

XI.M27 FIRE WATER SYSTEM

Program Description

This aging management program (AMP) applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, fire pump casings, hydrants, hose stations, standpipes, water storage tanks, and aboveground, buried, and underground piping and components that are tested in accordance with the applicable National Fire Protection Association (NFPA) codes and standards. Such testing assures the minimum functionality of the systems. Also, these systems are normally maintained at required operating pressure and monitored such that loss of system pressure is immediately detected and corrective actions initiated.

A sample of sprinkler heads is tested by using the guidance of NFPA 25, "Inspection, Testing and Maintenance of Water-Based Fire Protection Systems" (1998 Edition), Section 2-3.1.1, or NFPA 25 (2002 Edition), Section 5.3.1.1.1. These NFPA sections state "where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing." It also contains guidance to perform this sampling every 10 years after the initial field service testing.

The water-based fire protection system piping is subjected to required flow testing in accordance with guidance in NFPA 25 to verify design pressure or evaluated for wall thickness (e.g., non-intrusive volumetric testing or plant maintenance visual inspections) to ensure that aging effects are managed and that wall thickness is within acceptable limits. These inspections are performed before the end of the current operating term and at plant-specific intervals thereafter during the period of extended operation. The plant-specific inspection intervals are determined by engineering evaluation of the fire protection piping to ensure that degradation is detected before the loss of intended function. The purpose of the full flow testing and wall thickness evaluations is to ensure that corrosion, microbiologically influenced corrosion (MIC), or biofouling is managed such that the system function is maintained.

Chapter XI.M41 describes the aging management program for buried and underground water-based fire protection system piping and tanks.

Evaluation and Technical Basis

1. **Scope of Program:** The AMP focuses on managing loss of material due to corrosion, MIC, or biofouling of steel components in fire protection systems exposed to water. Fire hose stations and standpipes are considered as piping in the AMP. Fire hoses and gaskets can be excluded from the scope of license renewal if the standards that are relied upon to prescribe replacement of the hose and gaskets are identified in the scoping methodology description.
2. **Preventive Actions:** To ensure that no significant corrosion, MIC, or biofouling has occurred in water-based fire protection systems, periodic flushing and system performance testing are conducted in accordance with NFPA 25.
3. **Parameters Monitored/Inspected:** Loss of material due to corrosion and biofouling could reduce wall thickness of the fire protection piping system and result in system failure. Therefore, the parameters monitored are the system's ability to maintain pressure and

internal system corrosion conditions. Periodic flow testing of the fire water system is performed using the guidelines of NFPA 25, or wall thickness evaluations may be performed to ensure that the system maintains its intended function. Testing of sprinklers ensures that degradation is detected in a timely manner.

4. **Detection of Aging Effects:** The water-based fire protection system testing is performed to ensure that the system functions by maintaining required operating pressures. Wall thickness evaluations of fire protection piping are performed on system components using non-intrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion. These inspections are performed before the end of the current operating term and at plant-specific intervals thereafter during the period of extended operation.

As an alternative to non-intrusive testing, the plant maintenance process may include a visual inspection of the internal surface of the fire protection piping upon each entry to the system for routine or corrective maintenance, as long as it can be demonstrated that inspections are performed (based on past maintenance history) on a representative number of locations on a reasonable basis. These inspections are capable of evaluating (a) wall thickness to ensure against catastrophic failure and (b) the inner diameter of the piping as it applies to the design flow of the fire protection system.

If the environmental and material conditions that exist on the interior surface of the below grade fire protection piping are similar to the conditions that exist within the above grade fire protection piping, the results of the inspections of the above grade fire protection piping can be extrapolated to evaluate the condition of below grade fire protection piping. If not, additional inspection activities are needed to ensure that the intended function of below grade fire protection piping is maintained consistent with the current licensing basis for the period of extended operation.

Continuous system pressure monitoring, system flow testing, and wall thickness evaluations of piping are effective means to ensure that corrosion and biofouling are not occurring and that the system's intended function is maintained.

General requirements of existing fire protection programs include testing and maintenance of fire detection and protection systems and surveillance procedures to ensure that fire detectors as well as fire protection systems and components are operable.

Visual inspection of yard fire hydrants, performed annually in accordance with NFPA 25, ensures timely detection of signs of degradation, such as corrosion. Fire hydrant hose hydrostatic tests, gasket inspections, and fire hydrant flow tests, performed annually, ensure that fire hydrants can perform their intended function and provide opportunities to detect degradation before a loss of intended function can occur. Sprinkler heads are tested before the end of the 50-year sprinkler head service life and at 10-year intervals thereafter during the period of extended operation to ensure that signs of degradation, such as corrosion, are detected in a timely manner.

5. **Monitoring and Trending:** System discharge pressure is monitored continuously. Results of system performance testing are monitored and trended as specified by the associated plant commitments pertaining to NFPA codes and standards. Degradation identified by non-intrusive or visual inspection is evaluated.

6. **Acceptance Criteria:** The acceptance criteria are (a) the water-based fire protection system is able to maintain required pressure, (b) no unacceptable signs of degradation are observed during non-intrusive or visual inspection of components, (c) minimum design pipe wall thickness is maintained, and (d) no biofouling exists in the sprinkler systems that could cause corrosion in the sprinklers.
7. **Corrective Actions:** Repair and replacement actions are initiated as necessary. For fire water systems and components identified within scope that are subject to an aging management review (AMR) for license renewal, the applicant's 10 CFR Part 50, Appendix B, program is used for corrective actions for aging management during the period of extended operation. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.
8. **Confirmation Process:** For fire water systems and components identified within scope that are subject to an AMR for license renewal, the applicant's 10 CFR Part 50, Appendix B, program is used for confirmation process for aging management during the period of extended operation. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.
9. **Administrative Controls:** For the water-based fire water systems and components identified within scope that are subject to an AMR for license renewal, the applicant's 10 CFR Part 50, Appendix B, program is used for administrative controls for aging management during the period of extended operation. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the administrative controls.
10. **Operating Experience:** Water-based fire protection systems designed, inspected, tested, and maintained in accordance with the NFPA minimum standards have demonstrated reliable performance.

References

- 10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants*, Office of the Federal Register, National Archives and Records Administration, 2009.
- NFPA 25, *Inspection, Testing and Maintenance of Water-Based Fire Protection Systems*, 1998 Edition, National Fire Protection Association.
- NFPA 25, *Inspection, Testing and Maintenance of Water-Based Fire Protection Systems*, 2002 Edition, National Fire Protection Association.