCPT-20204	60 A, fused	60 A, non-fused	60 A, non-fused

**Table 1. Receptacle Requirements, Design Documents, and Configuration**

Article 210-21(b) of the NEC requires all of these receptacles to be fused because they are 60-Amp devices fed by an 80-Amp breaker. To maintain electrical safety of a connected device, the 60-Amp receptacle must be fused at 60 Amps because the upstream breaker is 80 Amps

WCD documented this issue in Sub-tier Surveillance Report S-16-WCD-RPPWTP-012-07. WCD issued two findings that were identified during a joint walk down with EA. One of these findings is described above regarding the inconsistencies between the field installation, design documents, and NEC

requirements. The second finding documents the fact that BNI did not include adequate acceptance criteria on the SETROUTE cards for these receptacles as required by BNI procedure 24590-WTP-GPP-CON-7101, *Construction Quality Control Program*. If the acceptance criteria on the SETROUTE cards had been adequate, the installation deficiencies for the receptacles could have been prevented or identified earlier by BNI personnel.

### **Transformer Conduit Bonding Jumper**

During a walk down in the LAW on December 14, 2016, EA and the WCD site inspectors identified that a bonding jumper on the flexible conduit going to transformer LTE-XFMR-20203 was disconnected. This transformer is located in a main hallway on the +28 elevation of the LAW. The jumper is required to be connected. The WCD site inspectors followed up with BNI site electrical personnel and the jumper was properly reconnected.

Craft electricians and supervisors are properly implementing the design provided by Engineering in accordance with approved construction procedures. The ORP electrical construction inspectors are closely monitoring electrical construction and identifying deficiencies as they occur. Construction by BNI and oversight by ORP are satisfactory. However the delay in resolving the exercise of electrical AHJ (identified above as a deficiency) impacts resolution of electrical design and construction issues including, the method of transitioning electrical cable from cable trays to cabinets and equipment discussed in this report.

## **5.5 Preservation Maintenance of Installed Equipment**

*Criterion:*

*Equipment that performs a safety function shall be sufficiently maintained before, during, and following installation to ensure it provides the necessary reliability and availability to perform its intended safety function, and to prevent damage, loss, or deterioration. Handling, storage, cleaning, packaging, shipping, housekeeping, and preservation of items shall be controlled to prevent damage or loss and to minimize deterioration. (NQA -1 Requirement 13; Policy Q -13.1 of the WTP QAM; and DOE Order 414.1C)*

EA examined BNI PvM implementation in accordance with the PvM implementing directive, BNI Procedure 24590-WTP-GPP-CMNT-004, *Periodic Maintenance and Surveillance Process*. The BNI Technical baseline description document (24590-WTP-RPT-ENG-01-001, *Technical Baseline Description*) identifies the PDSAs for the PTF (24590-WTP-PSAR-ESH-01-002-02), the LAW (24590-WTP-PSAR-ESH-01-002-03), the HLW (24590-WTP-PSAR-ESH-01-002-04), and the LAB (24590-WTP-PSAR-ESH-01-002-06) facilities. EA used the PDSAs to sample PvM documentation for components associated with safety class and safety significant systems.

GPP-CMNT-004 requires BNI Field Material Management, the Plant Operations Maintenance organization, and CON to implement the PvM program. AECOM, the WTP Operations contractor serving as the Plant Operations Maintenance organization, is responsible for equipment PvM, preventive maintenance (PM), corrective maintenance, and predictive maintenance from receipt through turnover. Once operable equipment is turned over to Startup/Operations, PvM ends and PM/calibration/surveillance begins. GPP-CMNT-004 also requires System Engineer-approved periodic maintenance and surveillance task forms (PMTFs) to capture vendor recommended PvM requirements and authorized deviations, if any. AECOM maintains PMTF PvM requirements and applicable equipment identification numbers (IDs) in the CHAMPS® Computerized Maintenance Management System (CMMS) software.

AECOM experienced approximately an 80% Operations/Maintenance planner staff turnover in 2016. Current staff consists of 26 planners/supervisors, of whom 13 are fully qualified. An additional six maintenance planners are close to achieving full qualification. To ensure acceptable work performance quality, AECOM management requires qualified planners to review the work of non-qualified planners; this is a good practice. Based on unimpeded work flow and the monthly PvM delinquent reports metric, AECOM is properly managing this workforce transition.

AECOM management is improving PvM implementation by initiating the replacement of the current PvM procedure, GPP-CMNT-004, with procedure GPP-RAMN-WC-0004, *Periodic Maintenance/Surveillance and Administrative Tickler Process*. (Note: Subsequent to this review the procedure was issued for use on February 27, 2017). Procedure GPP-RAMN-WC-0004 specifies that only qualified engineers are permitted to perform technical evaluations. This procedure also includes requirements to improve the controls for out-of-service declarations and revises approval authorities. AECOM also revised the PMTF (24590-CMNT-F00022) to accommodate process improvements and to remove auto-features to preclude accidental form entry errors. Procedure GPP-RAMN-WC-0004 also includes changes to improve PvM scheduling. Scheduling has historically used the grace period as the ending date before a delinquent report was processed. Procedure GPP-RAMN-WC-0004 includes new requirements to manage deferrals of PvM/PM activities by the due date instead of the grace period, and grace periods cannot be entered into without management approval. This approach better aligns with appropriate grace period management by other contractors in the DOE/NNSA complex. Additionally, AECOM has acquired Primavera P6 software as a new resource-loaded scheduling tool. AECOM chose this software to facilitate use of craft resources and improve the ability to complete PvM/PM by the scheduled due date.

AECOM has self-identified issues with the current collection of about 6500 PMTFs. Condition Report 16-01004, *Extent of Condition Review*, identified the need to re-examine the current PMTFs to clarify directions and establish initiation dates. AECOM prioritized PMTF review efforts based on the Startup Schedule in order to resolve this issue. Management assigned two engineers to review these documents. AECOM reports that nearly 800 of the approximately 6500 PMTFs have been re-evaluated. This effort is scheduled to be completed in October 2017.

EA reviewed a sample of ten PMTFs that were functionally classified as non-safety, safety class, or safety significant; subject to PvM activities; and associated with the following equipment components:

- Equipment ID: BOF-PY-SFW-FHY-0007, non-safety Fire Hydrant 7 (this component has the first recorded PMTF).
- Equipment ID: HLW-MA-HOP-FAN-00001A, Safety Significant HLW Melter Offgas Treatment Process System Offgas Booster Extraction Fan installed in the HLW.
- Equipment ID: LAW-ME-C2V-ACU-70000A, Safety Significant air conditioning unit installed in the LAW.
- Equipment ID: LAW-MA-LVP-EXHR-00001A, Safety Significant Melter Offgas System Exhauster installed in the LAW.
- Equipment ID: WTP-AD-10-SWIN-00007, non-safety Shield Window in storage and designated for installation in the PT facility.
- Equipment ID: WTP-AD-60-SWIN-00001, Safety Significant Radiation Shielding Window in storage and designated for installation in the LAB facility.

- Equipment ID: LAB-PV-BSA-V-10901, Q and non-Q valves (the first such valve to be included in CMMS) indicates installation of this component in the LAB facility.

In all samples, the CMMS accurately identifies the equipment, links to the applicable drawings, references the PvM requirements specified in PMTF(s), documents the work order history, and includes the completed work package for each PvM work evolution. For sampled safety system components, the CMMS safety system designation and PMTF technical evaluation were consistent with the applicable PDSA section functional classification and description. Work instructions are fully consistent with the PMTF requirements. The CMMS database work history documentation demonstrates that AECOM is performing the required maintenance at the specified frequencies.

The PMTF requirements that EA reviewed were fully consistent with the manufacturer's recommendations, with one exception: the PMTF for Equipment ID: LAW-MA-LVP-EXHR-00001A, PMTF-CMNT-13-0071, does not address the manufacturer's recommendation to hang a bag of desiccant in the inlet and discharge. After learning of this one exception, AECOM subsequently provided an internal memo, SUBJECT: *LAW LVP EXHAUSTER PRESERVATION MAINTENANCE EVALUATION*, dated August 13, 2012. The Cognizant System Engineer determined that LAW environmental monitoring demonstrated little potential for corrosion in comparison to the risk of having the desiccant inadvertently left within installed piping and sucked through exhauster downstream components. This detailed evaluation adequately addresses the basis for not following the manufacturer's recommendation.

EA walked down the LAW Melter Offgas System Exhausters, LAW-MA-LVP-EXHR-00001A, LAW-MA-LVP-EXHR-00001B, and LAW-MA-LVP-EXHR-00001C. CON effectively sealed Exhauster LAW-MA-LVP-EXHR-00001C with plastic covering. However, CON failed to completely cover Exhausters LAW-MA-LVP-EXHR-00001A and LAW-MA-LVP-EXHR-00001B as required by PMTF-CMNT-13-0071. Note: GPP-MGT-031, *Asset Preservation Maintenance*, Appendix B, Responsibility Matrix, identifies organizational responsibilities for, "Installation/ Removal of tarps, covers, etc., to protect asset from damage during surrounding construction activities, if applicable." Appendix B assigns this responsibility to CON for installed equipment. Equipment surfaces showed signs of dust and debris build up. The AECOM foreman indicated that this condition was a constant challenge throughout all facilities and intended to report this observation to CON. EA also discussed this condition with the AECOM Maintenance Manager.

EA walked down the LAB facility with a Maintenance foreman to observe outdoor valves subject to PvM requirements per PMTF-CMNT-11-0050, *Generic – Manual Valves (Stored Indoors or Installed Onsite)*. PMTF-CMNT-11-0050 PvM requirements for installed outdoor valves include lubricating exposed threads and cycling the valve (full open to closed). Valves were in a condition consistent with PvM requirements

All reviewed work order documentation consistently included a brief description of the technical PvM/PM requirements; the list of applicable asset IDs; the measuring and test equipment identification and calibration due date (when required); the work release authorization; the work instructions with steps checked off (some) and data entries completed; the completed work area walkdown form, including work team signatures; the identified hazards and controls; the work package pre-job briefing documentation, including worker signatures; the completed work package post-job debrief documentation; the completed data sheets; the reference to applicable drawings and supporting documents like NCRs or CDRs; the completion comments; a completed work package cover sheet; and the work completion/closeout signatures. This documentation demonstrates the workforce's commitment to consistently document work as specified.

AECOM only performs required PvM work performance at the Materials Handling Facility on Thursdays. The only PvM work performance scheduled during the EA visit consisted of five components in storage at the MHF. EA could not observe this work due to a site inclement weather work shutdown.

Overall, AECOM is using a largely new workforce to effectively accomplish PvM work planning and scheduling without any adverse schedule impacts. AECOM management demonstrated evidence of PvM system process improvements and work scheduling software enhancements. Sampled work documentation and field walk downs indicate that AECOM is adequately performing PvM of stored and installed safety-related equipment to ensure it provides the necessary reliability and availability to perform its intended safety function. Records contained in CMMS are consistent with PDSA functional classifications for safety-related SSCs and provide an adequate basis for PvM implementation. AECOM procedural implementation records indicate adequate efforts to prevent equipment damage or loss and minimize deterioration. Self-identified PMTF weaknesses have stimulated an AECOM re-review of all active PMTFs to improve the quality of these documents.

## **6.0 FINDINGS**

EA identified no findings during this assessment.

## **7.0 OPPORTUNITIES FOR IMPROVEMENT**

EA identified no opportunities for improvement during this assessment.

## **8.0 ITEMS FOR FOLLOW-UP**

EA previously identified a conflict of interest between ORP and BNI regarding the AHJ, which has yet to be resolved. ORP staff reviewed the issue and made recommendations to ORP management. Those recommendations remain under ORP management review. EA has identified the lack of timeliness in resolving this issue as a deficiency. EA will continue to follow ORP's resolution of this issue in subsequent assessments of WTP construction quality. EA will also continue to follow resolution of the issue regarding the method used to transition cables from the cable trays into various equipment, enclosures, and cabinets.

EA will continue to evaluate resolution of open NCRs and CDRs. EA plans to continue to follow-up on inspection of welding activities, piping and pipe supports, structural steel erection, pressure testing of piping, cable pulling, and installation of electrical and mechanical equipment. EA also intends to perform additional assessments of the program for preservation and maintenance of plant equipment.



## **Appendix A Supplemental Information**

### **Assessment Dates**

Onsite visit: December 12-14, 2016

### **Office of Enterprise Assessments (EA) Management**

Glenn S. Podonsky, Director, Office of Enterprise Assessments  
William A. Eckroade, Deputy Director, Office of Enterprise Assessments  
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments  
William E. Miller, Deputy Director, Office of Environment, Safety and Health Assessments  
C.E. (Gene) Carpenter, Jr., Director, Office of Nuclear Safety and Environmental Assessments  
Kevin G. Kilp, Acting Director, Office of Worker Safety and Health Assessments  
Gerald M. McAteer, Director, Office of Emergency Management Assessments

### **Quality Review Board**

William A. Eckroade  
John S. Boulden III  
Thomas R. Staker  
William E. Miller  
C.E. (Gene) Carpenter, Jr.  
Patricia Williams  
Gerald M. McAteer  
Michael A. Kilpatrick

### **EA Site Lead for Hanford Site**

Robert E. Farrell

### **EA Team Composition**

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

**Appendix B**  
**Documents Reviewed, Interviews, and Observations**

**Documents Reviewed**

- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 13, Pressure Testing of Piping, Tubing and Components, February 25, 2016
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 5, Post Installed Concrete Anchors, January 28, 2016
- Construction Procedure 24590-WTP-GPP-CON-3206, Rev. 6, Structural Steel Installation & On-Site Fabrication, January 28, 2016
- 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
- Construction Procedure 24590-WTP-GPP-CON-3503, Rev. 6C, Above Ground Piping Installation, August 29, 2013
- Specification No. 24590-WTP-3PS-PS02-T0003, Rev. 10, Engineering Specification for Field Fabrication and Installation of Piping, November 20, 2013
- Specification No. 24590-WTP-3PS-PH01-T0002, Rev. 6, Engineering Specification for Installation of Pipe Supports, July 13, 2011
- Procedure 24590-WTP-GPP-MGT-044, Rev. 8, Nonconformance Reporting and Control, November 11, 2016
- Procedure 24590-WTP-GPP-MGT-036, Rev. 5, WTP Self-Assessment and Line Surveillance, March 31, 2015
- Procedure 24590-WTP-GPP-RACA-CR-0112, Rev 4, Condition Report Evaluation and Action Plan Development, December 21, 2015
- Document number 24590-WTP-QAM-QA-06-001, Rev. 17, Quality Assurance Manual, August 22, 2014
- Construction Deficiency Report numbers 24590-WTP-CDR-CON-16-0325 through -0345.
- Nonconformance Report numbers 24590-WTP-NCR-CON-16-0234 through -0274
- Construction Procedure 24590-WTP-GPP-CON-7101, Rev 12 Construction Quality Control Program, June 6, 2016
- Procedure 24590-WTP-GPP-MGT-031, Rev 4, Asset Preservation Maintenance, December 21, 2015
- Procedure 24590-WTP-GPP-CMNT-004 Rev10, Periodic Maintenance and Surveillance Process, January 6, 2016
- SV-QA-13-095, Material Handling and Storage at the Yakima, Washington Storage Facility, October 9, 2013
- Drawing 24590-LAW-E2-E53T-00230, Rev. 7, LAW Vitrification Building Electrical Power Conduit Layout at EL. 28'
- Drawing 24590-LAW-E2-E53T-00231, Rev. 7, LAW Vitrification Building Electrical Power Conduit Layout at EL. 28'
- Drawing 24590-LAW-E9-50-00215, Rev. 8, Electrical Standards Raceway – Detail 35
- Drawing 24590-LAW-E9-50-00185, Rev. 6, Electrical Standards Raceway – Detail 21
- SETROUTE Raceway Installation Card, 24590-LAW-SRC-E-07-0163, Rev. 0
- UL Field Evaluation Services Finding Report, 24590-CM-HC4-E00Z-00002, Cable Tray Wiring Methods
- ORP/WCD Subtier Surveillance Report, S-16-WCD-RPPWTP-012-07, Welding Receptacles Installed at the Low-Activity Waste Facility
- UL Standard for Safety for Conduit, Tubing, and Cable Fittings, UL-514B, February 16, 2004
- 24590-WTP-RPT-ENG-01-001, Technical Baseline Description, September 28, 2016

- 24590-WTP-PSAR-ESH-01-002-02 Rev 6, Preliminary Documented Safety Analysis to Support Construction Authorization; PT Facility Specific Information, April 30, 2016
- 24590-WTP-PSAR-ESH-01-002-03 Rev 6, Preliminary Documented Safety Analysis to Support Construction Authorization; LAW Facility Specific Information, November 30, 2016
- 24590-WTP-PSAR-ESH-01-002-04, Preliminary Documented Safety Analysis to Support Construction Authorization; HLW Facility Specific Information, April 30, 2016
- 24590-WTP-PSAR-ESH-01-002-06 Rev 5, Preliminary Documented Safety Analysis to Support Construction Authorization; LAB Facility Specific Information, April 30, 2016
- 24590-WTP-GPP-RAMN-WC-0004 Rev 0, Periodic Maintenance/ Surveillance and Administrative Tickler Process (**This procedure not issued prior to the end of the this EA assessment**)
- 24590-CMNT-F00022, Periodic Maintenance and Surveillance (PM/S) Task Form, June 1, 2016
- 24590-WTP-PMTF-CMNT-07-0002, Hydrant 00007 ANN, February 29, 2008
- 24590-WTP-PWO-CMNT-16-0629, Annual Fire Hydrant Flush and Maintenance, July 26, 2016
- 24590-WTP-PMTF-13-0204, Generic- HLW HOP Fans, January 16, 2014
- 24590-WTP-HLW-M6-HOP-00003001 Rev0, *P&ID HLW Melter Offgas Treatment Process System Melter 1 Secondary Offgas Treatment*, July 20, 2011
- 24590-QL-POA-MACS-00004-09-00001, WTP Supplier Document Review Coversheet, January 9, 2013
- 24590-WTP-PWO-CMNT-16-0491, (MHF) Monthly Fan Exhauster Rotation, June 22, 2016
- 24590-WTP-PMTF-CMNT-16-00006, CSE-LAW ACU and Condenser Q Storage and Installed, February 3, 2016
- 24590-WTP-LAW-M8-C2V-00003001 Rev 6, LAW Vitrification Building Volumetric P&ID C2 Air Distribution El.28-0, June15, 2016
- 24590-QL-POA-MEHX-00005-08-00001, WTP Supplier Document Review Coversheet, April 23, 2014
- 24590-WTP-PWO-CMNT-16-0309, Semi-Annual Rotation for LAW Air Condition Units, April 21, 2016
- 24590-WTP-PMTF-CMNT-13-0071, Generic- LAW LVP Exhausters, February 6, 2013
- 24590-WTP-PMTF-CMNT-12-1180, Monthly, Semi-Annual, PM, LAW Exhausters, December 12, 2012
- 24590-WTP-PMTF-CMNT-12-1181, 3RY, PM, LAW Exhausters, December 13, 2012
- 24590-LAW-M6-LVP-0000104 Rev1, *P&ID-LAW Secondary Offgas/ Vessel Vent Process System Offgas Exhausters LVP-EXHR-00001A*, June 4, 2015
- 24590-QL-POA-MACS-00007-10-00003, WTP Supplier Document Review Coversheet, July 24, 2012
- 24590-WTP-PWO-CMNT-16-0892, Monthly & Semi-annual (April/ October) PM LAW Exhausters, September 12, 2016
- 24590-WTP-PWO-CMNT-16-0034, 3 Year Greasing of LVP Exhauster Motors, March 2, 2016
- 24590-WTP-PMTF-CMNT-13-0102, Generic - LAW/HLW/PT Shielding Window Assemblies, June 13, 2013
- 24590-WTP-M0-10-00001001 Rev2, WTP Vitrification Design Proposal Drawing Shielded Window CS/SST – 36” Thick Wall Assembly, April 1, 2004
- 24590-QL-POA-ADDP-00001-22-00001, WTP Supplier Document Review Coversheet, May 6, 2013
- 24590-WTP-PWO-CMNT-16-0597, (MHF) Monthly Shield Window Maintenance, July 27, 2016
- 24590-WTP-PMTF-CMNT-12-0598, CSE SWIM (Shielding Window Assemblies), September 20, 2012
- 24590-WTP-PMTF-CMNT-12-0656, AC – 2 YR Preservation Maintenance Of Lab Shield Windows, September 20, 2012

- 24590-LAB-M0-60-00002001 Rev1, Analytical Laboratory Design Proposal Drawing Shielded Window Assembly, July 21, 2004
- BNI PO# 24590-CD-POA-ADDP-00002, Site Storage and Handling, and Storage Maintenance Requirements Manual for the Shielding Windows, July 3, 2012
- 24590-WTP-PWO-CMNT-16-0707, (MHF) Annual Preservation Maintenance Of Lab Shielding Windows, August 22, 2016
- 24590-WTP-PWO-CMNT-16-0706, (MHF) 2YR PM for Lab Shielding Windows, August 22, 2016
- 24590-WTP-PMTF-CMNT-11-0050, Generic – Manual Valves (Stored Indoors or Installed Onsite), February 16, 2011
- 24590-WTP-PWO-CMNT-16-0765, Annual Clean, Cycle and Lubricate Lab Outside Stem and Yoke (OS&Y) Valves, August 22, 2016

### **Interviews**

- BNI WTP Site Manager
- BNI Field Engineers
- BNI Welding Engineers
- BNI QA Manager
- BNI QC Manager
- BNI QC Inspectors
- WCD Division Director
- WCD Site Inspectors and Facility Representatives
- WED Electrical Engineers
- AECOM Maintenance Manager
- AECOM Maintenance Coordinator
- AECOM Maintenance Planners (4)
- AECOM Maintenance Foreman

### **Observations**

- Observed performance of a pneumatic pressure test performed on Q instrument air piping in LAW LVP secondary offgas/vessel vent process system, recorded on document numbers 24590-LAW-PPTR-CON-16-0064
- Observed performance of a hydrostatic pressure test performed on CM chilled water system piping in BOF chiller compressor plant, recorded on document numbers 24590-BOF-PPTR-CON-16-0041
- Observed performance of a pneumatic pressure test performed on CM potable water system piping in the LAW domestic water system, recorded on document numbers 24590-LAW-PPTR-CON-15-0058
- Examined installation of electrical equipment in the LAW
- Examined exterior valve lineup during LAW walk down
- Performed walk down of LAW Melter Offgas System Exhausters

## **Appendix C Deficiencies**

Deficiencies that did not meet the criteria for a finding are listed below, with the expectation from U.S. Department of Energy (DOE) Order 227.1A, *Independent Oversight Program*, for site managers to apply their local issues management processes for resolution.

- Inability of ORP to resolve in a timely manner the conflict of interest resulting from Bechtel National, Inc. exercising electrical Authority Having Jurisdiction is contrary to the requirements of DOE Order 414.1C.