Office of Enterprise Assessments
Salt Waste Processing Facility Construction Quality and Fire Protection Systems Follow-up Review at the Savannah River Site

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Acronyms

ASME	American Society of Mechanical Engineers
CSSX	Caustic Side Solvent Extraction
CFR	Code of Federal Regulations
CPA	Central Process Area
CR	Condition Report
CRAD	Criteria, Review, and Approach Document
CRFI	Construction Request for Information
DOE	U.S. Department of Energy
DOE-SR	DOE Savannah River Operations Office
EA	Office of Enterprise Assessments
FHA	Fire Hazards Analysis
FME	Foreign Material Exclusion
FPE	Fire Protection Engineer
ITM	Inspection, Testing, and Maintenance
ITP	Inspection and Test Plan
M&TE	Measuring and Test Equipment
NCR	Nonconformance Report
NFPA	National Fire Protection Association
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
PC	Performance Category
PDSA	Preliminary Documented Safety Analysis
pcf	Pounds per Cubic Foot
PIV	Post Indicating Valve
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
QCIR	Quality Control Inspection Report
SRR	Savannah River Remediation LLC
SRS	Savannah River Site
SS	Safety Significant
SSC	Structure, System, or Component
SSO	Safety System Oversight
SWPF	Salt Waste Processing Facility
SWPFPO	DOE Salt Waste Processing Facility Project Office
WP	Work Package

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) independent Office of Enterprise Assessments (EA) conducted a review of construction quality and performed a follow up review of the fire protection program at the DOE Savannah River Site Salt Waste Processing Facility (SWPF). EA's Office of Environment, Safety and Health Assessments conducted this review from July 20 to 24, 2015. EA is performing a series of these reviews across the DOE complex to ensure that design and construction of DOE facilities meet the requirements of 10 Code of Federal Regulations 830 Subpart A, *Quality Assurance Requirements*, and DOE Order 420.1B, *Facility Safety*. DOE Order 420.1B requires fire protection programs to comply with the National Fire Protection Association (NFPA) codes. Parsons Corporation (Parsons) is under contract with DOE to design, construct, and commission the SWPF.

EA observed ongoing construction work activities, including pressure testing, cleaning/flushing, and drying (following cleaning/flushing) of piping systems; reviewed the identification and processing of nonconforming items under the Parsons corrective action program; and reviewed the Parsons quality assurance program. EA also reviewed the fire protection program and followed up on corrective actions for eight previous findings from an EA review conducted in January 2014.

EA determined that construction quality at SWPF is generally satisfactory in the areas that were reviewed. Parsons is adequately implementing the program for pressure testing, cleaning and flushing, and drying of piping systems. Parsons has developed appropriate corrective actions to resolve specific deficiencies for nonconforming items evaluated during the review.

EA found that the SWPF fire protection program has improved but still has some deficiencies. Parsons promptly implemented corrective actions for six findings from EA's January 2014 review, and identified all but one of the previous findings as closed. For the most part, Parsons' corrective actions to resolve the issues in the SWPF fire protection program were satisfactory. However, not all aspects of the previously identified issues were adequately addressed, resulting in 1 new finding for non-performance of required triennial fire protection self-assessments. EA recommends that Parsons develop a formal process for reviewing the pre-incident fire plan, schedule 5-year flow tests for all J-Area hydrants, and add explicit instructions on temperature requirements during installation of fire sealant material. Savannah River Remediation LLC (SRR) adequately addressed the other two previous findings on the fire water supply to the SWPF.

In addition, during facility walkthroughs EA identified several fire protection deficiencies including an issue with fire-proofing of structural supports, and other problems with fire suppression sprinkler system installation; control of combustibles; obstructed fire exits; and installation of fire barriers.

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1.0 PURPOSE

The U.S. Department of Energy (DOE) independent Office of Enterprise Assessments (EA) conducted a review of construction quality and the fire protection program at the DOE Savannah River Site (SRS) Salt Waste Processing Facility (SWPF). This review involved a periodic review of construction and a follow-up review of fire protection to determine whether corrective actions for previously identified issues had been successfully completed. These independent reviews are performed as part of an ongoing program of assessments of construction quality and fire protection programs at major DOE construction projects to ensure that construction contractors meet the requirements of Title 10 Code of Federal Regulations (CFR) 830, Subpart A, *Quality Assurance Requirements*, and DOE Order 420.1B, *Facility Safety*. EA conducted the onsite portion of this review from July 20 to 24, 2015.

2.0 SCOPE

This review addressed two specific, distinct topics: construction quality and fire protection. The scope of the construction quality review included observations of hydrostatic pressure testing of newly installed piping systems and subsequent cleaning, flushing, and drying of piping. EA also reviewed the corrective action and quality assurance (QA) programs of the contractor, Parsons Corporation (Parsons). Design and procurement programs were not included in the scope of the construction quality review. The scope of the fire protection program review included a follow-up on eight findings identified during an independent EA review in January 2014, as well as a facility walkthrough to observe current construction work activities and assess general compliance with DOE fire protection requirements.

3.0 BACKGROUND

The SWPF is under construction in the J-Area at SRS. The overall mission of the SWPF is to separate and concentrate the radioactive cesium, strontium, and actinide contaminants from the high-Curie salt solutions that are to be removed from the liquid waste tanks in the F- and H-Area Tank Farms at SRS. The concentrated strontium, actinide, and cesium waste slurry containing most of the radioactive contaminants will be sent to the Defense Waste Processing Facility for immobilization in a glass formulation by a vitrification process. The decontaminated salt solution left after removal of the highly radioactive contaminants will be sent to the Saltstone Production Facility for immobilization in a grout mixture and disposal in above-ground grout vaults.

The SWPF is divided into the Central Process Area (CPA), the Cold Chemicals Area, the Facility Support Area, and the Alpha Finishing Facility. Most radioactive materials will be stored and processed in the CPA, a reinforced concrete structure. The CPA includes six rooms that contain processing and holding tanks. These rooms are designated as "dark cells," shielded rooms for which no maintenance or entry is planned during the 40-year design life of the plant. The CPA is designed to DOE performance category (PC)-3 criteria. The remaining SWPF areas are housed in structural steel buildings designed as PC-1 structures.

Parsons is under contract with DOE to design, construct, and commission the SWPF. Parsons prepared a preliminary documented safety analysis (PDSA) for the SWPF that describes the facility design codes, safety systems, design basis accident analysis, pre-operational testing program, operational safety, and the

QA program. Construction work is about 90 percent complete. Work currently in progress includes construction-related testing and the installation of piping and instrumentation lines; the heating, ventilation, and air conditioning systems; electrical cables; and the fire protection system. The QA program requirements for design, construction, and operation of the SWPF, referenced in the PDSA, are specified in American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1-2004, *Quality Assurance Requirements for Nuclear Facility Applications*, and DOE Order 414.1C, *Quality Assurance*. Construction oversight is provided by the DOE Salt Waste Processing Facility Project Office (SWPFPO), which is part of DOE Savannah River Operations Office (DOE-SR). EA previously reviewed construction quality at SWPF in May 2012, January 2014, and November 2014. EA also reviewed Parsons' SWPF fire protection program for compliance with the requirements of DOE Order 420.1B, *Facility Safety*, and the implementing DOE standard, DOE-STD-1066-99, *Fire Protection* in January 2014. The January 2014 review included aspects of the SRS-wide fire water supply to the SWPF, operated and maintained by SRR.

4.0 METHODOLOGY

This independent review of the construction quality processes and the follow-up review of the fire protection program at SWPF was conducted in accordance with the *Plan for the Office of Enterprise Assessments Review of the Savannah River Site Salt Waste Processing Facility Construction Quality and Fire Protection System Follow-Up Review*, dated July 2015. EA reviewed multiple documents (work instructions, procedures, specifications, and drawings) related to the fire protection program and ongoing construction work activities, interviewed key personnel responsible for performing construction inspection activities, and conducted several construction site walkthroughs concurrently with the Parsons and DOE-SR engineers. EA observed three hydrostatic tests, cleaning and flushing of two piping systems, and draining and drying of a piping system after completion of pressure testing, cleaning, and flushing. EA also reviewed nonconformance reports (NCRs) and condition reports (CRs) that Parsons identified under its corrective action program and QA surveillance reports. EA followed up on corrective actions for the six findings and deficiencies identified in the SWPF fire protection program and the additional two findings concerning degraded fire pump performance identified during the January 2014 review. EA also reviewed revised fire protection documents related to the corrective actions and observed various construction work activities to determine compliance with DOE Orders and National Fire Protection Association (NFPA) codes.

This EA assessment focused on certain portions of the following EA criteria, review and approach documents (CRADs):

- CRAD 45-52, *Construction – Piping and Pipe Supports*
- CRAD 45-53, *Construction – Mechanical Equipment Installation*
- CRAD 45-34, *Fire Protection – Inspection Criteria, Approach, and Lines of Inquiry*, Rev. 1

The results of this review are discussed in section 5. Findings are described in Section 6, and opportunities for improvement (OFIs) are listed in Section 7. Supplemental information on the review, including the members of the EA team, the Quality Review Board, and EA management, is provided in Appendix A. A list of key documents reviewed, interviews conducted, and work activities observed is provided in Appendix B.

5.0 RESULTS

5.1 Construction Quality Review

EA evaluated the programs implemented by Parsons for compliance with the requirements of 10 CFR 830, Subpart A, *Quality Assurance Requirements*; DOE Order 414.1C, *Quality Assurance*; and DOE Order 420.1B, *Facility Safety*. Under 10 CFR 830 and DOE Order 414.1C, the contractor is required to use appropriate national consensus standards to implement DOE QA requirements. The PDSA references ASME NQA-1-2004, as the national consensus standard that Parsons will follow as the basis for the SWPF QA program. The QA requirements in ASME NQA-1 are specified in 18 basic and supplemental criteria. Parsons Document V-QP-J-0001, *Quality Assurance Plan*, describes in detail the application of the 18 NQA-1 requirements to the SWPF. The QA plan (QAP) establishes the planned and systemic actions necessary to provide adequate confidence that a structure, system, or component (SSC) will perform satisfactorily in service. The SWPF QAP incorporates the basic and amplified requirements of the supplemental criteria from NQA-1.

5.1.1 Corrective Action Program

Criteria: *A process shall be established to identify, 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. (ASME NQA-1 Criterion 16; SWPF QAP Section 16; and DOE Order 414.1C)*

Parsons Procedure PP-AS-1203, *Corrective Action Program*, establishes and implements the SWPF corrective action program, the purpose of which is to correct and prevent recurrence of issues affecting quality, regulatory compliance, or personnel or operational safety. A CR is required to be issued to correct any incident or condition that affects or has the potential to affect the environment, health, safety, or quality. A CR is not required for nonconforming items that can be resolved in accordance with Procedure PP-QA-4703, *Nonconforming Items*, for issues identified through the employee concerns program or through the employee suggestion program. Procedure PP-AS-1203 requires that a CR be initiated for issues identified through incidents/events and internal and external assessments or surveillances.

EA reviewed 20 closed CRs and 2 open CRs (see Appendix B). Sixteen of the CRs were issued to address findings and OFIs identified during previous independent oversight reviews. The remaining six CRs were issued to address findings identified through QA surveillances or internal QA audits: one for debris and grinding material identified by radiographs in some sections of piping (theses pipes had not yet been cleaned and flushed); two concerning radiography of welds; one for performance of a base metal repair without an approved procedure; and two for issues concerning measuring and test equipment (M&TE). EA determined that these CRs appropriately documented and evaluated issues identified by QA and EA in accordance with PP-AS-1203.

Procedure PP-QA-4703, *Nonconforming Items*, defines the requirements for identifying, documenting, evaluating, and correcting items that do not conform to SWPF project requirements. NCRs are issued to document and disposition nonconforming hardware items or incorrectly performed work. Examples of nonconforming items include: (1) failure to satisfy technical or design requirements; (2) indeterminate quality of an item; (3) incorrect installation of SSCs (construction errors); (4) failure of personnel to follow procedures, such as bypassing hold points or improperly performing inspections; or (5) documentation deficiencies. NCRs are not required to be issued for work in progress that has not been inspected and accepted by the quality control (QC) organization. QA issues a CR if an NCR is determined to be repetitive, programmatic, or the result of an activity failure, to evaluate and correct the

nonconforming condition. An NCR is issued whenever a work activity, such as a design modification or test affects a hardware item or component that was inspected and accepted by QC. The Parsons Design Engineering organization is required to approve the disposition of NCRs when the corrective action is "use as is" or "repair."

EA reviewed 43 closed NCRs and 18 open NCRs issued by Parsons between January, 2014 and July 7, 2015, to determine the types of nonconforming issues that were identified and subsequent mechanisms for resolution. Approximately 40 percent of the NCRs resulted from procurement and supplier deficiencies, including 14 that identified valves with casting defects. Corrective actions for the defective valves involved removal and replacement; the inferior parts were either scrapped or returned to the vendor. In a few cases, Parsons Design Engineering evaluated the defects, and determined that the valves were acceptable for the ranges of operating pressures in the SWPF. Most of the remaining NCRs were initiated to document and disposition construction problems, but some were initiated to document modifications to hardware that the QC inspectors had previously inspected and accepted. These design modifications included changes to pipe supports and cutting into a completed piping system to establish an isolation boundary to perform hydrostatic testing. The corrective actions for these NCRs typically consist of re-inspecting the hardware and components after the required modification or system restoration is complete. EA determined that the closed NCRs appropriately documented and evaluated the nonconforming conditions in accordance with PP-QA-4703.

The Parsons Engineering organization developed appropriate corrective actions to disposition the specific problems identified in the completed and closed NCRs. The corrective action program implementation was adequate to address and resolve procurement and construction quality deficiencies. When appropriate, CRs were issued to address nonconforming items initially identified as NCRs. For the sample of CRs and NCRs reviewed by EA, the corrective action program was adequate to address and resolve quality deficiencies.

5.1.2 Pressure Testing, Cleaning and Flushing, and Drying of Piping Systems

Criteria: *Construction and pre-operational tests for piping systems, such as pressure testing, cleaning and flushing operations, drying, and preservation of internal cleanliness, 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. (ASME NQA-1 Criterion 11; SWPF QAP Section 11; and DOE Order 414.1C)*

EA reviewed the program, specifications, and test procedures that control the processes for pressure testing, cleaning and flushing, and drying of piping systems. The technical requirements for performing these activities are stated in Specification 15112, *Pipe Leak Testing*, and Section 3.9 of Specification 15121, *Field Installation of Process Piping.* The SWPF code of record for piping is ASME B31.3-2002. The program, specifications, and test procedures that control the processes for pressure testing, cleaning and flushing, and drying of piping systems are summarized in the following paragraphs.

The Parsons Pressure Testing and Flushing group is responsible for preparing a work package (WP) for each test and controlling and directing performance of the tests. The WP shows the test boundaries and lists test requirements, preparation activities, test performance, and recovery/restoration from each pressure test. The WP also includes pre-job briefing and safety requirements, prerequisites, work instructions, sequence of work activities, and applicable construction drawings and other documents necessary to perform the test. Work steps in the WPs include sign-offs and inspection hold points that are based on Inspection and Test Plan (ITP) number ITP-15112-0001, *Pipe Leak Testing.* The ITP identifies

the inspection attributes and acceptance criteria that QC inspectors are required to inspect and verify during the pressure test. QC inspectors witness pressure tests, verify that the test procedures are followed, and perform the required inspections. QC inspectors complete a Quality Control Inspection Report (QCIR) to document the inspection results, and they record the QCIR number in the WP.

Work steps are also included in the WP, or an additional WP is issued, for cleaning and flushing the piping after the pressure tests are completed, and for draining and drying the piping and implementing the foreign material exclusion (FME) program for maintaining piping internal cleanliness after flushing is completed. QC does not inspect cleaning and flushing operations, or the draining and drying of the piping. Instead, the test engineers witness and sign off on these work steps.

A process is in place for Design Engineering to review test exceptions and clarify test requirements. The Pressure Testing and Flushing group submits a Construction Request for Information (CRFI) to Design Engineering when necessary to clarify pressure testing, cleaning, flushing, and/or drying operations. After the CRFI is approved, the CRFI number is referenced in the WP, and the WP may be amended to reflect any changes that Design Engineering approved for the test process.

Pressure Testing of Piping Systems

Specification Section 15112, *Pipe Leak Testing*, defines the requirements for leak (pressure) testing of piping in accordance with applicable codes specified in design documents. The specification covers both hydrostatic and pneumatic pressure testing, and it includes test pressures, test sequencing, test hold times, and inspection requirements. Design Engineering has adequately described the criteria for performing pressure testing of piping systems in the specification. EA reviewed the specification and the following procedures that control SWPF pressure testing of piping: DP-CS-7319, *Leak Test of Process Piping*; DP-CS-7323, *Leak Testing and Flushing Prerequisites*; DI-CS-016, *Instrument Tubing Blowdown and Leak Test*; DI-CS-019, *Sampling and Analysis Instructions for Piping Hydrostatic Test and Flushing*; and DI-CS-020, *Pneumatic Test Exclusion Area and Static Head Correction Factor Determination*.

The design code requirements for conducting pressure testing of piping are specified in ASME Code B31.3, Paragraph 345.4, for hydrostatic testing and ASME Code B31.3, Paragraph 345.5, for pneumatic testing. The pressure test acceptance criteria require visual examination of all pipe welds for leakage. The test process also invokes ASME Code Interpretation 21-42, issued October 2, 2007, which permits use of a pump to maintain test pressure during the 10-minute hydrostatic test hold time and during the time following the 10-minute hold required to complete the visual inspections required by the specification.

Since February, 2015, Parsons has issued two NCRs (numbers 1187 and 1204) for nonconforming items identified as a result of pressure testing. These NCRs were initiated to repair valves that leaked during pressure testing, and were adequately corrected and closed.

EA observed performance of the following hydrostatic tests: process cooling water return, WP 1064-004; aqueous salt solution and slurry/sludge piping, WP 1072, items 1, 11, 21, 41, 42, and 43; and safety significant air purge piping for tanks in dark cells, WP 0876-001. No deficiencies were identified except for some minor packing leaks that were repaired and retested. The pressure tests were declared successful. For the sample observed, EA concluded that SWPF pressure testing is adequate to demonstrate that the facility piping is leak tight and meets ASME Code requirements. All personnel involved in the testing gave significant attention to personnel safety during testing, including physical proximity control/access limitations, restraint of test couplings, and tagging of test boundaries.

Cleaning and Flushing of Piping Systems.

Paragraph 3.9 of Specification Section 15121, *Field Installation of Process Piping*, specifies the requirements for internal cleaning and flushing of piping including flushing methods and acceptance criteria. Cleaning and flushing activities generally follow pressure testing. The flush water is discharged through a number 20 mesh or finer screen for stainless steel piping, or a number 14 or finer mesh screen for carbon steel piping. The piping is required to be flushed with a water flow for a minimum of five minutes, or a minimum of five times the pipe volume over the length of piping being flushed. Piping systems are required to be drained of fluids within 14 days after flushing is completed and dried using clean, oil-free air. EA reviewed the specification and SWPF procedures DP-CS-7321, *Flushing/Cleaning of Process Piping*, and PL-CS-7205, *Process Pipe Flush Plan*. Both Procedure DP-CS-7321 and Specification 15121 contain tables establishing minimum flow rates in gallons per minute for flushing in each relevant pipe size. These flow rates are based on achieving turbulent flows in the pipes, which is necessary for debris removal. During flushing, flow rates are required to be measured and documented and the effluent is required to be examined to determine whether particulates or oil contaminants are present. After the five-minute flushing period, the mesh screen is examined, and the flushing cycle is required to be repeated if the test acceptance criteria are not met. Acceptance criteria include: verifying that no particles are present on the screen, no more than slight rust staining is present, and there is no visual evidence of contaminants (e.g., oil) in the flush water.

EA observed flushing of a portion of the aqueous salt solution and slurry/sludge piping (WP 1072, items 1, 5a, 5b, 11, and 43). Flow rates and flushing times/volumes were in accordance with procedure requirements and complied with the cleanliness criteria after the last flushing cycle. A test engineer was present to witness the flushing/cleaning operations, verify that flushing flow rates were maintained for at least the minimum times specified in the procedures, and examine the mesh screen and the discharge flush water. The flushing cycles were repeated until the acceptance criteria were met. For one of the flush operations that EA observed, flushing was repeated for nine cycles until the flushing acceptance criteria were met. The number of flush cycles and the volume of flush discharge water were recorded in the WP, and the WP step for flushing was signed off by the test engineer as complete.

Parsons has well-defined processes for performing flushing of piping. Personnel involved in the testing were knowledgeable regarding requirements, including the need to monitor and measure the quantity of the discharge water. The SWPF cleaning and flushing program is adequate to clean the piping and prove that the facility piping meets cleanliness requirements.

Water Removal and Drying of Piping Systems after Flushing

Paragraph 3.9 of Specification Section 15121 specifies the requirements for draining and drying the piping after flushing is completed. EA reviewed the specification and the following SWPF procedures that define the requirements for water removal and drying of piping: DP-CS-7321; PL-CS-7205; and DP-CS-7322, *Foreign Material Exclusion*.

The specification requires the water to be drained and the pipe dried within 14 days after completion of cleaning and flushing of a section of piping. Construction is required to initiate a CRFI and obtain Design Engineering approval if the flush water is to remain in the piping for longer than 14 days after flushing. DP-CS-7322 requires installation of FME tags at open ends of each pipe after successful completion of flushing.

EA observed drying of a section of caustic side solvent extraction (CSSX) piping (WP 1088-002, items 14 and 15). Compressed air was blown through the piping until the dew point of the air was measured to be minus 20 degrees Fahrenheit, the acceptance criterion in the specification. A test engineer was present

to witness the drying operations and sign off the step in the WP. An FME tag was placed on the piping ends after drying operations. The work that EA observed was performed in accordance with procedure requirements.

Review of Quality Records

EA reviewed a sample of completed and closed out WPs that document pressure testing, cleaning and flushing, and drying of piping systems: WP-0950, WP-0952, WP-1055, and WP1056. EA also reviewed the CRFIs associated with pressure testing listed in Appendix B; the QCIRs referenced in WPs 0950, 0952, and 1055; and the records documenting calibration of the M&TE used in the tests being observed. The M&TE records were for pressure gauges GPO ID numbers 0759, 0764, 3540, 3541, and 3547; PosiTector dew point meter GPO ID 3793; and flow meter GPO ID 2967.

Based on the sample reviewed, EA concluded that Parsons records adequately document performance of pressure testing, cleaning and flushing, and drying of piping systems; the required QC inspections; and calibration of M&TE.

5.1.3 Quality Assurance Surveillance Activities

Criteria: *Audits and other assessment techniques, such as surveillances, will be used to monitor and confirm the QAP is being effectively implemented. Surveillances must be documented in sufficient detail to identify the activity covered, identify the individuals performing the surveillance, and document results and any necessary corrective actions. (ASME NQA-1 Criterion 18; SWPF QAP Section 18; and DOE Order 414.1C)*

EA reviewed the QA surveillance activities that QA personnel perform to complement QA audits and evaluate onsite quality-related processes and worker safety activities. For specialized surveillances, subject matter experts are selected to perform surveillance activities. Parsons Procedure PP-QA-4701, *Surveillance Program*, specifies the requirements for the internal QA surveillance program.

EA randomly selected 16 QA surveillance reports for review, covering the following work activities: pipe welding, radiography and nondestructive examination of welds, hydrostatic testing, control of MT&E, accuracy of QC inspection reports, construction work package closure, installation of fire stop materials and sprinklers, and contamination controls for stainless steel materials.

EA found the Parsons QA surveillances to be satisfactory. CRs were initiated to document and correct findings identified during surveillances. The computerized database of the completed QA surveillances included a broad range of subject areas, indicating adequate surveillance of the full range of ongoing work activities. Based on the sample reviewed, EA concluded that the Parsons QA surveillance program is acceptable.

5.2 Fire Protection Program Follow-up Review

5.2.1 Resolution of Findings from the January 2014 Fire Protection Program Review

Criteria: *The contractor has implemented an issues management and corrective action system that captures issues identified from assessments and other sources, and categorizes them to ensure that problems are evaluated, reported, and corrected on a timely basis. [DOE Order 226.1B Contractor Requirements Document 2.b (3)]*

There were eight findings from EA's January 2014 fire protection program review, six were assigned to Parsons and two were assigned to SRR. Parsons entered the findings and OFIs into their Corrective Action System and provided EA with a spreadsheet, SPD-SWPF-0734, *HS 45 Independent Oversight Review of the Savanah River Salt Waste Processing Facility Construction Quality and Fire Protection System – Actions Taken for Identified Finding and Opportunities for Improvement*, which summarized the corrective actions taken to address each of the findings. SRR also implemented corrective actions for their two findings and provided the resolutions to the EA team. EA's review of these findings and the corresponding corrective actions are discussed below.

2014 Finding F-SWPF-1: *Key responsibilities for the SWPF Fire Protection Program were not consistent between the SWPF Fire Program Plan (Ref. F-PP-J-00001, Revision 0) and other fire prevention administrative procedures. Examples included: (1) the Shift Operations Manager was not the responsible person for implementing the impairment program as described in the Fire Protection Program Plan; (2) Engineering, Procurement, and Construction were not responsible for notifying Liquid Waste Operations in the event of a major water loss from the J-Area Fire Protection System, as is described in the Fire Protection Water System Interface Control Document (Document V-ESR-J-00017, Rev. 4); and (3) the SWPF Fire Protection Program Plan required periodic self-assessments to be performed by the Fire Protection Engineer (FPE), but no assessments were available for review.*

To address this finding, Parsons initiated CR No. 2014-61 and performed the following corrective actions:

(1) F-PP-J-00001, *Fire Protection Program Plan*, was revised and reissued on May 22, 2015. According to the spreadsheet, "This revision clarified responsibilities of personnel for buildings under construction and for operational buildings. The inter-department review included Construction personnel, Operations and Maintenance personnel, and Engineering personnel to ensure responsibilities identified were accurate and complete."
(2) The revision of F-PP-J-00001 included two new fire safety checklists: Form SWPF-657 for buildings under construction, and Form SWPF-658 for operational buildings.

EA reviewed the revised Fire Protection Program Plan, F-PP-J-00001 and found that the previously identified issues were corrected.

The original finding included a deficiency in that procedure PP-SH-4371, *Fire Protection*, Rev. 4, addressed fire prevention policies and programs only for construction activities, not for operational buildings, such as the Administration Building 704-J and Warehouse Building 763-S.

Parsons addressed this issue in Revision 1 of the Fire Protection Program Plan, F-PP-J-00001, by replacing FPC-001, *Fire Safety Checklist*, and FPC-002, *Fire Protection Building Assessment Checklist*, with two new checklists: Form SWPF-657, *Fire Safety Checklist for Buildings Under Construction*, and Form SWPF-658, *Fire Protection Building Assessment Checklist for Operational Buildings*. However, Parsons provided no evidence that any fire protection program self-assessments had been completed before or since EA's initial fire protection review in January 2014. Fire protection program self-assessments are required to be performed at least every three years, by or under the supervision of an FPE, as directed by DOE Order 420.1B, Chapter II, Section 3.b (13), and F-PP-J-00001, Rev. 1, Section 4.1. This issue was not entered on Parsons' spreadsheet or included in a CR.

EA concluded that the corrective actions for this finding were not fully effective in resolving all of the identified issues. Specifically, triennial fire protection program self-assessments have not been performed for the operational buildings at SWPF. (**See Finding F-SWPF-2015-1.**)

2014 Finding F-SWPF-2: *The fire pre-incident plan was not updated to reflect the current*

configuration of the fire hydrants and fire department connections to ensure a prompt and effective response by SRS emergency services in accordance with SRS Manual 2Q2-4-J.

EA issued this finding because critical fire suppression systems were not properly identified in the SWPF fire pre-incident plan, 221-000J, *Fire Control Pre-plan*, to ensure a timely and effective fire department response. Examples of deficiencies in the fire pre-incident plan included:

- Non-operational fire hydrants #29 and #30 were not flagged as "hydrant out of service" in accordance with the legend on the SWPF fire pre-incident plan drawing.
- The locations of fire department connections were not identified on the pre-incident plan drawing.

In response to this finding, Parsons initiated CR No. 2014-62, and performed the following corrective actions:

(1) Parsons reviewed 221-000J for the SWPF and provided redline mark-ups to DOE-SR in letter 00-700-22458. The updated pre-plan correctly shows that fire hydrants #29 and #30 are out-of-service, and the drawing shows the in-service fire department connections.
(2) Parsons also reviewed 704-000J, *Fire Control Pre-plan*, for the Administration Building and provided redline mark-ups to DOE-SR in letter 00-700-22806.

Parsons and the DOE-SR FPE explained that the SRS Fire Department developed the original fire control pre-incident plan, 221-000J, dated December 31, 2013, after a site walk down of the 221-J area. The fire control pre-incident plan with the above discussed deficiencies was then placed on site emergency response vehicles, without any review by the SWPF fire protection staff.

Parsons management stated that SWPF fire protection personnel and environmental, safety, and health subject matter experts accompany the SRS fire department personnel on monthly walk downs of the 221-J area. Changes to the fire control pre-incident plan are communicated informally (verbally) during the walk down. However, SWPF does not have a formal process for performing a periodic review to ensure that the fire control pre-incident plans maintained by the SRS fire department are current. (**See OFI-SWPF-2015-1**.)

EA found that the current version of the fire control pre-incident plan, 221-000J accurately shows that fire hydrants #29 and #30 are out-of-service, and identifies the in-service fire department connections on the drawing. However, the revised plan was erroneously re-issued as Revision 0, not as Revision 1, thus violating change control processes and obscuring the fact that the document had changed.

Overall, EA concluded that the corrective actions for this finding were sufficient.

2014 Finding F-SWPF-3: *The underground fire water ring main and standpipes were not installed in accordance with the requirements documented in NFPA 241, Standard for Safeguarding Construction, Alteration and Demolition Operations. Parsons had not fully installed the SWPF underground fire water ring main and standpipes, only two of the four standpipes had been hydrostatically tested, and none of the standpipes had been flow tested as required by NFPA 14, Standard for the Installation of Standpipe and Hose Systems.*

In response to this finding, Parsons initiated CR No. 2014-63 and documented the following status of corrective actions taken:

(1) The underground loop was installed, tested, and placed into service, as documented in WP-0551.
(2) Standpipes will be charged when the interior fire protection loop is complete and tested. Until such time, the Parsons Fire Protection Coordinator will work with the SRS fire department to determine whether compensatory actions are required.

EA reviewed the closure documentation for WP-0551, which includes drawing M-MA-J-00020, Rev. 1. The completed work package and drawing provide evidence that the installation and testing of the underground fire loop is complete and that it has been placed in service. Furthermore, Parsons placed all SWPF standpipe systems in service on July 23, 2015.

With the underground fire ring and standpipe systems installed, tested, and placed in service, EA concluded that the corrective actions for this finding were sufficient.

2014 Finding F-SRR-4: *S-Area pump performance is degraded in accordance with NFPA 25; impairment was not declared until December 2013, after significant degradation was apparent.*

The responsibility for addressing this finding was assigned to SRR, the contractor responsible for testing and maintaining the two S-Area fire pumps, which supply fire water to J-Area. The results of SRR's fire pump tests from 2010 to December 26, 2013 showed that the diesel-driven pump exceeded five percent degradation at rated and peak flows, which should have prompted SRR to declare the S-Area pumps impaired in 2012.

As a result of this finding, SRR retested both S-Area fire pumps (one electric driven and one diesel driven) in December 2014 to determine the extent to which the pumps were degraded. Results of the tests were considered unsatisfactory, and both pumps were subsequently overhauled and rebuilt. Afterward, the pump performance tests were repeated, as witnessed and validated by the pump vendor. Both pumps performed at or above 95 percent of the nameplate values; this performance is considered acceptable per NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*. SRR is considering replacing both fire pumps in fiscal year 2016 to ensure that they continue to perform in the acceptable range.

EA concluded that SRR's corrective actions for the previously degraded S-Area fire pumps were adequate.

2014 Finding F-SRR-5: *The compensatory measure cited in the S-Area pump impairment permits had not been demonstrated to provide adequate water flow and pressure to the warehouse as required by the warehouse hydraulic analysis and NFPA 25.*

As a result of the degraded condition of the S-Area fire pumps discussed above, SRR issued Impairment Permits 2013-606 and 2013-607 in December 2013. These impairment permits require that, in the event of a fire in S-Area or J-Area, post indicating valve (PIV) 40 is to be opened to allow the fire water supply from H-Area to support S-Area and J-Area fire water supplies. This finding was issued because SRR and Parsons had not conducted a flow test to verify adequate flow and pressure in order to demonstrate that the compensatory measure for the S-Area pump impairment was acceptable.

In response to this finding, in July 2014 SRR completed the flow test needed to verify the acceptability of the compensatory measure for the S-Area pump impairment using fire hydrants #4 and #20. These test results are documented in Table 6, *Hydrants 4 and 20 Flow Tests* (1200 gallons per minute at 133 pounds per square inch with the H-Area cross-tie PIV 40 open). These results were evaluated, along with calculations of the H-Area fire water supply, in Parsons Calculation No. F-CLC-S-00005.

EA reviewed the calculation and test reports, discussed the results with the DOE-SR and SWPF FPEs, and confirmed that the fire water supply flow and pressures meet or exceed the 763-S Warehouse highest sprinkler demand (1,200 gallons per minute at 101 pounds per square inch). Based on these results, EA concluded that SRR's corrective actions for this finding were satisfactory.

2014 Finding F-SWPF-6: *The flow test that supports the operational warehouse building hydraulic analysis has not been performed within the five-year time interval required by NFPA 25.*

The largest fire protection sprinkler system water volume demand for J-Area is the completed and operational J-Area Warehouse 763-S. Results of flow testing performed in 2008 near this warehouse are documented and analyzed in FHA-J-00002, *SWPF J-Area Warehouse Fire Hazards Analysis*. NFPA 25 requires flow testing to be performed every five years to determine the internal condition of the underground piping and to provide assurance that the minimum water flow and pressure can be achieved as established by the facility hydraulic analysis. As of January 2014, no flow test had been documented since 2008 to verify and demonstrate that the minimum water flow and pressure for fire suppression was available at the warehouse, thereby exceeding the five-year time interval specified by NFPA for performance of the flow test. Additionally, Parsons has not added all J-Area fire hydrants to the inspection, testing and maintenance (ITM) schedule (which uses the computer program MAXIMO) to ensure that the required five-year flow tests are performed. (**See OFI-SWPF-2015-2**.)

In response to this finding, Parsons initiated CR No. 2014-64 and arranged support from Tyco Simplex Grinnell to perform a five-year flow test of the underground distribution main. EA team members observed the test, including direct recordings of static and residual pressures at hydrant FH-4 and activities performed at the flow hydrant. After the test, Parsons provided EA with a copy of preventative maintenance work order number 21465, *5-Year Test of Fire Water Piping to FH-24*, and the Tyco Simplex Grinnell *Water Flow Test Report* dated July 22, 2015.

The EA team reviewed the report and performed independent calculations confirming that sufficient flows were generated. Additionally, EA noted only minimal differences in the 2015 flow and pressure values and the 2008 flow test results. While additional measures should be considered to prevent recurrence, EA concludes that Parsons' corrective actions to address this finding were satisfactory.

2014 Finding F-SWPF-7: *Contrary to the construction work package (Ref. WP-0579) the fire penetration program Inspection and Test Plan (ITP) is not consistent with applicable engineering specifications and manufacturer requirements.*

This finding concerned perceived discrepancies and inconsistencies between the engineering specifications and vendor requirements for the fire penetration seals, the directions in the Parsons construction work package (WP-0579) for installation of the fire penetration seals, and the inspection and acceptance criteria in the ITP.

In response to this finding, Parsons initiated CR No. 2014-65, consulted the PCI-Promatec vendor, and provided additional technical information on the fire penetration seals.

Parsons Construction issued CRFI 01575, dated September 11, 2013, regarding differences in the elastomer material density values listed in Paragraph 3.9.A.5 of Specification 07841: 150 pounds per cubic foot (pcf) nominal density versus the 147 pcf minimum density stated in the ITP for QC to use as acceptance criteria. Parsons Design Engineering responded to CRFI 01575 on October 31, 2013, stating that 150 pcf was a nominal value for the elastomer, and that it was appropriate for QC to use 147 pcf as the minimum acceptable density. Furthermore, during installation of the fire stop material, QC inspectors are required to sample each batch to ensure that the mixture meets the manufacturer's required minimum density of 147 pcf. The PCI-Promatec technical representative concurred with Parsons Design Engineering and indicated that the QC acceptance criteria were identical to the guidance and vendor information provided in their technical data sheets and in PCI-Promatec QCP-0052SW.

EA's follow-up included further review of Specification Section 07841, *Through-Penetration Firestop Systems*, Rev. 8; ITP-07841-0002, *Through-Penetration Firestop Systems (Inspection of PCI-Promatec SF 150-NH Penetration sealant in the CPA)*, Rev. 2; PCI-Promatec QCP-0052SW, Issue A; and PCI-Promatec product information letter from M. Jordan to W. Bryant, dated March 7, 2014. EA also conducted interviews with Parsons Engineering, the DOE-SR FPE, and the PCI-Promatec technical representative. EA concurs with Parsons and the PCI-Promatec technical representative and has determined that the discrepancies and inconsistencies between engineering specifications, vendor requirements, and the ITP for fire penetration seals have been clarified sufficiently. EA determined that Parsons' corrective actions have adequately addressed this finding.

However, Parsons did not include explicit directions in WP-0579 for the acceptable temperature range of the fire stop material and methods for maintaining these temperatures during the installation process. Although all SWPF personnel responsible for preparing and installing the fire penetration sealant have received PCI-Promatec classroom and hands-on training, written instructions or procedures with precautions for verifying temperatures will ensure a successful installation. (**See OFI-SWPF-2015-3**.)

2014 Finding F-SWPF-8: *The design and design analysis (Ref. CPA Fire Protection Plan at 124'-0", F-F2-0003, Rev E) for the operation of the deluge sprinkler system protecting the contactor cell does not consider the most demanding hydraulic scenario, nor does the design and installation account for the ceiling hoist system.*

The Contactor Cell is the only single room in the CPA that has multiple sprinkler systems. The standard design area used for the hydraulic analysis is 1500 square feet (SF). In the previous hydraulic analysis, that area had been located at one end of the cell.

In response to this finding, Parsons initiated CR No. 2014-66 and revised the design analysis in the CPA Fire Protection Plan. Parsons Engineering relocated the 1,500 square foot design area from the end of the cell to the center of the Contactor Cell and re-analyzed the hydraulics. Using the center of the cell creates the most hydraulically demanding scenario by taking into account the operation of both upper-level closed head sprinklers systems and the two open-head deluge systems.

EA reviewed the hydraulic analysis in the revised CPA Fire Protection Plan and found Parsons' methodology was acceptable. EA concludes that this finding has been satisfactorily addressed.

5.2.2 Walkthrough of SWPF Construction Areas for Fire Protection Follow-up

As part of this review, EA conducted a walkthrough of the SWPF construction project. During the walkthrough, EA identified the following additional fire protection deficiencies warranting management attention.

Automatic Sprinkler Systems

EA identified two concerns regarding the installed automatic sprinkler system. First, at least six automatic wet pipe sprinkler heads in the Facility Support Area Electrical Room were obstructed by adjacent angle-iron building supports. The location of the sprinklers in close proximity to the structural supports will negatively affect the discharge patterns. DOE Order 402.1B, Chapter II, Section 3.a (3) requires fire protection designs to meet or exceed applicable building codes and NFPA codes and standards. Furthermore, NFPA 13, *Standard for the Installation of Sprinkler Systems* (2010), Section 8.5, requires sprinklers to be positioned in accordance with minimum distances from continuous obstructions that are less than or equal to 18 inches below the sprinkler deflector so the obstructions do not prevent the

discharge pattern from fully developing. There has been no evaluation by a qualified FPE to ensure that the building supports will not affect the sprinkler discharge pattern.

The second concern involves the deluge valves that were installed to protect the Labyrinth rooms. All sprinklers installed in these systems are fusible bulb, closed head types, instead of open head types. NFPA 13, (2010), Section 3.4.4, states that deluge sprinkler systems consist of open sprinklers that are attached to a piping system such that water discharges from all sprinklers when the deluge valve opens. There has been no evaluation by a qualified FPE to ensure that the sprinklers installed in the deluge system comply with NFPA 13 requirements.

Control of Combustibles

The Parsons and DOE-SR FPEs accompanied EA during the SWPF construction project walkthrough. In several SWPF construction areas, EA identified transient combustibles, such as empty wooden packing crates, accumulated trash, and multiple piles of unused lumber and wooden scaffolding planks. SWPF project procedure PP-SH-4371, *Fire Protection*, Rev. 4, requires combustible waste materials to be collected daily in waste roll-off containers and disposed of properly. Additionally, NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations* (2009), Section 8.3, states that temporary storage of combustible construction or packing materials is not to be permitted in unprotected structures (i.e., those in which automatic fire suppression systems are not in service) under construction. At the time, none of the automatic fire suppression systems in the SWPF had been placed into service, so the building was unprotected and presented a considerable risk to DOE. Furthermore, the high bay Alpha Finishing Facility contains several multi-tiered scaffolds that are not constructed of noncombustible or approved fire-retardant lumber and planking as specified by NFPA 241 (2009), Section 8.2, A.8.2, and NFPA 5000, *Building Construction and Safety Code* (2009), Chapter 14. Multi-tier combustible scaffolding significantly increases the combustible fire loading within a facility, and because the scaffolds are constructed in vertical tiers and the building is unprotected, a fire could rapidly spread throughout this area.

Life Safety

During a walkthrough of the SWPF, EA observed several door openings in the outside wall of the building that were covered with plywood sheeting and/or blocked with lumber barricades, requiring workers to travel alternate paths and greater distances to exit the building in an emergency. A designated exit on the east side of the building was not clear and unobstructed during peak hours of occupancy of construction personnel. The EA team, the Parsons FPE and the DOE-SR FPE used this exit when leaving the building and noticed large wooden crates and construction supplies that obstructed the exit sign and formed a bottleneck in the egress path. Parsons took immediate actions to correct this issue.

EA also noted that building sprinkler systems were not in service. Sprinklers have been proven to save lives and increase chances for occupants to exit a burning building. NFPA 241 (2009), Section 7.8 requires the means of egress to be provided in accordance with Section 4.6.11 of NFPA 101, *Life Safety Code* (2009). NFPA 101, Section 4.6.11.2 requires adequate escape facilities, such as doors, walkways, stairs, ramps, and fire escapes to be maintained when any building is occupied, even during construction.

Fire Proofing

As part of the walkthrough of the SWPF construction area, EA examined the spray-on two-hour fire rated coating that had been applied to all walls, all structural steel, and all support members. Support members constructed of tubular steel have cutouts at each end where a steel bolt plate is welded on. Most of the bolt plates were not fully inserted into the cutout, leaving holes approximately one to two inches in

diameter in the tubular steel supports. The spray-on fire proofing applied to the tubular supports does not adequately cover these holes, exposing the interior of the tubular steel member to potentially high temperatures during a fire. Chapter 7 of NFPA 221, High Challenging Fire Walls, Fire Walls, and Fire Barrier Walls (2009) requires structural elements supporting fire barriers walls to have a fire resistance rating of not less than required for the fire barrier wall. (**See Finding F-SWPF-2015-2.**)

Fire Barrier Openings

Many door frames have been installed in openings that are credited fire barriers. NFPA 80, *Fire Doors and Other Opening Protectives* (2010), Section 6.3.1, states that only labeled door frames shall be used in fire barrier openings. Additionally, Section 4.2 requires listed items to be identified by a label that is applied in readily visible locations. The label or listing shall be considered evidence that the device or material has been evaluated by tests and that such devices or materials are produced under an in-plant, follow-up inspection program. EA noted at least six unlabeled door frames that were installed in openings that are credit fire barriers. Although Parsons produced a photo of a door frame containing an Underwriters Laboratory label after the walkthrough, this single photo is only limited evidence of code compliance.

6.0 FINDINGS

Findings are deficiencies that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. Findings define the specific nature of the deficiency and whether it is localized or indicative of a systemic problem, and identify which organization is responsible for corrective actions. Findings may identify aspects of a program that do not meet the intent of DOE policy or Federal regulation. DOE line management and/or contractor organizations must develop and implement corrective action plans for EA appraisal findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 227.1 to manage these corrective action plans and track them to completion. The Results section of this report also identifies deficiencies, including isolated non-compliances that did not meet the criteria for a finding. Site processes should be consulted in response to these deficiencies.

F-SWPF-2015-1: The required triennial self-assessments of the fire protection program for the completed, operational facilities at SWPF, such as the warehouse and administration building, are not being performed by or under the supervision of a FPE. (DOE Order 420.1B, Chapter II, Section 3.b (13), and the SWPF *Fire Protection Program Plan*, Rev. 1, Section 4.1)

F-SWPF-2015-2: Multiple tubular supports have spray-on fire proofing applied. Some of these supports contain holes that act as gaps in the fire proofing and invalidate the fire resistance rating. Without adequate closure for these holes, a fire could expose the interior of the tubular steel member to potentially high temperatures. (NFPA 221 (2009), Chapter 7)

7.0 OPPORTUNITIES FOR IMPROVEMENT

Opportunities for improvement are suggestions offered in Independent Oversight assessment reports that may assist cognizant managers in improving programs and operations. While they may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the review process. Opportunities for improvement are provided only as recommendations for line management consideration; they do not require formal resolution by

management through a corrective action process. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are suggestions offered by EA that may assist site management in implementing best practices or provide potential solutions to issues identified during the conduct of the review. In some cases, OFIs address areas where program or process improvements can be achieved through minimal effort.

OFI-SWPF-2015-1: Parsons should consider establishing a formal process for regular, periodic review and revision of the J Area Fire Pre-Incident Plan to ensure the plan accurately reflects the configuration of fire hydrants and fire department connections at SWPF as required by NFPA 1620, *Standard for Pre-Incident Planning* and SRS Manual 2Q2-4-J.

OFI-SWPF-2015-2: Parsons should consider including 5-year flow tests for all J-Area fire hydrants in the ITM schedule (using the computer program MAXIMO) to ensure required testing is performed in accordance with NFPA 25.

OFI-SWPF-2015-3: Parsons should consider revising the installation procedure for the PCI-Promatec fire stop material to include verification of the temperature requirements specified by the manufacturer before applying the sealant and during curing.

Appendix A
Supplemental Information

Dates of Review

Onsite Review: July 20-24, 2015

Office of Enterprise Assessments Management

Glenn S. Podonsky, Director, Office of Enterprise Assessments
William A. Eckroade, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environmental, Safety, and Health Assessments
William E. Miller, Director, Office of Nuclear Safety and Environmental Assessments
Patricia Williams, Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

Quality Review Board

William A. Eckroade
Karen L. Boardman
John S. Boulden III
Thomas R. Staker
William E. Miller
Patricia Williams
Gerald M. McAteer
Michael A. Kilpatrick

Office of Enterprise Assessments Site Lead for Savannah River Site

Jeff G. Snook

Office of Enterprise Assessments Team Composition

Rosemary B. Reeves, Lead
Joseph J. Lenahan
Barry L. Snook

Appendix B
Key Documents Reviewed, Interviews, and Observations

Key Documents Reviewed: Construction Quality

- S-SAR-J-00001, SWPF Preliminary Documented Safety Analysis, dated September, 30, 2008
- V-QP-J-00001, Rev. 5, SWPF Quality Assurance Plan, January 22, 2013
- PL-CS-7205, Rev. 0, Process Pipe Flush Plan, October 7, 2011
- DP-CS-7319, Rev. 5, Leak Test of Process Piping, October 6, 2014
- DP-CS-7321, Rev. 1, Flushing/Cleaning of Process Piping, October 6, 2014
- DP-CS-7322, Rev. 1, Foreign Material Exclusion, July 30, 2013
- DP-CS-7323, Rev. 1, Leak Testing and Flushing Prerequisites, March 8, 2013
- PP-QC-4802, Rev. 9, Quality Control Inspection, May 19, 2015
- PP-QA-4701, Rev. 7, Surveillance Program, July 2, 2015
- PP-QA-4703, Rev. 16, Nonconforming Items, January 22, 2015
- PP-QA-4711, Rev. 6, Control of Measuring and Test Equipment, June 30, 2015
- PP-AS-1203, Rev. 10, Corrective Action Program, October 29, 2014
- DI-CS-016, Rev. 0, Instrument Tubing Blowdown and Leak Test,
- DI-CS-019, Rev. 2, Sampling and Analysis Instrument for Piping Hydrostatic Test and Flush
- DI-CS-020, Rev. 0, Pneumatic Test Exclusion Area and Static Head Correction Factor Determination, February 20, 2013
- DI-QC-004, Rev. 1, Functional Check of Pressure Gauges, January, 24, 2013
- DI-CS-019, Rev. 2, Sampling and Analysis Instructions for Piping Hydrostatic Test and Flushing, February 13, 2013
- DI-QC-004, Rev. 1, Functional Check of Pressures Gauges, January 24, 2013
- ITP-15112-0001, Rev. 6, Section 15112, Pipe Leak Testing, (Process Piping), June 17, 2015
- ITP-15121-0002, Rev. 3, Section 15121, Field Inspection of Process Piping, March 28, 2013
- Specification Section 15112, Rev. 13, Pipe Leak Testing, December 19, 2014
- Specification Section 15121, Rev. 18, Field Installation of Process Piping, June 7, 2015
- Form SWPF-366, R1, Leak test Data Sheet, February 19, 2013
- Form SWPF-406, R0, Hydrostatic Inspection Report, Piping, June 18, 2010
- Form SWPF-569, R1, Pre-Test Hydrostatic Testing Checklist, March 18, 2013
- Construction Requests for Information initiated by the construction test group to clarify pressure test requirements: CRFI-1520, 1512, 1540, 1552, 1583, 1593, 1597, 1602, 1613, 1635, 1664, 1668, 1676, 1704, 1732, 1737, 1757, 1801, 1824, 1862, 1867, 1868, 1901, 1959,2012, 2022, 2044, 2056, 2071, 2090, 2115, 2159, 2165, 2185, 2215, 2226, and 2279
- WP-0876, Hydrostatic Testing and Flush of SS Air Purge Piping for Tanks in Dark Cells
- WP-0950, Hydrostatic Testing and Flush of PHWR Piping in Room R250, R216, R213, R214, and R215
- WP-0952, Perform Hydrostatic Test and Flush of AQU 0051, 6527, 6528 Connected Piping in Rooms R216, R138, and 138A
- WP-1055, Hydrostatic Testing of Piping from TK- 102 to P-102-1A/B/C
- WP-1056, Flushing of Piping from TK-102 to P-102-1A/B/C
- WP-1064, Hydrostatic Testing and Flush of Process cooling water return
- WP-1072, Leak Testing and Clean Flush of Aqueous Salt Solution and Slurry/Sludge Piping
- WP-1088, Hydrostatic Testing and Flush of Caustic Side Solvent Extraction Piping
- QA Surveillance Reports: SWPF-SR-3094, -3102, -3113, -3227, -3245, -3248, -3249, -3264, -3265, -3274,-3278, -3282, -3283, -3284, -3297, and -3300.

- SWPF-CR-2014-56, Condition Report: Grinding Material/Loose Debris Inside Pipe
- SWPF-CR-2014-67, Condition Report: Torque Wrench Function Checks
- SWPF-CR-2014-76, Condition Report: SWPF-SR-3094, General Surveillance URS Computed Radiography (CRT) Process, Observations and Recommendations
- SWPF-CR-2014-134, Condition Report: Inappropriate Rejection of ASME B16.34 Standard Class Casing Based on Radiographic Exams, NCR 1096
- SWPF-CR-2014-172, Condition Report: Backlog of Out of Tolerance Reports
- SWPF-CR-2015-1, Condition Report: Unapproved M&TE Form Used
- SWPF-CR-2015-18, Condition Report: Base Metal Repair
- SWPF-CR-2015-63, Condition Report: Consider revising the Pressure test and Cleaning and Flushing Test Procedures to Require the removal of Test Boundary Tags
- Non Conformance Reports initiated to document deficiencies with various valves: NCR-1006, -1025, -1096, -1104, -1187, -1204, -1228, -1249, -1250, -1266, -1276, -1289, -1293, -1310, and -1316
- Non Conformance Reports initiated to document construction deficiencies: NCR-1018, -1049, -1098, -1099,-1101, -1105, -1153, -1166, -1172, -1173, -1174, -1178, -1179, -1180, -1183, -1188, -1198, -1204, -1207, -1209, -1214, -1216, -1227, -1228, -1235, -1237, -1241, -1253, -1254, -1258, -1270, -1279, -1280, -1281, -1284,-1286, -1290, -1291, -1292, -1296, -1306, -1311, -1312, and -1315.
- Quality Control Inspection Reports: QCIR-25624, 25625, 27578, 27579, 30464, and 32178

Key Documents Reviewed: Fire Protection Program

- FHA-J-00002, SWPF J-Area Warehouse Fire Hazards Analysis, Rev 0
- V-ESR-J-00017, Fire Protection Water System Interface Control Document, Rev. 4
- F-F2-0003, CPA Fire Protection Plan at 124'-0", Rev E
- FA23, Fire Detection and Alarm System Process Area, Rev. 8
- F-PP-J-00001, SWPF Fire Protection Program Plan, Rev. 1, May 22, 2015
- PP-EN-5022, Salt Waste Processing Facility Project Procedures Manual
- PP-SH-4372, Control of Hot Work, Rev. 5, August 5, 2013
- PP-SH-4371, Fire Protection, Rev. 4, November 5, 2013
- Form SWPF-657, Fire Safety Checklist for Buildings Under Construction, Rev. 0
- Form SWPF-658, Fire Protection Building Assessment Checklist for Operational Buildings, Rev. 0
- LWDP-SUTP-DWPF-114, DWPF Fire Water Pumps Data Collection, Rev. 0, 6/23/2015
- Calculation Number F-CLC-S-00002, S-Area Fire Water Pump Flow Test Evaluation, Rev. 1, 7/15/2015
- Calculation Number F-CLC-S-00005, Evaluation of S-Area Hydrant Flow Testing Supplied by a H-Area Fire Water Pump, Rev. 0, August 28, 2014.
- Calculation Number C-CLC-J-00010, HVAC Duct Analysis at Firewall Penetrations, Rev. 0
- Calculation Number M-CLC-J-00096, Process Drain Line Sizing Calculation, Rev 1
- Preventive Maintenance Work Order #21465, 5-Year Test of Fire Water Piping to FH-24,
- Tyco SimplexGrinnell Water Flow Test Report, July 22, 2015
- Specification Section Number 07841, Through-Penetration Firestop Systems, Rev. 8, October 17, 2014
- ITP-07841-0002, Parsons Inspection and Test Plan, Rev. 2
- CRFI 01575, PCI Promatec SF150NH Final Acceptance Criteria/Repair Procedure/Minimum Density
- PCI-Promatec product information letter from Michael Jordan to William Bryant, dated 3/7/2014; and PCI Promatec QCP-0052SW, Issue A, October 01, 2010
- Spreadsheet attached to CR SPD-SWPF-0734 HS 45 Independent Oversight Review of the Savannah River Salt Waste Processing Facility Construction Quality and Fire Protection System – Actions Taken for Identified Finding and Opportunities for Improvement

- CR-2014-68, Condition Report: OFI-SWPF-2: Fire Protection Building Assessment Checklist Revision
- CR-2014-69, Condition Report: OFI-SWPF-3: Potential Revision of SWPF FHA (Ref. F-FHA-J-00001, Rev 1A2)
- CR-2014-70, Condition Report: OFI-SWPF-4: FHA Revision for Potentially Contaminated Discharge Water
- CR-2014-71, Condition Report: OFI-SWPF-5: Evaluate Fire Alarm Notification Devices
- CR-2014-72, Condition Report: OFI-SWPF-6: Evaluate Several Fire Isolation Valves
- CR-2014-73, Condition Report: OFI-SWPF-7: Evaluate Revision of FHA to Include Fire Related SS Controls
- CR-2014-74, Condition Report: OFI-SWPF-8: Evaluate Revision of FHA to Include Basis of Value and Need for Redundancy
- CR-2014-75, Condition Report: OFI-SWPF-9: Potentially Contaminated Water from Drain System Controlled Calculation
- CR-2014-61, Condition Report: F-SWPF-1: Fire Protection Documentation
- CR-2014-62, Condition Report: F-SWPF-2: The Fire Pre-Plan
- CR-2014-63, Condition Report: F-SWPF-3: Underground Fire Water ring Main and Standpipes
- CR-2014-64, Condition Report: F-SWPF-6: Warehouse Building Hydraulic Analysis Flow Test
- CR-2014-65, Condition Report: F-SWPF-7: Fire Prevention Program Inspection and Test Plan
- CR-2014-66, Condition Report: F-SWPF-8: Design and Design Analysis

DOE Documents Reviewed:

- SPD-SWPF-P-0022, SWPF Project Execution Plan, Rev 0, August 2014
- SPD-SWPF-P-0018, SWPF Certification and Verification Plan, Rev. 1, 5-14-2015
- SPD-SWPF-P-0023, SWPF Work Package Oversight Review Process, Rev. 1, 6-5-2015
- SPD-SWPF-0014, SWPF Integrated Project Team Charter, Rev. 7, 7-9-2014
- SPD-SWPF-002, Design Documentation Administration for the SWPF, Rev. 2, September 2012
- SWPF-09-DI-001, Desk Instruction SWPFPO Construction Oversight, Rev. 1, November 2009
- SWPF-15-DI-001, SWPF Construction Turnover to Testing and Commissioning Oversight, Rev. 0, April 2015
- SWPF-12-195-R1-DOE, SWPF Project, Engineering Personnel Qualifications, Rev 1, May 2013.
- SWPFPO Multi-Year Staffing Plan (Spreadsheet), July 2015

Interviews

- Parsons Director of Construction
- Parsons Director of Engineering
- Parsons Deputy Director of Engineering
- Parsons Construction Manager
- Parsons Construction Test Engineers
- Parsons Field Engineers
- Parsons QC Manager
- Parsons QC Inspectors
- Parsons QA Manager
- Parsons Fire Protection Coordinator
- Parsons Fire Protection Engineer
- SRR Fire Protection Engineers

- DOE-SR Fire Protection Engineering
- DOE SWPFPO Federal Project Director
- DOE SWPFPO Engineering Director
- DOE SWPFPO Engineering Design Authority Lead
- DOE SWPFPO Engineer, Mechanical
- DOE SWPFPO Engineer, Civil/SSO
- DOE SWPFPO Facility Representatives

Observations

- Hydrostatic test of various piping systems using work packages: WP 1064, WP 1066, and WP 1072.
- Cleaning and flushing of piping, Items 1, 5a, 21 and 43 in WP 1072.
- Drying of CSSX piping – Items 14 and 15 in WP 1088.
- Periodic flow test of underground fire protection water distribution main for SWPF area operating warehouse.
- Installed sprinklers in Facility Support Area electrical rooms and labyrinths.
- Control of combustibles in SWPF construction buildings.
- Life safety and provisions for fire escape exits.
- Adequacy of applied fire proofing materials on structural steel members.