

Assessment of the Operational Readiness of the Safety Class Sprinkler Systems in the Tritium Facilities

Site: Savannah River Site, Aiken, SC

Facility: Tritium Facility

System: Automatic Sprinkler Systems (Buildings 232-H, 233-H and 234-H)

System Classification: Safety Class

System Safety Function: The safety function of the automatic sprinkler system is to limit the consequences of fires to the general public. This is accomplished by extinguishing or suppressing fires, thereby limiting the hazardous material released.

OBJECTIVE:

VSS-1 This vital safety system is operational and personnel and processes are in place that ensures its continued operational readiness.

VSS-1.1 Vital Safety System (VSS) safety functions are defined and understood by responsible line managers, and supporting information/documentation is available and adequate. System testing is adequate to ensure operability.
(Approach Items 1, 2, 3, & 7)

Discussion of Results –

1a. The Tritium Safety Analysis Report (SAR), WSRC-SA-1-2, Rev 1, Chapter 4, Section 4.3 identifies the safety function of the sprinkler systems. The fire suppression systems in Buildings 232-H, 233-H and 234-H are designated as Safety Class (SC). The safety function of the fire suppression system is to limit the consequences of fires to the general public. These systems accomplish this function by extinguishing or suppressing fires, thereby limiting the hazardous material released.

Chapter 3 of the Tritium SAR documents the hazard/accident analyses for fire related accidents. The automatic wet pipe sprinkler systems in Buildings 232-H (Lines I/II and MTF), 233-H, and 234-H are SC Structures, Systems, and Components (SSCs) and are protected by Technical Safety Requirements (TSR) controls so credit can be taken for their operation.

1b The normal, abnormal and accident conditions under which the fire suppression systems are intended to operate is a random building fire event. . The systems are required to be operable in the same manner as any code compliant system installed in any industrial setting. The fire suppression systems are not credited with

performing during any other accident events, including seismically induced fire events.

- 1c. The functional requirement of the building fire suppression systems is to operate to prevent small fires from becoming area or full facility fires with sufficient reliability to reduce the frequency of an area fire to less than $1.0E-02/\text{yr}$ and a full facility fire to less than $1.0E-04/\text{yr}$. The performance criteria for the fire suppression systems are to comply with the code-of-record edition of NFPA 13 for design and installation and with the requirements of NFPA 25 for inspection, testing, and maintenance. (WSRC-SA-1-2, Sections 4.3.1, 4.3.2, and 4.3.3)

Buildings 232-H, 233-H, and 234-H are classified as Ordinary Hazard, Group 1 as defined by NFPA 13 per the Fire Hazards Analysis (FHA) for each building. The design of each building sprinkler system meets the requirements of the applicable code-of-record edition of NFPA 13 except that SRS engineering standards require the addition of a 500 gpm hose stream allowance where the code requires a 250 gpm hose stream. Inspection, testing, and maintenance of the sprinkler systems is performed in accordance with the 1999 edition of NFPA 25.

The Building 232-H fire sprinkler system has a water demand of 412.1 gpm at 98.28 psi at the base of the riser, plus an additional 500 gpm for hose streams. The Building 233-H fire sprinkler system has a water demand of 1271.2 gpm at 79.3 psi which includes a 500 gpm hose stream allowance. The Building 234-H fire sprinkler system has a water demand of 433.7 gpm at 103.7 psi at the base of the riser, plus an additional 500 gpm for hose streams.

The SC sprinkler system does not include any alarms because alarms are not required for sprinkler system operation. Supervisory alarms, pipe hangers, drain valves, inspectors test valves, etc. are not considered SC components because failure of one or more does not affect system operability.

2. The design and installation of fire suppression sprinkler systems are subject to the acceptance criteria required by NFPA 13, "Installation of Sprinkler Systems". Periodic surveillances are performed using the criteria specified in NFPA 25, "Standard for the Inspection, Testing, And Maintenance of Water-Based Fire Protection Systems". Trained and qualified personnel perform all surveillances using approved procedures.

Acceptance criteria for all surveillances are defined in the Technical Services Maintenance Division (TSMD) Procedure Manual Y14.20, Procedure 9990. This procedure reproduces the requirements of the applicable NFPA codes and standards for the inspection, testing, and maintenance of fire protection systems and components. Surveillance frequencies for the fire suppression systems are monthly, quarterly, semi-annual, annual, 5 year, etc.

The monthly, quarterly, semi-annual, and annual surveillances assure the operability of the sprinkler system and components (i.e. control, check, and alarm valves, sprinklers, piping, hangers, gauges, alarm devices, etc.). The surveillances include visual inspection of all components, manipulation of valves, verification of alarms, flow water through the system, etc. Hydrant flow tests are conducted at 5-year intervals by the fire department to demonstrate that the water supply distribution system is capable of delivering the required supply. The basis for the demand is documented in the fire hazards analysis for each building. Hydrant flow tests were performed in July 1993 and January 1998. Surveillances are scheduled, performed, and reviewed as preventative maintenance activities through the site's work management system, PASSPORT.

Personnel, who are qualified and trained for the task, as outlined in WSRC Manual 2Q, perform routine inspections and minor maintenance of fire suppression equipment. Chapter 12 of the SAR discusses procedures and training. Qualified fire protection engineers approve inspection, test and maintenance procedures prior to use. The results are also reviewed and approved qualified fire protection engineers after completion.

3. Inspections, tests and maintenance activities are performed on the fire suppression systems according to the frequencies and requirements specified in NFPA 25. Tritium personnel perform monthly inspections. Either Tritium personnel or TSMD personnel perform surveillances for quarterly, semi-annual, annual and beyond frequencies.

The TSRs, WSRC-TS-96-17, identify specific surveillances to assure operability of the fire suppression systems.

- Monthly - visual inspection of the suppression system control valves, alarm check valves, and dry-pipe valves (Buildings 232-H, 233-H, 234-H)
- Annual - visual inspection of the building fire suppression system piping, fittings, and sprinkler heads including Building 232-H, Room 208 dry-pipe valves (Buildings 232-H, 233-H, 234-H)
- Annual – perform functional test of the building fire suppression system (Buildings 232-H, 233-H, 234-H)
- Quarterly – perform priming water level functional test of the dry-pipe system serving Room 208 in building 232-H.

The 5-year hydrant flow test is addressed through the Administrative Controls section of the TSRs for the fire protection program.

7. Sprinkler system configuration is managed under the Tritium Configuration Management Implementation Plan. Drawings are maintained in the WSRC Document Control program. Drawings consist primarily of the vendor print files and are validated by a configuration walkdown of the systems. Configuration walkdowns resulted in a controlled set of process and instrumentation drawings (P&IDs) of each system. Calculations of system performance are also primarily in the vendor

print file, with additions through the years prepared as WSRC documents. System Design Description (SDD) documents are not complete yet, but a schedule has been prepared for completion of this task.

Facility line managers are trained in the functionality of the fire suppression systems. Shift Operations Managers (SOM) receive training on the SAR, the TSRs, and on all systems in all buildings. SOMs are required to pass a comprehensive written exam and an oral board exam. Shift Managers (SM) receive training on the SAR, the TSRs, and on all systems within their assigned building. SMs are required to pass a written comprehensive exam and an oral board exam. SOMs and SMs are required to requalify every 2 years.

- VSS-1.2** The backlog for surveillances, tests, inspections, maintenance, repair, upgrades, or other work on the system is managed and kept to an appropriate minimum. (Approach Item 6).

Discussion of Results –

6. Preventative maintenance surveillances are scheduled and tracked against a fixed due date with a corresponding late date. Site performance against a milestone is tracked and issued in a monthly report to DOE fire protection personnel at the fire protection program meeting. Since records were first kept, all surveillances for the SC sprinkler systems in the Tritium Facility have been performed within the required time. Should a surveillance becomes delinquent, the affected fire protection system is classified as impaired. The impairment is entered in the Fire Protection Database System (FPDS), the impairment is evaluated for Limiting Conditions for Operation (LCO) impacts, and compensatory measures are implemented as necessary.

TSMD tracks corrective maintenance through PASSPORT. Work critical to the operability of the system is performed under the “Fix it Now” (FIN) program. Items in the system greater than 30 days old are tracked separately. Items over 90 days old are identified in a report to management for additional attention. The current backlog of corrective maintenance items does not affect the operability of the SC fire suppression system.

Modifications to the fire suppression systems are tracked in a database maintained by Tritium Fire Protection. Design Change Forms (DCFs) have been prepared, prioritized and placed on the facility list for funding. These modifications are the result of a formal review titled “Assessment of the Validity of the Fire Protection system Performance at the Tritium Facility” performed by Arthur D. Little Program Resources, Inc. for DOE-SR. Due to funding constraints, a small number of upgrades are awaiting approval. Where upgrades are not practical, engineering evaluations, position papers, equivalencies, and exemptions have been prepared and submitted to DOE. Both the DOE-SR assessment and the subsequent Uni-

identified Safety Question Evaluation (USQE) performed by WSRC concluded that the deficiencies identified in the assessment did not degrade the operability of the fire suppression system.

Corrective actions are tracked in the Commitment Tracking System (CTS) until complete. These actions are the result of various audits, surveillances, drills, and other sources. The CTS currently includes some items on the fire suppression system. These items are tied to issues identified in the Arthur D. Little report. These items do not affect the operability of the fire suppression system as previously stated.

- VSS-1.3** Configuration Management and Maintenance programs effectively ensure operational availability of the system.
(Approach Items 5, 8, & 9).

Discussion of Results –

5. Preventative maintenance on the fire suppression system is performed in accordance with the WSRC Manual 1Y, Conduct of Maintenance. Work packages are written/planned by the maintenance organization. The packages are reviewed and approved by the fire protection system design authority (DA)/system engineer (SE). The DA/SE is responsible for specifying post maintenance test activities to ensure work has been performed properly. Corrective maintenance is performed in a like manner.

Operations personnel perform walkdowns of the facility once per shift which include the fire protection systems. Operations personnel in each building complete daily round sheets. These round sheets include recording gauge readings from pressure gauges on the fire suppression system to ensure adequate system pressure.

The Tritium Facility Fire Protection Coordinator (FPC) performs quarterly fire and life safety inspections of all buildings in the facility. These inspections include casual inspections of the fire suppression systems.

Routine formal assessments of the fire protection program and fire protection systems are included in the Tritium Self Assessment Program. Additionally, periodic assessments are performed through the site fire protection engineering program. Issues and/or concerns identified during these assessments are recorded and tracked to completion in the CTS.

8. All routine surveillances of fire suppression systems are reviewed by the DA/SE and the cognizant technical function (CTF), who must be a qualified fire protection engineer. All design changes affecting the fire suppression systems are reviewed and approved by the fire protection system design authority and a quali-

fied fire protection engineer. The design authority reviews all procedure changes and design change packages for an Unidentified Safety Question (USQ) and a Design Authority Technical Review (DATR) of the proposed change. All changes affecting the SC systems must be submitted and approved by the Tritium Operations Review Committee (TORC) for adequacy. The TORC chairman or designee signs the USQ/DATR package, design change package, or procedure change indicating TORC approval.

Following modifications, the sprinkler systems are subjected to acceptance and/or reacceptance testing according to the requirements of NFPA 13. In addition, qualified fire protection engineers or a National Institute for Certification in Engineering Technologies (NICET) Level 3 certified inspector inspect the system to assure compliance with the code requirements prior to testing.

9. The procedures and drawings addressing the fire suppression systems are all controlled under a formal document control program. Changes and retrieval are controlled under WSRC Manuals 1B, 1Q and B14-1.

VSS-1.4 The system is operable and available to fulfill its safety function when required. (Approach Items 4 & 10).

Discussion of Results –

- 4a. In the past three years, the fire suppression systems have never failed to meet specified test acceptance criteria either from routine surveillances or from acceptance/reacceptance testing following modification.
- 4b. In May of 1998 the 233-H pre-action sprinkler system failed to trip as expected when a fire alarm was received. This system was converted from a pre-action system to a wet pipe system in 1999. In the past three years, this is the only time a facility fire suppression system has failed to respond as expected.
- 4c. According to the SAR, the sprinkler system is not credited with 100% reliability/availability, but simply the normal reliability experienced by general industry.

Since the fire suppression systems were reclassified as SC, three of the four systems in Buildings 232-H, 233-H, and 234-H have not been impaired. One zone of the sprinkler system serving Building 233-H was impaired for 7 days in CY 2000 (less than 2%) to install additional sprinklers for the Tritium Modernization and Consolidation (TCON) project in Room 44. As a result of impairments, the fire suppression systems were not capable of performing as required less than 1% of the time for the one system affected. The remaining systems were available 100% of the time.

10. Fire protection water for sprinkler systems in the Tritium Facilities is provided by the H-Area fire water system. Two 600,000-gallon water storage tanks are provided as the supply source. One tank is a Design Basis Earthquake (DBE) designed tank. The outlet valve for this tank is normally closed such that water will be readily available after a DBE. The second tank is normally on line.

Three fire pumps supply the underground loop. Two diesel fire pumps rated at 2,500 gpm @ 120 psig are located in one building. A single electric fire pump rated at 2,500 gpm @ 120 psig is located in a separate building. The pumps can take suction from either or both of the 600,000 gallon tanks. An additional fire protection water source, which is normally valved out, is available from the Defense Waste Processing Facility fire water system loop in S-Area.

The fire water system is designed to ensure that water is available throughout the loop at 2,000 gpm at a minimum pressure of 90 psig. The three 2,500 gpm fire pumps are sized such that the maximum fire protection flow demand is less than 100% of the rated pumping capacity of any two pumps. The largest demand with the Tritium Facilities is less than any single pump or single tank. Normal system pressure in the Tritium Facility loop is maintained between 122 psig and 127 psig by two 5-hp Jockey pumps. The electric pump is set to start when system pressure drops below 117 psig and the diesel pumps are set to start at 115 psig and 110 psig. The fire pumps run until manually stopped. Relief valves, set at 132 psig, are installed on the discharge of each pump.

In January 1994 during startup of Building 233-H, the Replacement Tritium Facility, facility personnel and the SRS Fire Department successfully demonstrated the ability to shuttle an adequate supply of water from the H-Area tank during a fire drill evolution for the Defense Nuclear Facilities Safety Board (DNFSB). This provides an additional source of water for the Tritium fire suppression systems.

CONCLUSIONS –

The Tritium Facilities SAR identifies the 232-H, 233-H, and 234-H fire suppression systems as SC SSCs. The individual systems are required to function under normal, abnormal, and accident conditions in order to prevent small fires from becoming full facility fires. The design and installation of the fire suppression systems meet the NFPA 13 requirements. The fire suppression systems are tested and maintained per NFPA requirements. Facility line managers are trained in the functionality of the fire suppression systems and the importance of these SC SSCs in relation to the Authorization Basis of the Tritium Facilities.

All work activities including maintenance, surveillances, tests, modifications, etc performed on the Tritium Facilities SC fire suppression systems are prioritized, scheduled and tracked through the PASSPORT work management system. System impairments, when required, are controlled through FPDS and evaluated for impacts to the Authorization Basis. The current backlog of work activities does not affect the operability of the SC fire suppression systems.

All work activities are performed in accordance with the WSRC Conduct of Maintenance manual. Additional verification of system operability is provided through regularly scheduled walk-downs by operations personnel, fire and life safety inspections, and assessments through the facility and the site fire protection group. A USQ/DATR is performed for all changes affecting the SC fire suppression systems. All changes are reviewed and approved by the DA/SE, a qualified fire protection engineer, and TORC prior to implementation. Documents are controlled and maintained through a formal program.

With the exception of a single incident in 1998 in Building 233-H, the SC fire suppression systems have always performed as expected. Following the 1998 incident, Building 233-H was converted from a pre-action system to a wet pipe system. The systems have been available greater than 99% of the time. Water for the fire suppression systems is provided by redundant tanks, electric and diesel fire pumps, an alternate connection to another site facility, and by the fire department through a shuttle operation.

DOE Employee who reviewed this assessment _____ Date_____

Hours required to complete assessment.

DOE: _____ hrs

Contractor: 76 hrs