

NRC INSPECTION MANUAL

IRIB

INSPECTION PROCEDURE 71111 ATTACHMENT 05

FIRE PROTECTION

Effective Date: 01/01/2020

PROGRAM APPLICABILITY: IMC 2515 App A

CORNERSTONE: Initiating Events
Mitigating Systems

INSPECTION BASES: Inspection Manual Chapter (IMC) 0308, "Reactor Oversight Process Basis Document," Attachment 2, "Technical Basis for Inspection Program"

SAMPLE REQUIREMENTS:

| Sample Requirements | | Minimum Baseline Sample Completion Requirements | | Budgeted Range | |
|------------------------------------|------------|---|-------------|-------------------|-----------------|
| Sample Type | Section(s) | Frequency | Sample Size | Samples | Hours |
| Fire Area Walkdown and Inspection* | 03.01 | Annual | 16 per site | 16 to 24 per site | 30+/-4 per site |
| Fire Brigade Drill Performance | 03.02 | Annual | 1 per site | 1 per site | 5±1 per site |

* Recommend performing one-fourth of the annually planned samples every quarter.

71111.05-01 INSPECTION OBJECTIVES

01.01 To verify implementation of an adequate fire protection program (FPP) in regard to material condition and operational status of fire detection and suppression systems and equipment and fire barriers used to prevent fire damage or fire propagation.

01.02 To verify adequate onsite fire brigade training and drill performance.

71111.05-02 GENERAL GUIDANCE¹

Typically, there are two types of fire protection Licensing Bases; Deterministic or Risk-informed Performance-based:

Deterministic²:

This inspection procedure (IP) covers annual inspection of operating plants licensed under Title 10 of the *Code of Federal Regulations* (10 CFR) 50.48(a) to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," 10 CFR 50.48(b), Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979."

Risk-informed Performance-based:

10 CFR 50.48(c) via National Fire Protection Association (NFPA) 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition.

For those fire protection structures, systems, and components installed to satisfy the U.S. Nuclear Regulatory Commission's (NRC's) regulatory requirements and designed and installed using NFPA codes and standards, the code edition in force at the time of the design and installation is the code of record (COR) to which the design is evaluated.

The updated final safety analysis report or fire hazard analysis report should identify and justify deviations from the COR. A licensee may apply the equivalency concept (justification for not meeting code and alternatives used to meet the code) in meeting the provisions of the NFPA codes and standards. When the licensee states that its design "meets the NFPA code(s)" or "meets the intent of the NFPA code(s)" and does not identify any deviations from such codes, the NRC expects that the design conforms to the codes and that the design is subject to inspection against the NFPA COR.

The "Authority Having Jurisdiction," as described in NFPA codes and standards, refers to the Director of the NRC Office of Nuclear Reactor Regulation (NRR), or his or her designee, consistent with the authority specified in 10 CFR 1.43, "Office of Nuclear Reactor Regulation."

Use plant specific fire risk insights (e.g., fire risk ranking of the plant fire areas) to select fire areas important to risk for inspection. Review the last triennial fire protection inspection report and probabilistic risk assessments (PRA) if applicable as a guide for determining areas. Consider the risk insights developed by licensees that have adopted a risk-informed, performance-based FPP in accordance with 10 CFR 50.48(c) and NFPA 805. Consider the plant configuration, out-of-service equipment, operating experience, maintenance activities, and the effects that a fire may have on safety.

¹ Note: For AP1000 designs, in addition to areas having safety-related Structures, Systems and Components (SSCs), focus on areas with systems classified as Regulatory Treatment of Nonsafety Systems (RTNSS) of high or intermediate importance. A list of SSCs classified as RTNSS is in Chapter 16 of the Vogtle Electric Generating Plant (VEGP) Updated Final Safety Analysis Report (UFSAR), Table 16.3-1 (ML18179A291). The list of Risk-Significant SSCs within the Scope of Design Reliability Program, which evaluates the design of the AP1000 and identifies the aspects of plant operation, maintenance, and performance monitoring pertinent to risk-significant SSCs, is in Chapter 17 of the VEGP.UFSAR, Table 17.4-1 (ML18179A292). RTNSS is discussed in Section C.IV.9 "Regulatory Treatment of Nonsafety Systems" of Regulatory Guide 1.206, "Applications for Nuclear Power Plants," (ADAMS Package Accession No. ML070720184).

²The AP600 fire protection system was licensed as part of 10CFR52, Appendix C, AP600 Design Certification. Since AP1000 is very similar to AP600, the basis for the AP1000 fire protection system is that of AP600. The AP1000 compliance with BTP CMEB 9.5-1 is the same as for AP600. See VEGP UFSAR Section 9.5.1, "Fire Protection System," (ML18179A283).

For each sample, conduct a routine review of problem identification and resolution activities using Inspection Procedure (IP) 71152, "Problem Identification and Resolution."

71111.05-03 INSPECTION SAMPLES

03.01 Fire Area Walkdown and Inspection Sample.

Verify the adequate implementation of the FPP by conducting a walkdown of selected fire area and performing a review to verify program compliance, equipment functionality, material condition, and operational readiness.

Specific Guidance

Review the licensee's combustible loading calculation for the particular fire zone for the fire area selected against the FPP-defined hazards and defense-in-depth (DID) features to verify it is adequate. The concept of DID to fire protection in plant areas important to safety by the following means:

- preventing fires from starting;
- rapidly detecting, controlling, and extinguishing fires that do occur; and
- providing protection for structures, systems, and components important to safety so that a fire that is not promptly extinguished by fire suppression activities will not prevent the safe shutdown (SSD) of the reactor.

Use the prefire plan as a tool in evaluating the attributes listed below for the selected fire areas. The prefire plan should define the hazards and fire protection DID features to assist the inspector in determining whether the attributes of the fire area are within the limits of the licensing basis defined in the FPP. The required content of the prefire plans will be defined in the FPP and will include information such as locations of fire hose stations and portable extinguishers, locations of sprinkler isolation valves, Post-Fire SSD (referred to as Nuclear Safety Capability Assessment (NSCA)) equipment in the area, and other such information. The accuracy of the prefire plan is important because the plan will be a major tool to inform and guide the fire brigade team leader in determining the most likely location of the fire in the fire area and the best strategy for approaching the fire.

Select a fire area based on the licensee-approved FPP and perform an area walkdown to verify the following:

a. Control of Transient Combustibles and Ignition Sources

1. The licensee is controlling transient combustible materials and location of transient combustible materials in accordance with its administrative control procedures and its fire PRA if applicable. Give special focus to transient combustibles located near ignition sources and SSD or NSCA cables and equipment.
2. The licensee is performing hot work, welding, cutting, heat treating, grinding, brazing, flame or plasma arc cutting, or arc gouging in accordance with its FPP administrative control procedures.

b. Fire Detection Systems

1. Inspect the physical condition of the fire detection devices.
2. Note any devices that show physical damage, blockage, or potential interference which could impact functionality.

c. Water-Based Fire Suppression Systems

1. Sprinklers and nozzles are not obstructed³ by equipment (e.g., ventilation ducts, cable trays/conduits, or temporary scaffolding), are not damaged or painted, and are installed in the proper orientation (e.g., upright, pendent, or sidewall). Floor drains in areas protected by sprinkler/water spray systems are open and unobstructed, and drainage is directed to areas that will not be adversely affected by the runoff.
2. Water supply control valves to the system are open, and the fire water supply and pumping capability is operable and capable of supplying the water supply demand of the system (verify through visual observation or surveillance record⁴ - . Verify that trim valves on alarm check valves and deluge valves are aligned to the correct position for automatic operation.
3. Spot check sprinkler piping, hanger, or seismic braces condition and damage or leakage. Look for corroded piping or hangers, broken hangers, improper pipe alignment or other adverse conditions.
4. During regular system testing fire pumps should remain in full service. Fire pumps are sometimes impaired during testing due to concerns of pressure surges and water hammer damaging water mains. For diesel fire pump, check fuel storage tank has sufficient fuel. Pressure maintenance (jockey or make-up) pump is installed on fire water systems in order to maintain system pressures from small fluctuations without turning on the main fire pump.
5. Material conditions such as mechanical damage, painted sprinklers/nozzles, and corrosion will not affect the performance of the system.

d. Gaseous Fire Extinguishing Systems

1. The nozzles of gaseous extinguishing systems (e.g., Halon 1301, carbon dioxide, and clean agents (e.g., FM200, Inergen)) are not obstructed⁵ or blocked by equipment (e.g., ventilation ducts cable, trays/conduits or temporary scaffolding) that would significantly impede the dispersal of a gaseous agent.

³ NFPA 13, Standard for the Installation of Sprinkler Systems,” 2019 Edition, Section 3.3.133.1 Continuous Obstruction States: An obstruction located at or below the level of sprinkler deflectors that affect the discharge pattern of two or more adjacent sprinklers. NFPA 13, 2019 Edition, Section 3.3.133.2 Noncontinuous Obstruction States: An obstruction at or below the level of the sprinkler deflector that affects the discharge pattern of a single sprinkler.

⁴ Monticello Nuclear Generating Plant Special Inspection (ADAMS Accession No. [ML11363A182](#) and NRC Information Notice 2013-06, “Corrosion in Fire Protection Piping Due to Air and Water Interaction,” ADAMS Accession No. [ML13031A618](#)) for an example of fire water system corrosion blockage).

⁵ The obstruction created by equipment adversely impacts the distribution pattern of the nozzle spray pattern and affect the fire extinguishment performance.

2. The fire extinguishing agent charge pressure is within the normal band, extinguishing agent supply valves are open, and the system is in the appropriate mode. Observe any corrosion, physical damage to system tanks and cylinders or potential interface with functionally. System actuation panels are powered on, and the panels are free of trouble indications or standing alarms. Look for longstanding uncorrected equipment problems.
3. Fire dampers and electrically supervised self-closing fire doors are unobstructed so that they can close automatically upon actuation of the gaseous system. Observe any material condition that may affect the performance of the system, such as mechanical damage to doors or dampers and open penetrations (i.e., open floor drains may preclude proper gaseous concentration following actuation. **Confirm drains are factored into system design and acceptance test results**). In rooms protected with a total flooding gaseous fire extinguishing system, verify that all egress doors are properly labeled to warn the occupants of the danger of a system discharge and that egress door latches fully engage to maintain design concentrations. Note properly mark/label pull stations and audible and visual pre-discharge alarms to indicate their functions.
4. Room penetration seals are sealed and in good condition to prevent airflow and to prevent loss of the gaseous extinguishing agent concentration following discharge.
5. Inspect material conditions such as mechanical damage, corrosion, damage to doors or dampers, open penetrations, or nozzles blocked by plant equipment (e.g. overhead obstructions) that may affect the performance of the system.

e. Manual Firefighting Equipment and Capability

1. Portable fire extinguishers are appropriate for the class of fire hazard and are available at their designated locations in or near the area being inspected. Access to the fire extinguishers is unobstructed by plant equipment or other work-related activities.
2. The general condition of portable fire extinguishers is satisfactory (e.g., there is no corrosion, the pressure gauge reads in the acceptable range, nozzles are clear and unobstructed, and charge test records indicate testing within the normal periodicity).
3. Fire hose stations are installed at their designated locations; the general condition of hoses and hose stations is satisfactory (e.g., there is no corrosion or holes in, or chafing of, the hose; the nozzles are not mechanically damaged and not obstructed; and the valve hand wheels are in place); and access to the hose stations is unobstructed and testing records indicate testing within the normal periodicity.
4. Standpipes and hose connections necessary for manual firefighting in areas containing equipment required for SSD or NSCA in the event of an earthquake.
5. Water supply control valves to the standpipe system are open, and the fire water supply and pumping capability is operable and able to supply the water flow and

pressure demand.

6. The general condition of yard fire hydrants is satisfactory to ensure water supplies are available in a fire emergency (e.g., material conditions such as mechanical damage, corrosion, damage to yard fire hydrants).
 7. If tanks are used for fire water supply, they should free from corrosion, corrosion could occur at tank bottom at inaccessible locations.
 8. Access to manual actuators for fixed suppression systems (e.g., gaseous systems, dry sprinkler systems) is unobstructed by **maintenance** work-related activities.
- f. For plants that have transitioned to NFPA 805 licensing basis verify that the licensee has evaluated that any radiation release to any unrestricted area that results from the direct effects of fire suppression activities (but not involving fuel damage) shall be as low as reasonably achievable and shall not exceed applicable 10 CFR Part 20, "Standards for protection against radiation limits," (see NFPA 805, Section 1.5.2, "Radioactive Release Performance Criteria"). This is a new requirement in NFPA 805 that have not previously existed in NRC fire protection regulations.
- g. To meet the radioactive release performance criteria, licensees generally credited engineering controls (e.g., floor drains, storage tanks, ventilation systems, portable fans, etc.) and/or administrative controls (e.g. pre-fire plans, fire brigade response activities, etc.). Licensees also identified the administrative controls in the pre-fire plans for implementation by the fire brigade to ensure that any radioactive release due to suppression activities or smoke migration do not exceed the public dose limits of 10 CFR Part 20.
- h. The licensee met the radioactive release performance criteria if it demonstrated on a fire area basis that the effects of fire suppression activities and smoke migration are contained in a system that was designed to maintain and control radioactive waste.
- i. Passive Fire Protection Features
1. Electrical raceway fire barrier systems such as cable tray and conduit (including the associated support system) fire wraps or blanket materials are in good condition with no cracks, gouges, or holes in the barrier material and no gaps in the material at joints or seams, and banding, wire tie, and other fastener pattern and spacing appear appropriate.
 2. Fire doors self-close without gapping (e.g., as the result of fire door damage from previous obstructions), and the door latching hardware functions securely.
 3. The condition of ventilation system fire damper material, including fusible links, where applicable, is adequate to ensure unobstructed operability. For those dampers that cannot be readily observed in the selected plant areas, review the licensee's surveillance efforts directed toward verifying the continuing operability of ventilation fire dampers.

4. Structural steel fireproofing material, such as fibrous or concrete encapsulation, is installed in such a way that the structural steel is uniformly covered (there are no bare areas).
5. Fire barrier and fire area/room/zone electrical and piping penetration seals are not missing from locations where they are needed to complete a fire barrier wall. Seals appear to be properly installed and in good condition.
6. For pressurized-water reactors, reactor coolant pump (RCP) oil collection systems designed to collect oil leakage and spray from all potential RCP oil collection system leakage points have been installed and are properly maintained (i.e., time permitting, the actual installation should be verified during outages after work on the pumps has been completed). Oil collection pans and spray shields properly positioned and maintained to collect all oil leakage.

j. Compensatory Measures and Fire Watch

1. Verify that the licensee has put in place compensatory measures for out-of-service, degraded, or inoperable fire protection equipment and systems or features (e.g., detection and suppression systems and equipment, passive fire barrier features, SSD, or NSCA equipment functions or capabilities). A fire watch is often the compensatory measure of choice for a large variety of fire protection system and feature malfunctions and deficiencies. The established fire watch or other compensatory measures should be commensurate with the significance of the deficiency.
2. Fire watches are typically tracked via a fire watch log. The log can be checked against the security key card entry records to validate that proper completion of fire watches. Another inspection method could be to wait in an area that requires a fire watch inspection to see if the individual performing the fire watch comes through the area. This latter method could be combined with an inspection of that area as a fire area sample.
3. Inspect the licensee's plans for permanent corrective actions, including effectiveness in returning the fire protection equipment to service in a reasonable period of time. Review the licensee corrective actions to address fire protection non-compliances that are rely upon long compensatory measures and schedule to complete the compensatory measures and the licensee efforts to eliminate the reliance on the compensatory measures.

03.02 Fire Brigade Drill Performance Sample

Verify adequate onsite fire brigade training and performance during an announced/unannounced fire drill or an actual event.

Specific Guidance

The inspection evaluates the licensee's onsite fire brigade performance **through the direct observation of the fire brigade during training evolutions or drill performance**. Inspectors may not be able to observe and evaluate all **aspects** of the drill activities as part of a single drill. Therefore, inspectors may need to observe the conduct of several

fire brigade drill segments (announced and unannounced) throughout the year to adequately sample this area. The purpose of this sample is to ensure the capability of the fire brigade team members, the leadership ability of the brigade leader, use of turnout gear and firefighting equipment, and the effectiveness of the team operation.

Select an unannounced drill or **fire brigade live fire training exercise**. An announced fire drill is acceptable but not the preferred option. Observe and/or evaluate the licensee's fire brigade performance in the following activities and programs to assess their operational effectiveness in combating fires, particularly drills in areas of the plant that are pertinent to 10 CFR 50.48(b) when available:

- a. Brigade Staffing Size. Collateral responsibilities of the fire brigade team members should not conflict with their responsibilities related to the fire brigade during a fire.
- b. Proper Donning of Fire Gear. Each team member sets out his or her designated protective clothing and turnout gear and properly dons the gear.
- c. Proper Donning, Availability, and Program Control of Self-Contained Breathing Apparatuses (SCBAs). SCBAs are available and are properly worn and used. Each individual should completely don his or her bunker gear (e.g., helmets, hood, pants, coats, gloves, boots, and air packs). This includes donning an SCBA, before entering the fire scene. Evaluate the SCBA program, including storage, training, expectations for use, and maintenance.
- d. Procedure Adherence. Control room personnel follow the procedures for fire verification and response initiation, including identifying the fire's location, dispatching the fire brigade, and sounding the alarms. **The licensee declares the emergency action levels and makes the appropriate notifications in accordance their NRC approved Emergency Response Plan commitment(s)**. The licensee declares the emergency action levels and makes the appropriate notifications in accordance with NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," issued November 1980, and 10 CFR Part 50.
- e. Command and Control. The fire brigade leader exhibits command of the fire brigade and has a copy of the prefire plans or firefighting strategy.
 1. Planning. The manager in charge of the response (e.g., the shift supervisor or senior reactor operator (not the fire brigade leader)) has access to prefire plans or firefighting strategy and applicable procedures. Starting at the muster area, the fire brigade leader maintains command and control.
 2. Briefing. Fire brigade team members are briefed, discuss the plan of attack, receive individual assignments, complete communications checks, and generally get ready to combat the fire. The discussion of the plan of attack should be consistent with the prefire plans or firefighting strategies and should include potential hazards in the fire area. The fire brigade takes the appropriate access route specified in the strategies and procedures and arrives at the fire scene in a timely manner. For fire drills conducted in the radiation control areas, the fire brigade may follow the specified, most direct route.

3. Communication. Control/command is set up near the location of the fire after the fire is assessed, and communications are established with the control room and fire brigade team members. Radio communications among the command post, control room, and plant operators and among fire brigade team members remain efficient and effective for the duration of the drill.
 4. Implementation. Fire hose lines are capable of reaching all necessary fire hazard locations, the lines are laid out without flow constrictions, and the hose is simulated as being charged with water. The fire area of concern is entered in a controlled manner following the principle of “two-in/two-out” (two fire brigade team members enter while two remain outside the area of concern). Additionally, the fire brigade team members stay low to the floor and feel the door for heat before entering the fire area of concern. The fire brigade brings sufficient firefighting equipment to the scene to properly perform its firefighting duties. Team members of the fire brigade check for fire victims and propagation of the fire into other plant areas. Effective smoke removal operations are simulated in accordance with prefire plans and firefighting strategies by aligning ventilation in the fire area or by placing smoke removal units at the proper doors. Areas protected by gaseous fire extinguishing systems should not be ventilated before the brigade confirms that the fire is extinguished. If the simulation of smoke removal is not part of the drill, verify the availability and condition of such equipment (e.g., fans, hoses).
- f. Scenario Adherence, Drill Objectives, Postdrill Critique, and Equipment Restoration. The licensee performs a post critique to discuss fire brigade performance and determine if drill scenario was properly implemented and acceptance criteria for the drill objectives were met.

71111.05-04 REFERENCES

1. Cross Reference of Generic Communications to IP 71111.05 and Inspection Resources, available at <http://drupal.nrc.gov/nrr/ope/33988> (nonpublic)
2. Operating Experience, gateway available at <http://drupal.nrc.gov/nrr/ope> (nonpublic).
3. Information Handling Services Codes and Standards, available at <http://www.internal.nrc.gov/TICS/library/standards/ihs.html> (nonpublic).
4. NRC Technical Library, available at <http://www.internal.nrc.gov/TICS/library/index.html> (nonpublic).
5. National Fire Protection Association (NFPA) 805, “Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants,” 2001 Edition.
6. Regulatory Guide 1.189, “Fire Protection for Nuclear Power Plants,” Revision 2, October 2009, Agencywide Documents Access and Management System (ADAMS) Accession No. [ML17340A875](#).
7. NRC Regulatory Issue Summary 2005-07: “Compensatory Measures to Satisfy the Fire Protection Program Requirements,” April 2005, ADAMS Accession No. [ML042360547](#)

8. NUREG/CR-3175, "Compensatory and Alternative Regulatory Measures for Nuclear Power Plant FIRE Protection (CARMEN-FIRE)," August 2015, ADAMS Accession [ML15226A446](#)
9. NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Revision 1, November 1980, ADAMS Accession No. [ML040420012](#).
10. Regional Reactor Inspector Training and Reference Handbook, Inspection Procedure 71111.05XT NFPA 805 (Triennial), Revision 0, April 2017, ADAMS Accession No. [ML17110A559](#)
11. NRC Information Notice 2013-06, "Corrosion in Fire Protection Piping Due to Air and Water Interaction," ADAMS Accession No. [ML13031A618](#)
12. Monticello Nuclear Generating Plant Special Inspection Report ADAMS Accession No. [ML11363A182](#)

END

Attachment 1
Revision History for IP 71111.05

| Commitment Tracking Number | Accession Number Issue Date Change Notice | Description of Change | Description of Training Required and Completion Date | Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information) |
|----------------------------|--|--|--|---|
| | 08/31/2006 | Researched commitments back 4 years; none found. | None | |
| | 09/10/04 CN 04-023 | Issued Inspection Procedure (IP) 71111.05AQ, "Fire Protection Annual/Quarterly," to separate 71111.05T, "Fire Protection (Triennial)," from IP 71111.05AQ. No substantial changes. | None | |
| | 07/07/05 CN 05-018 | Updated guidance to assess fire brigade performance. | None | |
| | ML061910174 09/05/06 CN 06-022 | Added "Completion Status," identifying a sample size of 24. | None | |
| | ML072830418 01/31/08 CN 08-005 | The 2007 Reactor Oversight Process (ROP) realignment reduced the sample size to 16 and resource hours to 35. Replaced "tour" with "perform a DID walkdown." (ROPFF 1155) | None | |
| | ML092780058 11/16/09 CN 09-027 | Updated the procedure to incorporate specific elements of NFPA 805. | None | ML092780063 |
| | ML102570167 09/30/10 CN 10-020 | Revised IP 71111.05AQ to address feedback form 71111.05-1542. The revision added a reference section to the procedure. | None | |

| Commitment Tracking Number | Accession Number Issue Date Change Notice | Description of Change | Description of Training Required and Completion Date | Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information) |
|----------------------------|--|--|--|---|
| | ML18085A040 08/01/18 CN 18-025 | Eliminated redundancy and improved IP 71111.05 for plain writing. Relocated optional requirements to the guidance section for better alignment with the sample completion requirements in Section 8.04 of IMC 2515, "Light-Water Reactor Inspection Program—Operations Phase." Added a reference to Monticello Nuclear Generating Station Special Inspection in Section 03.01c.2. Changed IP number from 71111.05A/Q to 71111 Attachment 5 to accommodate RRPS and future efforts to automate inspection report auto-generation. | None | ML18088A003 Closed FBF: 71111.05AQ-1783 ML18213A246 |
| | ML19170A368 08/07/19 CN 19-026 | Updated to include comments submitted by NEI dated December 20, 2018 (ADAMS Package Accession Number ML19150A550). Added criteria to include inspecting areas having RTNSS for AP1000 designs. | None | ML19178A155 |