Independent Oversight Review of the Hanford Site Waste Treatment and Immobilization Plant Construction Quality

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Acronyms

ASME	American Society of Mechanical Engineers
ASTM	ASTM International
BOF	Balance of Facilities
BNI	Bechtel National, Inc.
CDR	Construction Deficiency Report
CM	Commercial Grade
CRAD	Criteria, Review and Approach Document
DOE	U.S. Department of Energy
FWCL	Field Welding Checklist
HLW	High-Level Waste
HSS	Office of Health, Safety and Security
INPO	Institute of Nuclear Power Operations
LAB	Analytical Laboratory
LAW	Low-Activity Waste
MSOW	Management Suspension of Work
MT	Magnetic Particle Examination
NCR	Nonconformance Report
NDE	Nondestructive Examination
NQA	Nuclear Quality Assurance
ORP	Office of River Protection
P&ID	Piping and Instrumentation Diagram
PICA	Post Installed Concrete Anchor
PIER	Project Issues Evaluation Report
PMI	Positive Material Identification
psi	Pounds per Square Inch
PTF	Pretreatment Facility
Q	Quality Related
QA	Quality Assurance
QC	Quality Control
RT	Radiographic Examination of Welds
S/CI	Suspect/Counterfeit Item
SSC	Structures, Systems, and Components
WCD	WTP Construction Oversight and Assurance Division
WTP	Waste Treatment and Immobilization Plant

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1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Enforcement and Oversight (Independent Oversight) within the Office of Health, Safety and Security (HSS) conducted an independent review of selected aspects of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The review, which was performed June 10-14, 2013, was the latest in a series of ongoing quarterly assessments of construction quality performed by Independent Oversight at the WTP construction site.

2.0 SCOPE

The scope of this quarterly assessment of construction quality review included observations of ongoing work activities, the Bechtel National, Inc. (BNI) corrective action program, 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 are not included within the scope of the quarterly construction quality reviews. Ongoing work activities have been affected by reductions in construction craft staffing and design and process concerns which may result in redesign of some systems and/or structures. Work activities observed during the current review included observation of DOE Office of River Protection (ORP) welding inspections and one hydrostatic and three pneumatic pressure tests. Independent Oversight examined nonconformance reports (NCRs) and construction deficiency reports (CDRs) identified by BNI under its corrective action program, as well as corrective actions to address deficiencies identified in installation of post installed concrete anchors (PICAs). Independent Oversight also reviewed the BNI self-assessment program in the construction organization, QA surveillance reports, and the results of quality control (QC) tests performed on samples of concrete placed in the High-Level Waste (HLW) facility.

Independent Oversight reviewed various construction quality documents and conducted several construction site walkthroughs, concurrent with the DOE-ORP staff. During the walkthroughs, Independent Oversight observed inspections of welding activities and pressure testing of piping and instrument tubing. Independent Oversight also examined specifications and procedures that control installation of PICAs, structural concrete, and electrical cable, as well as pressure testing of piping.

3.0 BACKGROUND

ORP was established in 1998 to manage the 56 million gallons of liquid or semi-solid radioactive and chemical waste stored in 177 underground tanks at the Hanford Site. ORP serves as DOE line management for two functions: the Tank Farms, which maintain the 177 underground storage tanks; and the WTP, which is responsible for treatment, and disposal of the waste stored in the underground tanks. WTP is an industrial complex for separating and vitrifying radioactive and chemical waste stored in the underground tanks. The WTP complex consists of five major components: the Pretreatment Facility (PTF) for separating the waste; the HLW and Low-Activity Waste (LAW) facilities where the waste will be immobilized in glass; the Analytical Laboratory (LAB) for sample testing; and the balance of facilities (BOF) that will house support functions. WTP is currently in the design and construction phase. Design and construction activities at WTP are managed by BNI under contract to ORP. Construction oversight is

provided by DOE-ORP staff, specifically by the ORP WTP Construction Oversight and Assurance Division (WCD). Because of the safety significance of WTP facilities, Independent Oversight has scheduled quarterly reviews to assess the quality of ongoing construction.

4.0 METHODOLOGY

This independent review of the WTP construction project was conducted in accordance with applicable sections of Nuclear Facility Construction Criteria Review and Approach Documents (CRADs) HSS-CRAD-45-52, *Piping and Pipe Supports*, HSS-CRAD-45-53, *Mechanical Equipment Installation*, HSS-CRAD-64-15, *Structural Concrete*, and HSS-CRAD-64-20, *Feedback and Continuous Improvement Inspection Criteria and Approach - Contractor*.

5.0 RESULTS

Activities examined by Independent Oversight during the review are discussed below. Each activity is briefly described, followed by a discussion of the review performed by Independent Oversight. Conclusions are summarized in Section 6, and items for follow-up are discussed in Section 7.

NCRs and CDRs

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 (Q) and commercial grade (CM) structures, systems, and components (SSC). NCRs are issued to document and disposition Q nonconforming conditions, while CDRs are used to document and disposition CM nonconforming conditions. SSC designated as Q (previously classified as QL) in the design documents are required to be constructed or manufactured in accordance with the WTP QA program, and the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1 standard. SSC 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 are purchased as CM items from vendors who are qualified as CM suppliers.

Independent Oversight reviewed the 44 NCRs issued by BNI between March 7 and June 11, 2013, and a sample of 90 of the approximately 270 CDRs issued by BNI between March 11 and June 12, 2013, to evaluate the type of nonconforming issues that were identified, their apparent causes, and subsequent corrective actions.

Approximately 25 percent of the NCRs were initiated to document construction or installation errors, or damage to installed components resulting from construction activities. Design/engineering issues, such as drawing or design errors, accounted for 10 percent of the NCRs. The remaining NCRs, approximately 65 percent of the total, were issued to resolve equipment and hardware procurement problems. Examples of these procurement problems included hardware/components that were delivered to the site without the required supporting documentation demonstrating compliance with purchase specifications, improperly labeled hardware, hardware/equipment that did not comply with project specification requirements, and missing parts or damage that occurred during transit. Corrective actions to address the procurement problems varied from obtaining the required documentation from the vendor to performing rework on site. Some examples of rework performed on site are repairing deficient welds, replacing damaged gaskets in valves, or replacing incorrect fastener assemblies (bolts, nuts, and washers) in components. If extensive rework is required or if the item delivered to the site does not comply with the purchase specifications, the hardware is rejected and returned to the vendor

The CDRs that Independent Oversight reviewed were issued to document the following types of nonconforming conditions: 18 for procurement issues; 65 for construction deficiencies, including 50 CDRs initiated to disposition deficiencies in installation of PICAs in the LAB and BOF; and 7 related to design engineering issues. The CDRs related to deficiencies in installation of PICAs are discussed under Deficiencies in Installation of PICAs, below.

Eight of the NCRs and three of the CDRs documenting procurement issues concerned inadequate quality verification records supplied by vendors documenting fabrication of 11 vessels/tanks that have been installed in the black cells in the PTF or are planned to be installed in future high radiation areas in the HLW. The purchase orders for the tanks required records documenting positive material identification (PMI) for all materials (steel plate and weld filler materials) used to fabricate the tanks; records documenting all welding activities, including welder qualification records, welding procedures, welding checklists, and weld repairs; nondestructive examination (NDE) records for 100 percent of the welds; and hydrostatic testing for each tank. During a secondary documentation review, BNI identified deficiencies in the records for the 11 tanks, including missing PMI records, illegible records, incomplete welding records, incomplete NDE records, incomplete hydrostatic pressure test records, missing signatures on records, and references to outdated purchase orders or incorrect design documents. During the March 2013 quarterly review, Independent Oversight reviewed the nine NCRs initiated by BNI to document and disposition similar problems identified during secondary documentation reviews for nine other tanks installed in the black cells in the PTF.

BNI engineering is currently performing a detailed review to determine the extent of corrective actions necessary to resolve the issues regarding the vessels/tanks. Corrective actions could include performance of additional NDE, independent PMI testing to determine the chemical composition of steel plate and filler material, detailed reviews of vendor purchase orders (if practical) to reconstitute missing records, and performance of hydrostatic pressure testing. When receipt inspection was performed on vessel/tank RLD-VSL-00008, the inspection disclosed an excessive number of welds that required repair to meet ASME Code quality requirements and a dimensional nonconformance. These inspections included completing a radiographic examination (RT) of a head to shell weld and visual examinations of several welds. The RT revealed a crack in the head to shell weld, while the visual exams disclosed undercut welds in several nozzle welds and numerous welds with arc strikes. When the tank dimensions were measured, it was found that the vessel bottom dish/vessel walls did not meet concentricity tolerances. Since this tank was scheduled to be installed in a black cell in the HLW and will be inaccessible due to high radiation levels after plant startup, a decision was made to not install this vessel due to the nonconformances discovered during receipt inspection. A new tank will be fabricated to replace RLD-VSL-00008. The tank with the defective welds and dimensional errors will be utilized for testing.

Independent Oversight determined that for the completed NCRs/CDRs reviewed, the BNI engineering organization developed appropriate corrective actions to disposition the identified problems. The NCR/CDR process and implementation appear adequate to address and resolve construction quality deficiencies. Closeout and resolution of a number of some open NCRs may be difficult and could impact costs and the construction schedule.

Deficiencies in Installation of Post Installed Concrete Anchors (PICAs)

PICAs are installed in the concrete structure after the concrete has hardened and attained its design strength to provide anchorage for equipment in locations where embedded plates and cast in-place anchor bolts are not available. The types of hardware and components supported by PICAs include structural steel platforms, pipe supports, instrument racks, transformers, electrical components, and conduit and instrument supports. During a review of CM pipe support installation records in September 2011, ORP-WCD personnel identified incorrect or missing data in the documentation of installation of CM PICAs.

On September 21, 2011, BNI issued Project Issues Evaluation Report (PIER) number 24590-WTP-PIER-MGT-11-0918-C, *Post Installed Concrete Anchor (PICA) Documentation*. The action items for this PIER required review of the PICA records for all anchors installed between July 19, 2010, and May 2012. After completing this review, field engineering determined that additional actions were necessary to resolve PICA documentation and installation issues. BNI concluded that reviewing the PICA records was not sufficient to resolve the documentation issues, but actual physical inspections of PICA installations were required. BNI issued PIER Number 24590-WTP-PIER-MGT-12-1246-B, Rev. 0, *Post Installed Anchor Bolt Installation and Documentation*, to perform additional actions to resolve questions concerning installation of the CM PICAs and the PICA installation records. These actions included reviewing the construction installation procedure, performing inspections to examine additional PICAs, and reviewing additional PICA installation records.

The current status of the re-inspection effort for CM PICAs was discussed with the BNI Civil Field Engineer. The PICA re-inspections have identified numerous installation discrepancies, including insufficient embedment depths, insufficient spacing between adjacent PICAs, incorrect torque or tension loads used for installing some types of PICAs, and loose nuts and missing washers. Due to the large number of installation errors identified during the initial review discussed above, BNI decided to expand their re-inspection program and perform inspections to re-examine all CM PICAs installed on the WTP project. There are approximately 1850 records documenting installation of CM PICAs, each record typically representing four to ten PICAs. As of May 31, 2013, the inspections were completed for the PICA installations documented on approximately1400 records. These records included 99 percent of those for PICAs installed in the BOF, 81 percent of PICAs installed in the LAW, and 100 percent of the PICAs installed in the LAB. Installation errors were identified on one or more PICAs documented on 485 of the records. CDRs were initiated to document and disposition the incorrectly installed PICAs. Engineering has completed evaluation of more than half of the CDRs and concluded that for most of the CDRs dispositioned through June 1, 2013, the installed PICAs could support the applied loads ("use-as-is"). Repairs and/or rework were required to restore the design margin and required safety factors for less than ten percent of the CDRs.

The CM PICA installation deficiencies appear to have resulted from: (1) inadequate PICA installation instructions and procedures; (2) inadequate craft training; and (3) inadequate support and monitoring of the PICA installations by field engineers. Field engineers are responsible to verify correct installation of CM PICA. QC inspectors do not inspect CM PICAs. BNI Specification No. 24590-WTP-3PS-FA02-T0004, *Engineering Specification for Installation and Testing Post Installed Concrete Anchors and Drilling/Coring of Concrete*, and BNI Construction Procedure 24590-WTP-GPP-CON-3205, *Post Installed Concrete Anchors*, specify the technical requirements for installation, inspection, and testing of PICAs. Revisions to the Engineering Specification and Construction Procedure are in process to clarify PICA installation instructions. Independent Oversight reviewed draft copies of proposed revisions to the PICA specification and construction procedure that are being developed by BNI. The PICA inspection record in the current revision, Revision 3C (October 17, 2012) of Construction Procedure 24590-WTP-GPP-CON-3205 covers all seven types of PICAs used on the WTP project: wedge anchors, drop-in anchors, ceramic epoxy anchors, ramset epoxy anchors, power actuated anchors, four types of maxibolt undercut anchors, and wedge-bolt anchors. Because the installation requirements, methods, and inspection attributes are different for each type of anchor, the draft procedure includes a specific data sheet for each type of PICA, listing specific installation steps and corresponding inspection attributes to be verified by field engineers for each type of PICA. Additional changes in the draft of the Engineering Specification and Construction Procedure include clarification of installation instructions and technical details, such as minimum spacing between anchors and existing installed anchors or embedded plates, and minimum edge distances. One deficiency identified by Independent Oversight in the draft Construction Procedure data sheets for epoxy type anchors was the lack of a requirement to verify that the required epoxy cure time was met before application of the tension test loads.

PICAs used in Q applications were not included in this review for the following reasons:

- The only types of PICAs used in Q applications on the WTP project are the undercut type (also used in some CM applications), which are installed by drilling a hole in the concrete using a special type of drill bit that flares out to form a cone shaped, or undercut, hole at the bottom of the drill hole; installing the anchor in the hole; and expanding it into the undercut area using a hydraulic jack so that the tensile load from the bolt is transferred into the concrete by the anchor bearing against the undercut hole. The undercut anchor installation criteria are specified in the site procedures.
- Location, anchor type (diameter and length) of the undercut anchors are shown on the design drawings, so the spacing between anchors is controlled.
- QC inspectors perform independent inspections of 100 percent of the Q anchors, during which they verify the correct hole depth and the use of correct load on the hydraulic jack to expand the anchor.

BNI is performing a causal analysis to determine the factors underlying the deficiencies in the installation of the PICAs. Independent Oversight determined that BNI's approach to determining the extent of condition was adequate. CM PICA installation has been controlled by a management suspension of work (MSOW) until the revisions the Construction Procedure and Engineering Specification are issued and field engineers and craft personnel receive training on the revised PICA installation and inspection instructions. Prior to installing any anchors, the PICA installation record for structural anchor bolts is reviewed and approved by construction management per the partial release criteria of 24590-WTP-MSOW-MGT-12-0019.

Management Self-Assessment Program

Self-assessments provide opportunities to identify problems with work processes and completed work activities. Independent Oversight reviewed BNI Construction Procedure 24590-WTP-GPP-MGT-036, *WTP Self Assessment*. This procedure describes a process for managers and employees to use to perform self-critical evaluations of their work processes and activities to ensure that work is being performed as expected and to monitor work results to ensure that completed work meets project requirements. The responsible manager assigns individuals or teams to perform the self-assessment in a particular subject area. Lines of inquiry are developed to address the scope of the assessment, and the self-assessment is conducted by observing work in progress, interviews, document reviews, or data collection and evaluation.

BNI Procedure 24590-WTP-GPP-MGT-036 provides definitions of compliance-based and performance-based assessments. The procedure defines a compliance-based assessment as a self-assessment in which the primary focus is to determine whether work items were completed in accordance with a procedure, requirement, standard, or other implementing document. A compliance-based assessment typically includes a review of documentation to measure whether those performing the task are following the prescribed method or rule, and includes only minimal observation of work being performed. A performance-based assessment is an assessment that evaluates work being performed. In addition to ensuring that work items are completed in accordance with a procedure, requirement, standard, or other implementing document, a key objective of a performance-based assessment is actual observation of ongoing work activities, followed by performing an evaluation based on improving the performance of that activity. The last paragraph in the Overview section of the Procedure states: (1) typically, a self assessment combines performance and compliance-based activities; (2) while both elements are essential, WTP places a high degree of importance on performance based assessments; and, (3) a performance based assessment is an excellent means of positively affecting the products or services resulting from a process.

Independent Oversight reviewed a list of construction self-assessments completed in 2013. The focus areas for the self-assessments that were completed through May 2013 included: 3 self-assessments of

construction safety; 1 self-assessment of the construction training program; 20 self-assessments of completed construction records; and 1 self-assessment of subcontractor administrative controls.

Independent Oversight selected three of the construction self-assessments in 2013 that addressed records. The purpose of the self-assessments was to determine whether the records were complete and accurate and whether any identified errors affected the completed work and document quality. The following self-assessments were reviewed:

- Quarterly Piping Record Assessment for Fourth Quarter 2012 – 103 of 1081 records were reviewed, and no issues were identified.
- Quarterly Mechanical Record Assessment for First Quarter 2012 – 13 of 59 records were reviewed. No errors were identified in 6 records, and a total of 12 errors were identified in the other 7 records. All identified errors were administrative. PIER 24590-WTP-PIER-MGT-13-0533 was initiated to document the records reviewed, types of errors, and resolution.
- Fourth Quarter Civil Record Assessment – 27 of 206 records were reviewed. Errors were identified in 13 records, involving failure to complete the records per procedural requirements or incomplete documentation. PIERs 24590-WTP-PIER-MGT-13-0406 and 0439 were initiated to document the records reviewed, types of errors, and resolution.

None of the errors in the records identified during the three self-assessments reviewed by Independent Oversight affected the quality of equipment installation or completed work.

The self-assessments completed by the field engineering organization in 2013 were compliance-based, limited to reviewing completed records (documents) only. No work in progress was observed, no interviews were conducted, and no data was collected or evaluated during these self-assessments. In the May 2013 Quarterly Report issued on May 22, 2013, Independent Oversight identified an opportunity for improving field engineering's self-assessment process by relying more on performance-based assessments and/or completing a higher percentage of performance-based self-assessments. BNI initiated PIER 24590-WTP-PIER-MGT-13-0743-D to address this improvement opportunity in June 2013. A field engineering self-assessment was in progress during the current review to evaluate the effectiveness of the use of hold tags to identify nonconforming hardware or equipment on the project site.

Quality Assurance Surveillances

BNI Procedure 24590-WTP-GPP-QA-601, *Quality Assurance Surveillance*, describes the process used to plan, conduct, and document QA surveillances of work activities at WTP. The onsite QA staff conducts these surveillances, which generally focus on observations of work activities to determine if procedures are being followed. Independent Oversight reviewed the list of 40 QA surveillances completed to date in 2013. These surveillances covered a wide range of ongoing work activities. Some of the surveillances included follow up on externally identified issues, such as those identified by WCD or during QA audits performed by the BNI offsite QA organization. Independent Oversight randomly selected six of the 2013 QA surveillances for review:

- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-008, Documentation and Conduct of Extent of Condition/Cause Reviews. The scope of this surveillance was to evaluate the flowdown of extent-of-condition requirements from the BNI Quality Assurance Manual to the project implementing procedure 24590-WTP-GPP-MGT-043, *Corrective Action Management*. A noncompliance was identified regarding the requirements for identifying extent of condition for Level C PIERs. An opportunity for improvement was also identified. The surveillance was classified as unsatisfactory.

- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-037, Pipe Support Installation in the LAW. Installation of a pipe support on a section of the CM chilled water system in the LAW was observed during this surveillance. No findings were identified, and the surveillance was classified as satisfactory.

- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-041, Magnetic Particle Examination Quality Level Q. The scope of this surveillance was to observe a field engineer, who is certified as a Level II in magnetic particle (MT) examinations, performing MT examinations of five completed Q welds. The following items were reviewed during the surveillance: certification records of field engineer, MT equipment calibration and satisfactory operability checks, preparation of welds for MT exam, observation of MT exams to verify that NDE was performed in accordance with procedures, and review of records documenting MT results. No relevant indications were observed during the MT exams. No findings were identified, and the surveillance was classified as satisfactory.

- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-046, Follow up of DOE Audit Findings, HLW, 12-DOE-AU-005. The scope of this surveillance was to perform a follow-up on nine findings identified by DOE during a 2012 audit of the WTP project QA program to ensure that the issues were being addressed appropriately. The conclusion of this surveillance was that corrective actions were proceeding satisfactorily. No findings were identified, and the surveillance was classified as satisfactory.

- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-047, HLW Concrete Placement, Pour Number HCC3103. The scope of this surveillance was to observe an HLW concrete wall placement to verify that this Q concrete placement was performed in accordance with the site concrete specification and construction procedure. The following items were observed during the surveillance: completed concrete pour card, cleanliness and preparation of surfaces for concrete, placement and consolidation of concrete in the forms, QC inspection activities, and QC testing for acceptance of freshly mixed concrete. No findings were identified, and the surveillance was classified as satisfactory.

- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-048, Enhancement of S/CI [suspect/ counterfeit item] Program. The scope of this surveillance was to perform follow-up to determine whether the corrective actions recommended in Institute of Nuclear Power Operations (INPO) Event Report 12-86, Counterfeit Parts and Equipment Vulnerability, had been satisfactorily implemented at WTP. The conclusion of this surveillance was that enhancements to the WTP S/CI program to address the INPO recommendations were satisfactorily implemented. No findings were identified, and the surveillance was classified as satisfactory.

The BNI QA surveillance program was found to be satisfactory for the sample reviewed by Independent Oversight. QA surveillances were performed to observe the full range of ongoing work activities. QA surveillances were also performed to follow up on issues identified by external organizations.

Concrete Placement Records

Concrete placement activities have been deferred in the PTF due to design and process questions. Concrete placement continues in the HLW, although at a slow pace due to reductions in construction craft staffing. Independent Oversight reviewed the results of QC tests performed on concrete samples from six Q concrete placements in the HLW facility completed between February 20 and May 15, 2013. These tests included slump, temperature, and unit weight testing on the freshly mixed concrete and unconfined compression tests on concrete cylinders cured in the concrete laboratory for 7 to 28 days. The concrete

design strength is verified based on the unconfined compression strength of concrete cylinders. The cylinders are either 4 inches in diameter and 8 inches high or 6 inches in diameter and 12 inches high. The concrete strength is determined by casting samples of concrete in cylindrical molds; the samples are moist cured in a field laboratory for a specified period and then subjected to an unconfined compression test. Typically, the concrete design strength at WTP is based on concrete test cylinders cured in the laboratory for 28 days. The results of the unconfined compression tests are used to verify the concrete quality and demonstrate that the concrete meets the design strength requirements. The methods for sampling the concrete, casting and curing the cylinders, and performing the unconfined compression tests are specified in ASTM standards. At WTP, the unconfined compression strength of the concrete at 28 days generally exceeds the specified design strength by 1000 pounds per square inch (psi) or more for all classes of structural concrete. The unconfined compression tests performed on concrete samples from five of the six concrete wall placements reviewed showed that the average concrete strength at an age of 28 days in these placements ranged from 6370 to 7120 psi. The required strength for the concrete is 5000 psi. The 28 day test results for the concrete placed on May 15 were not available since it had not reached 28 days during this review. The quality of concrete at WTP has been good.

Electrical Cable Installation

Installation of CM permanent electrical power and control cables has commenced in the LAB. Independent Oversight reviewed BNI Construction Procedure 24590-WTP-GPP-CON-3304, Rev. 2B, *Electrical Cable Installation*, and Specification No. 24590-WTP-3PS-E00X-T0004, Rev. 7, *Engineering Specification for Installation of Cables*. The specification and construction procedure define the technical and quality requirements for installation of CM and Q electrical cables in conduits, raceways, and underground duct banks. A proprietary BNI computer program, SETROUTE, provides details on length, type, and routing of the cables; and is an inspection record. Design engineering is responsible for performing cable pull calculations to determine maximum pulling tension values to avoid damage to the cables. Appendix A of the Engineering Specification contains a cable pulling chart that lists limitations, such as degrees of conduit bend, and maximum cable lengths that may be pulled without performing cable pulling calculations. Field engineers are responsible for establishing a sufficient number of pull points during conduit layout so that the cable tension limits specified in the Appendix A pull chart are not exceeded during cable installation (cable pulling). Field engineering is required to notify design engineering if the tension values in the cable pulling chart cannot be met.

Specification No. 24590-WTP-3PS-E00X-T0004 and Construction Procedure 24590-WTP-GPP-CON-3304 define standards to be implemented to avoid cable damage during cable installation work activities. These include minimum temperature values for cable installation, minimum cable bending radius, conduit lubrication requirements, maximum cable pulling tension, methods to measure cable pulling tension during cable installation, cable pull-bys, and cable repair. The specification and procedure also specify additional requirements for cable installation in cable trays, including cable arrangement and spacing, cable tray fill, methods to secure cables in cable trays, and cable dressing. Cable installation and inspection checklists are included as appendices to the Construction Procedure. CM cable installation is monitored on a random basis by field engineers, and QC personnel perform inspections of Q cable installation activities. Activities monitored by field engineers and inspected by QC personnel are recorded on a cable inspection/checklist form. The Engineering Specification requires performance of a series of tests prior to energization. For example, construction personnel perform continuity testing and insulation resistance testing prior to energization or turnover to startup, and the startup organization is responsible for performing additional testing, such as High Voltage (Hi-Pot) tests.

Independent Oversight concluded that Construction Procedure 24590-WTP-GPP-CON-3304 is adequate to control cable installation work activities, and it includes specific work instructions to ensure that the technical requirements and limitations in the engineering specification are met.

Pressure Testing of Piping

Independent Oversight observed one hydrostatic pressure test on the radioactive liquid waste system in the LAW and three pneumatic pressure tests on instrument sensing lines in ventilation systems in the LAB. The WTP site work process for conducting leak testing is specified in Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 8A, *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. ASME Code B31.3, Paragraph 345.5, Pneumatic Testing specifies the requirements for pneumatic pressure testing.

Independent Oversight attended the pre-test briefings, reviewed drawings and test data sheets, observed pressurization of the systems to the specified test pressure, observed the minimum hold times, and witnessed the system walkdown and inspection of the piping and instrument lines within the test boundary. Pre-job briefings addressed safety guidelines, emergency plan, the size and setting of the pressure relief valve, test sequence, test boundaries, test pressure, system pressurization and de-pressurization, inspection activities, and work completion. The pressure test and inspection boundaries were shown on marked-up piping and instrumentation diagrams (P&IDs), and the attached valve lineup sheets listed the test valve position and referenced test plug or blind flange locations. The locations of limited access/safety barriers were established in accordance with procedure requirements by calculating stored energy.

Pressure Test Package No. 24590-LAW-PPTR-CON-12-0263, Radioactive Liquid Waste Disposal System, included the test data sheets, test information, test requirements, valve lineup sheets, and marked-up P&IDs for the pressure test performed on piping classified as CM in a section of the radioactive liquid waste disposal piping in the LAW. The required hold time was 10 minutes at a pressure of 106.5 psi. The system test pressure was adjusted to account for the elevation difference between the test gauges and the welds and piping to be inspected. Independent Oversight verified that the calibration stickers on the test pressure gauges were current and that whip restraints were installed on pressure hoses. The system was pressurized to 110 psi and held for 11 minutes, slightly in excess of the pressure test requirements. The walkdowns and inspections of the pipe welds were performed by field engineering personnel, who are responsible for inspecting CM piping; QC inspectors generally do not perform inspections of CM work and equipment. Independent Oversight witnessed the walkdown inspection and reviewed the test data sheets, which recorded the test information, test requirements, required signoffs for pre-test reviews, documentation of measuring and test equipment used, and test results. There were no leaks in the piping or pipe welds, and the test was declared acceptable. Independent Oversight reviewed the completed post-test data sheets and test acceptance by field engineering.

The requirements for pneumatic pressure tests of various sections of instrument sensing lines on the LAB ventilation systems observed by Independent Oversight are specified in Pressure Test Packages 24590-LAB-PPTR-CON-13-0012, Plant Room V&ID C3V System Exhaust; 24590-LAB-PPTR-CON-13-0014, Plant Room V&ID C2V System Exhaust; and 24590-BOF-PPTR-CON-13-0024, Inbleed, Hotcell & RLD Vessel C5V Exhaust. These test packages included the test data sheets, test information, test requirements, valve lineup sheets, and marked-up P&IDs and as-built sketches for the pressure test performed on instrument lines (tubing). The instrument lines within the pressure test boundaries are classified as CM. The minimum test pressure was 15 psi, with a specified hold time of 10 minutes. Independent Oversight verified that the calibration stickers on the test pressure gauges were current and that whip restraints were installed on pressure hoses. The systems were pressurized to approximately 15.5 psi and held for 11 minutes, slightly in excess of the pressure test requirements. The walkdowns and inspections of the tubing and fittings were performed by field engineering personnel. Independent Oversight witnessed the walkdowns and inspections and observed the leak tests performed on the

compression fittings used at joints between instrument tubing sections and to connect valves and other components to the instrument tubing. The tests were declared acceptable.

The four pressure tests witnessed by Independent Oversight were completed in accordance with the requirements of Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 8A. No leaks were identified, and the tests were successfully completed.

ORP-WCD Welding Inspection Program

The ORP-WCD staff performs independent inspections of one or more inspection attributes for approximately 5 percent of quality-related welds and is currently reviewing 100 percent of the weld records. ORP-WCD randomly selects welds for examination, and also places witness points on weld inspection documentation to ensure that a variety of welds are inspected by ORP-WCD across all facilities. A witness point requires BNI construction to notify ORP-WCD when the work is scheduled to be performed; the work activity than cannot be performed or proceed past that point unless ORP-WCD inspects the construction process or waives the witness point. Welds selected by ORP-WCD for inspection include structural steel, piping, pipe supports, vessel (tank) welds, and weld repairs. Most of the welds examined by ORP-WCD are Q, but the ORP-WCD staff also includes some CM welds in their independent sample.

Independent Oversight observed the visual fit-up inspections for two piping welds in the LAW and final visual inspections of four structural welds in the HLW that were performed by the ORP-WCD staff. The piping welds were a three-inch pipe-to-pipe weld for the LAW primary offgas process system, and a four-inch pipe-to-nozzle weld for the LAW autosampling system. Acceptance criteria for piping welds are specified in the BNI welding control manual and ASME B31.3. The structural welds were for attachment of tube steel members to the HLW structural steel beams for cable tray supports. Acceptance criteria for visual examination of structural welds are specified in the American Welding Society Structural Welding Code AWS D1.1. These welds were preselected by ORP-WCD as DOE inspection witness points and were designated as witness points on the field welding checklists (FWCLs). ORP-WCD also reviewed FWCLs and drawings associated with the welds. The ORP-WCD welding inspection program was found to be satisfactory for the sample reviewed by Independent Oversight.

6.0 CONCLUSIONS

Independent Oversight determined that construction quality at WTP is adequate in the areas that were reviewed. BNI Engineering has developed appropriate corrective actions to disposition the closed NCRs and CDRs that Independent Oversight reviewed. Resolution and closeout of some open NCRs may impact costs and the construction schedule. Concrete quality is good. Both the program for pressure testing of installed piping and the QA surveillance program are adequate. BNI is continuing to perform corrective actions necessary to address errors in installation of PICAs.

However, within the BNI self-assessment program in the construction organization, self-assessments conducted by the field engineering organization continue to concentrate on completed construction records. Field engineering conducted no performance-based self-assessments of work in progress during the first five months of 2013.

7.0 ITEMS FOR FOLLOW-UP

Independent Oversight will continue follow up on inspection of welding activities, piping and pipe supports, pressure testing of piping, cable pulling, and cable terminations. Independent Oversight will also review corrective actions to address identified discrepancies in the PICA installation process and will perform additional review of self-assessments conducted by field engineering.

Appendix A
Supplemental Information

Review Dates

June 10-14, 2013

Office of Health, Safety and Security Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
William A. Eckroade, Principal Deputy Chief for Mission Support Operations
John S. Boulden III, Director, Office of Enforcement and Oversight
Thomas R. Staker, Deputy Director for Oversight
William E. Miller, Deputy Director, Office of Safety and Emergency Management Evaluations

Quality Review Board

William Eckroade
John Boulden III
Thomas Staker
William Miller
Michael Kilpatrick

Independent Oversight Site Lead for Hanford Site

Robert Farrell

Independent Oversight Team Composition

Joseph Lenahan

Appendix B
Documents Reviewed

- Construction Procedure 24590-WTP-GPP-CON-3503, Rev. 6B, Aboveground Piping Installation, February 28, 2013
- Construction Procedure 24590-WTP-GPP-CON-3509, Rev. 2D, Pipe Support Installation, February 28, 2013
- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 8A, Pressure Testing of Piping, Tubing and Components, September 6, 2012
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 3C, Post Installed Concrete Anchors, October 17, 2012
- Construction Procedure 24590-WTP-GPP-CON-3304, Rev. 2B, Electrical Cable Installation March 13, 2013
- Specification No. 24590-WTP-3PS-EooX-T0004, Rev. 7, Engineering Specification for Installation of Cables, March 11, 2011
- Specification No. 24590-WTP-3PS-DB01-T0001, Rev. 8, Engineering Specification for Furnishing and Delivering Ready-Mix Concrete, March 26, 2007
- Specification No. 24590-WTP-3PS-D000-T0001, Rev. 8, Engineering Specification for Concrete Work, August 17, 2012
- Specification No. 24590-WTP-3PS-FA02-T0004, Rev. 5, Engineering Specification for Installation and Testing Post Installed Concrete Anchors and Drilling/Coring of Concrete, July 7, 2010
- Construction Procedure 24590-WTP-GPP-MGT-043, Rev. 4A, Corrective Action Management, November 30, 2012
- Construction Procedure 24590-WTP-GPP-MGT-044, Rev. 1C, Nonconformance Reporting and Control, May 2, 2013
- Construction Procedure 24590-WTP-GPP-MGT-036, Rev. 2A, WTP Self Assessment, October 8 , 2012
- Construction Procedure 24590-WTP-GPP-QA-601, Rev. 6B, Quality Assurance Surveillance, May 14, 2012
- Design Guide 24590-WTP-GPG-M-017, Rev. 8E, Design Parameters & Test Pressures for Equipment & Piping, February 14, 2013
- Procedure Number 24590-WTP-MN-CON-01-001-10-10. Rev. 6, Bechtel Nondestructive Examination Standard Visual Examination VT-AWS D1.1
- Document No. 24590-WTP-QAM-QA-06-001, Rev. 12, Quality Assurance Manual, March 22, 2013
- Construction Deficiency Report numbers 24590-WTP-CDR-CON-13-0254 through 13-0325, 13-0477 through 13-0486, and 13-0496 through 13-0501. The following Construction Deficiency Reports document nonconforming PICAs, numbers 24590-WTP-CDR-CON-13-0254 through 13 -0268, 13-0273, 13-0275, -0277, 13-278, 13-0280, 13-0281, 13-0292, 13-0294 through 13-0303, 13-0309, 13-0311 through 13-0317, 13-0320, 13-0477 through 13-0480, 13-483, 13-484, 13-0500 and 13-0501.
- Nonconformance Report numbers 24590-WTP-NCR-CON-13-048 through -0091
- WTP Self Assessment Report 24590-WTP-SAR-CON-13-0007, Quarterly Piping Record Review for Records Closed the Fourth Quarter of 2012
- WTP Self Assessment Report 24590-WTP-SAR-CON-13-0022, Fourth Quarter (2012) Civil Records Assessment
- WTP Self Assessment Report 24590-WTP-SAR-CON-13-0023, Quarterly Mechanical Records Assessment for 1st Qtr 2012

- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-008, Documentation and Conduct of Extent of Condition/Cause Reviews
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-037, Pipe Support Installation in the LAW
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-041, Magnetic Particle Examination Quality Level Q
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-046, Follow up of DOE Audit Findings, HLW, 12-DOE-AU-005
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-047, HLW Concrete Placement, Pour Number HCC3103.
- QA/QC Surveillance Report Number 24590-WTP-SV -QA-13-048, Enhancement of S/CI Program
- System Pressure Test Document No. 24590-LAW-PPTR-CON-12-0263, Radioactive Liquid Waste Disposal System
- System Pressure Test Document No. 24590-LAB-PPTR-CON-13-0012, Plant Room V&ID C3V System Exhaust
- System Pressure Test Document No. 24590-LAB-PPTR-CON-13-0014, Plant Room V&ID C2V System Exhaust
- System Pressure Test Document No. 24590-BOF-PPTR-CON-13-0024, Inbleed, Hotcell & RLD Vessel C5V Exhaust