



# **Fire Protection Program Implementation Assessment at the Savannah River Site Salt Waste Processing Facility**

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## Acronyms

AHJ	Authority Having Jurisdiction
BNA	Baseline Needs Assessment
CFR	Code of Federal Regulations
CRAD	Criteria and Review Approach Document
CTS	Commitment Tracking System
DOE	U.S. Department of Energy
DOE-SR	DOE Savannah River Operations Office
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
FHA	Fire Hazards Analysis
FPC	Fire Protection Coordinator
FPE	Fire Protection Engineer
FPP	Fire Protection Program
HEPA	High Efficiency Particulate Air
ITM	Inspection, Testing, and Maintenance
MPFL	Maximum Possible Fire Loss
NFPA	National Fire Protection Association
OFI	Opportunity for Improvement
PBVS	Process Building Ventilation System
SRNS	Savannah River Nuclear Solutions, LLC
SRR	Savannah River Remediation, LLC
SRM	Savannah River Operations Office Manual
SRS	Savannah River Site
SS	Safety Significant
SSC	Structure, System, and Component
STAR	Site Tracking, Analysis, and Reporting System
SWPF	Salt Waste Processing Facility
SWPFPO	Salt Waste Processing Facility Project Office
TSR	Technical Safety Requirement
USFS-SR	U.S. Department of Agriculture Forest Service-Savannah River

# **Fire Protection Program Implementation Assessment at the Savannah River Site Salt Waste Processing Facility April 1-4 and April 29 – May 2, 2019**

## **Summary**

### **Scope:**

This assessment evaluated the implementation and effectiveness of the fire protection program (FPP) established by Parsons Corporation for the Savannah River Site (SRS) Salt Waste Processing Facility (SWPF), specifically for Process Building 221-J, based on the requirements of U.S. Department of Energy (DOE) Order 420.1C, Change 1, *Facility Safety*. The DOE Savannah River Operations Office (DOE-SR) and its SWPF Project Office (SWPFPO) oversight processes related to fire protection were also assessed. This assessment was requested by DOE-SR to identify any significant issues in fire protection prior to the upcoming SWPF operational readiness review.

### **Significant Results for Key Areas of Interest:**

#### Fire Protection Program

Overall, while there are some weaknesses to be addressed, Parsons Corporation has developed an adequate FPP and is implementing program improvements. Parsons adequately conducts a comprehensive (triennial) self-assessment of the FPP, manages combustibles, and has appropriate wildland fire management agreements in place. Weaknesses were identified in the areas of maintenance training and the performance and periodic review of the fire hazards analysis.

#### Fire Protection Systems

The fire protection systems in Process Building 221-J are adequate for the hazards anticipated during hot operations. Inspection, testing, and maintenance of fire protection systems are adequately performed. SWPF has an adequate and reliable fire water supply with ample pressure and flow. Identified weaknesses include an inadequate evaluation of smoke buildup on exhaust filters, missing hydraulic analyses for some sprinkler systems, and the lack of a periodic flow testing program for the SWPF underground fire water distribution system.

#### Federal Oversight

DOE-SR has adequately established an oversight program for fire protection at SWPF. While DOE-SR and SWPFPO are adequately overseeing the SWPF fire protection program and implementation in Process Building 221-J, two opportunities for improvement were identified.

#### Best Practices and Findings

There were two Best Practices identified during this assessment:

- The SRS Fire Department conducts monthly walkthroughs of Process Building 221-J to validate the baseline needs assessment and pre-incident plans.
- The Savannah River Nuclear Solutions, LLC Site Utilities Division uses an interactive computer model of the fire water supply piping that provides real-time indication of system alignments.

The assessment team identified one Finding during this assessment. Facility fire protection assessments are not conducted annually as required, do not evaluate all critical FPP elements, and do not include sufficient rigor.

### **Follow-up Actions:**

No follow-up activities are planned.

## **Fire Protection Program Implementation Assessment at the Savannah River Site Salt Waste Processing Facility**

### **1.0 INTRODUCTION**

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment to evaluate the implementation of the Parsons Corporation (subsequently referred to as Parsons) fire protection program (FPP) at the Savannah River Site (SRS) Salt Waste Processing Facility (SWPF) Process Building 221-J. EA also assessed supporting elements of the SWPF FPP (Baseline Needs Assessment and Pre-incident Plans) that are established and maintained by the SRS Fire Department, operated by Savannah River Nuclear Solutions, LLC (SRNS), which provides emergency response to SWPF. Finally, the fire water infrastructure systems in S-Area, managed by Savannah River Remediation, LLC (SRR), and H-area, managed by Savannah River Nuclear Solutions, LLC (SRNS) that support the SWPF fire suppression systems were evaluated. The DOE Federal Project Director requested this assessment in order to aid the DOE Field Element in verifying that the Parsons SWPF FPP is adequate to support the upcoming radioactive processing operations. The onsite portions of this assessment were conducted from April 1 to 4 and from April 29 to May 2, 2019.

The implementation and effectiveness of key elements of the Parsons FPP and the facility-specific FPP requirements at Process Building 221-J were assessed in accordance with the *Plan for the Office of Enterprise Assessments Assessment of the Savannah River Site Salt Waste Processing Facility Fire Protection Program Implementation, April – May 2019*. The DOE Savannah River Operations Office (DOE-SR) and its SWPF Project Office (SWPFPO) oversight activities related to fire protection were also assessed.

SWPF is under the direction of the Office of Environmental Management. The responsible field office for SWPF is DOE-SR. The major facility at SWPF is Process Building 221-J, which is a non-reactor hazard category 2 nuclear facility. Process Building 221-J consists of four primary areas: the Central Processing Area, the Alpha Finishing Facility, the Cold Chemicals Area, and the Facility Support Area. The Central Processing Area is a multi-level reinforced concrete structure designed to meet natural phenomena hazard seismic performance category 3 criteria. The adjacent Alpha Finishing Facility, the Cold Chemicals Area, and the Facility Support Area are single-level braced-frame steel structures designed to meet seismic performance category 1 criteria.

SWPF was designed and constructed by Parsons under contract with DOE. Parsons is also responsible for commissioning and operating SWPF for one year. Now that construction of SWPF is complete, the facility is in the process of cold commissioning, which is anticipated to last through the third quarter of 2019. Hot operations are tentatively scheduled to start in late 2019.

Parsons was very responsive during this assessment and initiated significant revisions to various key FPP programmatic documents to address EA's initial comments. Parsons provided draft revisions of these documents, such as the FPP Plan, fire hazards analysis (FHA), and various procedures, to the assessment team for informal review. This assessment included evaluations of some of these draft documents, and the results are discussed in Section 3.0 of this report. However, because they are draft documents and have not yet been fully implemented, the assessment team could not verify implementation effectiveness.

## **2.0 METHODOLOGY**

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which is implemented through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms “best practices, deficiencies, findings, and opportunities for improvement (OFIs)” as defined in DOE Order 227.1A.

To guide this assessment, the assessment team used the following sections of CRAD 31-12, *Fire Protection Program Criteria and Review Approach Document*, Rev. 1, January 25, 2018:

- FPP
- Fire Prevention and Protection Structures, Systems, and Components (SSCs) and Design Requirements
- Operations, Surveillance, Testing and Maintenance
- Contractor Self-Assessment Program.

The assessment team also used criteria and lines of inquiry developed specifically for this assessment from DOE Orders 226.1B, *Implementation of Department of Energy Oversight Policy*, 426.1A, *Federal Technical Capability Program*, and 420.1C, *Facility Safety*. These criteria address DOE field element oversight related to fire protection and are attached to the review plan.

The assessment team examined key documents, many of which were in draft form, such as system descriptions, work packages, procedures, manuals, analyses, policies, and training and qualification records. The assessment team also conducted interviews with key personnel responsible for developing, executing, and monitoring the associated systems and programs, including maintenance projects and tracking corrective actions to closure. The assessment team walked down significant portions of Process Building 221-J to evaluate the effectiveness of the FPP. The members of the assessment team, the Quality Review Board, and management responsible for this assessment are listed in Appendix A.

In January 2014, EA assessed the SWPF FPP during construction and identified eight findings related to fire protection. EA conducted a follow-up review in July 2015, also during construction, and identified two findings related to fire protection. During a 2017 fire protection assessment at the SRS H-Canyon and K-Area, EA followed up on these findings and identified that all but one had been adequately addressed through corrective actions. The status of the remaining finding regarding contractor self-assessments was examined during this 2019 assessment (see Section 3.4).

## **3.0 RESULTS**

### **3.1 Fire Protection Program**

The objective of this portion of the assessment was to ensure that Parsons has established and implemented a comprehensive FPP that includes use of applicable National Fire Protection Association (NFPA) codes and standards, elements and requirements for design and operations, site emergency response capabilities as identified in a baseline needs assessment (BNA) and pre-incident plan(s), identification and evaluation of fire-related safety hazards in current and comprehensive FHAs, performance of periodic facility fire protection assessments, and an integrated sitewide wildland fire management plan. (10 CFR Part 830; 10 CFR Part 851; DOE Orders 420.1B and 420.1C, Change 1, Attachment 2, Chapter II, *Fire Protection*)

### 3.1.1 Fire Protection Program Description Documentation

The Parsons FPP is formally established in F-PP-J-00001, *Salt Waste Processing Facility Fire Protection Program Plan*, Revision 3. During this assessment, Parsons initiated revisions to the FPP Plan to address the team's initial comments. Revision 3C1 was provided to the team in draft form. The assessment team reviewed the approved (Rev. 3) and draft (Rev. 3C1) FPP Plans, both of which include the elements and requirements for design, operations, emergency response, fire analysis and assessments, wildland fire, and site-specific fire protection criteria. The approved and draft FPP Plans establish responsibilities for providing interpretation and interface between organizations to ensure compliance with the contract DE-AC09-02SR22210, *Design, Construction, and Commissioning of a Salt Waste Processing Facility*, the SWPF standards/requirements identification document, DOE orders and standards, and NFPA codes and standards affecting fire protection. The draft FPP Plan specifies that DOE Order 420.1B was implemented as the basis for the design and construction of SWPF and that FPP operations are based on DOE Order 420.1C, Change 1, which defines the execution of the FPP.

Responsibilities for implementing the Parsons FPP is divided between two organizations, Operations and Engineering.

- Under Operations, the fire protection lead is responsible for the operational portion of the FPP and meets the DOE criteria of a qualified fire protection engineer (FPE). The fire protection coordinator (FPC) is responsible for all fire protection system inspection, testing, and maintenance (ITM) activities and oversees technicians in conducting ITM and repairs on fire protection systems. However, Parsons could not provide any records of formal training in conducting ITM and repairs on fire protection systems for the FPC or technicians. Contrary to DOE Order 420.1C, the Parsons-approved FPP Plan does not require that the FPC and technicians receive formal training in conducting ITM and repairs on fire protection systems. (See **Deficiency D-Parsons-1**.)
- Under Engineering, the Fire Detection-Fire Suppression Cognizant System Engineer and the Engineering FPE are responsible for FPP documentation, design, fire protection procedures, fire analyses and assessments, the combustible control program, the impairment program, and review of site-specific fire protection criteria (e.g., the BNA, SWPF pre-incident fire plans, the wildland fire management plan). Both of these staff members are sufficiently qualified and trained for their assigned responsibilities, as required by DOE Orders 420.1B for design and 420.1C, Change 1 for program operations.

### 3.1.2 Fire Hazards Analysis

Section 5.0 of PP-EN-5022, *Preparation of Fire Hazards Analysis*, appropriately establishes instructions for developing the FHA and specifies the personnel responsible for the concurrence and approval of the FHA. However, this approved procedure does not require that an FHA be performed by, or under the direction of, an FPE, nor does it require that the FHA be reviewed every three years and revised as appropriate per DOE Order 420.1C, Change 1. (See **Deficiency D-Parsons-2**.)

During this assessment, F-FHA-J-00001, *Salt Waste Processing Facility Project Fire Hazards Analysis*, was being revised. Revision 2A2A of F-FHA-J-00001 was provided to the assessment team for review. The draft FHA was prepared by an FPE and the fire and related safety hazards were consistent with the documented safety analysis (DSA). However, due to ongoing changes to the analysis at the time of this assessment, the assessment team was unable to confirm that the mitigation of hazards was adequately evaluated to minimize risk from fire in the facility. The FHA revision is scheduled for DOE-SR review and approval prior to the start of the readiness review for hot operations.

### 3.1.3 Combustible Controls

The assessment team reviewed Procedure PP-EN-5043, *Combustible Load and Ignition Sources*, Revision 1A1, which was in draft pending final reviews and approvals. The draft procedure identifies controls to manage combustibles in Process Building 221-J. Although this procedure has not been approved, weekly and monthly combustible loading inspections have been ongoing. To verify implementation of the combustible controls, the assessment team reviewed the December 2018 monthly combustible loading checklist and three weekly combustible loading checklists completed in March 2019. All surveillances were complete. Additionally, walkthroughs of Process Building 221-J confirmed that Parsons is adequately managing combustibles.

### 3.1.4 Facility Fire Protection Assessments

Contrary to the requirement to perform a facility fire protection assessment annually, the most recent one for Process Building 221-J was last performed in June 2017. While the June 2017 assessment was a comprehensive checklist documented on Form SWPF-040, *Parsons Surveillance Report*, this assessment contained erroneous information, had numerous items marked “N/A” for not applicable, and did not provide an adequate evaluation of the following key elements of the FPP:

- Applicable codes and standards
- Fire and explosion hazards
- Protection of high value property
- Water runoff and containment
- Facility fire prevention and planning documents
- Fire barrier requirements and integrity
- Fire safety training
- Status and tracking of previous findings
- Equivalencies and exemptions.

The 2017 facility assessment did not specify any facility fire protection records or documents that were reviewed and evaluated in conducting the assessment. The shortcomings in the conduct of facility fire protection assessments are significant because a rigorous evaluation of all elements of the program and physical fire protection features is necessary to identify potential vulnerabilities and minimize the potential for fires.

Contrary to DOE Order 420.1C, Parsons is not performing the facility fire protection assessment for Process Building 221-J within the required frequency, and the 2017 assessment was inadequate in evaluating the programmatic and physical elements of the FPP. (See **Finding F-Parsons-1**.)

In response to the assessment team’s comments, Parsons began developing a new procedure, PP-EN-5049, *Facility Fire Protection Assessments*, to address this issue. EA provided preliminary comments on this draft procedure verbally at the end of the assessment.

### 3.1.5 Baseline Needs Assessment

The SRS sitewide BNA, F-TRT-G-00010, *Fire Department Emergency Response Baseline Needs Assessment*, adequately describes the emergency response services required for SRS, using protection goals that are defined in DOE Order 420.1C, DOE-STD-1066-2012, and applicable NFPA codes and standards. The assessment team met with SRS Fire Department personnel to validate F-TRT-G-00010 content and determined that, overall, the sitewide BNA adequately analyzes the emergency response



needs for SWPF as delineated in DOE-STD-1066-2012. DOE-SR approved the BNA via letter OSSES-18-019, *Request for Approval of Savannah River Site Fire Department (SRSFD) Baseline Needs Assessment (BNA), Revision 9 (reference letter, Schifer to Bartholomew dated 12/18/17)*. The SRS Fire Department's monthly walkthroughs of Process Building 221-J to maintain familiarity with new construction and to validate the status of the BNA and pre-incident plans are a **Best Practice**.

### 3.1.6 Pre-Incident Plans

The assessment team reviewed SWPF 221-000J, *Fire Control Preplan*, which was in draft pending final approval. Information provided in the draft pre-incident plan is consistent with NFPA 1620, *Standard for Pre-Incident Planning*, guidance, and includes identification of locations that will contain hazardous materials and instructions for operating the high efficiency particulate air (HEPA) filter deluge sprinkler systems. The team confirmed that during the November 2018 walkthroughs, all fire fighters received hands-on training in operating the manual deluge valves that protect the HEPA filters. The appropriate instructions and pictures for operating the HEPA deluge control valves are provided in the draft pre-incident plan.

### 3.1.7 Wildland Fire

The SRS wildland fire management plan is governed by Service Agreement G-FSP-G-00044, *Functional Service Agreement Between Savannah River Nuclear Solutions, LLC and United States Department of Agriculture Forest Service-Savannah River (USFS-SR) for Atmospheric Technologies Group Support for Wildland Fire Program*, September 18, 2018. The plan establishes an effective structure and approach to implement an integrated sitewide fire management plan with the goal of minimizing the damage caused by a wildland fire, to the extent possible. The wildland fire management plan is consistent with the guidelines established in NFPA 1143, *Standards for Wildland Fire Management*, per DOE Order 420.1C, Change 1.

### 3.1.8 Fire Protection Program Conclusions

Parsons has made significant progress in developing and revising FPP plans and procedures, but many of the documents were in draft and not yet fully implemented, so implementation effectiveness of the plans and procedures could not be fully verified. The SRS Fire Department has prepared an adequate pre-incident plan, and the emergency response capabilities meet the site's needs as established in the BNA. Monthly walkthroughs conducted by the SRS Fire Department ensure that the BNA and pre-incident plans are current, which is identified as a **Best Practice**. DOE-SR and USFS-SR have established and maintain an adequate sitewide wildland fire management plan. However, the assessment team identified one finding related to the facility assessment program and two deficiencies, relating to the lack of a formalized training program for personnel conducting ITM and repairs, and the absence of requirements to conduct a three-year review of the FHA and that an FPE must conduct the analyses.

## 3.2 Fire Prevention and Protection Structures, Systems, and Components and Design Requirements

The objective of this portion of the assessment was to ensure that the site contractor has technically adequate designs and specifications for fire protection SSCs in order to establish and maintain the protection thresholds specified in safety authorization bases and FHAs, including key design basis documents with supporting elements (calculations, drawings, etc.) to support facility safety basis development and implementation using sound engineering/scientific principles and appropriate standards. Furthermore, the adequacy of the fire protection design must be verified or validated by individuals or

groups other than those who performed the work, prior to approval and implementation of the design. (10 CFR 830.122; DOE Order 420.1C, Change 1, Attachment 2, Chapter II)

### 3.2.1 Design Basis Documentation and Design Requirements

The assessment team reviewed the fire suppression systems at Process Building 221-J to confirm, in part, that the fire protection systems are appropriate for the facility fire scenarios identified in S-SAR-J-00002, *SWPF Documented Safety Analysis*, Rev. 2; that the fire suppression systems are designed and installed compliant with the required codes and standards; and that an appropriate ITM program for fire protection features is in place and is being conducted. The fire protection systems are classified in the DSA as defense in depth and are identified in §5.5.5.2.6, *Programmatic Administrative Controls, Fire Protection Program*, as an administrative control to ensure adequate worker protection. The DSA identifies S-TSR-J-00001, Rev. 0, *Technical Safety Requirements (TSRs)*, and programmatic administrative controls for the FPP. Elements of the FPP are adequately covered in TSR §5.8.2.6, *Fire Protection Program*. Additionally, the team reviewed TSR §5.8.3.3, *Ignition Source Control*, to ensure that electrical components are confirmed by engineering evaluation to not pose an ignition hazard and found it to be adequate.

However, the assessment team identified the following issues with the fire protection system as described in the DSA, TSR, and FHA:

- **A potential adverse system interaction exists between the deluge water piping to the Process Building Ventilation System (PBVS) and the HEPA filter enclosures<sup>1</sup>.** Deluge water piping supplying Filters 001, 002, 003, and 004 is not seismically mounted, and exhibits a potential vulnerability to the HEPA filter enclosures due to an adverse system interaction. As part of the PBVS, the HEPA filter enclosures are classified as safety significant (SS), credited for filtering releases and maintaining confinement. Although the PBVS is not credited for post-seismic operation, a scenario in which a seismic event is accompanied by a loss of power causing a shutdown of exhaust fans, along with a failure of the deluge piping, could result in a breach of the filter enclosure with adverse consequences to the worker. Parsons did not provide evidence that the apparent system interaction (two over one) to the HEPA filter enclosures had been evaluated. (See **Deficiency D-Parsons-3**.)
- **Smoke from a cell fire could compromise the exhaust HEPA filters, and no evaluation is provided in the DSA.** The system performance evaluation for the HEPA filters in Chapter 4 of the DSA does not address the impact of smoke from a cell fire plugging the HEPA filters. This potential failure (with or without fire suppression) is identified in the FHA as a credible vulnerability. DOE-STD-3009-94, Change Notice 3, requires that credited safety basis controls be evaluated for their ability to meet their performance criteria. No evaluation is provided in the DSA as required by DOE-STD-3009-94, Change Notice 3. (See **Deficiency D-Parsons-4**.)
- **Fire suppression system hydraulic calculations were not performed for all sprinkler systems.** The assessment team reviewed most hydraulic calculations that evaluate the performance capability of sprinkler systems for the SWPF Process Building, Alpha Finishing Facility, and the Cold Chemical Area. Although the calculations in many cases correlate well with sprinkler system physical piping arrangement drawings and provide adequate pressure margin, the assessment team identified some

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<sup>1</sup> The potential interaction of non-seismically-designed equipment upon a credited safety basis control SSC is referred to as “two over one” considerations. This is defined in DOE-STD-1021-93, Change Notice 1, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*.

deficiencies. A crosswalk that identifies all sprinkler systems and their respective fire area, system drawing, and calculation number is not a controlled referenceable document. The crosswalk document provides a necessary reference for addressing fire sprinkler system characteristics and hydraulic adequacy. Additionally, calculations were not performed for all sprinkler systems. Thirty-two sprinkler systems service Process Building 221-J; however, 12 of these systems have no calculation to verify that they meet the required performance criteria specified in the FHA and NFPA 13-2002, *Standard for the Installation of Sprinkler Systems*. (See **Deficiency D-Parsons-5**.)

- **The determination of maximum possible fire loss (MPFL) did not consider all direct and indirect costs.** The draft FHA Table 3-6 presents the monetary values of each fire area and is based on the total value of the area plus associated cleanup costs. In addition to these costs, DOE-STD-1066-99 and DOE-G-420-1-3, *Implementation Guide for DOE Fire Protection and Emergency Services Programs for Use with DOE Order 420.1B, Facility Safety*, prescribe consideration of the structure and equipment replacement, post-fire clean-up, and post-fire recovery costs. In addition, cost of lost time (considered mission interruption costs) should also be included. Moreover, Savannah River Operations Office Manual (SRM) 420.1.1B, *SR Fire Protection Program Manual*, states that the direct and indirect costs should consider the cost of lost time (considered mission interruption costs); the cost of environmental clean-up; exposure damage to other buildings, structures and property; and the cost of re-establishing operations, e.g., redesign approval and start-up. These additional costs were not included in the MPFL.
- **Two documents containing inputs and bases that support safety basis criteria are not included in the document control system.** The basis for the acceptable quantity of combustibles is not referenced and is not contained in the document control system. Also, the calculation that determines the MPFL is an informal spreadsheet without a document number and is not independently reviewed or approved. DOE-STD-1073 requires DSAs, TSRs, documented design requirements, safety management plans, and any documents that are referenced by, or support, DSAs, to be controlled documents. (See **Deficiency D-Parsons-6**.)

The assessment team performed a walkdown of the deluge system that provides water spray to the PBVS HEPA filter enclosures for Filters 001, 002, 003, and 004, and identified that the SS classification system boundary for the HEPA filters deluge system shown on the piping and instrumentation diagram is not located at the vendor-supplied system boundary. A section of black steel pipe is within the SS boundary but not discussed in the FHA or DSA. Parsons concurred, and a design change notice, DCN-2225, was initiated to correct the piping and instrumentation diagram.

SWPF fire suppression systems are all fed from a J-Area underground closed-loop fire main. The underground closed-loop fire main is fed by two underground pipe lines from the S-Area fire water system, which includes post-indicator isolation valves, sectional control valves, and fire hydrants. The loop also has the capability to be fed from the H-Area fire water system through a cross-tie line isolated by a normally closed post-indicator valve. Annual operational testing documentation for the underground sectional control valves in J-Area is generally adequate. However, the procedure requires that the operator fully close and then open the valve and record the number of turns for each open/close cycle. Full valve operation is determined by comparing the number of turns closed to the number of turns open. Only one number is recorded for the turns to operate the valve, and it is not specified whether this number represents turns to open or turns to close.

Although the S-Area (maintained by SRR) and H-Area (maintained by SRNS Site Utilities Division) underground piping and components are generally aged, no significant chronic issues exist and the infrastructure meets the general requirements for an adequate and reliable water supply per DOE Order 420.1B/C. S-Area fire pumps have been recently replaced and now provide additional pressure and flow

margin to the SWPF fire sprinkler systems. S-Area underground piping consists largely of ductile iron and CPVC material from the mid-1980s. System health reports indicate that there have been no pipe failures in the last five years. Sectional control valves are cycled annually as required by NFPA 25. SRR has no proactive plans for replacing S-Area aged piping and performs replacements on an as-needed basis. H-Area piping consists predominately of ductile iron piping from the 1950s. SRNS is developing a program to proactively replace aged piping and valves on an incremental basis. ITM on sectional control valves is performed per NFPA requirements, and valves are replaced on an as-needed basis determined by annual cycling. H-Area fire water loop infrastructure has experienced a limited number of leaks, most significant of which were two leaks near Building 704-H due to graphitic corrosion; the affected section of piping was replaced. The SRNS Site Utilities Division uses an interactive computer model of underground piping infrastructure that indicates facilities impacted by closure of sectional control valves. SRNS's use of this interactive model is a **Best Practice**.

### **3.2.2 Fire Prevention and Protection SSCs and Design Requirements Conclusions**

Overall, the fire scenarios and consequences evaluated in the FHA are appropriately translated and considered in the hazard evaluation and accident analysis sections in the DSA. Analyses that support fire protection performance criteria are generally acceptable. The interactive computer model of the underground piping infrastructure used by the SRNS Site Utilities Division is identified as a **Best Practice**. However, vulnerabilities related to adverse system interaction and smoke and soot loading on the HEPA filters may exist. Also, not all fire sprinkler systems have hydraulic performance analyses to validate required performance criteria, and important bases for FPP documents are not supported by referenceable controlled documentation.

### **3.3 Operations, Inspection, Testing, and Maintenance**

The objective of this portion of the assessment was to determine whether the site contractor has a complete spectrum of fire prevention controls, consistent with the DSA, FHA, and TSRs, and procedures to ensure that all required fire protection features (e.g., appropriate construction types, fire barriers, fire alarm and signaling systems, manual and automatic fire suppression systems) have been installed. These systems must be inspected, tested, and maintained using calibrated instrumentation to ensure that the safety systems are available to perform their intended safety functions when required, in accordance with system requirements and performance criteria in the safety basis, NFPA, and other applicable standards and requirements. (DOE Order 420.1C, Change 1, Attachment 2, Chapter II; and applicable NFPA codes and standards from the site-specific contract)

#### **3.3.1 Fire Safety Systems Operations, Inspection, Testing, and Maintenance**

Fire protection systems installed in Process Building 221-J include automatic sprinkler systems, fire barriers and fire doors, duct heat detectors, fire dampers, and manual fire alarm pull stations. These systems are relied on as defense in depth, except for the manually operated deluge systems that protect HEPA filter systems, which are credited as SS.

ITM activities for maintaining the sprinkler systems are performed by Parsons maintenance technicians overseen by a Parsons FPC and a licensed outside subcontractor, who transfers the field data into a computerized vendor form. The Parsons FPP relies on work orders, rather than procedures, to direct ITM activities. The work orders are generally adequate and consistent with NFPA codes and standards and meet the intent of DOE Order 422.1, *Conduct of Operations*, with the exception that the work orders are not walked down or verified prior to use. To verify implementation of the work orders, the assessment team reviewed four transmittals containing ITM records from completed work orders. Overall, technicians are performing ITM on the sprinkler systems as directed by work order instructions and the

computer-generated records are complete. However, the work orders do not require an inspection of the sprinkler system information sign or the standpipe system hydraulic design nameplate as required by NFPA 13 and NFPA 25. During walkthroughs of Process Building 221-J, the assessment team identified that system information signs and hydraulic nameplates were missing. Parsons took immediate action by ordering the required signs for each system.

Fire alarm system inspection and testing is performed by a licensed outside contractor. The assessment team reviewed Transmittals 38 and 44, *Fire Alarm Inspection Report*, and determined that the records were complete. However, the records only indicate whether an alarm device “Passed” or “Failed,” with no details of how the alarm devices were tested or the acceptance criteria. Additionally, voltage readings are required on various elements of the system but are not recorded. Parsons does not have an established procedure or written criteria for performing ITM on the fire alarm system as required by DOE Order 420.1C, Change 1, relying instead on the outside subcontractor’s test results. (See **Deficiency D-Parsons-7.**)

The SRS Fire Department performs annual flushing and maintenance of the SWPF fire hydrants. Manual 2Q2-1.5, Procedure 513.4, *Flushing and Maintenance of Fire Hydrants and Curb Boxes in J and S Areas*, defines work processes for the ITM of the SWPF fire hydrants, including instructions for documenting, evaluating, and resolving deficiencies identified during ITM activities. The assessment team reviewed the annual flushing and maintenance records for 30 fire hydrants performed in February and May 2018. All records were complete in accordance with Procedure 513.4. However, neither Parsons nor the SRS Fire Department conducts five-year flow testing on the SWPF underground fire water distribution system. Interviews revealed that only annual flushing and lubrication of fire hydrants are performed by the SRS Fire Department. Parsons does not have an established program for conducting five-year flow testing of the underground fire water distribution system as required by NFPA 25. (See **Deficiency D-Parsons-8.**)

### **3.3.2 Operations, Inspection, Testing, and Maintenance Conclusions**

Overall, the operations, inspection, testing, and maintenance of fire protection systems required by the safety basis and FHA adequately meet DOE requirements. However, Parsons does not have an established procedure or written criteria for performing ITM on the fire alarm system or for conducting five-year flow tests of the SWPF underground fire water distribution system.

### **3.4 Contractor Self-Assessment Program**

The objective of this portion of the assessment was to determine whether the site contractor has performed a comprehensive (triennial) self-assessment of the FPP (or a series of more frequent assessments that, when combined, are equivalent) that evaluates the full scope of the program at least every three years, or at a frequency with appropriate justification approved by the DOE head of field element. (DOE Order 420.1C, Attachment 2, Chapter II)

The assessment team reviewed *Assessment of the Fire Protection Program Plan Salt Waste Processing Facility*, April 26, 2018. This Parsons self-assessment evaluated the full scope of the FPP, satisfying the requirements of DOE Order 420.1C, Change 1. Overall, the self-assessment was thorough in evaluating the programmatic elements and was performed at a level of detail that resulted in the identification of meaningful findings and OFIs, including issues similar to those that are discussed in this report. Additionally, completion of the triennial self-assessment adequately addresses finding F-SWPF-2015-1, which was identified in the *Office of Enterprise Assessments Salt Waste Processing Facility Construction Quality and Fire Protection Systems Follow-up Review at the Savannah River Site – January 2016*.

### **3.5 DOE Field Element Oversight**

The objective of this portion of the assessment was to determine whether an effective DOE oversight program is in place to evaluate the adequacy of Parsons FPP, through operational awareness activities; assessments of facilities, operations, and programs; and assessments of the contractor assurance system. The oversight program must include performance of the roles and responsibilities of the Authority Having Jurisdiction (AHJ) and Building Code Official. This responsibility includes the review and, where justified, approval of the contractor's FPP; equivalencies to DOE technical standards and industry codes on fire protection; and emergency services organization BNAs. The DOE oversight program shall include an issues management process for documenting, prioritizing, and tracking findings related to fire protection. In addition, DOE-SR and SWPFPO oversight of fire protection systems and equipment shall be performed by qualified, trained fire protection staff competent to perform their role (i.e., FPEs) with sufficient technical capability and knowledge to effectively evaluate contractor performance with respect to fire protection.

#### **3.5.1 DOE Field Element Oversight Processes and Programs**

SWPFPO is a branch of DOE-SR dedicated solely to oversight of the SWPF project as performed under contract DE-AC09-02SR22210. The head of the SWPFPO is the Federal Project Director, who reports directly to the DOE-SR site manager.

SRM 226.1.1F, *Integrated Performance Assurance Manual (IPAM)*, provides suitable directions for implementing the DOE oversight and quality assurance requirements of DOE Orders 226.1B and 414.1D at SRS. The manual specifies an appropriate series of oversight processes for evaluating Parsons operations, activities, programs, and management systems. Day-to-day oversight of Parsons fire protection activities is currently performed by a licensed FPE through a DOE support contractor assigned to SWPFPO. Additional day-to-day oversight is conducted by Facility Representatives. Periodic oversight of fire protections systems and activities, including programmatic reviews, are performed by the responsible FPE within DOE-SR.

The fire protection requirements of DOE Order 420.1C and DOE STD-1066-2012 are implemented at SRS through SRM 420.1.1B, *Fire Protection Program Manual*. This manual establishes an appropriate set of baseline requirements for a comprehensive FPP and is used by DOE-SR for conducting oversight of fire protection across the site.

#### **Authority Having Jurisdiction**

As defined in SRM-420.1.1B, the manager or deputy manager of DOE-SR has decision-making authority for matters concerning fire protection at SWPF, as the AHJ and the Building Code Official. None of the fire protection AHJ responsibilities for SWPF have been delegated to Parsons. The AHJ is authorized to approve equivalencies to fire protection requirements, not exemptions. There are four approved equivalencies regarding fire protection for the SWPF project. The assessment team reviewed these equivalencies and determined that they were appropriately approved by the AHJ. Recent AHJ actions related to SWPF fire protection that demonstrate that the role of AHJ is appropriately defined, understood, and performed for SWPF include the approvals of: the sitewide wildland fire management plan (October 2018); the Parsons FPP (March 2018); Revision 9 of the BNA (February 2018); and, occupancy of Process Building 221-J (August 2017).

DOE-SR has an assigned Building Code Official, but he has not been required to issue any interpretations or actions for the SWPF project within the last five years.

## **DOE Assessments Related to Fire Protection**

Because SWPF is a project rather than an operational facility, assessments of contractor performance are slightly different from assessments for operating facilities under the DOE-SR sitewide program. SWPFPO establishes the annual assessment plan for SWPF in accordance with SRM 226.1.1F, considering the current stage of the project and anticipated progress in the coming year. Assessments involving key elements of the FPP are identified, scheduled, and performed by one of the DOE-SR FPEs. In accordance with SRM 226.1.1F, completed assessments are entered in the Site Tracking, Analysis, and Reporting System (STAR) for issues management, tracking, and trending. Monthly counterpart meetings are held to discuss oversight results and provide feedback to Parsons.

A search of STAR indicated that 16 DOE assessments related to fire protection were performed over the previous 3 years by DOE-SR, including SWPFPO. The assessment team reviewed these assessments to determine the rigor of oversight and to verify adequate closure of the corrective actions. The assessments had appropriately detailed lines of inquiry and were conducted by a team either composed of, or including, FPEs. Overall, for the subjects covered, the assessments were thorough and performed at a level of detail that resulted in the identification of meaningful findings and OFIs. The assessment reports were appropriately entered into STAR, and commitment tracking system (CTS) numbers were assigned for each of the findings. The assessment team verified that the corrective actions were reasonable and reviewed the closure statements and documentation for five of the assessment reports.

A recent assessment conducted by an Integrated Project Team that included DOE-SR FPEs was performed to ensure that Parsons had adequately addressed all of the functional areas in the management self-assessment prior to the introduction of chemical simulant for testing. The assessment concluded that three of the six objectives were partially met, and identified several issues in the fire protection functional area, including a pre-start action to revise the fire pre-incident plan with an updated chemical inventory.

The assessments demonstrated that an appropriate level of rigor and depth is applied in conducting oversight of Parsons FPP. The assessments are appropriately planned, conducted, and documented. The results are entered into STAR, tracked until closure, and corrective actions are reviewed for effectiveness.

## **Issues Management System**

Based on the 16 DOE assessments reviewed, the reports are appropriately entered into the STAR system and each issue (finding) is assigned a CTS number for development and tracking of corrective actions until closure. The assessments of SWPF pertinent to FPPs or systems are conducted by one of the DOE-SR FPEs, who verifies appropriate closure of any issues identified by the assessment.

As the project nears the operational readiness review, there has been an increased emphasis on timely resolution of open issues. In the case of fire protection, the Integrated Project Team adopted an “in-process review” technique in which the Parsons FPE develops a draft document and schedules a face-to-face review meeting with the DOE FPE. The draft document is projected on a screen and the review occurs in real-time, with revisions made on the spot. This approach allows open discussion on any questions or concerns, eliminating the delays typically associated with a more formal review process.

For the fire protection issues reviewed, SWPFPO or other DOE-SR elements evaluated the completed corrective actions for adequacy prior to closure as specified in SRM 226.1.1F. The assessment team noted that in one case, Assessment 2016-SA-006213, Parsons had closed issues without adequately addressing the problem. In this case, the DOE-SR FPE notified Parsons and opened a new finding to ensure that a more thorough response was made.

### 3.5.2 Fire Protection Engineers and Other Technical Staff Performing Oversight

Roles and responsibilities for oversight are described in several documents. During construction, SPD-SWPF-P-0010, *Construction Management Plan for Construction of the SWPF*, described activities of the Integrated Project Team and the specific role of the Federal Project Director. For commissioning, SPD-SWPF-0805, *Readiness Core Requirements Responsibility Matrix*, identifies the individuals responsible for verification of the readiness core requirements, which includes the safety management programs. The readiness of the FPP will be evaluated by DOE-SR FPEs as a safety management program and as part of the safety basis.

SPD-SWPF-P-0022, *Project Execution Plan for the SWPF*, specifies the implementation of the ISMS principle of *Competence Commensurate with Responsibilities* for the oversight team. This plan adequately implements the personnel training and qualification requirements of DOE Order 426.1, *Federal Technical Capability*, for the SWPF project.

SWPFPO is currently engaged in a detailed in-process review of the Parsons FPP and the implementing procedures in preparation for the upcoming operational readiness review. During this commissioning phase, DOE-SR's primary FPE support at SWPF is provided by a full-time support contractor. The SWPFPO FPE contractor is a licensed professional engineer in fire protection with a master's degree in fire protection engineering and four years of site-specific experience at SRS in addition to previous experience in fire protection. Prior to this staff addition, resolution and closeout of some issues related to fire protection was often delayed due to a backlog of fire protection work. Ongoing FPE support to SWPF is provided through the Technical Services Division of DOE-SR. One FPE from this group is assigned to support SWPF with ancillary duties at multiple facilities across SRS, including being an active member of six integrated project teams. The Technical Services Division has a number of identified vacancies in this area and is working on hiring additional FPEs. (See **OFI-DOE-SR-1**.)

The assessment team reviewed the qualifications of the DOE-SR FPE assigned to support SWPF. The FPE is well qualified, with a degree in fire protection engineering, and has completed the Technical Qualification Program under DOE-STD-1137, *Fire Protection Engineering Functional Area Qualification Standard*. This FPE has 7 years of experience with DOE and 12 years of previous site-specific experience at SRS in fire protection.

Oversight of the SWPF emergency management response capabilities of the SRS Fire Department is conducted by a DOE-SR emergency management specialist using a direct contact, hands on approach. The emergency management specialist observes all training and exercises, reviews self-assessments and drill reports, and oversees all facility and site exercises. DOE-SR comments from training and exercises are verbally relayed to the contractor and incorporated into the site after-action report. These DOE-SR reviews are typically not adequately documented. (See **OFI-DOE-SR-2**.)

### 3.5.3 DOE Field Element Oversight Conclusions

DOE-SR has an adequately documented and established fire protection oversight program. DOE-SR adequately conducts oversight for the SWPF fire detection and protection systems, dependent on the specific stage of the project, with direct involvement from FPEs from either or both DOE-SR and its support contractor. Although there were areas of weakness in the Parsons FPP, as identified in this independent assessment, DOE-SR and SWPFPO are adequately overseeing the Parsons FPP as implemented at SWPF.



## 4.0 BEST PRACTICES

Best practices are safety-related practices, techniques, processes, or program attributes observed during an assessment that may merit consideration by other DOE and contractor organizations for implementation. The following best practices were identified as part of this assessment:

- The SRS Fire Department conducts monthly walkthroughs of Process Building 221-J to maintain familiarity with new construction and to validate the status of the BNA and pre-incident plans.
- The SRNS Site Utilities Division uses an interactive computer model of the underground piping infrastructure that indicates facilities impacted by closure of sectional control valves.

## 5.0 FINDINGS

Findings are deficiencies that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. DOE line management and/or contractor organizations must develop and implement corrective action plans for findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 226.1, *Implementation of Department of Energy Oversight Policy*, to manage the corrective actions and track them to completion.

### Parsons Corporation

**Finding F-Parsons-1:** Parsons is not performing the facility fire protection assessment for Process Building 221-J within the required frequency, and the 2017 assessment was inadequate in evaluating the programmatic and physical elements of the FPP. (DOE Order 420.1C, Change 1, Attachment 2, Chapter II, Section 3.f (2))

## 6.0 DEFICIENCIES

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

### Parsons Corporation

**Deficiency D-Parsons-1:** The Parsons-approved FPP Plan does not require that the FPC and technicians receive formal training in conducting ITM and repairs on fire protection systems. (DOE Order 420.1C, Change 1, Attachment 2, Chapter II, Section 3.d (2)(a))

**Deficiency D-Parsons-2:** Parsons approved procedure PP-EN-5022 does not require that an FHA be performed by, or under the direction of, an FPE, nor does it require that the FHA be reviewed every three years and revised as appropriate. (DOE Order 420.1C, Change 1, Attachment 2, Chapter II, Section 3.f)

**Deficiency D-Parsons-3:** Parsons has not performed an evaluation of the potential adverse system interaction that exists for the deluge water piping mounted above the PBVS HEPA filter enclosures. (DOE-STD-1020)

**Deficiency D-Parsons-4:** Parsons has not provided an evaluation of smoke from a cell fire, which could compromise the exhaust HEPA filters, in the DSA Chapter 4 system performance evaluation. (DOE-STD-3009-94, Change Notice 3)

**Deficiency D-Parsons-5:** Parson has not performed fire suppression system hydraulic calculations for 12 sprinkler systems. (NFPA 13, Section 23.3.5.1)

**Deficiency D-Parsons-6:** Parsons has not entered into the document control system two documents containing inputs and bases that support the safety basis and FPP criteria. (DOE-STD-1073)

**Deficiency D-Parsons-7:** Parsons does not have an established procedure and written criteria for performing ITM on the fire alarm system. (DOE Order 420.1C, Change 1, Attachment 2, Chapter II, Section 3.d (1))

**Deficiency D-Parsons-8:** Parsons does not have an established program for conducting five-year flow testing of the underground fire water distribution system. (NFPA 25, Section 7.3)

## **7.0 OPPORTUNITIES FOR IMPROVEMENT**

The assessment team identified two OFIs to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the assessment process. These OFIs are offered only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

### **DOE-SR**

**OFI-DOE-SR-1:** Consider filling vacancies in fire protection engineering to ensure continuity of oversight and maintain project-specific knowledge in preparation for upcoming retirements.

**OFI-DOE-SR-2:** Consider providing written comments in order to document oversight and verbal feedback provided to the SRS Fire Department.

## **Appendix A Supplemental Information**

### **Dates of Assessment**

Onsite Assessment:     April 1-4, 2019  
                                  April 29 – May 2, 2019

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

Nathan H. Martin, Director, Office of Enterprise Assessments  
April G. Stephenson, Deputy Director, Office of Enterprise Assessments  
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments  
Kevin G. Kilp, Deputy Director, Office of Environment, Safety and Health Assessments  
C.E. (Gene) Carpenter, Jr., Director, Office of Nuclear Safety and Environmental Assessments  
Charles C. Kreager, Acting Director, Office of Worker Safety and Health Assessments  
Gerald M. McAteer, Director, Office of Emergency Management Assessments

### **Quality Review Board**

April G. Stephenson  
Steven C. Simonson  
Thomas R. Staker  
Michael A. Kilpatrick

### **EA Site Lead for Savannah River Site SWPF**

Kevin Witt

### **EA Assessors**

Rosemary Reeves – Lead  
Joseph Panchison  
Barry Snook