UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
OFFICE OF FEDERAL AND STATE MATERIALS
AND ENVIRONMENTAL MANAGEMENT PROGRAMS
WASHINGTON, DC 20555-0001

March 25, 2013

NRC INFORMATION NOTICE 2013-06: CORROSION IN FIRE PROTECTION PIPING DUE TO AIR AND WATER INTERACTION

ADDRESSEES

All holders of an operating license or construction permit for a nuclear facility under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," including those that have permanently ceased operations and have spent fuel in storage in the spent fuel pool.

All holders of an operating license or construction permit for a non-power reactor (research reactor, test reactor, or critical assembly) under 10 CFR Part 50, including those that have permanently ceased operations and have spent fuel in storage at their facility.

All holders of and applicants for a power reactor early site permit, combined license, standard design certification, standard design approval, or manufacturing license under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

All holders of and applicants for a fuel cycle facility license under 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

All holders of and applicants for a gaseous diffusion plant certificate of compliance or an approved compliance plan under 10 CFR Part 76, "Certification of Gaseous Diffusion Plants."

All holders of and applicants for a specific source material license under 10 CFR Part 40, "Domestic Licensing of Source Material."

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert NRC applicants and licensees to recent operating experience involving the loss of function of fire protection sprinkler systems with the potential for air-water interactions. The NRC expects that recipients of this IN will review the information for applicability to their facilities and

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consider actions, as appropriate. However, suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

Perry Nuclear Power Plant, Unit 1

In March 2012, NRC inspectors discovered that FirstEnergy Nuclear Operating Company, licensee for the Perry Nuclear Power Plant, did not install sprinkler piping in accordance with National Fire Protection Association (NFPA) Standard 13 - 1972, "Standard for the Installation of Sprinkler Systems," which specified that all sprinkler pipe and fittings shall be installed so that the system may be drained. During a walkdown of the system, the inspectors and licensee engineering staff identified a 6-inch pipe section that could not be drained because the drainage points were located on a smaller diameter pipe that fed from the side of the 6-inch pipe.

During the inspection, the licensee performed boroscopic video examination of the 6-inch main feed line internals. The examination revealed that the galvanized coating remained on the dry upper portion of the pipe. However, the examination also revealed that the lower portions of the piping containing residual water were corroded. The licensee determined that the system was previously actuated but was not fully drained. Residual water in the piping system caused the corrosion of portions of the piping material. Subsequently, the licensee developed a modification plan to replace portions of the sprinkler piping system to eliminate areas that could not be drained.

Additional information can be found in "Perry Nuclear Power Plant—NRC Triennial Fire Protection Inspection Report 05000440/2012008," dated May 20, 2012, in the NRC's Agencywide Documents Access and Management System (ADAMS) under Accession ADAMS Accession No. ML12143A342.

Monticello Nuclear Generating Plant, Unit 1

On September 2, 2011, maintenance personnel at the Monticello Nuclear Generating Plant discovered that portions of the intake structure building pre-action sprinkler system piping were partially blocked and incapable of passing flow. Monticello's intake structure building pre-action sprinkler system is relied upon, in part, to satisfy an approved exemption to 10 CFR Part 50, Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979," Section lll.G.2.b, concerning separation of components in the intake structure building.

Xcel Energy, licensee for the Monticello Nuclear Generating Plant, determined that the installation of the intake structure building pre-action sprinkler system in 1983 did not comply with design requirements for providing required pipe slope to ensure proper draining of the system following flow testing or system actuation. This condition allowed water to remain in the system, which then contributed to accelerated internal corrosion. These corrosion products accumulated and blocked the sprinkler pipe. The licensee flushed the sprinkler system, replaced portions of the piping that contained substantial blockage, and performed internal inspections to confirm removal of the blockage as part of the immediate corrective actions before returning the system to service.

The NRC dispatched a special inspection team to review the facts surrounding the event, as documented in "Monticello Nuclear Generating Plant NRC Special Inspection Team Report 05000263/2011010," dated December 29, 2012. The report can be found under ADAMS Accession No. ML11363A182. Additional information also can be found in Monticello Nuclear Generating Plant Licensee Event Report 50-263/2011-006, dated October 31, 2011 (ADAMS Accession No. ML113050425).

LaSalle County Station

On October 1, 2010, Exelon Generation Company, LLC, licensee for the LaSalle County Station, performed a flow test of the pre-action sprinkler system in the chemistry lab. The licensee discovered that a mud-like substance blocked flow through a valve attached to a drainage hose. Furthermore, this substance was blocking the flow through one of the branch lines. Subsequently, the licensee determined that the mud-like substance was made up of corrosion products.

The piping in the pre-action system was galvanized and pressurized with air. Water was present in portions of the system because the system was not properly drained following previous flow testing. As a result, the oxygen in the pressurized air and the trapped water resulted in a potentially corrosive environment. Over time, the corrosion built up in the piping and resulted in blockage in one of the branch lines. As part of their corrective actions, the licensee flushed all of the branch lines and revised their testing procedure to flush the entire system. The licensee also considered installing low-point drains and pressurizing the system with nitrogen instead of air to reduce the possibility of corrosion.

At the 2011 Nuclear Energy Institute's Fire Protection Information Forum, the industry presented details on the circumstances of this event. This information can be found under ADAMS Accession No. ML13014A100.

BACKGROUND

Nuclear facilities must have a fire protection program to ensure public health and safety. These programs describe features necessary for fire protection, such as fire prevention, detection, and suppression. The fire protection program ensures that nuclear material is safely treated and radioactive releases to the environment are minimized in the event of a fire.

DISCUSSION

Fire protection suppression system reliability and performance capabilities are a primary feature of plant fire protection. Licensees rely on fire sprinkler systems to protect the plant from potential fires. All licensees are required to meet commitments in their approved fire protection programs and install and maintain fire-suppression systems in accordance with their NFPA codes and standards of record.

Piping systems filled with water or kept completely dry are not as susceptible to internal corrosion as piping partially filled with water and air. All three examples discussed had portions of the piping system partially filled with water, in which corrosion occurred as a result of the partially filled piping. The corrective actions that licensees took included draining the pre-action

sprinkler system piping of water and installing drain lines to ensure that the lowest portions of the systems can be drained. However, even a properly designed pre-action system is susceptible to corrosion when it is filled with water numerous times because of testing or inadvertent actuation. Licensees can consider pressurizing pre-action systems with nitrogen instead of air to reduce the possibility of corrosion. Licensees also may take other corrective actions to restore systems to service, such as cleaning the piping using mechanical means, flushing the piping systems, and performing flow tests to verify system operation. Although the operating experience only identified this issue relating to pre-action sprinkler systems, dry-pipe sprinkler systems may also have air-water interaction within the piping which may lead to similar corrosion issues.

Although the NRC has no specific regulatory requirements to inspect for corrosion in partially filled piping in sprinkler systems, licensees have committed to NFPA standards for sprinkler systems. NFPA 13 - 2013, "Standard for the Installation of Sprinkler Systems," has no requirements to perform internal inspections of partially filled piping throughout a pre-action system or to perform internal obstruction inspections. Licensees are typically committed to older versions of NFPA 13, which also did not include such requirements after initial installation or for performance of internal obstruction inspections.

Currently, NFPA 25 - 2011, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems," requires periodic obstruction inspection and testing and flushing the system if sufficient obstructions are found. Specifically, Table 5.1.1.2 of NFPA 25 (2011 edition) requires an internal obstruction inspection of piping to be conducted every 5 years. Section D.4.1 of Annex D of NFPA 25 contains a recommendation to investigate thoroughly dry pipe and pre-action systems using noncoated ferrous piping for obstructions from corrosion after they have been in service for 15 years, for 25 years, and every 5 years thereafter. However, many licensees are not committed to NFPA 25 and may not be performing periodic obstruction inspections. The events discussed in this IN show that even galvanized piping is subject to corrosion. Although not required, licensees are encouraged to inspect sprinkler systems with the potential for air and water interactions that have been inadvertently actuated or flow tested, and which may not have been properly drained, for corrosion.

Nuclear power plant operating experience shows that water-based fire protection systems are subject to loss of material because of corrosion. As a result, corrosion has resulted in blockages of the sprinkler system flow and failed flow tests. Licensees can detect degradation in fire protection sprinkler systems with the potential for air and water interactions before a loss of function by inspecting and testing the systems in accordance with NFPA standards, along with visual inspections.

Along with the recipients of this IN, the NRC expects that power reactor renewed license holders will review this information for applicability to their aging management programs related to corrosion of fire protection piping to determine whether enhancements to their current program would preclude these types of events from occurring in fire water systems. Enhancements to consider include incorporating current NFPA code and standard requirements or expanding the scope of obstruction inspections.

CONTACT

This information notice requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or the appropriate NRC project manager.

/RA/

Lawrence E. Kokajko, Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

/RA/

John D. Kinneman, Director
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards

/RA/

Laura A. Dudes, Director
Division of Construction Inspection
and Operational Programs
Office of New Reactors

/RA/

Larry W. Camper, Director
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Technical Contacts: Daniel Frumkin, NRR
301-415-2280
E-mail: daniel.frumkin@nrc.gov

Dariusz Szwarc, RIII
630-829-9803
E-mail: dariusz.szwarc@nrc.gov

Note: The NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under the NRC Library.

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