Independent Oversight Review of the Savannah River Site Salt Waste Processing Facility Construction Quality and Fire Protection Systems

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Acronyms

AC	Alternating Current
ASME	American Society of Mechanical Engineers
ASP	Alpha Strike Process
CFR	Code of Federal Regulations
CPA	Central Process Area
CR	Condition Report
CRFI	Construction Request for Information
CRAD	Criteria, Review and Approach Document
Cs	Cesium
CSSX	Caustic-Side Solvent Extraction
DC	Dark Cells
DCR	Design Change Request
DOE	U.S. Department of Energy
DOE-SR	DOE-Savannah River Operations Office
DSA	Documented Safety Analysis
FHA	Fire Hazards Analysis
FPC	Fire Protection Coordinator
FPE	Fire Protection Engineer
gpm	Gallons per Minute
H	Hold Point
HEPA	High-Efficiency Particulate Absorption
HP	Horsepower
HSS	DOE Office of Health, Safety and Security
HVAC	Heating, Ventilation, and Air Conditioning
ITM	Inspection, Testing, and Maintenance
ITP	Inspection and Test Plan
lb/ft^3	Pound per Cubic Foot
M&TE	Measuring and Test Equipment
NCR	Nonconformance Report
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
OOT	Out of Tolerance
PC	Performance Category
PDSA	Preliminary Documented Safety Analysis
PIV	Post Indicating Valve
PM	Preventive Maintenance
psi	Pounds per Square Inch
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
QCIR	Quality Control Inspection Report
SAR	Safety Analysis Report
Sr	Strontium
SRS	Savannah River Site
SS	Safety Significant

SSC	System, Structure, or Component
SWPF	Salt Waste Processing Facility
SWPFPO	SWPF Project Office
V	Verification
W	Witness
WP	Work Package

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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 the construction quality and fire protection systems at the DOE Savannah River Site (SRS) Salt Waste Processing Facility (SWPF). The review was performed by the HSS Office of Safety and Emergency Management Evaluations and was carried out within the broader context of an ongoing program of assessments of construction quality at DOE major construction projects. These reviews are performed to ensure that design and construction of DOE facilities meet the requirements of Title 10 Code of Federal Regulations (CFR) 830 Subpart A, Quality Assurance Requirements, specifically the requirement to employ quality processes that include the planning and conduct of independent assessments to measure item and service quality, to measure the adequacy of work performance, and to promote improvement.

2.0 BACKGROUND

The overall mission of the SWPF is to separate and concentrate the radioactive cesium (Cs), strontium (Sr), 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 Sr, actinide, waste slurry, and Cs solution 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 grout vaults at the Saltstone Disposal Facility.

The SWPF is divided into four areas: the Central Process Area (CPA), the Cold Chemicals Area, the Facility Support Area, and the Alpha Finishing Facility. All radioactive materials are stored and processed in the CPA, which is a 136 foot wide by 235 foot long reinforced concrete structure supported on an 8 foot thick basemat. 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.

The CPA includes six rooms (room numbers R191 through R196) that contain processing and holding tanks. These rooms are designated as dark cells (DCs). The DCs are shielded rooms for which no maintenance or entry is planned for the 40-year design life of the plant. The DCs will be inaccessible after plant startup due to high radiation levels. There are some valves that are located in the DC areas, but the valve internals can be sleeved out and replaced from the operating decks. Any moving parts that are expected to fail can be replaced from outside without entry into the DC, and all welded construction is used for the piping and vessels in these areas. All piping and fittings installed in the DC areas are seamless stainless steel. There are other rooms that will be inaccessible during normal plant operation due to high radiation levels. These rooms include the North Alpha Strike Process (ASP) Labyrinth areas, Rooms 131A through 131F, and the South ASP Labyrinth areas, Rooms 136A through 136C. These other rooms will be accessible when the plant is periodically shut down for routine maintenance.

The SWPF is being designed and constructed by Parsons, which will also operate the facility for one year following construction completion. 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 quality assurance (QA) program. Construction work is currently approximately 70 percent complete, and work currently in progress includes installation of piping and pipe supports; instrumentation lines; the heating, ventilation, and air conditioning (HVAC) systems; electrical cable tray supports; the fire protection system; and electrical cables. 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 DOE Savannah River Operations Office (DOE-SR) staff in the Salt Waste Processing Facility Project Office (SWPFPO). Independent Oversight previously performed a construction quality review at SWPF in May 2012 that was documented in a report issued in September 2012.

3.0 SCOPE

The scope of this review encompassed various topics relating to pressure testing and flushing of piping systems, HVAC ductwork installation, preservation and protection of mechanical equipment, and review of work plan documents, inspection procedures, drawings, and specifications for installation of HVAC ductwork and mechanical equipment. The review team evaluated a sample of nonconformance reports (NCRs) identified by the contractor (Parsons) under its corrective action program. Surveillance activities performed by the Parsons QA staff were also reviewed. Design and procurement programs were not included in the scope of the construction quality review; however, some aspects of the design requirements for the fire protection program were reviewed. The SWPF fire hazards analysis (FHA) and technical baseline documentation for the fire protection system were also evaluated.

Independent Oversight reviewed various construction documents and conducted several construction site walkthroughs, concurrent with Parsons, DOE-SR, and SWPFPO staffs. During the walkthroughs, Independent Oversight observed a leak test performed on a section of HVAC ductwork and observed preservation maintenance activities performed on a pump. Independent Oversight reviewed the program for control of measuring and test equipment (M&TE) and reviewed drawings, specifications, and procedures that control installation of HVAC ductwork, mechanical equipment installation, and pressure testing and flushing of piping systems. Independent Oversight also reviewed various aspects of the fire protection program including installation of penetration seals, evaluation of the need for installing fire protection material on HVAC ducts, the adequacy of the fire protection program for construction operations, and implementation of compensatory measures necessary to account for degraded S-Area Fire Water Supply System fire water pumps that supply fire water to the SRS S- and J-Areas.

4.0 METHODOLOGY

This independent review of the construction quality processes and fire protection systems at SWPF was conducted in accordance with the Plan for the Independent Oversight Review of the Savannah River Site Salt Waste Processing Facility Construction Quality and Fire Protection Systems, dated January 2014. The review included inspection of documents (i.e., work instructions, procedures, specifications, drawings); interviews of key personnel responsible for performing construction and inspection work activities and for the fire protection program; and site walkdowns to examine the fire suppression safety systems and selected SWPF components and activities. The review considered the requirements of 10 CFR 830, Subpart A, *Quality Assurance Requirements*; DOE Order 414.1A, *Quality Assurance*; DOE Order 420.1B, *Facility Safety*; and National Fire Protection Association (NFPA) codes and standards. Title 10 CFR 830 and DOE Order 414.1C require the contractor to utilize appropriate national consensus

standards to implement DOE QA requirements. The PDSA references ASME NQA-1-2004, *Quality Assurance Requirements for Nuclear Facility Applications*, 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 number V-QP-J-0001, *Quality Assurance Plan*, describes in detail the application of the 18 NQA-1 requirements to the SWPF. The Quality Assurance Plan (QAP) establishes the planned and systemic actions necessary to provide adequate confidence that a system, structure, or component (SSC) will perform satisfactorily in service. The SWPF QAP incorporates the basic and amplified requirements of the supplemental criteria from NQA-1.

The review was focused on certain portions of the following criteria, review and approach documents (CRADs):

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

Supplemental information on the review, including the members of the Independent Oversight team, the Quality Review Board, and HSS management, is provided in Appendix A. A listing of key documents reviewed, interviews conducted, and evolutions observed are provided in Appendix B.

5.0 RESULTS

Activities examined by Independent Oversight during the review are discussed below. The inspection criteria are shown in italics, followed by Independent Oversight activities for the criteria. The inspection criteria are based on DOE orders, DOE standards, the SWPF contract, the SWPF PDSA, the QAP, and codes and standards referenced in SWPF design analyses and SRS operating requirements. Conclusions are summarized in Section 6, findings are described in Section 7, opportunities for improvement (OFIs) are listed in Section 8, and items for follow-up are discussed in Section 9.

5.1 Construction Quality Review

Pressure Testing and Flushing of Piping Systems

Criteria: Construction and pre-operational tests for piping systems, such as pressure testing and cleaning and flushing operations, shall be conducted in accordance with methods approved by the design organization. Test procedures shall include test requirements, acceptance criteria, test prerequisites, inspection hold points, and instructions for recording data. Testing shall be observed by qualified inspection personnel. Test results shall be recorded and evaluated by qualified personnel. (NQA-1, Criterion 11; Section 11 of the SWPF QAP; and DOE Order 414.1C)

Independent Oversight reviewed the program for pressure testing and flushing of piping systems. Specification section 15112, *Pipe Leak Testing*, defines the requirements for leak testing of piping in accordance with applicable codes specified in design documents. The specification covers both hydrostatic and pneumatic pressure testing, including test pressures, test sequencing, test hold times, and inspection requirements. Section 3.9 of Specification 15121, *Field Installation of Process Piping*, specifies the requirements for internal cleaning and flushing of piping including flushing methods, acceptance criteria, draining, and drying of the piping after flushing is completed. The SWPF site work process for conducting pipe leak testing and flushing is contained in the following procedures: DP-CS-7319, *Leak Test of Process Piping*; DP-CS-7321, *Flushing/Cleaning of Process Piping*; DP-CS-7322, *Foreign Material Exclusion*; and DP-CS-7323, *Leak Testing and Flushing Prerequisites.* 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 B31.1, Paragraph 345.5, for pneumatic testing. The scope of each pressure test is defined in a document called a work package (WP) that is prepared in accordance with Parsons Procedure PP-CS-7201, *Construction Work Release Procedure*. The WPs are prepared to subdivide work activities into a manageable quantity of work with easily defined boundaries. The WPs include pre-job briefing and safety requirements, prerequisites, work instructions, sequence of work activities and steps, including sign offs, inspection hold points, references to appropriate Inspection and Test Plans (ITPs), and applicable construction drawings and other documents necessary to perform the work. WPs are controlled in accordance with the document control requirements of the QA program.

Independent Oversight reviewed ITP-15112-0001, *Pipe Leak Testing*, which identifies the inspection attributes that are required to be completed by quality control (QC) inspectors and recorded in the pressure test WP. Hold (H), witness (W), and verification (V) points are listed in the ITP, along with corresponding acceptance criteria that QC inspectors are required to inspect and verify during the pressure test. The H, W, and V points are listed in the WP. The test may not proceed past an H, W, or V point until the QC inspector signs the WP step indicating that he/she completed the required inspection activity. A Quality Control Inspection Report (QCIR) is completed to document the inspection results, and the QCIR number is recorded in the WP.

Independent Oversight was not able to observe any piping pressure tests or pipe flushing operations during the onsite review period. Activities related to pressure testing and flushing during the review were limited to observing pre-test walkdowns being performed by Parsons engineers and QC inspectors. The purpose of a pre-test walkdown is to verify that piping scheduled to be pressure tested conforms to design requirements, sufficient pipe supports are installed to support the piping during the hydrostatic test, and that test boundaries have been established and identified in the field. Part of the test prerequisites include document reviews to verify all piping welds in the test boundary were examined and accepted by QC inspectors. Independent Oversight discussed the pre-test reviews and walkdowns with the pressure test engineers. During the walkdowns, discrepancies are recorded on a document called a punchlist. The items on the punchlist are closed, with the resolution for the discrepancies noted on the punchlist. Independent Oversight reviewed the punchlists prepared for three hydrostatic tests to determine the type of discrepancies being identified. Most of the discrepancies involved minor issues such as incorrect gaps between supports and piping, small deviations between the as-built elevation and design elevation of a section of piping, or missing gaskets in flanges that could be corrected by rework. Some discrepancies were corrected by design engineering with a design change notice that accepted the existing condition.

Independent Oversight reviewed the following completed WPs for three hydrostatic tests: WP-0771, WP-0917, and WP-0948. Documents reviewed included test data sheets that recorded test pressures, hold times, and the identification of pressure gauges used in the test, as well as calibration and calibration due dates; the completed step-by-step test instructions that contained the test sequence; test boundaries; system pressurization and de-pressurization; mandatory H, W, and V inspection points; identification of test personnel, test engineer, and QC inspectors; and references to corresponding QCIRs completed by the QC inspectors to document their inspections. No leaks were identified during the pressure tests.

Independent Oversight also reviewed the completed records for WP-0862 and WP-0948 for flushing of piping after completion of hydrostatic testing. Documents reviewed included the instructions for performing the flushing/cleaning operations, required flow rates, M&TE used during flushing, acceptance criteria, requirements for draining and drying the piping following completion of the flushing operations, and sealing the piping to maintain cleanliness and foreign material exclusion. The flushing/cleaning operations were witnessed by a QC inspector, who documented the inspection on a QCIR.

Independent Oversight reviewed QCIR numbers 22611, 22814, 25439, 25440, 25662, and 25663 that document the QC inspections performed for the piping system hydrostatic pressure test and flushing and cleaning evolutions for the WPs listed above. The inspection results were adequately documented.

HVAC Ductwork Installation and Testing

Criteria: *A program shall be established for control of purchased items and services, including subcontractors. Subcontractors are required to maintain and implement a QA program in accordance with NQA-1. (NQA-1, Criterion 7; Section 7 of the SWPF QAP; and DOE Order 414.1C)*

The requirements for design, installation, testing, and operation of the HVAC systems for the SWPF are specified in the PDSA, in various project construction specifications, and in the construction drawings. Parsons subcontracted the task for design, fabrication, installation, and testing the HVAC system for the SWPF to Intermech, Inc. An engineering firm retained by Intermech provided HVAC shop layout drawings, designed the HVAC seismic supports, and prepared the construction installation drawings and installation specifications for the HVAC system. Intermech prepares WPs in accordance with Parsons Procedure PP-CS-7201 for installation of the HVAC system. Construction craft employed by Intermech install the HVAC system, using Intermech installation procedures. Intermech is responsible for performing QC inspections of the work performed by its construction workers and for maintaining a QA program that complies with NQA-1 requirements. Intermech procures the materials used to fabricate and install the HVAC system, including the ductwork, supports, dampers, sheet metal, weld filler materials, and other components under its QA program. A member of the Parsons QA staff is assigned fulltime to perform QA surveillances to monitor and oversee work performed by Intermech. The QA surveillances of subcontractor work activities are performed in accordance with Parson Procedure DP-QA-4712, *Supplier Assessment Process for Surveillance Activities*. The results of the QA surveillances are discussed below in the section titled Quality Assurance Surveillance Activities.

Independent Oversight observed an HVAC duct leak test performed on a section of general service ductwork under WP 0795. The test method was specified in Intermech Procedure WIP-SWPF 11.50, *HVAC Duct and Housing Structural Capability and Leak Test*. Independent Oversight verified that the instruments used in the test had calibration stickers that identified the instruments and were current. The leak test met the test acceptance criteria. Independent Oversight examined the Intermech weld rod issue facility and storage of weld filler materials supplied by Intermech for HVAC work. The controls for storage and issue of weld rod filler material complied with the Parsons specification and the requirements of the American Welding Society specifications.

Independent Oversight reviewed documentation in completed WP-0648, *Installation of Stainless Steel HVAC HEPA [high-efficiency particulate absorption] Filter Staging Ductwork Located in R201*. The records included the work instructions that were signed by Intermech construction craft supervision indicating work was completed, installation drawings, welding records that document identification of welders, weld filler materials, and welding procedure specifications, as well as inspection records completed by Intermech QC inspectors. The records in the WP were complete and legible and adequately documented the completed work activities.

Independent Oversight also reviewed the Intermech corrective action program and a sample of Intermech NCRs. Intermech submits NCRs with a recommended disposition (use-as-is, rework, repair, or reject/scrap) to Parsons Engineering for review and approval as required by Parsons Procedure PP-PR-6201, *Supplier/Subcontractor Deviation, Information or Nonconformance Requests*. Independent Oversight reviewed Intermech NCR numbers NCR-SWPF-155 through -170 that were initiated by Intermech to document construction problems (i.e., missing parts, fabrication errors, and installation errors). The NCRs and recommended dispositions were submitted to Parsons Engineering as supplier

deviation requests in accordance with Procedure PP-PR-6201. Intermech does not proceed with any construction work to implement the corrective actions that it recommended as resolution to the NCRs until it receives approval from Parsons Engineering. Independent Oversight concluded, for the work activities reviewed, that Intermech was performing work in accordance with NQA-1 requirements. Parsons Oversight of Intermech is adequate.

Maintenance, Preservation, and Protection of Stored and Installed Equipment

Criteria: *Mechanical equipment that performs a safety function shall be sufficiently maintained before, during, and following installation to ensure it provides the necessary reliability and availability to perform its intended safety function, and to prevent damage, loss, or deterioration. Maintenance procedures shall incorporate specific information from mechanical equipment design drawings, procurement specifications, manufacturer's instructions, and other design basis documents, including applicable industry codes and standards. (NQA-1, Criterion 13; Section 13 of the SWPF QAP; DOE Order 414.1C and DOE Qrder433.1)*

Independent Oversight examined the storage, preservation, and maintenance of mechanical equipment, including a tour of Warehouse 763-S, accompanied by Parsons engineers, to observe storage conditions of safety-significant (SS) equipment and materials. This warehouse is a temperature-controlled facility (maintained between 40 to 140 degrees Fahrenheit) that meets the requirements for an NQA-1 classified Level B storage area. Parsons procedure numbers PP-CS-7204, *Field Material Control*, and DP-CS-7217, *Field Material Control Implementation*, define the methods used to receive, identify, and establish and maintain control of equipment and materials during storage. Handling of equipment and materials from the time of delivery to the warehouse until they are withdrawn for installation in the facility was discussed and demonstrated by warehouse personnel. Upon arrival at the warehouse, a Material Receiving Report is generated to document the arrival of equipment or materials. Warehouse personnel perform an inspection to determine the quantity and condition of the equipment and materials received. The results are documented on a field material control receiving checklist (Form SWPF-479). Equipment and material that require inspection by QC are placed in a "Hold Area" designated for interim storage of equipment or materials pending completion of QC inspection. Hold areas are identified and physically separated from other controlled storage areas. The QC inspections necessary to verify that the equipment and materials comply with the purchase specifications are performed in accordance with Parsons procedure number DP-QC-4803, *QC Material Receiving Inspection*. QC inspections are performed using criteria provided by Engineering in a receiving inspection criteria package, and the QC receiving inspection results are documented on a QC Materials Receiving Inspection Report (Form SWPF-200). After the receiving and QC inspections are completed, the equipment and materials are moved into a designated area in the warehouse, and identification and traceability of the materials are maintained. The requirements for storage are based on input from the design engineering organization and the manufacturer. Information specific to the materials and equipment, including the storage location, is maintained in the master procurement database and can be retrieved by warehouse personnel.

NCRs are initiated and hold tags are placed on equipment or materials that are damaged or fail to pass the QC receipt inspection. Nonconforming equipment and materials are placed in barricaded hold areas that are controlled to maintain segregation of nonconforming equipment and materials from conforming materials and equipment. The hold areas for nonconforming equipment and materials are separate from those for equipment and materials pending completion of QC inspection. Independent Oversight recorded a sample of NCR numbers from NCR tags attached to nonconforming equipment and materials to review the dispositions and corrective actions.

Parsons procedure PP-MN-8701, *Asset Preservation and Maintenance Process*, establishes a preventive maintenance (PM) program to prevent damage and degradation to equipment during storage or after

installation prior to commissioning. The PM program is conducted through the use of work orders that are based on the manufacturer's recommendations and input from Engineering. Independent Oversight examined shielded windows stored in their shipping crates in the warehouse and discussed the PM program for these components with Parsons engineers. Pending installation of the shielded windows into their permanent location in the CPA hot cells, the PM program requires verification that an argon gas blanket is maintained in the annulus between the inner and outer glass panels in the window modules. Independent Oversight reviewed Work Order 14487 that provides instructions for periodic inspections to verify that the argon gas blanket is maintained during storage in the warehouse.

Independent Oversight, accompanied by Parsons engineers, toured various areas of the SWPF to observe ongoing construction activities and measures being used for protection of stored or installed mechanical equipment. Overall, material condition of stored or installed equipment was good. Installed instrumentation was wrapped in protective covers, and instrument racks were protected with plastic and then covered with temporary plywood covers. Openings in pipes, pumps, tanks/vessels, and instrument lines were closed with caps or tape to maintain cleanliness and prevent internal contamination. Mechanical equipment, such as motors and pumps, was protected from construction activities. Drive shafts on pumps and motors were covered with metal shields. Motors were covered with an insulation blanket and wrapped with protective covers, with energized heat lamps and desiccants installed under the motor covers to prevent build-up of moisture, and with humidity-indicating devices to detect the presence of moisture. Independent Oversight examined the humidity-indicating devices on eight installed motors and observed no moisture was present.

Independent Oversight reviewed the PM program and witnessed a periodic inspection and maintenance evolution performed on an ITT Gould model LF 3196 i-Frame caustic transfer pump, equipment tag number P-302. A Baldor Reliance 30 horsepower (HP) motor that provides motive power to rotate the pump is part of the pump component assembly. Work Order 17164 is used to perform quarterly pump maintenance. The quarterly maintenance included a check of the plastic enclosure surrounding the pump and motor, verification that the heat lamp was operating, visual reading of the humidity indicator, visual check of the desiccant material, temperature reading of the motor enclosure, and manual rotation of the pump shaft for 15 and one quarter turns. Independent Oversight reviewed the recommendations for storage and maintenance for this centrifugal pump in the ITT Gould Pumps Installation, Operation, and Maintenance Manual for the Model LF 3196 i-Frame. For short terms (of less than six months), the manufacturer recommends storage in a covered and dry location free from dirt and vibrations. For longer-term storage, the manufacturer recommended the above conditions, along with keeping the pump free from heat and instructions to rotate the shaft by hand several times at least every three months. Independent Oversight also reviewed the Installation and Operating Manual for the Baldor Reliance 30 HP alternating current (AC) motor. The motor manufacturer recommends rotation of the motor shaft at least 15 times once every quarter. The recommendation of the motor manufacturer is the basis for the rotation of 15 turns specified in the work order. Appendix A of Procedure PP-MN-8701 provides additional PM recommendations for electric motors.

Independent Oversight determined that for the sample reviewed, material condition, preservation, and protection of stored and installed equipment were adequate.

Installation of Mechanical Equipment

Criteria: Mechanical equipment that performs a safety function shall be installed in accordance with approved procedures, design drawings, manufacturer's instructions, and other design basis documents, including applicable codes and standards. The procedures, instructions, and drawings shall include or reference appropriate quantitative or qualitative acceptance criteria for determining that prescribed results have been satisfactorily attained. (NQA-1, Criterion 5; Section 5 of the SWPF QAP; and DOE

Order 414.1C)

Independent Oversight reviewed the partially completed work package WP-0492, *Installation of Equipment in R131A/B/C/D/E/F North ASP Labyrinth #1/2/3/4/5/6, Installation of Pumps. Alignment and Pipe Stress*, for the work activities required to install various SS pumps in the CPA. The pumps included in the scope of work under WP-0492 have been placed on the pump foundations and are currently stored in place in the CPA. Discussions with the field engineer responsible for pump installation disclosed that the pumps have been moved into position on their pump bases in the CPA but have not been shimmed, aligned, or grouted. WP-0492 references Parsons Procedure DP-CS-7320, *Installation of Mechanical Equipment*, and includes instructions for pre-installation checks, locating, setting, leveling, and aligning of the pumps. Independent Oversight also reviewed ITP-11821-0001, *11821 Centrifugal Pumps*, and verified the required QC inspection attributes were included in WP-0492.

Independent Oversight selected pump P-102-1A, Filter Feed/Solids Transfer Pump, for a documentation review. This ITT Goulds centrifugal pump, model CV3196 i-Frame, has been placed on its base in R131D of the North ASP Labyrinth, but has not been shimmed, leveled, aligned, or grouted. Manufacturer's data and drawings for the pump and its corresponding 30 HP Baldor-Reliance motor are included in the WP. Independent Oversight verified that the manufacturer's recommendations for leveling the base plate by adding or removing shims and wedges, including required tolerances, were incorporated into the WP. Based on the sample reviewed, Independent Oversight concluded that the instructions for completion of the installation of the pumps were adequate.

Program for Control of M&TE

Criteria: M&TE used in the installation, inspection, and acceptance of work activities affecting quality shall be calibrated and controlled in accordance with approved standards and procedures that are traceable to approved National Standards. The program for control of M&TE shall include calibration procedures, handling and storage controls, status indication, corrective actions for lost, damaged, or out of calibration M&TE, and maintenance of calibration records. (NQA-1, Criterion 12; Section 12 of the SWPF QAP; and DOE Order 414.1C)

Independent Oversight reviewed the program for control of M&TE used for construction, inspection, and testing activities. Examples of M&TE include torque wrenches used for installation of concrete expansion anchors and tightening bolts on piping flanges, pressure gauges used in hydrostatic testing activities, and calipers used for aligning mechanical equipment. Independent Oversight reviewed Parson Procedure PP-QA-4711, *Controlling Measuring and Test Equipment*, which establishes the requirements for the calibration and control of M&TE used for inspection and acceptance of the work performed on the SWPF project.

Independent Oversight examined the M&TE facility where M&TE is stored and reviewed the controls for issuing and maintaining M&TE. The M&TE facility is maintained as a Level "B" storage area, with temperature controlled, as specified in NQA-1. The project QA manager assigns an M&TE coordinator who is responsible to maintain, control, and issue M&TE.

When M&TE is checked out, the date, user name, WP, and work scope where the M&TE is to be used are recorded. The M&TE user is responsible for verifying that the M&TE is appropriate for use on the planned work or test activity and for ensuring that the correct range, accuracy level, and instrument tolerance is selected for use in the work or test activity. The M&TE users maintain control of the M&TE issued to them; document the work performed with the M&TE in construction records; and report lost, damaged, or suspected performance issues to the M&TE coordinator. When M&TE is returned (checked-

in), the M&TE coordinator inspects the M&TE, records the return date, and verifies the systems/components tested are entered into the M&TE computer database.

Calibration of M&TE is performed at an offsite facility accredited by a nationally recognized accreditation service agency that is approved by the International Laboratory Accreditation Cooperation. M&TE is calibrated to National Institute of Standards and Technology (NIST) recognized standards. In some cases, equipment must be returned to the original equipment manufacturer for periodic calibration. An M&TE database is maintained that records the following information: equipment name, model number and serial number, range/size, acceptance tolerance/required accuracy, calibration interval, last calibration date, and calibration due date. Calibration intervals vary depending on the type of M&TE, but typically do not exceed one year. The M&TE coordinator showed examples of controls used to prevent M&TE that were approaching their calibration expiration dates from being used inadvertently to perform work after the calibration due date. M&TE with an upcoming calibration expiration date is taken out of service one to two weeks before the date, tagged and segregated from other M&TE, and prepared for shipment to the offsite calibration facility.

When M&TE is found to be inoperable, unreliable, defective, or out-of-tolerance (OOT), all usage of the OOT M&TE since the last time it was calibrated is identified and evaluated for any impact or consequences on completed work. The evaluation is documented in a record titled Out of Tolerance Evaluation Form that is forwarded to Engineering for concurrence. An NCR is initiated if the OOT evaluation indicated that work activities that were previously accepted were impacted. Independent Oversight reviewed a sample of ten OOT Evaluation Forms. The M&TE evaluated on eight of the evaluation forms had not been used to accept work either since its last calibration date or it was a new M&TE that was found OOT on its initial calibration. Two OOT evaluation forms were issued for M&TE that was found to be OOT and potentially impacted completed work (OOT 0010, for an electronic balance that was evaluated by SWPF NCR 0657, and OOT 0014 for three pressure gauges that were evaluated by SWPF NCR 0684).

Pressure gauges used for pressure testing of piping systems are checked to verify that they are functioning properly after each day's use. The requirements for the functional check are specified in Parsons Procedure DI-QC-004, *Functional Check of Pressures Gauges*. The M&TE coordinator performs a functional verification check for each pressure gauge when it is returned to the M&TE facility to verify that the pressure gauge is functioning properly. The functional check is documented in a log book and the M&TE database. Appendix A in Procedure DI-QC-004 contains the acceptance criteria for the pressure gauge functional checks. If the gauge is found to be OOT, the gauge is tagged as "out of tolerance" and placed in a hold area, pending repair, recalibration, or disposal. Any pressure test that was performed using a gauge that was found to be OOT is evaluated to determine if a retest is necessary. Since dual gauges are used when performing pressure tests, performance of a retest probably will not be necessary if the functional test on the other gauge used in the test determines that the second gauge is within tolerance. The daily functional check precludes using an OOT gauge on pressure tests for an extended period of time and reduces any rework necessitated by an OOT pressure gauge. Independent Oversight reviewed the records documenting the functional checks performed on four pressure gauges used on previously completed pressure test results, and verified that the functional checks were performed as required by DI-QC-004 and that the results showed the gauges were functioning properly.

Some equipment that is in use on the site is not classified as M&TE, but does have calibration requirements. This equipment is classified as "Calibrated Equipment" and is assigned to various individuals who are responsible to maintain the equipment and verify that the calibration of the equipment is maintained. An electronic balance scale is used to weigh samples of the silicon elastomeric fire resistant material used to seal penetrations in the CPA to verify that the materials meet the minimum density requirements. The scale is assigned to the QC inspector responsible for inspecting the fire

protection program. Independent Oversight reviewed the calibration data for the scale, identified as GP 01839, and verified that the calibration was current and traceable to NIST standards. A functional check is performed by the QC inspector using a calibrated test weight each day the scale is used. Independent Oversight performed a review of the M&TE database. Overall, control of the M&TE at the SWPF site is good. However, Independent Oversight noted that functional checks are not performed on torque wrenches during the interval between the annual calibrations performed at the offsite facility. Inexpensive equipment is available to perform periodic functional checks on torque wrenches to verify that the torque wrenches remain within an acceptable range between annual calibrations. If a torque wrench is found to be out of calibration during performance of the annual calibration review, a considerable number of completed work or inspection activities could be suspect, leading to an extensive amount of rework. Periodic functional checks had not been performed at weekly or monthly intervals to identify torque wrenches that were degraded to prevent the use of a potentially defective torque wrench on SS work in the interim between annual calibration checks. **(See OFI-SWPF-1.)**

Qualification of QC Inspection Personnel

Criteria: Inspection and Test personnel shall be qualified and certified in accordance with NQA-1 requirements and shall pass an annual eye and physical examination. Records for qualification of inspection and test personnel shall be maintained. (NQA-1, Criterion 2; Section 2 of the SWPF QAP; and DOE Order 414.1C)

The levels of qualification, duties, and responsibilities for QC inspection personnel are specified in ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*. Independent Oversight reviewed the Parsons QC inspector qualification/certification program, document number PL-QC-4800, and Procedure DP-QC-4801, *Quality Control Inspector Certification*, which implements the requirements at SWPF for education, training, experience, and certification of nondestructive evaluation personnel.

Independent Oversight reviewed the qualification and certification records of four QC inspectors who performed inspections of pressure testing and flushing activities on piping systems. Records reviewed included those documenting education, experience, training, written exam results, and annual vision acuity exams. Independent Oversight verified that the four QC inspectors were qualified and certified in accordance with Parsons QC Inspector Qualification Plan. Independent Oversight determined that for the sample reviewed, the Parson QC inspector certification and qualification program, including the implementing procedures, meets the requirements of NQA-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. (NQA-1, Criterion 16; Section 16 of the SWPF QAP; and DOE Order 414.1C)

Independent Oversight reviewed Procedures PP-AS-1203, *Corrective Action Program*, and Procedure PP-QA-4703, *Nonconforming Items*. Procedure PP-AS-1203 establishes and implements the SWPF corrective action program to correct and prevent recurrence of issues affecting quality, regulatory compliance, or personnel or operational safety. Condition reports (CRs) are used to document issues that affect or have the potential to affect safety or quality. Procedure PP-QA-4703 defines the requirements for identifying, documenting, evaluating, and correcting items that are identified as nonconforming with SWPF project requirements. NCRs are issued to document and disposition nonconforming hardware items or incorrectly performed work. The QC manager is responsible for reviewing and validating the

nonconforming condition. Examples of nonconformances 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.

Independent Oversight selected and reviewed approximately 40 closed NCRs and 40 other NCRs that were still open (NCRs that were issued by Parsons since August 2012 and pertain to piping and piping system components) to determine the types of nonconforming issues that were identified and subsequent mechanisms for resolution. The open NCRs included six that were attached to materials stored in Warehouse 763-S that require resolution before the materials can be released to construction. The nonconforming materials were segregated from conforming materials in the warehouse as required by NQA-1. Corrective actions generally involved rework and/or repair of the nonconforming items. Approximately half of the open NCRs were initiated for defects identified in valves; these NCRs pertaining to defective valves were reviewed during a QA surveillance documented in Surveillance Report Number SWPF-SR-2849, discussed below in the Quality Assurance Surveillance Activities section.

When appropriate, CRs were issued to address nonconforming items initially identified as NCRs. Independent Oversight determined that for the closed NCRs, the Parsons engineering organization developed appropriate corrective actions to disposition the identified problems. For the sample reviewed, implementation of the corrective action program was adequate to address and resolve construction quality deficiencies.

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. (NQA-1 Criterion 18; Section 18 of the SWPF QAP; and DOE Order 414.1C)

Independent Oversight reviewed QA surveillance activities. Surveillances are used to complement QA audits and are performed by QA personnel to evaluate onsite quality-related processes and worker safety activities. For specialized surveillances, subject matter experts are selected to perform surveillance activities. Independent Oversight reviewed Procedure PP-QA-4701, *Surveillance Program*, which controls the internal QA surveillance program. Procedure PP-QA-4712 controls surveillance activities of subcontractors.

Independent Oversight reviewed the computer database that records QA surveillance reports and randomly selected 17 surveillance reports related to work activities examined during the current construction quality review. These surveillances included:

- Surveillance report numbers SWPF-SR-2821, -2851, -3011, -3013, and -3027, for QA surveillance of the implementation of control of M&TE. Deficiencies were identified during two of the surveillances; the deficiencies concerned errors in the computer database and in the M&TE history file. The Parsons QA staff initiated three CRs (CR 2013-226, CR 2013-227, and CR 2014-002) to correct these administrative issues. The QA staff's overall conclusion regarding the five surveillances reviewed was that the M&TE controls at SWPF are being implemented in accordance with QA program requirements.

- Surveillance report numbers SWPF-SR-2819, -2953, -2957, -2968, -2994, -3009, -3024, and -3025, for QA surveillance of Intermech HVAC installation work activities. These surveillance reports summarize the daily oversight and reviews performed to observe Intermech construction activities at the SWPF site and at the Intermech offsite fabrication facility. No deficiencies were identified.
- Surveillance report number SWPF-SR-2927, a joint assessment of Intermech HVAC installation work activities by a DOE and a Parsons representative. This assessment included a review of closed HVAC fabrication WPs, inspection of HVAC material storage and housekeeping, and observation of controls to prevent cross contamination of stainless steel and carbon steel materials, including control of tools. The assessment participants concluded that Intermech was adequately meeting the requirements of the ASME NQA-1 program. One observation was noted that concerned difficulty in locating Material Test Reports in the computer database that are referenced in the WPs. The assessors were able to review the documentation they requested, but it was time consuming and inconvenient to locate some records.
- Surveillance report number SWPF-SR-2936, a QA surveillance to review and determine if the qualifications of Parsons test engineers were current and complied with the requirements of Parsons Procedure DP-CM-8200. The QA assessors who performed the surveillance determined that the qualifications of all Parsons test engineers currently assigned to SWPF were current and met the requirements of Procedure DP-CM-8200. Independent Oversight verified that the qualifications for two of the test engineers who supervised the hydrostatic tests performed under WP-0771, WP 0917, and 0948 were current.
- Surveillance report number SWPF-SR-3016, a QA surveillance of concrete expansion anchor installation work activities. No deficiencies were identified. The QA assessor observed that the concrete expansion anchors were installed in accordance with the manufacturer's recommendations and that a QC inspector performed all of the inspections required by ITP 05120, *Structural Steel* (anchorage for SS/PC-1, SS/PC-2, and General Service/PC-3 equipment).
- Surveillance report number SWPF-SR-2849, an analysis by QA of NCRs related to valves. This assessment was performed by a four-person team to review 517 NCRs issued between January 1, 2011, and April 15, 2013, and to determine the reason or reasons why a large number (25 percent of the 517) are related to valves. Types of problems include casting defects in the valve bodies, dimensional issues, and internal damage discovered when valves are disassembled for welding to pipe spools. The team concluded that the reason so many discrepancies were identified with valves is that a large number are purchased as off-the-shelf items and then subjected to rigorous inspections under the commercial grade dedication program.

The Parsons QA surveillances were found to be satisfactory. Review of the computer data listing the areas reviewed for completed QA surveillances shows that QA surveillances are performed to assess the full range on ongoing work activities. Based on the sample reviewed, Independent Oversight concluded that the Parsons QA surveillance program is acceptable.

5.2 Fire Protection Program

Fire Protection Program Documentation

Criteria: A documented fire safety program exists as required by applicable orders, standards, and the Parsons contract. (DOE Order 420.1B; DOE-STD-1066-99)

SWPF has developed and issued a Fire Protection Program Plan (F-PP-J-00001, rev. 0) that applies to all buildings associated with the SWPF and is intended to meet the objectives of DOE Order 420.1B, *Facility Safety*. The plan identified key responsibilities for implementation of the fire program for buildings

during construction and operations. Contrary to the plan, the implementation of many of these roles and responsibilities were observed to be inconsistent between the plan and other fire protection program procedures. For example, the Shift Operations Manager is not the person responsible for implementing the impairment program as described in the *Fire Protection Program Plan,* nor are Engineering, Procurement, and Construction 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* (ref. V-ESR-J-00017, rev. 4). The SWPF Fire Protection Procedure (ref. PP-SH-4371, rev. 4) identifies fire prevention policies and programs but was limited to construction activities and did not address buildings that were operational including the Administrative Building (Building 704-J) and the Warehouse Building (Building 763-S). Many other inconsistencies exist between the description of the program and the actual implementation of the SWPF fire prevention procedures. For example: (See **F-SWPF-1.)**

- The SWPF Fire Protection Program Plan requires periodic self-assessments to be performed by the Parson's fire protection engineer (FPE), but no assessments were available for review.
- The plan requires the Parsons fire protection coordinator (FPC) to attend the onsite Fire Safety Course as initial training. Independent Oversight reviewed training documentation and verified the FPC, who is designated with the primary responsibility, completed the training, but the person designated as the backup FPC has not completed the training.
- Neither the primary nor the backup FPC had obtained training on how to utilize the fire system impairment program referenced in the SWPF Fire Protection Plan. DOE O 420.1B requires a comprehensive program with formalized procedures for fire system impairments (DOE O 420.1B, Chapter II, Fire Protection, 3(b)(2)(f)).

Fire Pre-Plans

SWPF has established and maintained frequent contact with the SRS fire department during the construction period of the project. Pre-plans have been developed for SWPF that identify the key fire exposures, accessibility routes, and access to fixed fire suppression systems. Critical fixed fire suppression systems were not properly identified to ensure a timely and effective fire department response in the latest revision of the SWPF pre-plan (Ref. 221-000J Fire Control Pre-plan, dated December 31, 2013)**.** For example, fire hydrants #30 and #29 were not operational during the assessment, and neither of these hydrants was designated as "hydrant out of service" in accordance with the legend on the site pre-plan drawing. The fire department connections were not identified on the plan. Prompt identification by the fire department of these connections is necessary to pressurize the existing standpipe systems in the event of a fire. The SWPF FPE has responsibility for maintaining the pre-plan, as documented in the SWPF Fire Protection Program Plan. (See **F-SWPF -2.**)

Control of Combustibles

SWPF has established combustible control requirements, and routine assessments are being performed by the Parsons FPC. The SWPF Fire Protection Program Plan requires quarterly assessments to be completed, but the frequency has been increased to monthly, revealing an emphasis by the Parson's project team for controlling transient conditions and reducing exposures to fire conditions.

The Fire Protection Building Assessment Checklist (Ref. F-PP-00001, rev. 0) was observed being completed for Warehouse 763-S and SWPF. Many of the items included on the checklist are intended for assessing fire conditions for operational buildings, and, as a result, many of the items were routinely answered with a NA (not applicable) response. The checklist is not optimally effective and not fully aligned with the information towards either building under construction or operations (similar to the Fire

Protection Program Plan) since the attributes for each vary significantly. Currently, the same checklist is used for both the warehouse and SWPF. (See **OFI-SWPF-2.**)

Fire Prevention and Protection

Criteria: A complete spectrum of fire prevention controls and procedures are in existence and have been implemented as required by applicable fire safety criteria. (DOE Order 420.1B; Site & Facility PDSA)

Criteria: All fixed fire protection features (appropriate construction types, fire barriers, fire alarm and signaling systems, manual and automatic fire suppression systems, etc.), that are required by authorization basis documents and fire hazards analyses, have been installed and are tested and maintained, as required by applicable fire safety criteria. (DOE Order 420.1B; Site & Facility PDSA)

Criteria: A process exists to assure that all fire prevention and protection features are reviewed and approved by a qualified fire protection engineer. (DOE Order 420.1B)

Water Supply

Independent Oversight reviewed the fire protection water supply for the SWPF facility located in J-Area. Water is supplied to SWPF for manual fire-fighting operations, as well as the automatic Fire Protection System inside J-Area, by three connections to the existing underground S-Area Fire Protection Water Supply System. Two eight-inch fire water supply lines are extended from the existing system to eventually form a loop around the entire SWPF site. The eight-inch loop will supply J-Area fire hydrants and water needs. An eight-inch branch off the S-Area system supplies the 763-S Warehouse that is currently operational. At the time of this assessment, the SWPF project construction was approximately 70 percent complete; however, the last remaining tie-in to the underground fire loop around the site has not been completed. As a result, portions of the loop that provide fire water to the SWPF project are not operational and are not available for use by the fire department. This lack of intended fire water is contrary to the requirements delineated in NFPA 241, *Safeguarding Construction, Alteration, and Demolition Operations*, Section 8.7, which requires underground water mains and hydrants be installed, completed, and in service prior to construction work. Furthermore, installed standpipes are not complete and operational. The lack of operational standpipes is contrary to NFPA 241, Section 7.6, which requires that, where standpipes are required in new buildings or where standpipes exist, standpipes be maintained in conformity with the progress of building construction in such a manner that they are always ready for use. Only two of the four standpipes have been tested, and none of the standpipes have been flow tested as required by NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*. Additionally, these preliminary tests were not identified in the specification requirements for fire water systems. (See **F-SWPF-3.**)

The J-Area water supply is provided by two fire water pumps, one electric and one diesel driven, both rated at 2,000 gallons per minute (gpm) at 120 pounds per square inch (psi); these pumps automatically start based on low water pressure sensed in the grid. The pumps take suction from a tank, reserving 240,000 gallons for fire protection. Independent Oversight reviewed the results of pump testing that is required to be performed annually by NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems*. Test reports, dating from 2010 through the most current annual test, completed on December 26, 2013 were reviewed for compliance to NFPA 25, which specifies that an annual test of each pump assembly shall be conducted under minimum, rated, and peak flows of the fire pump. The purpose of the test is to demonstrate that there exists no less than 95 percent of the pressure at rated flow and rated speed of the initial unadjusted field acceptance test curve. Degradation in excess of five percent of the pressure of the initial unadjusted acceptance test curve or nameplate requires an investigation to reveal the cause of degraded performance. Review of annual test documentation revealed

that the diesel-driven pump exceeded five percent degradation at rated and peak flows in 2010; in 2011, questionable data was obtained that showed that the same pump developed higher discharge pressure at rated flow than the original installation baseline acceptance curve. The 2012 annual test data show significantly greater than five percent degradation at rated and peak flows. Contrary to the requirements of NFPA 25, no known investigation of this degraded condition was performed and no impairment was declared by SRR with appropriate notifications to facilities served by the pumps. This condition however was cited in the SWPF draft FHA. Impairment Permits 2013-606 and 2013-607 were issued in December 2013 regarding the degraded condition of the pumps. (See **F-SRR-4**) The issued impairment permits require that, in the event of a fire in S-Area or J-Area, the cross connect valve (post indicating valve, or PIV, 40) be opened to allow fire water supply from H-Area. This cited compensatory measure has not been demonstrated to provide adequate water pressure and flow to warehouse building 763-S as determined by the warehouse hydraulic analysis. Opening the referenced cross-tie PIV from H-Area has not been demonstrated by a flow test to support the required S-Area warehouse water demand. A flow test is required with a lineup that opens the PIV cross-tie and secures the S-Area pumps to determine acceptability. (See **F-SRR-5.**)

The largest fire protection sprinkler system water volume demand for J-Area is the completed and operational J-Area Warehouse 763-S, which has a water volume demand of 1,200 gpm at 101 psi for the sprinklers and an additional 500 gpm for a hose stream allowance, a total requirement of 1,700 gpm at 101 psi. This flow and pressure demand was derived by hydraulic analysis and was supported by flow testing performed in 2008 near the J-Area Warehouse. Flow testing is required 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. In 2008, the flow test indicated that the available water supply had a static pressure of 150 psi with pumps operating and a flow and residual pressure of 1,286 gpm at 130 psi. These results are documented and analyzed in the J-Area Warehouse FHA, FHA-J-00002, *SWPF J-Area Warehouse Fire Hazards Analysis.* The documented flow test that supports the operational warehouse hydraulic analysis has not been performed within the NFPA-required five-year time interval. The need for a flow test is of special importance due to the degraded S-Area pumps. Based on the current condition of the S-Area pumps, it is questionable whether sufficient pressure and flow is available to support the warehouse with the highest sprinkler system water volume demand. (See **F-SWPF-6.**)

Engineered Design Features

Independent Oversight reviewed attributes of the fire protection engineered design features and evaluated the effectiveness and compliance of the fire protection design SSCs to requirements established in the facility safety basis and FHAs, as well as recognized standards and good engineering fundamentals and practice. Although the design attributes of the fire protection program are generally comprehensive and robust, Independent Oversight observed some areas that were not consistent with project criteria, NFPA, and recognized industry standards as noted below:

1. **Passive Fire Barriers – Penetration Seal Program:** Independent Oversight observed that implementation of the fire penetration program, including the installation of penetration seals for SS barriers, was not in compliance with engineering specifications and vendors requirements. The ITP and associated WP (Ref. WP-0579) had not been updated to ensure applicable engineering specifications and manufacturer recommendations were being met. Independent Oversight reviewed several CRFIs (Construction Requests for Information) that had been issued by construction requesting guidance from Engineering. For example, a CRFI was issued (Ref. CRFI, No 01575) on September 11, 2013, requesting clarification for basic information including minimum depth of installation for pen seals, final acceptance attributes, proper repair procedure, and minimum density requirements for samples. These fundamental questions revealed that there was inadequate guidance

for the QC inspectors to adequately perform their work and to provide consistent guidance to the construction craft who were responsible for installation. Engineering response to this CRFI indicated that the ITP would be revised by November 15, 2013; however, the ITP had not been revised as of the time of this assessment. A similar engineering response to a CRFI (Ref. CRFI No 01269) noted that the ITP (ref. ITP-07841-0002, Rev 1) would be revised to address allowable gaps and acceptance criteria. The CRFI was issued February 13, 2013. This represents another example of discrepancies being identified and the ITP not being revised. Other examples of inconsistencies noted within the ITP and Parson's engineering specification (Ref. Through-Penetration Firestop Systems, rev 5) include: (See **F-SWPF-7.**)

a. The Parson's engineering specification indicates a minimum criterion for density after curing of 150 pounds per cubic foot (lbs/ft^3), while the ITP indicates a value of 147 lbs/ft^3.

b. The manufacturer of the penetration seal product, PCI-Promatec, noted in its product data information key attributes for installation. One of these attributes includes the temperature range for this material to be 50 to 90 degrees Fahrenheit. Interviews with the QC inspectors revealed that specific actions including installing portable blowers were taken to modify the temperature of the product during installation; however, no formal documentation or guidance is included in the WP for the installers to address this attribute of the product. Additional manufacturer guidance (vendor information letter from Promotec, Michael Jordan to William Bryant, dated 3/7/2014) was provided. The letter emphasized that the ideal temperature for installation is around 70 degrees Fahrenheit and that the pot life and curing times for SF-150NH are influenced by their temperature and or the ambient temperature of the air, substrate, and penetrants. This information was not included in any of the installation procedures or quality documentation.

2. **Contactor Cell:** The current analysis and associated design (Ref. CPA Fire Protection Plan at 124'-0", F-F2-0003, rev E) for the contactor cell limits the operation of the two closed head sprinkler systems to activate based on a fire occurring on one side of the contactor cell. This analysis may not represent the most hydraulic demanding scenario, since there is no physical separation between the two systems. The most demanding hydraulic scenario appears to involve the actuation of both closed head sprinkler systems initiated by a fire in the center of the contactor cell, thereby initiating the two open head deluge sprinkler systems currently designed to protect the area below the contactor deck. This configuration of all four fire suppression systems operating at one time is currently unanalyzed and may result in the highest sprinkler demand for the entire building, while also affecting the current analysis for credited containment volume required for sprinkler discharge water. The latest revision of the deluge system design was issued November 4, 2013. The Independent Oversight team requested the latest design drawings and received the engineering documents on January 9, 2014. The design that was forwarded to the assessment team indicated a design involving two separate deluge systems. The system design drawings did not account for the ceiling hoist system and indicated sprinkler branch mains crossing the width of the cell. The recently issued FHA also evaluated this design as two deluge sprinkler systems dividing the contactor cell into an east and west system. (See **F-SWPF-8.**)

3. **Analysis of Duct Wrap Installations:** Analysis of Duct Wrap Installations: The SWPF FHA (Ref. F-FHA-J-00001, rev. 1A2) notes that "hangers and supports that support wrapped ductwork will be wrapped." The FHA should ensure adequate analysis has been documented for all duct wrap installations, based on the requirements of NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids and NFPA 90A Standard for the Installation of Air-conditioning and Ventilating Systems. The manufacturer of Pyroscat fire resistant duct wrap (Pyroscat Duct Wrap XL, Datasheet Code: 7-14-237) is listed for one and two

hour fire resistive enclosure protection. Utilizing this duct wrap for supports and hangers within SWPF should be evaluated as part of a complete listed fire assembly and installation. An evaluation supported by appropriate documentation should be prepared by Parsons to adequately describe these duct wrap installations in the context of requirements as established in applicable NFPA codes and standards. (See **OFI-SWPF-3.**)

4. **Drainage and Containment of Potentially Contaminated Water:** The adequacy of drainage and containment of potentially contaminated water discharge from sprinkler systems at the CPA has not been analytically validated for all areas of the building. Adequacy of drainage and containment is required for the largest credible volume as determined by the FHA and NFPA 801, Section 5.10. Refer to further discussion in the FHA/Documented Safety Analysis (DSA) Integration section. (See **OFI-SWPF-4.**)

5. **Fire Alarm Notification Device Locations:** The adequacy of fire alarm notification devices located in the contactor cell and shown on the fire alarm drawing (Ref. Fire Detection and Alarm System Process Area, Drawing FA23, rev. 8) that are not designed for use in radiation areas have not been fully evaluated. Neither the specification, *Fire Alarm and Detection System Specification*, (Ref. No. 747904), nor the current design address this concern. The neoprene gaskets for these mounting devices do not provide an adequate seal to prevent contamination from leaching through installed conduit to adjacent clean areas. (See **OFI-SWPF-5.**)

6. **Fire Protection Isolation Valve Configuration:** Several fire isolation valves were observed to be installed with the stem upright (requiring use of a portable ladder to reach in the overhead). These sprinkler control and isolation valves are not installed in a manner that allows ready access in the event of an emergency. (See **OFI-SWPF-6.**)

Inspection, Testing, and Maintenance

Criteria: Surveillance and testing of the system demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria.

Criteria: Surveillance and test procedures confirm that key operating parameters for the overall system and its major components remain within safety basis, NFPA, and applicable consensus standards operating limits.

Independent Oversight reviewed inspection, testing, and maintenance (ITM) records and documentation for the J-Area Warehouse Building 763-S and the Administration Building 704-J. Review of ITM was confined to only these buildings since these buildings are complete and operational, whereas the Process Building is not operational and still under construction.

ITM of the fire suppression system generally demonstrates that the system is capable of accomplishing its functional requirements and continues to meet applicable system performance criteria. All ITM procedures confirm that key operating parameters for the overall fire suppression system and the fire alarm system (and their major components) remain within NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*; NFPA 72, *National Fire Alarm Code*; and other applicable NFPA standards and codes. However, Independent Oversight noted one exception to ITM requirements regarding the flow test that supports the warehouse sprinkler system operating capability not being performed within the NFPA-required frequency of five years. Further discussion may be found in the section of this report called Water Supply.

FHA/DSA Integration

Criteria: Within the scope of the review, the FHA conclusions shall be incorporated into the safety authorization (preliminary safety design review, preliminary DSA, or DSA, as appropriate) and demonstrate the adequacy of controls provided by the system to eliminate, limit, or mitigate identified hazards, and define the process for maintaining the controls and controlling their use.

Criteria: The safety authorization basis is consistent with the fire hazards analysis; demonstrates the adequacy of controls provided by the system to eliminate, limit, or mitigate identified hazards; and defines the processes for maintaining the controls current at all times and controlling their use.

In accordance with DOE Order 420.1B, the conclusions of the FHA are to be incorporated in the DSA for Category 1, 2, or 3 nuclear facilities to provide consistency between fire accidents analyzed in the DSA and the actual fire hazards analyzed in the facility. Pursuant to this requirement, Independent Oversight identified areas that were not sufficiently addressed, namely:

1. The FHA does not identify or evaluate the fire-related SS controls identified in the Draft Safety Analysis Report (SAR) Table 5.8-1, Summary of Technical Safety Requirements including Combustibility Controls, Flammability Controls and Ignition Source Controls. The FHA Guideline (*Ref. Implementation Guide for DOE Fire Protection and Emergency Services Programs, DOE Guide 420.1-3)* considers this to be an important element of an acceptable FHA. (See **OFI-SWPF-7.**)

2. The north ASP pump and valve operating area and the south caustic-side solvent extraction (CSSX) pump and valve operating areas (Fire Area 2) are evaluated in the FHA as exceeding the 50 million dollar value criteria as listed in DOE Order 420.1B and would then be required to have redundant fire protection systems. The FHA does not include the basis for the valuation of the listed areas (54 million) and the need for redundant fire protection systems. This detail was not identified in the FHA as an open item. (**OFI-SWPF-8**)

3. Drainage and containment of potentially contaminated fire water should be discussed and analyzed more thoroughly in the FHA. Drainage and containment of potentially contaminated water should be discussed in the PDSA. The calculation (M-CLC-J-00096, Process Drain Line Sizing Calculation) evaluates adequacy of the drain system from the North ASP Pump and Valve Gallery Labyrinths and the CSSX Pump and Valve Labyrinths. This calculation confirms adequacy of drainage to the sump from this area. However, no analytical basis is provided that supports confirmation of drainage capability from other building areas. The 2008 design change request (DCR) 0233 was implemented to provide the means to prevent the accidental release of contaminated fire suppression system water to the environment. An information-only calculation that determined required drain piping sizing was made part of the DCR. The drainage system sizing was based on three activated heads discharging 55 gpm for 30 minutes in design areas. Since implementation, sprinkler head types have been changed that will require reevaluation and discussion in the FHA, due to differences in discharge flow rates. A controlled calculation, similar to calculation M-CLC-J-00096, has not been performed and documented to determine the adequacy of the drain system to contain potentially contaminated water from all process building areas. Additionally, no calculation or evaluation was performed for containment and removal of contaminated water from the water spray system to the HEPA filter plenum. The FHA does not adequately discuss this issue. (See **OFI-SWPF-9.**)

6.0 CONCLUSIONS

Independent Oversight determined that construction quality at SWPF was adequate in the areas reviewed. Parsons has developed appropriate corrective actions to disposition the closed NCRs that Independent Oversight reviewed. Review of the test results and procedures for pressure testing and flushing of piping systems showed this work was adequate. Control of M&TE meets the requirements of ASME NQA-1. Parsons oversight of the subcontractor installing the HVAC system to verify the subcontractor is performing work in accordance with the contract specifications and ASME NQA-1 is adequate. The Parsons QA surveillance program is adequate. Material condition, preservation, and protection of stored and installed equipment was adequate.

Regarding the adequacy of the fire protection program at SWPF, the results were mixed. On the positive side, most of the fire protection objectives of Department of Energy (DOE) Order 420.1B, Facility Safety, were met; in most cases an adequate design strategy was implemented to reduce fire risk; and deviations from established fire protection design criteria were supported by approved equivalencies.

However, there were several significant examples where fire system design and fire protection program requirements were deficient. One of the most significant weaknesses is with the required fixed water supply system necessary to support emergency services response during the construction phase of the project. The underground fire water supply system was not adequately installed or integrated with the standpipe system and this condition could have compromised the SRS Fire Department's ability to protect the facility's occupants and physical assets in the event of a fire. Other weaknesses included fire system design analyses and documentation that was incomplete for some duct fire dampers, containment for potentially contaminated fire water, and the contactor cell sprinkler system; lack of coordination between engineering and construction with the passive fire barrier program; a potentially inadequate S-Area fire water supply; deficient hydrant flow testing at the warehouse; and inadequately defined and implemented roles and responsibilities for the SWPF fire protection program.

Senior SWPF project management attention will be required to address the identified deficiencies and ensure implementation of an adequate fire protection program and compliant fire system designs.

7.0 FINDINGS

This Independent Oversight review identified eight findings which are summarized below. Findings indicate significant deficiencies or safety issues 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 may identify aspects of a program that do not meet the intent of DOE policy or Federal regulation.

F-SWPF-1: Key responsibilities for the SWPF Fire Protection Program were not consistent between the Fire Program Plan (ref. F-PP-J-00001, rev 0) and other fire prevention administrative procedures.

F-SWPF-2: The Fire Pre-Plan has not been 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.

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.

F-SRR-4: S-Area pump performance is degraded in accordance with NFPA 25; impairment was not declared until December 2013.

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

F-SWPF-6: The flow test that supports the operational warehouse building hydraulic analysis has not been performed within the NFPA 25 required 5 year time interval.

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.

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.

8.0 OPPORTUNITIES FOR IMPROVEMENT

This Independent Oversight review identified nine OFIs. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are suggestions offered by the Independent Oversight review team that may assist site management in implementing best practices, or provide potential solutions to minor issues identified during the conduct of the review. In some cases, OFIs address areas where program or process improvements can be achieved through minimal effort. It is anticipated that these OFIs will be evaluated by the responsible line management organizations and either accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

OFI-SWPF-1: SWPF should consider procuring inexpensive equipment to perform periodic functional checks on torque wrenches to verify the torque wrenches remain within an acceptable range between annual calibrations.

OFI-SWPF-2: SWPF should consider revising the Fire Protection Building Assessment Checklist to make it more effective, aligning the information towards either buildings under construction or operations (similar to the Fire Protection plan), since the attributes for each type of building vary significantly. Currently, the same checklist is used for both the warehouse and SWPF.

OFI-SWPF-3: SWPF should consider revision of the SWPF FHA (Ref. F-FHA-J-00001, rev. 1A2) to adequately address the engineering analysis for duct wrap installations supporting a listed assembly in accordance with NFPA 90A and 91.

OFI-SWPF-4: SWPF should consider revision of the FHA because the adequacy of drainage and containment of potentially contaminated water discharge from sprinkler systems at the Process Building has not been analytically validated for all areas of the building.

OFI-SWPF-5: SWPF should evaluate the fire alarm notification devices, located in the contactor cell and shown on the fire alarm drawing (Ref. Fire Detection and Alarm System Process Area, Drawing FA23, rev. 8), that are not designed for use in radiation areas.

OFI-SWPF-6: SWPF should evaluate several fire isolation valves that were observed to be installed with the stem upright (requiring use of a portable ladder to reach in the overhead).

OFI-SWPF-7: SWPF should consider revision of the FHA as it does not identify or evaluate the fire-related SS controls identified in the Draft SAR Table 5.8-1, Summary of Technical Safety Requirements including Combustibility Controls, Flammability Controls and Ignition Source Controls.

OFI-SWPF-8: SWPF should evaluate and revise the FHA to include the basis for the valuation of the listed areas (54 million) and the need for redundant fire protection systems.

OFI-SWPF-9: SWPF should consider performance and documentation of a controlled calculation similar to calculation M-CLC-J-00096 to determine the adequacy of the drain system to contain potentially contaminated water from all Process Building areas.

9.0 ITEMS FOR FOLLOW-UP

Independent Oversight will continue to follow up on the pressure testing of piping, mechanical equipment installation in SS systems, testing and installation of HVAC systems, and the installation and maintenance of fire protection systems.

Appendix A
Supplemental Information

Dates of Review

Onsite Review: January 7-16, 2014

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 P. Staker, Deputy Director for Oversight
William E. Miller, Deputy Director, Office of Safety and Emergency Management Evaluations

Quality Review Board

William A. Eckroade
John S. Boulden III
Thomas R. Staker
William E. Miller
Michael A. Kilpatrick

Independent Oversight Site Lead for Savannah River Site

Phillip D. Aiken

Independent Oversight Team Composition

Phillip D. Aiken, Lead
Joseph J. Lenahan
Rosemary B. Reeves
Jeffrey L. Robinson
Joseph J. Panchison

Appendix B
Key Documents Reviewed, Interviews, and Observations

Key Documents Reviewed:

- Procedure DP-CS-7317, Rev. 0, Field Material Control Implementation, April 17, 2012
- Procedure DP-CS-7319, Rev. 4, Leak Test of Process Piping, July 15, 2013
- Procedure DP-CS-7320, Rev. 0, Installation of Mechanical Equipment, May 11, 2011
- Procedure DP-CS-7321, Rev. 0, Flushing/Cleaning of Process Piping, August 13, 2013
- Procedure DP-CS-7322, Rev. 1, Foreign Material Exclusion, July 30, 2013
- Procedure DP-CS-7323, Rev. 1, Leak Testing and Flushing Prerequisites, March 12, 2013
- Procedure DP-QC-4801, Rev. 2, Quality Control Inspector Certification, March 18, 2011
- Procedure DP-QC-4803, Rev. 2, QC Material Receiving Inspection, March 28, 2013
- Procedure PP-MN-8701, Rev. 3, Asset Preservation and Maintenance Process, October 17, 2013
- Procedure PP-CS-7201, Rev. 13, Construction Work Release Procedure, June 17, 2013
- Procedure PP-CS-7204, Rev. 7, Field Material Control, October 22, 2013
- Procedure PP-QC-4802, Rev. 6, Quality Control Inspection, September 19, 2013
- Procedure PP-QA-4701, Rev. 5, Surveillance Program, February 22, 2010
- Procedure PP-QA-4703, Rev. 13, Nonconforming Items, November 5, 2013
- Procedure PP-QA-4711, Rev. 4, Control of Measuring and Test Equipment, October 2, 2013
- Procedure DP-QA-4712, Rev. 2, Supplier Assessment Process for Surveillance Activities, July 12, 2013
- Procedure PP-AS-1203, Rev. 8, Corrective Action Program, November 5, 2012
- Procedure PP-PR-6021, Rev. 4, Supplier/Subcontractor Deviation, Information, or Nonconformance Request, March 21, 2013
- Procedure DI-CS-020, Rev. 0, Pneumatic Test Exclusion Area and Static Head Correction Factor Determination, February 20, 2013
- Procedure DI-QC-004, Rev. 1, Functional Check of Pressures Gauges, January 24, 2013
- ITP-11821-0001, Rev. 0, 11821 Centrifugal Pumps, August 1, 2013
- ITP Number ITP-15112, Rev. 3, Section 15112, Pipe Leak Testing, (Process Piping), March 28, 2013
- ITP Number ITP-15121-0002, Rev. 3, Section 15121, Field Inspection of Process Piping, March 28, 2013
- Document Number PL-QC-4800, Rev. 0, Quality Control Inspector Qualification/Certification Plan, March 15, 2010
- Document Number PL-CS-7205, Rev. 0, Process Pipe Flush Plan, October 7, 2011
- Specification Section 15112, Rev. 9, Pipe Leak Testing, February 11, 2013
- Specification Section 15121, Rev.11, Installation of Process Piping, October 21, 2013
- SWPF Preliminary Documented Safety Analysis, Document Number S-SAR-J-00001, dated September, 30, 2008
- Intermech Procedure WIP SWPF 11.50, HVAC Duct and Housing Structural Capability and Leak Test, March 7, 2013
- QA Surveillance Report numbers SWPF-SR-2819, -2821, -2849, -2851, -2927, -2936, -2953, -2957, -2968, -2994, -3009, -3011, -3013, -3016, -3024, -3025, and -3027
- Condition Reports numbers SWPF-CR-2013-226, 2013-227, and 2014-002
- NCRs identified during warehouse receipt inspections: NCR-0539, -0542, -0788, -0908, -0957, and -0982

Key Documents Reviewed (continued):

- NCRs initiated to document deficiencies with valves: NCR-0526, -0638, -0648, -0649, -0655, -0661, -0662, -0674, -0682, -0693, -0699. -0724, -0740,-0745, -0762, -0786, -0810, -0811, -0812, -0813, -0816, -0823, -0832, -0834, -0835, -0851, -0861, -0892, -0924, -0927, -0939, -1001, -1002, -1006
- NCRs initiated to document construction or procurement deficiencies: NCR -0539, -0657, -0684, -0720,-0723, -0728, -0735, -0747, -0768, -0769, -0770, -0775, -0779, -0780, -0781, -0783, -0784, , -0792, -0798, -0799, -0802, -0805, -0808, -0809, -0814, -0822, -0825, 0829, -0853, -0856, -0893, -0926, -0943, -0961, -0986, -0989, -0995, -0999, -1000, -1005, -1007
- Parsons Document number V-QP-J-00001, SWPF Quality Assurance Plan
- F-FHA-J-00001, revision 1, Salt Waste Processing Facility Project, Fire Hazard Analysis, 6-18-2009
- Design Change Notice No 1068, Removal of Sprinklers, Fire Barrier Changes, Fire Damper Changes and Fire Wrap Changes, 12-1-2011
- Design Change Notice No 1123, Change Wet Pipe Sprinkler Systems to Deluge Systems, 12-1-2011
- SWPF-NCR-0686, rev 1, Fire Proofing of NFSA, 11-5-2013
- F-FHA-J-00001, revision 1A2, Salt Waste Processing Facility Project, Fire Hazard Analysis, 12-11-2013
- PP-SH-4372, rev 5, Control of Hot Work, 8-5-2013
- Hot Work Permit No 3330, SWPF Hot Work Area Inspection, 1-7-2014
- Fire System Impairment Permit No 2013-606, Water Supply/Fire Pumps (Diesel), 12-12-2013
- Fire System Impairment Permit No 2013-607, Water Supply/Fire Pumps (Electric), 12-12-2013
- Data Sheet US: 7-14-237, Morgan Thermal Ceramics, Pyroscat Duct Wrap XL
- Contractor's Material and Test Certificate for Aboveground Piping, Salt Waste Process Facility, 3-15-2011
- Document No 00-700-14618, Classifications of Salt Waste Processing Facility (SWPF) Electrical Areas, 2-11-2010
- S-CLC-J-00041, rev 0, SWPF Fire Radiological Consequence Analysis, 5-15-2012
- Design Change Notice No 0777, Electrical Classification Changes, 4-6-2010
- F-ESR-J-00005, rev 0, SWPF Fire Protection Equivalency Request – Omission of Sprinklers in Waste Transfer Enclosure; West Utility Chase; HVAC Shielding Chase; South Utility Chase and Contactor Support Floor Chase; and East CSSX Tank Cell
- Drawing A-A1-J-0009, rev 3, Life Safety FHA Fire Areas and Fire Walls at Elevation 100'-0"
- Drawing A-A1-J-0010, rev 2, Life Safety FHA Fire Areas and Fire Walls at Elevation 116'-0"
- Drawing A-A1-J-0011, rev 2, Life Safety FHA Fire Areas and Fire Walls at Elevation 124'-0"
- Drawing A-A1-J-0012, rev 3, Life Safety FHA Fire Areas and Fire Walls at Elevation 139'-0"
- Design Change Notice No 1329, rev 0, Seal and Sleeve Schedule Updates, 8-28-2013
- Document No 16721, rev 2, Fire Alarm and Detection System Specification, 5-16-2012
- V-ESR-J-00017, rev 4, Fire Protection Water System Interface Control Document (ICD-17), 10-23-2013
- 2013-SA-006733, SWPF Fire Protection Assessment, 11-30-2013
- 221-000J, rev 0, 221-000J Fire Control Preplan, 12-31-2013
- ITP-07841-0002, rev 1, Inspection and Test Plan, Inspection of PCI Promatec SF150 –NH Penetration Sealant in CPA, 5-10-2011
- P-CLC-J-00368, rev 1, Evaluation of PCI Promatec SF-150 NH Elastomer Used Within the Penetration Sleeves, 4-26-2011
- CRFI No 01576, rev 0, Electrical Conduit, Cable Trays & Sprinkler Pipe Clearance for PCI Promatec SF150-NH Installation, 10/17/2013

Key Documents Reviewed (continued):

- CRFI No 01575, rev 0, PCI Promatec SF150-NH Final Acceptance Criteria/Repair Procedures/Minimum Density, 9-11-2013
- CRFI No 01269, rev 4, HDSE Penetration Seal (PCI Promatec SF-150NH), 2-13-2013
- CRFI No 01466, rev 0, Penetrations- Grout at Spares vs HDSE, 9-4-2013
- CRFI No 01621, rev 0, Penetrations- Grout at Spares vs HDSE, 9-4-2013
- CRFI No 01574, rev 0, Fireproofing Electrical Penetrations, 11-7-2013
- CRFI No 01567, rev 0, HDSE Penetration Seal (PCI Promatec SF150-NH) Cleanliness Requirements, 11-4-2013
- C-CGD-J-00022, rev 1, Replacement Item Evaluation/Commercial Grade Dedication and Material Upgrade – Product No SF-150NH, 9-10-2013
- P-CGD-J-00018, rev 0, Replacement Item Evaluation/Commercial Grade Dedication and Material Upgrade – Pyroscat Duct Wrap XL, 2-10-2011
- Document No 15330, rev 1, Fire Protection Wet Pipe Sprinkler System, 11-17-2008
- Document No 07841, rev 5, Through – Penetration Firestop Systems, 3-5-2013
- Transmittal No 13-3052, SF-150NH Training Certificates, 8-9-2013
- P-CLC-J-00368, rev 2, Evaluation of PCI Promatec SF-150NH Elastomer used within the Penetration Sleeves, 4-26-2011
- PP-MN-8723, rev 0, Fire Protection Impairment Control procedure, 5-10-2012
- F-CLC-J-00001, rev 0, Automatic Sprinkler Systems Hydraulic Calculation, 7-31-07
- F-PP-J-00001, rev 0, SWPF Fire Protection Program Plan, 7-9-2010
- S-SAR-J-00001, rev 0, Salt Waste Processing Facility – Preliminary Documented Safety Analysis, 9-30-2008
- F-PP-00001, rev 0, The Fire Protection Building Assessment Checklist, 12-1-2013
- WP-0579, rev 0, Work Package for the Installation of Penetration Seals, Promatec SF-150NH
- CPA Fire Protection Plan at 124’-0”, F-F2-0003, rev E
- Drawing F-F2-0002, rev D, CPA Fire Protection Plan at 116’-0”, 5-31-2013
- Drawing F-F2-0001B, rev C, CPA Fire Protection Plan at 100’-0”, 8-23-2013
- Drawing F-F2-0003, rev E, CPA Fire Protection Plan at 124’-0”, 11-4-2013
- Work Order 16358, Quarterly Inspection of Warehouse 763-S Fire Sprinkler System, 11-1-2013
- Work Order 16359, Quarterly Test of Warehouse 763-S Fire Sprinkler System, 11-1-2013
- Work Order 16360, Semi-Annual Fire Protection Testing in Administration Building, 10-23-2013
- Work Order 16361, Semi-Annual Fire Protection Inspection in Administration Building, 10-23-2013
- Work Order 16362, Quarterly Inspection of Administration Building Fire Sprinkler System, 11-1-2013
- Work Order 16363, Quarterly Test of Fire Sprinkler System in Administration Building, 11-1-2013
- Work Order 16357, Semi-Annual Fire Protection Testing in Warehouse 763-S, 11-2-2013
- Work Order 16356, Semi-Annual Inspection of Fire Protection System in Warehouse 763-S, 11-2-2013
- Design Change Notice 0458, Revision 1, Fire Protection for HEPA Filters and Glove Boxes, 10-21-2009
- Design Change Request 0190, Revision 0, Revise Low Level Drain Sump, 2-12-2008
- Calculation M-CLC-J-00096, Revision 1, Process Drain Lines Sizing Calculation, 11-18-2013
- Calculation F-CLC-J-00011, Revision 1, Air Temperature Change at HEPA Filters Resulting from Fire in a Process Cell, 5-25-2010
- Fire Detection/Protection System Description F-SD-J-00001, 11-12-2009
- Victaulic Design Guide 26.12, Design Data for Seismic Applications of Victaulic Grooved System, Revision A, 10-20-2000

Key Documents Reviewed (continued):

- Specification 15201, Seismic Restraint of Mechanical Systems and Equipment, Revision 2, 8-22-2011
- Specification 15330, Fire Protection Wet Pipe Sprinkler System, Revision 3, 10-4-2012
- Specification 15331, Fire Protection Interior Distribution System, Revision 1, 11-11-2008
- Specification 15332, Fire Protection Underground Water Supply System, Revision 1, 10-17-2008
- Specification 16721, Fire Alarm and Detection System, Revision 2, 5-16-2012
- Vendor Calculation 30122-SDC-51, Revision 5, Hydraulic Calculation Fire Sprinkler and Standpipe System, 12-10-2013
- Vendor Calculation 30122-SDC-50, Revision 5, Hydraulic Calculation Fire Sprinkler and Standpipe System, 12-10-2013
- Vendor Calculation 30122-SDC-39, Revision 4, Hydraulic Calculation Fire Sprinkler and Standpipe System, 11-21-2013
- S-Area 2010 Annual Diesel Driven Fire Pump Test, Manual SW4-15.44, 12-12-2010
- S-Area 2011 Annual Diesel Driven Fire Pump Test, Manual SW4-15.44, 11-23-2011
- S-Area 2012 Annual Diesel Driven Fire Pump Test, Manual SW4-15.44, 12-4-2012
- S-Area 2013 Annual Diesel Driven Fire Pump Test, Manual SW4-15.44, 12-26-2013
- H-Area 2013 Annual Diesel Driven Fire Pump #1 Test, Manual SP-16, 10-23-2013
- H-Area 2013 Annual Diesel Driven Fire Pump #2 Test, Manual SP-16, 10-23-2013
- S-Area Diesel and Motor Driven Fire Pump Test Initial Acceptance Data and Curve, Factory Mutual Report, July 1991
- Drawing W-751553, Revision 22, S-Area Fire Water Storage P&ID, 1-19-1999
- Calculation Job Number 4238, Warehouse 763-S Hydraulic Analysis, 11-8-2008
- Drawing F-PA-H-0001, Revision 17, H-Area Outside Underground Fire Protection Piping, Sheets 1 & 2, 9-20-2011
- Drawing C-CY-J-0025, Revision 8, Fire Protection Piping Plan SWPF Operations Area, 10-4-2013
- Drawing C-CY-J-0026, Revision 3, Fire Protection Piping Plan Offsite Areas, 10-4-2013

Interviews:

- Director of Construction
- Deputy Director of Engineering
- Construction Manager
- Plant Manager
- Maintenance Manager
- Pressure Test Engineer
- QC Manager
- Fire Protection Coordinator
- QA Inspectors
- Fire Protection Engineer
- QA Manager
- HVAC System Engineer
- Intermech Test Engineer
- Intermech QA Engineer Mechanical Lead
- Intermech Technical Representative
- SRS Fire Protection Engineering

Observations:

- Hydrostatic pre-test walkdowns
- Periodic inspection and maintenance evolution performed on an ITT Gould Model LF 3196 i-Frame Caustic transfer pump, equipment tag number P-302