



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**

REGION III  
2443 WARRENVILLE ROAD, SUITE 210  
LISLE, IL 60532-4352

December 29, 2011

Mr. Timothy J. O'Connor  
Site Vice President  
Monticello Nuclear Generating Plant  
Northern States Power Company, Minnesota  
2807 West County Road 75  
Monticello, MN 55362-9637

**SUBJECT: MONTICELLO NUCLEAR GENERATING PLANT NRC SPECIAL INSPECTION  
TEAM (SIT) REPORT 05000263/2011010**

Dear Mr. O'Connor:

On December 15, 2011, the U.S. Nuclear Regulatory Commission (NRC) completed a Special Inspection at your Monticello Nuclear Generating Plant (MNGP) to evaluate the facts and circumstances surrounding the September 2, 2011, identification of substantial blockage in the intake building fire protection piping. The determination to initiate a Special Inspection was made on September 12, 2011, based on the risk and deterministic criteria specified in Management Directive 8.3, "NRC Incident Investigation Program," and due to the equipment performance issues that occurred. The Special Inspection began on September 12, 2011, and was conducted in accordance with Inspection Procedure 93812, "Special Inspection." The basis for initiating the special inspection and the focus areas for review are detailed in the Special Inspection Charter (Attachment 2 of the enclosure).

The enclosed inspection report documents the inspection results, which were discussed at the interim meeting on October 14, 2011, and at the exit meeting on December 15, 2011, with yourself and other members of your staff.

The inspection examined activities conducted under your licenses as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your licenses. The inspectors reviewed selected procedures and records, observed activities, interviewed plant personnel, and evaluated the facts and circumstances surrounding the event, as well as actions taken by your staff in response to the unexpected equipment conditions.

Based on the results of this inspection, one NRC-identified finding of very low safety significance was identified. The finding was not associated with a violation of regulatory requirements. Additionally, four licensee-identified violations which were determined to be of very low safety significance are listed in this report. The NRC is treating these violations as non-cited violations (NCVs) consistent with Section 2.3.2 of the Enforcement Policy.

If you contest the subject or severity of the NCVs, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Regional Administrator, U.S. Nuclear Regulatory Commission - Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532-4352; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the Resident Inspector Office at the Monticello Nuclear Generating Plant.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records System (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

*/RA/*

Steven A. Reynolds, Director  
Division of Reactor Safety

Docket No. 50-263  
License No. DPR-22

Enclosure: Inspection Report 05000263/2011010  
w/Attachments:  
1. Supplemental Information  
2. Special Inspection Team Charter  
3. Timeline of Events

cc w/encl: Distribution via ListServ™

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No.: 50-263

License No.: DRP-22

Report No.: 05000263/2011010

Licensee: Northern States Power Company, Minnesota

Facilities: Monticello Nuclear Generating Plant

Location: Monticello, Minnesota

Dates: September 12 through December 15, 2011

Inspectors: C. Tilton, Senior Reactor Engineer, DRS  
D. Szwarc, Reactor Engineer, DRS  
P. Voss, Monticello Resident Inspector, DRP

Approved by: A. M. Stone, Chief  
Engineering Branch 2  
Division of Reactor Safety

Enclosure

## SUMMARY OF FINDINGS

IR 05000263/2011010; 9/12/2011-12/15/2011: Monticello Nuclear Generating Plant; Special Inspection.

This report covers a 5-week period of inspection by two regional inspectors and a resident inspector. One Green finding was identified by the inspectors. The finding was not associated with a violation of regulatory requirements. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" (SDP). Findings for which the SDP does not apply may be (Green) or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

### A. NRC-Identified and Self-Revealed Findings

#### Cornerstone: Mitigating Systems

- Green. The inspectors identified a finding of very low safety significance (Green) involving the licensee's failure to accomplish activities affecting quality in accordance with procedures. Specifically, the licensee failed to incorporate operating experience in accordance with procedures. This impacted the licensee's ability to implement an effective aging management program for the fire protection system. No violation of NRC requirements was identified.

The performance deficiency was determined to be more than minor because it was associated with the Mitigating Systems cornerstone attribute of Protection Against External Factors (Fire) and affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e., core damage). Using IMC 0609, Appendix F, Fire Protection SDP, and the Monticello SPAR model, the inspectors determined that this finding had very low safety significance. The inspectors did not identify an associated crosscutting aspect for this finding. (Section 4OA5.7b.(1))

### B. Licensee-Identified Violations

Four violations of very low safety significance identified by the licensee were reviewed by the inspectors. Corrective actions planned or taken by the licensee were entered into the licensee's corrective action program. These violations and corrective action tracking numbers are listed in Section 4OA7 of this report.

## **REPORT DETAILS**

### **Event Summary**

Local fire suppression in the intake structure consists of an automatic pre-action sprinkler system. When the deluge valve, located in the intake tunnel, actuates, water enters the sprinkler system piping. The Intake Structure Sprinkler System Drain valve, FP-171-1, is located within a short distance downstream of the deluge valve. During testing, water passing through this open valve demonstrates the deluge valve opened as expected. The Sprinkler Inspectors Test valve, FP-171-10, is located a distance downstream, at the opposite end of the Intake Structure.

On August 26, 2011, during the performance of Surveillance Test 0323-01, "Fire Protection System Sprinkler Functional Tests," the licensee found blockage at valve FP-171-10. At this time, the shift manager declared the fire system non-functional. The licensee established a 14-day fire protection system impairment (consistent with Procedure 0323-01) and the previously established continuous compensatory fire watch with backup suppression remained in effect. Maintenance personnel confirmed the valve was plugged with debris and removed the blockage.

On August 28, 2001, when the licensee performed Surveillance Test 0323-01 as the Post Maintenance Test (PMT) to verify the blockage was removed from valve FP-171-10, additional blockage was found in the piping. After further investigation, the licensee found significant blockage in the fire sprinkler line up stream of valve FP-171-10, as well as in three vertical risers to sprinkler heads. The majority of the blockage was on the west end of the intake structure which is above Division 2 residual heat removal service water (RHRSW) pumps and motors. Laboratory analysis performed later determined the blockage consisted of internal pipe corrosion byproducts. The fine corrosion byproducts resulted in a clay-like substance.

On September 2, 2011, after additional inspections of the subject fire system piping, the licensee concluded the sprinkler suppression piping was not capable of operating per its design due to the significant fouling. The condition was reported to the NRC under 10 CFR Part 50.72(b)(3)(ii)(B) as an unanalyzed condition affecting plant safety systems.

### **4OA5 Other Activities - Special Inspection (93812)**

#### **Inspection Scope**

A Special Inspection was initiated following the NRC's review of the deterministic and conditional risk criteria specified in Management Directive 8.3, "NRC Incident Investigation Program." The inspection was conducted in accordance with NRC Inspection Procedure (IP) 93812, "Special Inspection." The Special Inspection Charter, dated September 12, 2011, is included as Attachment 2. The team reviewed technical and design documents, procedures, maintenance records, corrective action documents, interviewed station personnel, gathered information from the plant computers and event recorders with alarm printouts, and performed physical walkdowns of plant equipment. A list of specific documents reviewed is provided in Attachment 1.

As detailed in the Special Inspection Charter (Attachment 2), the following items were reviewed and associated results obtained.

.1 Perform a walkdown of the intake structure to evaluate the condition of the fire suppression system, identify any potential impact on safety-related equipment and components, and evaluate the adequacy of compensatory measures.

a. Inspection Scope

The inspectors performed a walkdown of the intake structure with the licensee on September 13, 2011, in order to determine if a credible fire could develop in the room that could affect multiple safety-related systems, structures, or components. The inspectors evaluated the location of safe shutdown equipment, the extent of fixed and transient combustibles, and the adequacy of other existing fire protection features in the area. The inspectors also assessed the suitability of compensatory measures taken by the licensee following identification of the degradation of the sprinkler system.

b. Findings and Observations

The intake structure comprises Fire Area IX / Fire Zone 23A and contains various pumps and associated motors: two circulating water pumps, four RHRSW pumps, electric fire pump, screen wash/fire pump, four emergency service water pumps, two makeup pumps, two seal water pumps, and the fire system jockey pump. The area also contains motor control center 123/113, the electric fire pump control panel, and the screen wash/fire pump control panel. Two parallel non-safety-related cable trays run in the north/south direction and two cable trays run in the east/west direction in the area.

Most of the pump motors in the room contain small amounts of lubricating oil (five to nine quarts each). The circulating water pump motors contain 38 gallons of lubricating motor oil; however, these motors are not located on the main floor. The four RHRSW pump motors each contain 13 gallons of lubricating oil and are separated from other equipment by a shroud. The area as a whole has a very low fire load of approximately 13,000 British Thermal Units per square foot (Btu/ft<sup>2</sup>).

Based on the walkdown of the intake structure, the inspectors determined due to the low fire loading, the most likely fire scenario in the area would be limited to the ignition source (e.g. pump motor) and not spread throughout the area.

The inspectors verified the licensee implemented appropriate compensatory measures in the area for the fire impairment. The compensatory measures included a continuous fire watch and verifying the functionality of hose stations located in the area.

.2 Evaluate the licensee's actions to correct the current condition. This includes assessing the licensee's extent of condition review and subsequent inspection or testing of affected piping.

a. Inspection Scope

The inspectors reviewed the licensee's actions pertaining to restoring the intake structure pre-action sprinkler system to service. The inspectors reviewed the licensee's post maintenance testing, engineering evaluation for restoring functionality (EC 18475),

and the as-left hydraulic analysis. The inspectors also reviewed the licensee's extent of condition review of other similar systems.

b. Findings and Observations

The licensee declared the intake structure pre-action sprinkler system non-functional on September 2, 2011 upon discovery of silting and corrosion products in the piping. Subsequently, the licensee tested the sprinkler system branch lines in the intake structure to determine the extent of the clogging. The licensee performed visual inspections by removing portions of the piping and sprinklers, examining the pipe internals through the use of a video boroscope, and using radiography. Through these examinations, the licensee concluded a significant portion of the piping had blockage, with the most severe blockage occurring at the west end of the room where portions of the sprinkler system piping at the far west end of the room were 100% blocked.

In order to return the system to service, the licensee flushed all of the sprinkler system branch lines, replaced the piping at the far west end of the room, and replaced all of the sprinklers in the room. After flushing the lines, the licensee performed confirmatory inspections using a video boroscope and radiography. These additional inspections showed no loose material remained in the piping.

The licensee performed an engineering evaluation (EC 18745) to evaluate the intake structure fire protection system piping capability following restoration activities. The evaluation included a revised hydraulic analysis that concluded the sprinkler system could provide a sufficient amount of water to the area.

The licensee's extent of condition review identified dry-pipe pre-action sprinkler systems were also installed in the emergency diesel generators (EDG) 11 and 12 rooms. The inspectors reviewed work order (WO) 00341476 which documented flushing of debris found in the EDG 11 sprinkler system in 2007. However, the licensee did not have documentation showing a flush was also performed for the EDG 12 sprinkler system. Following questions from the inspectors, the licensee inspected the piping in the EDG 12 sprinkler system on September 21, 2011 and confirmed it was free of obstructions.

.3 Evaluate the function of the fire protection system in the degraded condition.

a. Inspection Scope

The inspectors discussed with the licensee the functionality of the intake structure pre-action sprinkler system in the degraded condition.

b. Findings and Observations

To evaluate the as-found condition of the intake structure pre-action sprinkler system, the licensee performed a hydraulic analysis (MN11-995-160-100). This analysis considered the reduced piping diameter which existed on September 2, 2011, based on piping blockage measurements taken by the licensee. The licensee also performed a transport analysis (0067-0039-01) to determine whether the debris discovered in the intake structure pre-action sprinkler system would be transported through the system and block water flow through the sprinklers. Based on the results of these analyses, the licensee concluded the system would have remained functional in the degraded state and the debris in the system would have passed flow through the sprinkler heads.

The inspectors challenged the licensee's conclusion that the debris in the piping would likely have been transported through the piping as particles and would have been flushed out through the sprinkler heads. The inspectors believed the debris would likely have caused the sprinkler heads to become clogged and not pass water through. As a result of the inspectors concerns, the licensee did not take credit for past functionality of the sprinkler system.

.4 Evaluate the adequacy of the design of the fire protection sprinkler system.

a. Inspection Scope

The inspectors reviewed the licensee's original system design and hydraulic analysis to determine if the system had been appropriately designed. The inspectors compared the design of the system to applicable NFPA standards.

b. Findings and Observations

The licensee installed a combined dry-pipe and pre-action sprinkler system in the intake structure in 1983. This system contains sprinklers attached to piping designed to be kept dry. Heat detectors were installed in the area and would actuate (open) a deluge valve to fill the piping with water. The sprinklers would also react to a heat source due to a fire and operate to allow water to flow.

The inspectors determined the original system design met the requirements of National Fire Protection Association (NFPA) 13, "Standard for the Installation of Sprinkler Systems." The licensee had committed to the 1983 edition of this standard. However, the licensee determined through their Root Cause Evaluation (RCE) that the system was not installed per design. Specifically, the licensee determined the slope of the piping was not correct and therefore, resulted in water not draining properly. A licensee identified violation related to this deficiency is discussed in Section 4OA7 of this report.

However, the inspectors identified a properly designed dry-pipe system would also be susceptible to corrosion. The inspectors noted the NFPA standards do not specify the gas to be used to pressurize the dry portion of the system nor the piping material. The piping in the sprinkler system was constructed of carbon steel and the licensee pressurized the dry-pipe portion of the system with oxygen. Since 1983, the system was filled with water numerous times due to inadvertent actuation or testing. Each of these times, the system was drained and pressurized with oxygen. The corrosion resulting from the interaction of the oxygen and water with the carbon steel piping was accelerated by the numerous wetting and drying cycles. In conclusion, the system was designed properly but the improper installation and multiple actuations lead to a buildup of corrosion products in the piping.

.5 Determine if there are potential generic implications for other plants relying upon raw water sources for their fire protection systems.

a. Inspection Scope

The inspectors reviewed industry standards and requirements for testing dry-pipe pre-action systems. The inspectors also reviewed operating experience information related to these types of systems.

b. Findings and Observations

The inspectors identified potential generic implications for other plants with a combined dry-pipe and pre-action sprinkler system. These insights will be submitted to regional management for further consideration.

.6 Determine whether verifying water flow through the fire protection piping is required by industry standards or NRC requirements. Evaluate whether the licensee's current and past surveillance procedures meet these industry standards or NRC requirements.

a. Inspection Scope

The inspectors reviewed the licensee's fire protection program commitments, NRC regulations and requirements, and applicable NFPA standards to determine requirements for verifying the functionality of water-based fire suppression systems.

b. Findings and Observations

The licensee installed the pre-action sprinkler system in 1983 in accordance with NFPA 13, the standard in effect at the time of installation. Section 1-11.2 of NFPA 13, only required a hydrostatic test to be performed on a new system. The inspectors verified the licensee did perform a hydrostatic test (WRA 83-02978) when the system was installed. The standard did not contain any requirements for conducting periodic flow tests or obstruction examinations.

The inspectors noted the licensee used procedure 0324, "Fire Protection System – Sprinkler System Tests," to test the functionality of the intake structure sprinkler system. Step 45 of this procedure, required the licensee to open the intake structure sprinkler system test valve FP-171-10. Step 45 further stated that discharge of water from test valve verified operation of the deluge valve and confirmed the piping was not blocked. The requirement to observe water flow from the inspectors test valve was added to Procedure 0324 on June 4, 2010. The required frequency for performing the test was once every 24 months and August 26, 2011 was the first time the test had been conducted using the new requirements. The inspectors determined that prior to the August 26, 2011 event, the licensee did not have a requirement for verifying water flow through the inspectors test valve in the intake structure.

Therefore, the inspectors determined that there were no specific NRC requirements for verifying water flow in sprinkler systems. The NRC approved the licensee's fire protection program in which the licensee committed to installing and maintaining the system in accordance with applicable NFPA standards (NFPA 13 – 1983 edition in MNGP case).

In addition, the inspectors noted NFPA 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems" contained additional inspection and testing requirements for periodic obstruction investigations. Specifically, Table 5.1.1.2 of NFPA 25 (2011 edition) requires an internal obstruction inspection of piping to be conducted every five years. Section 14.3.3 of NFPA 25, further requires a complete flushing be performed if sufficient obstructions are found. The licensee was not committed to this standard and therefore was not performing periodic obstruction investigations. However, as stated in the root cause evaluation as an extent of condition corrective action, the licensee planned to conduct a gap analysis of NFPA 25 and

current plant requirements. The licensee created a preventative maintenance change request (PMCR) # 00024867 on October 4, 2011 to perform an inspection of the sprinkler main in the intake structure at the flushing valves. The PMCR stated that if significant blockage is found, further branch inspections are to be performed and to flush the sprinkler main and the branches. The inspectors noted that this would meet the intent of NFPA 25.

.7 Evaluate license renewal requirements/commitments completed to date and those which could be potentially affected by fouling in the fire protection piping.

a. Inspection Scope

The inspectors reviewed the License Renewal Application (LRA), Aging Management Programs related to Fire Water and Open Cycle Cooling Water (OCCW), implementing procedures, surveillance results and work orders. The inspectors also interviewed individuals responsible for the programs.

b. Findings and Observations

(1) Failure to Follow Fire Water Aging Management Program Implementing Procedure

Introduction: The inspectors identified a finding of very low safety significance (Green) involving the licensee's failure to accomplish activities affecting quality in accordance with procedures. Specifically, the licensee failed to incorporate operating experience in accordance with procedures. This impacted the licensee's ability to implement an effective aging management program for the fire protection system. No violation of NRC requirements was identified.

Description: The NRC approved the Monticello Nuclear Generating Plant License Renewal Application (LRA) on November 8, 2006. As part of the LRA, the licensee committed to manage the effects of aging of their structure, systems and components by implementing aging management programs (AMPs.) Appendix B of LRA describes in detail the purpose and implementing strategies of the AMPs. The Fire Water AMP is defined in Section B.2.1.18. Each AMP has ten elements, which jointly, effectively and efficiently provide reasonable assurance that aging effects will be managed so that the systems and components within the scope of the program will continue to perform their intended functions consistent with the current licensing basis through the period of extended operation. Operating experience is one of the elements listed in each AMP.

Section 3.10 of PBD/AMP-014, "Fire Water System Aging Management Program Basis Document," describes the licensee's approach in implementing operating experience. It states, in part:

"Industry and plant experience is evaluated for system performance impacts. Performance issues are documented and evaluated in the site Corrective Action Program. With regard to items that potentially affect the Fire Water System Program, the OE [*Operating Experience*] is forwarded to the program owner for evaluation and potential action that may include incorporating the issue into existing inspection or test procedures. Consequently, aging related issues are captured and evaluated within the corrective action system."

The period of extended operation for the Monticello site began September 9, 2010 which corresponds to the date the aging management programs became effective.

On September 12, 2011, while reviewing PBD/AMP-014 and a sample of corrective actions, the inspectors noted the licensee did not incorporate seven instances of internal and external operating experience. These included:

- (external) In 2006, Nine Mile Point identified an obstruction of sprinkler heads in fire water pre-action fire zones caused by lake water sediment and corrosion products as documented in an external operating experience report.
- (external) In 2006, Forsmark (Sweden) reported clogged fire protection sprinkler nozzles as documented in an external operating experience report.
- (internal) In 2007, the licensee identified blockage caused by corrosion products in the emergency diesel generator (EDG) sprinkler system. The EDG sprinkler is a dry-pipe pre-action system similar to the one located in the intake structure. The licensee initiated a CAP document to evaluate the condition in the intake structure sprinkler system; however, the licensee did not initiate actions to assess the Fire Water AMP.
- (external) In 2008, Prairie Island (also a Northern States Power Company licensee) identified silting and plugging of their turbine-generator bearing fire protection system.
- (external) In 2008, Crystal River identified internal corrosion and slime buildup in their pre-action sprinkler system as documented in an external operating experience report.
- (internal) In 2009, the licensee identified blockage in the intake structure sprinkler system while performing a PMT. The licensee initiated a CAP document to evaluate the condition; however, the licensee did not initiate actions to assess the Fire Water AMP.
- (external) In 2010, La Salle reported clogging of the pre-action spray system located in a laboratory as documented in an external operating experience report.

The inspectors were concerned because as of September 9, 2010, the licensee had not incorporated the previously discussed operating experience in their Fire Water Aging Management Program. Procedure PBD/AMP-014 required an evaluation of industry and plant experience for system performance impacts. In addition, the licensee failed to evaluate and take action of incorporating these issues into existing inspections and/or test procedures.

Specifically, the licensee originally believed no aging mechanism existed for the suppression piping inside of the intake building because the system was a dry system. Therefore, they assessed locations susceptible to degradation for further sampling and inspection without taking into account this section of the fire protection system. However, the piping in the sprinkler system was constructed of carbon steel and the licensee pressurized the dry-pipe portion of the system with oxygen. Since 1983, the system was filled with water numerous times due to inadvertent actuation or testing. Each of these times, the system was drained and pressurized with oxygen. The

corrosion resulting from the interaction of the oxygen and water with the carbon steel piping was accelerated by the numerous wetting and drying cycles. As indicated in the operating experience above and in the actual operation of the suppression system, dry systems have experience aging effects, specifically internal corrosion, due to periodic wetting of the internal surfaces. As required by the aging management program, the licensee should have assessed this operating experience with respect to equipment aging effects and establish appropriate corrective or followup actions to be taken.

In addition, the inspectors noted the licensee did not identify aging as a contributing cause in the root cause evaluation for the most recent blockage in the intake building sprinkler system. Therefore, no CAP documents were initiated to address and correct the effects of aging. Moreover, the licensee failed to identify this incident as a potential operating experience needing to be addressed as required by PBD/AMP-014.

The licensee acknowledged the inspectors' concerns and initiated corrective action program document AR 1308266 to address the issue. As part of their corrective actions, the licensee plans to perform an evaluation of the Fire Water AMP to ensure aging is managed and systems are capable of performing their intended functions. The inspectors reviewed the licensee's action request and had no concerns.

Analysis: The inspectors determined the failure to incorporate operating experience was contrary to the requirements of procedure PBD/AMP-014, "Fire Water System Aging Management Program Basis Document" and was a performance deficiency. This impacted the licensee's ability to implement an effective aging management program for the fire protection system. The performance deficiency was determined to be more than minor because it was associated with the Mitigating Systems cornerstone attribute of Protection Against External Factors (Fire) and affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e., core damage). Specifically, the availability and reliability of the fire suppression system were affected because by not incorporating operating experience, the aging management program could not provide reasonable assurance that aging effects will be managed so that the systems will continue to perform its intended functions consistent with the current licensing basis through the period of extended operation.

The inspectors determined the finding could be evaluated using risk-assessment tools of IMC 0609, Appendix F, "Fire Protection Significance Determination Process," and performing bounding analyses using the Monticello Standard Plant Analysis Risk (SPAR Model), Version 8.15. The inspectors reviewed and discussed the licensee's bounding risk-assessment documented in Probabilistic Risk-Assessment (PRA) Memo 11-01-, Revisions 0 and 1, "Risk-Assessment of Intake Fire Suppression System Plugging." The inspectors determined the finding was of very low safety significance (Green) because the risk increase using bounding assumptions was below  $1E-6$ .

The inspectors determined the cause of the performance deficiency (failure to incorporate operating experience) was not associated with a crosscutting aspect as defined in IMC 0310, "Components Within the Cross-Cutting Areas."

Enforcement: No violation of regulatory requirements occurred. (FIN 05000263/2011010-01, Failure to Follow Fire Water Aging Management Program Implementing Procedures).

.8 Determine if there is a performance deficiency through a review of the licensee's corrective action program to identify prior occurrences of fire protection system blockage or silting and applicable operating experience.

a. Inspection Scope

The inspectors independently searched the corrective action program (CAP) for CAP documents, work orders, and action requests potentially related to the event. These CAPs included documentation of previous instances where the licensee may have had indications of the condition of the intake structure fire protection sprinkler system, and documentation of several spurious actuations of the system. In addition, the inspectors reviewed copies of procedures related to the events described in the CAP documents, to determine whether the licensee's actions were in compliance with their procedures. The inspectors also reviewed CAP documents generated by the licensee's root cause evaluation team to determine whether the team had identified these deficiencies during the course of their own review.

b. Findings and Observations

The inspectors identified several instances where the licensee had opportunities to recognize the condition of the intake structure fire protection system, but failed to take appropriate actions. The inspectors determined the licensee's root cause team had independently identified the same performance deficiencies; therefore, the performance deficiencies described below and documented in Section 4OA7 of this report were determined to be licensee-identified:

- On August 11, 2007, the licensee performed work order (WO) 341476 to flush the emergency diesel generator (EDG) sprinkler system. Maintenance personnel noted that no water flowed through the inspectors test valve and the licensee took corrective actions (AR 01106463) to determine the cause of the blockage and to remove the obstructions. The licensee developed a corrective action (WO 342675-02) to flush the intake structure sprinkler system because both systems were of the same design. This work order was postponed ten times and was not performed as of the August 26, 2011 blockage discovery in the intake structure sprinkler system inspectors test valve. The inspectors determined that this was a licensee identified violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," for the failure to promptly identify and correct this condition. The obstructions in the intake structure sprinkler system would likely have been identified sooner had the licensee completed WO 342675-02 to flush the sprinkler system.
- In April 2009, the licensee performed work on the RHRSW system under WO 381724, which required the removal of portions of the fire protection sprinkler piping in the intake structure. Following the work, the fire protection piping was reinstalled, and on April 30, 2009, during the post-maintenance test (PMT), workers again found blockage in the piping which prevented the water from reaching the test valve. When the condition was identified, CAP 01180222 was written to document the blockage condition that was found during the PMT. However, when the condition was evaluated during a functionality assessment of the system, the assessment was limited and narrowly focused. The inspectors determined that this was a licensee identified NCV for a failure to follow 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," for the inadequate Fire Protection System

functionality assessment. Had the assessor properly pursued this information during the functionality assessment, the extent of the blockage in the piping would have been identified.

- On April 30, 2009, when site personnel were unable to complete the step which required water flow through the inspector test, the PMT should have been documented as a failed PMT. Instead, all procedure steps and acceptance criteria were marked off as being complete, and the test documentation contained no information about the blockage condition and its adverse impact on the ability to complete the test. As a result, individuals reviewing the completed test did not recognize that the acceptance criteria had not been met, and the procedure was processed as a successfully completed procedure. The inspectors determined this was a licensee-identified NCV for a failure to follow 10 CFR Part 50, Appendix B, Criterion XI, "Test Control." The inspectors concluded that correctly controlling and documenting the results of this test, including documentation of the failure to meet the acceptance criteria, would have allowed the organization to recognize the impact of the blockage on the equipment.

.9 Review the licensee's root cause evaluation plan and schedule. Evaluate whether the root cause evaluation plan is of sufficient depth and breadth. Confirm that the time allowed to perform the root cause evaluation is commensurate with the safety significance of this issue.

a. Inspection Scope

The inspectors reviewed the licensee's root cause evaluation for this condition and associated corrective actions. The inspectors performed an independent root cause analysis before reviewing the licensee's root cause.

b. Findings and Observations

The licensee began a root cause evaluation (RCE) for this condition on September 12, 2011. The RCE was completed on October 6, 2011. The licensee identified improper installation of the pipe as the root cause of the condition as the system was not able to drain properly and therefore corrosion byproducts accumulated towards the end of the intake building fire protection header. The inspectors determined this was a licensee-identified NCV of License Condition 2.C.4 for the failure to implement and maintain in effect all provisions of their approved fire protection program. Specifically, the installation of the intake structure pre-action sprinkler system did not comply with NFPA 13 (1983) section 3-11.1.1, which requires that all sprinkler pipe and fittings shall be so installed that the system may be drained and resulted in the plugging of the sprinkler system. This prevented water from flowing through sprinkler heads and caused the system to be non-functional. This licensee identified NCV is further documented in Section 4OA7 of this inspection report.

Although, the inspectors agree improper installation caused the material to remain in the system, the inspectors identified numerous weaknesses in the licensee's root cause analysis and subsequent corrective actions:

- The inspectors determined the licensee failed to identify other possible causes that contributed to this condition and potentially exacerbated it. The fire protection sprinkler in the intake building is a pre-action type system which is kept dry and

pressurized with air. Pressurization with air created an oxygen-rich environment which accelerates corrosion in carbon steel pipe. In addition, system actuation - either planned or unplanned - filled the pipe with water, resulting in a wetting and drying cycle. This condition increases the rate of oxidation in the pipe as it strips off the layer of corrosion formed (which acted as a barrier between the oxygen and the metal and therefore minimized additional corrosion) and exposes new metal to oxygen. Neither of these two possible contributing causes was analyzed or assessed in the licensee's root cause evaluation.

- The licensee identified seven instances where Operating Experience from traditional industry sources was relevant to the condition at Monticello, but was not implemented at the site using their existing OE program. The inspectors noted that the corrective action for this item was to benchmark industry guidance on the threshold for evaluating industry OE, such as the seven examples identified during the root cause evaluation. While benchmarking can be a very useful tool to assess consistency with industry, the inspectors were concerned the licensee was not evaluating how their current program failed, resulting in insufficient reviews of the identified seven OEs previously described. The licensee initiated AR 01308276 to evaluate this issue.
- The inspectors noted the extent of cause should result in the identification of other equipment, programs, processes, organizational factors, or performance areas that are vulnerable to the same or similar causes. In addition, it should identify the extent to which these areas have been impacted by those causes. The inspectors observed that the licensee's extent of cause was narrowly focused in its review of these areas. Specifically, (1) the licensee's extent of cause was limited to evaluating other dry pipe sprinkler systems for improper pipe slope, and (2) did not include a review of other equipment installed during the same time period (subject to the same modification process) as the affected fire protection piping. In addition, the inspectors noted that recent examples of the failure to translate design requirements into the installation of equipment were not evaluated in the extent of cause section of the report, such as the early 2011 failure to install fire protection piping for the main transformer in accordance with design requirements. At that time, this installation error was discovered, not by a process the licensee had in place, but by an individual new to the project performing a system walkdown for orientation purposes.
- The inspectors noted the licensee assessed the as-left condition of the intake structure fire protection pipe using radiography test (RT) results they conducted to evaluate as-found blockage when they initially discovered this incident. The inspectors questioned the adequacy of using RT results for determining wall thickness of pipes as the licensee's procedures dictate the preferred method to establish wall thickness of pipes is ultrasonic testing (UT). In addition, the RT indicated barely any degradation of pipe wall. The inspectors were concern because the extent of blockage found during this incident did not correspond to the insignificant degradation identified in the RTs. This discrepancy could lead to potentially undetected degradation in the intake structure fire protection pipe or somewhere else in the system. In addition, the inspectors were concern because for this specific application, UT gives a more accurate measurement of wall thickness than RT. As a result of the inspector's concern, the licensee conducted UT measurements and discovered significant degradation in the lower region of the pipe

where water tended to form “puddles.” However, the degradation on these sections of pipe did not exceed the ASME minimum wall thickness requirements.

- The inspectors also noted that the licensee’s extent of condition actions included using NFPA 25 and NFPA 12a as references to perform a gap analysis, and using the results to revise inspection and testing methods. The NFPA code also includes specific sections on appropriate maintenance and related items. Following completion of the inspection, it remained unclear to the inspectors whether or not the licensee’s gap analysis would include review and incorporation of relevant NFPA maintenance practices. Inclusion of a review of maintenance practices in the gap analysis would aid the identification of methods to further mitigate piping corrosion due to periodic wetting and drying of the pipe.

The inspectors concluded the licensee’s root cause evaluation was not comprehensive. The licensee’s approach was too focused therefore did not identify broader causes described in the weaknesses above. In addition, as stated in Section 4OA5.7, the licensee did not identify an aging mechanism as a contributing cause. After performing a detailed review of the licensee’s corrective actions initiated as a result of the root cause evaluation, the inspectors determined the proposed corrective actions bounded the root cause evaluation weaknesses. Therefore, the inspectors concluded that weaknesses associated with the licensee’s root cause evaluation did not represent a violation of NRC requirements.

#### 4OA6 Management Meetings

##### 1. Interim Meeting Summary

On October 14, 2011, the inspectors presented the preliminary inspection results to Mr. T. O’Connor and other members of the licensee staff. The licensee acknowledged the issues presented. The inspectors confirmed that proprietary information reviewed as part of this inspection was returned to the licensee.

##### 2. Exit Meeting Summary

On December 15, 2011, the inspectors presented the inspection results to Mr. T. O’Connor and other members of the licensee staff. The licensee acknowledged the issues presented.

#### 4OA7 Licensee-Identified Violations

The following four violations of very low safety significance (Green) were identified by the licensee and are violations of NRC requirements which meet the criteria of Section 2.3.2 of the NRC Enforcement Policy for being dispositioned as an NCV.

- The licensee identified a finding of very low safety significance (Green) and associated NCV of License Condition 2.C.4 through a planned surveillance test for the failure to implement and maintain in effect all provisions of their approved fire protection program. Specifically, the installation of the intake structure pre-action sprinkler system did not comply with NFPA 13 (1983) section 3-11.1.1, which requires that all sprinkler pipe and fittings shall be so installed that the system may be drained and resulted in the plugging of the sprinkler system. This prevented water from flowing through sprinkler heads and caused the system to be non-

functional. The performance deficiency was determined to be more than minor because it was associated with the Mitigating Systems cornerstone attribute of Protection Against External Factors (Fire) and affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e., core damage). The Region III Senior Risk Analyst (SRA) used the risk assessment tools of IMC 0609, Appendix F, Fire Protection SDP, and performed bounding analyses using the Monticello Standard Plant Analysis Risk (SPAR Model), Version 8.15. The SRA also reviewed and discussed the licensee's bounding risk assessment documented in PRA Memo 11-01-, Revisions 0 and 1, "Risk Assessment of Intake Fire Suppression System Plugging." The finding was determined to be of very low safety significance (green) because the risk increase using bounding assumptions was below 1E-6. The licensee entered this issue into their corrective action program as AR 01305183, "Intake Fire Sprinkler Configuration Discrepancy," and restored the functionality of the sprinkler system by flushing the piping and replacing system components. The licensee further planned to modify the system to allow proper drainage in accordance with the design requirements.

- The licensee identified a finding of very low safety significance (Green) and associated NCV of License Condition 2.C.4 for the failure to implement and maintain in effect all provisions of their approved fire protection program. This includes adhering to the 10 CFR 50, Appendix B Quality Assurance Program requirements for the design, procurement, installation, testing and administrative controls for the fire protection program. Title 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," requires, in part, that measures shall be established to assure that conditions adverse to quality, such as deficiencies are promptly identified and corrected. Contrary to the above, from August 21, 2007 until August 26, 2011, the licensee failed to promptly identify and correct a condition adverse to quality that resulted in the plugging of the intake structure sprinkler system. Specifically, the licensee failed to perform corrective actions (work order 342675-02) to flush the intake structure sprinkler system following a blockage event in the EDG rooms in 2007. The performance deficiency was determined to be more than minor because the plugging in the intake structure pre-action sprinkler system was left uncorrected for four years and became a more significant safety concern. The inspectors concluded that this finding was associated with the Mitigating Systems cornerstone. The Region III SRA used the risk assessment tools of IMC 0609, Appendix F, Fire Protection SDP, and performed bounding analyses using the Monticello Standard Plant Analysis Risk (SPAR Model), Version 8.15. The SRA also reviewed and discussed the licensee's bounding risk assessment documented in PRA Memo 11-01-, Revisions 0 and 1, "Risk Assessment of Intake Fire Suppression System Plugging." The finding was determined to be of very low safety significance (Green) because the risk increase using bounding assumptions was below 1E-6. The licensee flushed the system, restored functionality, and wrote AR 01303860 to document the multiple rescheduling.
- The licensee identified a finding of very low safety significance (Green) and associated NCV of License Condition 2.C.4 for the failure to implement and maintain in effect all provisions of their approved fire protection program. This includes adhering to the 10 CFR 50, Appendix B Quality Assurance Program requirements for the design, procurement, installation, testing and administrative controls for the fire protection program. Title 10 CFR Part 50, Appendix B, Criterion V, "Instructions,

Procedures, and Drawings,” requires, in part, that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions procedures, or drawings.” Contrary to the above, on April 30, 2009, the license failed to follow procedure FP-OP-OL-01 “Operability/Functionality Determination,” when assessing identified blockage in the intake structure fire protection sprinkler piping. Specifically, the assessor failed to justify assumptions, perform an extent of condition, and obtain additional condition bounding information to ensure an accurate assessment of the condition. The performance deficiency was determined to be more than minor because it was associated with the Mitigating Systems cornerstone attribute of Protection Against External Factors (Fire) and affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e., core damage). Using IMC 0609, Appendix F, Fire Protection SDP, and the Monticello SPAR model, the inspectors determined that this finding had very low safety significance. The licensee entered this issue into their corrective action program as AR 01304353, “Inaccurate functionality assessment for CAP 1180222,” in order to perform further evaluation of the deficiency.

- The licensee identified a finding of very low safety significance (Green) and associated NCV of License condition 2.C.4 for the failure to implement and maintain in effect all provisions of their approved fire protection program. This includes adhering to the 10 CFR 50, Appendix B Quality Assurance Program requirements for the design, procurement, installation, testing and administrative controls for the fire protection program. Title 10 CFR Part 50, Appendix B, Criterion XI, “Test Control,” requires, in part, that “test results shall be documented and evaluated to assure that test requirements have been satisfied.” Contrary to this requirement, on April 30, 2009, the licensee failed to document and evaluate the results of a PMT that did not meet all of its acceptance criteria. Specifically, when a step in the PMT required flow through the inspector test valve was not accomplished, the PMT was not annotated as failure and the PMT work order was signed off as complete without further evaluation. The performance deficiency was determined to be more than minor because it was associated with the Mitigating Systems cornerstone attribute of Protection Against External Factors (Fire) and affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e., core damage). Using IMC 0609, Appendix F, Fire Protection SDP, and the Monticello SPAR model, the inspectors determined that this finding had very low safety significance. The licensee entered this issue into their corrective action program as AR 01304348, “Failed PMT results not captured in PMT WO,” in order to perform further evaluation of the deficiency.

ATTACHMENTS:      1.      Supplemental information  
                                 2.      Special inspection charter  
                                 3.      Event timeline

## **SUPPLEMENTAL INFORMATION**

### **KEY POINTS OF CONTACT**

#### Licensee

T. O'Connor, Site Vice President  
J. Grubb, Plant Manager  
P. Anderson, Regulatory Assurance Director  
G. Sherwood, Program Engineering Manager  
P. Kissinger, Regulatory Assurance Manager  
P. Young, Program Engineering Supervisor  
B. Dixon, Program Engineering Supervisor  
C. Blook, Licensing Engineer

#### Nuclear Regulatory Commission

A. Stone, Chief, Division of Reactor Safety, Engineering Branch 2

### **LIST OF ITEMS OPENED, CLOSED AND DISCUSSED**

#### Opened and Closed

05000263/2011010-01	FIN	Failure to Follow Fire Water Aging Management Program Implementing Procedure
---------------------	-----	--

## LIST OF DOCUMENTS REVIEWED

The following is a partial list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspector reviewed the documents in their entirety, but rather that selected sections or portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

### CALCULATIONS

<u>Number</u>	<u>Description or Title</u>	<u>Date/Rev</u>
81N301	Hydraulic Calculation for Intake Structure	10/06/83
MN11-995-160-100	Intake Structure Pre-Action Sprinkler System Hydraulic Analysis	0

### CORRECTIVE ACTION DOCUMENTS GENERATED DURING THE INSPECTION

<u>Number</u>	<u>Description or Title</u>	<u>Date</u>
1302981	Gloves Were Not Used To Perform Inspection	09/08/11
1303597	Check Valve Has No Equipment ID	09/14/11
1303654	Block-Completed Service Water Inspect Form Lacks Detail	09/14/11
1303780	Lack Of EDG Sprinkler Flushing Documentation	09/14/11
1303860	Intake Sprinkler Flush WO Rescheduled Multiple Times	09/15/11
1304047	License Renewal Testing Performance	09/16/11
1304800	EC-18745 Had A Transcription Error	09/21/11
1308068	Intake Sprinkler RCE Didn't Specifically Address Age Mgmt	10/13/11
1308146	Need Guidance For Using SW Inspection Form For Fire Systems	10/13/11
1308180	CAP Screen Team Failed to Record SCAQ Determination For A RCE	10/13/11
1308266	Fire Water OE Was Not Factored Into AMP	10/14/11
1308276	Wording of Action in RCE is Not Specific	10/14/11

### CORRECTIVE ACTION DOCUMENTS REVIEWED DURING THE INSPECTION

<u>Number</u>	<u>Description or Title</u>	<u>Date</u>
696791	Converted Issue No.:4002086 Title: 4" Gate Valve FP-82-1 Is PR	02/25/04
1061683	Spurious actuation of Intake Structure deluge system	11/14/06
1066042	Intake Deluge activated during RHRSW run	12/07/06
1072672	Received unexpected fire system actuation in Intake	01/18/07
1092089	Spurious Intake HAD signal but deluge failed to actuate	05/10/07
1092335	Intake Sprinkler System spurious trip, Fire Pps Auto Start	05/13/07
1100115	Low 'A' RHR Room ESW flow	07/02/07
1105540	Actuation of Fire System During Battery Replacement of C-371	08/06/07

## **CORRECTIVE ACTION DOCUMENTS REVIEWED DURING THE INSPECTION**

<b><u>Number</u></b>	<b><u>Description or Title</u></b>	<b><u>Date</u></b>
1105808	FP-152-2 EDG Room Deluge Trip Shortly After Reset	08/07/07
1106280	FME: EDG Deluge Seat Missing Rubber	08/10/07
1106463	Found sprinkler piping plugged during flush of EDG deluge	08/11/07
1180222	Intake Structure Sprinkler Blockage	04/30/09
1301107	Known Equip. issue adversely affects test completion	08/26/11
1301631	FP-171-10 failed PMT	08/31/11
1302334	Sprinkler Piping In Intake Plugged With Clay Like Debris	09/02/11
1302778	On 9/9/11, Intake Fire Suppress 14 day Impairment Exceeded	09/07/11
1303209	Response to fire impairment could be more aggressive	09/10/11
1303212	Opportunities were missed to resolve fire system blockage	09/10/11
1303860	Intake sprinkler flush WO rescheduled multiple times	09/15/11
1304047	License Renewal Testing Performance	09/16/11
1304348	Failed PMT Results Not Captured in PMT WO	09/19/11
1304353	Inaccurate Functionality Assessment for CAP 01180222	09/19/11
1304563	Drain path for IS Sprinkler piping not used	09/20/11
1305091	Security Preaction Fire Systems – EOC	09/23/11
1305183	Intake fire sprinkler configuration discrepancy	09/23/11
1306728	Off-Gas Compressor Drain Line PM	10/03/11
1307159	EOC for removing items from TS and changes to screening	10/06/11

## **DRAWINGS**

<b><u>Number</u></b>	<b><u>Description or Title</u></b>	<b><u>Revision</u></b>
Fig 1 Fire Zone 23-A	Intake Structure Pump Room	0
F01696	Color Coded Intake Fire Protection Piping	09/16/11
NH-36048	Fire Protection System Interior Locations	81
NH-36516	Fire Protection System Yard Areas	79
NH-36666	P&ID Screen Wash, Fire & Chlorination System Intake Structure	85

## **MISCELLANEOUS**

<b><u>Number</u></b>	<b><u>Description or Title</u></b>	<b><u>Date/Rev</u></b>
NX-16995	Intake Structure Pre-Action Sprinkler System (Vendor)	3
PRA-MEMO-11- 014	Risk Assessment of Intake Fire Suppression System Plugging	1

## **PROCEDURES**

<b><u>Number</u></b>	<b><u>Description or Title</u></b>	<b><u>Revision</u></b>
0324	Fire Protection System – Sprinkler System Tests	44
4 AWI-04.05.06	Post-Maintenance Testing	18
A.3-15-A	Fire Zone 15A – No. 12 DG Room: Strategy A.3-15-A	7

## PROCEDURES

<u>Number</u>	<u>Description or Title</u>	<u>Revision</u>
A.3-23-A	Fire Zone 23-A Intake Structure Pump Room Strategy A.3-23-A	11
PBD/AMP-007	Aging Management Program Basis Document; Open-Cycle Cooling Water System Program	3
PBD/AMP-014	Aging Management Program Basis Document; Fire Water System	3
FP-OP-OL-01	Operability/ Functionality Determination	9
FG-PA-RCE-01	Root Cause Evaluation Manual	17
FP-PA-OE-01	Operating Experience Program	16
FP-PA-SW-1	SW/MIC Program	6
FP-PE-PHS-01	Program Health Process	12
FP-WM-PLA-01	Work Order Planning Process	16
Form 3590	Service Water System Inspection	9
Ops Man B.08.05-05	Operations Manual Section: Fire Protection, System operation	52

## ROOT CAUSE EVALUATION

<u>Number</u>	<u>Description or Title</u>	<u>Date/Rev</u>
QF-0433	RCE: Intake Structure Fire Sprinkler Piping Blockage	3

## WORK DOCUMENTS AND COMPLETED SURVEILLANCES

<u>Number</u>	<u>Description or Title</u>	<u>Date/Rev</u>
WRA 83-02978	Intake Structure Pump Room Hydrostatic Test	12/02/83
WRA 92-5457	Replace Fire Protection Piping between valves FP 6&7	07/28/92
WO 00330915	FIR, Intake Deluge Failed to Actuate	05/11/07
WO 00308070	Replace Heat Detector For Intake Structure Deluge System Flush DG Deluge System Thru Valve Near FZ-4375 and FP-159	05/14/07
WO 00341476		08/11/07
WO 00342675	FP-171-2 Intake Structure Sprinkler Valve Maintenance	08/21/07
WO 00384321	Intake Sprinkler Test Valve Plugged [need task 2]	08/27/07
PMCR 01109543	Increase Frequency of Deluge Solenoid Valve PMID 9461	08/30/07
WO 00312490	V-UH-52 - Replace Fan Motor	10/16/07
WO 00366402	0323-01 Fire Prot System Sprinkler Functional Test	07/22/09
WO 00381724-0	Service Water Component Inspection	11/13/09
WO 00381724-2	Remove/reinstall pipe interferences in the intake tunnel and intake building to facilitate RHR "A Loop" removal	4/28/09
PCR 01236104	0324 Rev 40 License Renewal	06/04/10
WO 00438526	WO 384321 FP-171-10 Failed PMT	09/11/11
WR 00071626	Sprinkler Piping Upstream Of FP-171-10 Is Plugged	09/12/11
WO 00439540	Inspect Sprinkler Branch Lines in 12 EDG Room	09/21/11

## **WORK DOCUMENTS AND COMPLETED SURVEILLANCES**

<b><u>Number</u></b>	<b><u>Description or Title</u></b>	<b><u>Date/Rev</u></b>
PMCR 1305208	FP-171-2 Flush Intake Structure Fire Sprinkler Piping	10/04/11
0273	Fire Station Hose Station Valve Operability and Flow Blockage Test	09/06/11
0319	Fire Protection System – Yard Hydrant Barrel Inspection	09/06/11

## LIST OF ACRONYMS USED

ADAMS	Agencywide Document Access Management System
AMP	Aging Management Program
CFR	Code of Federal Regulations
EDG	Emergency Diesel Generator
FPP	Fire Protection Program
IMC	Inspection Manual Chapter
IP	Inspection Procedure
LRA	License Renewal Application
NCV	Non-Cited Violation
NFPA	National Fire Protection Association
NRC	U.S. Nuclear Regulatory Commission
OCCW	Open Cycle Cooling Water
OE	Operating Experience
PARS	Publicly Available Records System
PMCR	Preventative Maintenance Change Request
PMT	Post Maintenance Testing
PRA	Probabilistic Risk Analysis
RCE	Root Cause Evaluation
RHRSW	Residual Heat Removal Service Water
SDP	Significance Determination Process
SIT	Special Inspection Team
SPAR	Standard Plant Analysis Risk
SRA	Senior Risk Analyst
TS	Technical Specification
USAR	Updated Safety Analysis Report
WO	Work Order



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
LISLE, IL 60532-4352**

September 12, 2011

MEMORANDUM TO: Caroline Tilton, Senior Reactor Inspector  
Engineering Branch 2, DRS

FROM: Steven A. Reynolds, Director */RA/*  
Division of Reactor Safety

SUBJECT: SPECIAL INSPECTION CHARTER  
MONTICELLO NUCLEAR GENERATING PLANT  
SEPTEMBER 2, 2011, UNANALYZED CONDITION OF THE  
INTAKE STRUCTURE FIRE SUPPRESSION SYSTEM

At 8:15 p.m., EDT on September 2, 2011, the licensee at Monticello made a 50.72 event notification (EN 47237) after a portion of the fire suppression sprinkler system located in the intake structure was unable to pass flow during surveillance testing. The licensee entered a 14-day fire protection system impairment action, instituted a continuous compensatory fire watch, and stationed backup suppression. Subsequently, the licensee found substantial fouling of the sprinkler suppression piping such that it was incapable of passing flow.

The sprinkler system located in the intake structure is relied upon, in part, to satisfy an exemption for the station to 10CFR50, Appendix R, Section III.G.2.B concerning the separation of safety-related components in the intake structure. The sprinkler system provides fire suppression for the safety-related service water supply to both divisions of the residual heat removal, emergency diesel generator, emergency core cooling room coolers, and emergency filtration systems. The significant amount of fouling caused the fire suppression system to be unable to perform its design function. Specifically, the system was incapable of preventing the loss of more than one train of safety-related equipment in the event of a fire, which is part of the fire protection design basis.

A bounding conditional core damage probability calculation for this condition was in the range of about  $3.3E-6$  to  $8.5E-6$ , placing the risk in the "special inspection" area. There is large uncertainty whether there are risk significant credible fire scenarios which could lead to the risk significance associated with the above values. A field walkdown by a fire protection inspector would be necessary to determine whether any risk significant credible fire scenarios exist.

In addition, typical Technical Specification or administrative surveillance requirements for the fire protection systems do not require verification of adequate water flow through the sprinkler portions of fire protection piping. As such, significant fouling could be undetected using typical industry surveillance practices; therefore, this issue could have generic implications. The

CONTACT: A. M. Stone, DRS  
(630) 829-9729

licensee recently revised the surveillance to include a flow test as a result of a license renewal commitment.

Accordingly, based on the deterministic criteria in Management Directive 8.3 and as provided in Regional Procedure 8.31, "Special Inspections at Licensed Facilities," you are to lead a Special Inspection that will commence on September 12, 2011. You will be supported by Dariusz Szwarc, Reactor Inspector and Patricia Voss, Monticello Resident Inspector.

This special inspection is intended to evaluate the facts, circumstances, and licensee actions surrounding the September 2, 2011, incident described above. The specific Charter for the Team is enclosed.

Enclosure: As Stated

cc w/encl: M. Virgilio, EDO  
M. Satorius, RA, RIII  
C. Pederson, DRA, RIII  
S. West  
G. Shear  
S. Reynolds  
K. O'Brien  
D. Roberts, RI  
J. Clifford, RI  
P. Wilson, RI  
S. Weerakkody, RI  
R. Croteau, RII  
W. Jones, RII  
J. Munday, RII  
H. Christensen, RII  
K. Kennedy, RIV  
T. Pruett, RIV  
A. Vogel, RIV  
J. Lara, RIII  
V. Mitlyng  
P. Chandrathil  
C. Scott Thomas  
P. Voss  
P. Tam  
N. Shah  
RidsNrrPMMonticello Resource  
NRR Reactive [Inspection@nrc.gov](mailto:Inspection@nrc.gov)

## MONTICELLO SPECIAL INSPECTION CHARTER

This Special Inspection Team (SIT) is chartered to assess the circumstances surrounding the identification of substantial fouling of the fire sprinkler piping in the intake building at the Monticello Nuclear Generating Plant.

The Special Inspection will be conducted in accordance with Inspection Procedure 93812, "Special Inspection," and will include, but need not be limited to, the items listed below. This charter may be revised based on the results and findings of the inspection.

1. Perform a walkdown of the intake structure to evaluate the condition of the fire suppression system, identify any potential impact on safety-related equipment and components, and evaluate the adequacy of compensatory measures.
2. Evaluate the licensee's actions to correct the current condition. This includes assessing the licensee's extent of condition review and subsequent inspection or testing of affected piping.
3. Evaluate the function of the fire protection system in the degraded condition.
4. Evaluate the adequacy of the design of the fire protection sprinkler system.
5. Determine if there are potential generic implications for other plants relying upon raw water sources for their fire protection systems.
6. Determine whether verifying water flow through the fire protection piping is required by industry standards or NRC requirements. Evaluate whether the licensee's current and past surveillance procedures meet these industry standards or NRC requirements.
7. Evaluate license renewal requirements/commitments completed to date and those which could be potentially affected by fouling in the fire protection piping.
8. Determine if there is a performance deficiency through a review of the licensee's corrective action program to identify prior occurrences of fire protection system blockage or silting and applicable operating experience.
9. Review the licensee's root cause evaluation plan and schedule. Evaluate whether the root cause evaluation plan is of sufficient depth and breadth. Confirm that the time allowed to perform the root cause evaluation is commensurate with the safety significance of this issue. Communicate to the licensee that the NRC will inspect the completed root cause evaluation and the associated corrective actions as part of our normal inspection activities.

### Charter Approval

/RA/

A. Stone, Chief, Branch 2, DRS

/RA by N. Shah Acting for/

K. Riemer, Chief, Branch 2, DRP

/RA/

S. Reynolds, Director, DRS

## Event Timeline

### Monticello Nuclear Power Plant (MNGP) Intake Building Fire Sprinkler Blockage

- 1983 The Intake Structure Sprinkler System was installed in 1983. System testing requirements were implemented per the Technical Specifications (TS). The licensee did not commit to an industry code in whole. Pre-action system testing at the time solely consisted of verifying that the deluge valve opened upon receipt of signal.
- 1992 NFPA 25 published in order to consolidate inspection test and maintenance from design codes into a single code for water based fire protection systems. NFPA 13A contains very general guidance to perform internal inspections when age or service conditions warrant. The licensee was committed to NFPA 13A but was not committed to NFPA 25.
- 1995 NFPA was revised to address obstructions in pipe and appropriate corrective actions. The licensee was not required to comply with these changes.
- 2001 The site relocated the Fire Protection Program (FPP) elements from the TS to the FPP and USAR in accordance with GL 86-10, Implementation of Fire Protection Requirements, and GL 88-12, Removal of Fire Protection Requirements from Technical Specifications. The pre-action system testing requirement for the sprinkler valve was also carried forward from the TS.
- 2003 The site recognized some Appendix R requirements were not met for the intake structure.
- 9/23/2004 NRC approved an exemption to some Appendix R requirements for the intake structure sprinkler. Appendix R exemption established current requirements.
- 3/16/2005 The licensee created NRC commitment M05-033A to revise procedures to be used for aging management activities of the fire water system and apply testing in accordance with applicable NFPA codes and standards. The commitment did not state use of NFPA 25.
- 01 - 02/2006 NRC License Renewal on-site inspection conducted 1/23/2006 to 2/9/2006.
- 11/07/2006 License Renewal Application approved on 11/7/2006.
- 11/14/2006 A spurious actuation of Intake Structure pre-action system occurred resulting from soil compaction activities. Although water did not discharge from the sprinklers, the piping did fill with water.
- 12/07/2006 The Intake Structure pre-action sprinkler deluge valve activated during RHRSW run. Although water did not discharge from the sprinklers, the piping did fill with water.
- 01/18/2007 Received unexpected fire system actuation in the Intake Structure.

- 01/19/2007 Fans on the Unit Heaters in Intake Structure were not running which caused unusually high localized temperatures and subsequent actuation of the pre-action sprinkler system.
- 05/13/2007 The intake sprinkler system experienced a spurious trip, and the fire pumps auto started.
- 05/10/2007 A solenoid valve deficiency caused failure to fill the Intake Structure sprinkler system when demanded (CAP 1 092089). The valve was replaced and tested under WO 330915. Discussion with the System Engineer indicated that mud and silt were observed during the work to replace the solenoid valve. PMCR 1109543 was completed to periodically replace SV-3339 (Intake Structure Deluge Valve Solenoid), SV-4652 (Turbine Bearings Sprinkler Initiating Valve), SV- 4653 (Turbine Exciter Sprinkler Initiating Valve) and the magnetic bypasses for FP-I52-2 (Diesel Generator Sprinkler Valve) and FP-157- 2 (Radwaste Shipping Building Sprinkler).
- 8/11/2007 Emergency Diesel Generator Sprinkler System's Inspectors Test Connection Valve was found plugged during flush of EDG sprinkler system (CAP 01106463). During performance of WO 341476 to flush the Emergency Diesel Generator Sprinkler System, no flow was observed when attempting to flush through valve FP- 159, Inspectors Test Valve. The plugging was determined to be localized pipe scale at a nozzle near the inspector test valve. The following actions, applicable to the Intake Sprinkler system, were developed out of the CAP condition evaluation Extent of Condition investigation:
- Initiated WO 342675-02 to flush Intake Structure fire sprinkler branches in August 2007 (WO had not yet been performed as of the date of the August 2011 event).
  - Initiated PMCR 1157869 for preventive maintenance to flush the Intake Structure sprinkler system on a 10-year frequency (complete). First due 07/01/2019 (PMRQ 24867-02).
- 2008 NFPA 25 added a 5-year inspection requirement to look for internal obstructions in both wet and dry systems by opening a header flush connection and a branch line. If obstructions are found then corrective actions are prescribed. There was no process in place to formally evaluate this change as OE.
- 4/30/2009 WO 381724 was performed to replace a large portion of 18" RHRSW piping in the intake tunnel area during the 2009 RFO. To facilitate this work, a portion of the Intake Structure sprinkler piping was removed. The PMT had a step to verify the system was full by verifying flow past FP-I71-IO. It was during this activity the obstruction was identified due to no water flow. AR 1180222 was written to address this condition, pipe scale was observed in the inspector test valve orifice similar to what was found in EDG sprinkler system in 2007. At that time, blockage was assumed to be local and since there were no sprinkler heads downstream of FP-171-10, it was concluded that the sprinkler system remained functional. WO 384321 (Priority 3) was created at that time to clean out the test valve. CAP 1180222 was closed to WO 384321.

- 7/09/2009 WO 366402 documents completion of routine scheduled test 0323-01, Fire Protection System Sprinkler Functional Test, with no issues. This result was due to the test methodology consisted of opening FP-171-1 (adjacent to sprinkler valve FP- 171-2), instead of FP- 171-10 (most hydraulically remote valve). Because of the close proximity of FP-171-1 to FP-171-2, this line-up could not detect the plugging observed in April 2009.
- 6/04/2010 Procedure 0324, Fire Protection System - Sprinkler System Tests, was revised to change the test to use the sprinkler systems inspectors test connection (valve) - based on a review of NFPA 25 (PCR 01236104). The new revision used the Intake Sprinkler System inspector test valve, FP- 171-10, rather than the drain valve, FP- 171-1, adjacent to the deluge valve. This change was made as a commitment associated with the station's application for License Renewal. Although this test does not manage an aging effect (loss of material impacting pressure boundary) it was determined this test was important to ensure the functionality of the sprinkler system is maintained. The review of applicable NFPA codes and standards was narrowly focused on the aging management commitment and missed the opportunity to incorporate a 5-year look for obstructions. The individuals determining which NFPA codes and standards that needed to be implemented were not aware there was localized blockage at FP-171-10. The individual who revised the procedures had knowledge there was localized blockage at the inspector test valve site glass. However, there was no additional evidence the system was plugged and there was not an urgent need to perform a flow test through the pre action sprinkler systems. WO 384321 was in the WM system to clear FP-171-10 blockage. Note this revised test method was not performed until August 2011, when the plugging issue was identified.
- 8/26/2011 During routine testing of the Intake Structure Sprinkler System, the expected flow was not observed through the intake structure sprinkler inspectors test valve, FP-171-10 (WO 419017, 0323-01 Fire Protection System Sprinkler Functional Test). This was the first performance of the procedure since its test methodology was revised in 2010. Operations personnel appropriately declared the system non-functional. The previously established 14-day fire protection system impairment and continuous compensatory fire watch with backup suppression remained in effect. (CAP 01301107 was initiated 08/26/2011, and closed to CAP 01302334)
- 8/28/2011 Workers identified the piping upstream from FP- 171-10 was plugged with pipe scale and the PMT failed because no flow was observed through the FP-171-10 sight glass (WO 384321-1), CAP 01301631 was initiated to document the failed PMT. WO 438526 was initiated to restore the system.
- 9/02/2011 A CAP AR was initiated to document the full extent of the plugging in the fire system piping. The first three sprinkler riser nipples and associated branch line piping upstream of FP-171-10 were found plugged. The NRC was notified of a significant unanalyzed condition in a 10 CFR 50.72 event notification EN 47327. (CAP 01302334)
- 9/07/2011 CAP 01302778 was initiated to document that on September 9, 2011, the Intake Fire Suppression 14 day Impairment would be exceeded. (CAP 01303212)
- 9/18/2011 The Intake sprinkler was flushed, inspected, and returned to functional status.

If you contest the subject or severity of this NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Regional Administrator, U.S. Nuclear Regulatory Commission - Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532-4352; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the Resident Inspector Office at the Monticello Nuclear Generating Plant.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records System (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

*/RA/*

Steven A. Reynolds, Director  
Division of Reactor Safety

Docket No. 50-263  
License No. DPR-22

Enclosure: Inspection Report 05000263/2011010  
w/Attachments:  
1. Supplemental Information  
2. Special Inspection Team Charter  
3. Timeline of Events

cc w/encl: Distribution via ListServ™

DOCUMENT NAME: G:\DRSIII\DRS\Work in Progress\MON 2011 010 SIT Official Version.docx  
 Publicly Available     Non-Publicly Available     Sensitive     Non-Sensitive  
To receive a copy of this document, indicate in the concurrence box "C" = Copy without attach/encl "E" = Copy with attach/encl "N" = No copy

OFFICE	RIII		RIII		RIII				
NAME	AMStone for CTilton:jb		AMStone		SReynolds				
DATE	12/29/11		12/29/11		12/29/11				

**OFFICIAL RECORD COPY**

Letter Mr. Timothy J. O'Connor from Mr. Steven A. Reynolds dated December 29, 2011.

SUBJECT: MONTICELLO NUCLEAR GENERATING PLANT NRC SPECIAL INSPECTION  
TEAM (SIT) REPORT 05000263/2011010

cc w/encl: Distribution via ListServ

DISTRIBUTION:

Amy Snyder  
RidsNrrDorLpl3-1 Resource  
RidsNrrPMMonticello  
RidsNrrDirslrib Resource  
Cynthia Pederson  
Jennifer Uhle  
Steven Orth  
Jared Heck  
Allan Barker  
Carole Ariano  
Linda Linn  
DRPIII  
DRSIII  
Patricia Buckley  
Tammy Tomczak  
[ROPreports Resource](#)