UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE RD. SUITE 210
LISLE, IL 60532-4352

September 15, 2016

EA–16–175

Mr. Peter A. Gardner
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 INSPECTION REPORT 05000263/2016010 AND PRELIMINARY WHITE FINDING

Dear Mr. Gardner:

The enclosed inspection report documents a finding that has preliminarily been determined to be White, a finding with low to moderate safety significance that may require additional U.S. Nuclear Regulatory Commission (NRC) inspections, regulatory actions, and oversight. This finding was assessed based on the best available information, using the Significance Determination Process (SDP). The NRC will inform you in writing when the final significance has been determined.

On September 1, 2016, the NRC met with you and other members of your staff to discuss an issue affecting the safety-related high pressure coolant injection (HPCI) system. Specifically, improperly planned and performed pre-April 2005 maintenance initiated a crack in a HPCI oil pipe and, for numerous years, the licensee failed to perform maintenance to resolve repeated identification of HPCI oil leakage. These failures resulted in a sudden increase in oil leakage on March 22, 2016, extending the unavailability of HPCI during a maintenance window and causing a loss of safety function. Because actions have been taken to repair the oil leak thereby restoring the HPCI safety function, this issue does not represent a continuing safety concern. The NRC assessed this finding using the best available information, and Manual Chapter 0609, “Significance Determination Process.” The basis for the NRC’s preliminary significance determination is described in the enclosed report. The finding is also an apparent violation of NRC requirements and is being considered for escalated enforcement action in accordance with the Enforcement Policy, which can be found on the NRC’s website at http://www.nrc.gov/about-nrc/regulatory/enforcement/enforce-pol.html.

Before the NRC makes a final decision on this matter, we are providing you with an opportunity to (1) attend a Regulatory Conference where you can present your perspective on the facts and assumptions used to arrive at the finding and assess its significance, or (2) submit your position on the finding to the NRC in writing. If you request a Regulatory Conference, it should be held within 30 days of the date of this letter. We encourage you to submit supporting documentation at least one week prior to the conference in an effort to make the conference more efficient and effective. The focus of the Regulatory Conference is to discuss the significance of the finding and not necessarily the root cause(s) or corrective action(s) associated with the finding. If you choose to attend a Regulatory Conference, it will be a Category 1 meeting open for public observance. The NRC will issue a public meeting notice and press release to announce the conference. If you decide to submit only a written response, it should be sent to the NRC within 30 days of the date of this letter. If you decline to request a Regulatory Conference or to submit a written response, you relinquish your right to appeal the NRC's final significance determination, in that by not choosing an option, you fail to meet the appeal requirements stated in the Prerequisites and Limitations sections of Attachment 2, "Process for Appealing NRC Characterization of Inspection Findings (SDP Appeal Process)," of NRC Inspection Manual Chapter 0609.

Please contact Kenneth Riemer at 630–829–9628, and in writing, within 10 days from the date of this letter to notify us of your intentions. If we have not heard from you within 10 days, we will continue with our final significance determination and enforcement decision. The final resolution of this matter will be conveyed in separate correspondence.

Because the NRC has not made a final determination in this matter, no Notice of Violation is being issued for this inspection finding at this time. In addition, please be advised that the number and characterization of the apparent violation described in the enclosed inspection report may change based on further NRC review.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 2.390, "Public Inspections, Exemptions, Requests for Withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC's Public Document Room or from the Publicly Available Records (PARS) component of the NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Patrick L. Louden, Director
Division of Reactor Projects

Docket No. 50–263
License No. DPR–22

Enclosure:
Inspection Report 05000263/2016010

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No:	50–263
License No:	DPR–22
Report No:	05000263/2016010
Licensee:	Northern States Power Company, Minnesota
Facility:	Monticello Nuclear Generating Plant, Unit 1
Location:	Monticello, MN
Dates:	June 1 through September 1, 2016
Inspectors:	P. Zurawski, Senior Resident Inspector D. Krause, Resident Inspector M. Holmberg, Senior Reactor Inspector
Approved by:	K. Riemer, Chief Branch 2 Division of Reactor Projects

Enclosure

SUMMARY

Inspection Report 05000263/2016010; Monticello Nuclear Generating Plant; Operability Determinations and Functionality Assessments.

The enclosed inspection report documents a finding that has preliminarily been determined to be White, a finding with low to moderate safety significance that may require additional NRC inspections, regulatory actions, and oversight. The significance of inspection findings is indicated by their color (i.e., greater than Green, or Green, White, Yellow, Red) and determined using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process," dated April 29, 2015. Cross-cutting aspects are determined using IMC 0310, "Aspects Within the Cross-Cutting Areas," dated December 4, 2014. All violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy, dated February 4, 2015. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG–1649, "Reactor Oversight Process," dated February 2014.

NRC-Identified and Self-Revealed Findings

Cornerstone: Mitigating Systems

Preliminary White. A self-revealing finding preliminarily determined to be of low to moderate safety significance (White), and an associated apparent violation of Technical Specification 5.4.1.a, were identified for the licensee's failure to plan and perform maintenance affecting the safety-related high pressure coolant injection (HPCI) system in accordance with written documents appropriate to the circumstance as required by Regulatory Guide 1.33, Appendix A, Section 9, Procedures for Performing Maintenance. Specifically, improperly planned and performed pre-April 2005 maintenance initiated a crack in a safety-related HPCI oil pipe and, for numerous years, the licensee failed to perform maintenance to resolve repeated identification of HPCI oil leakage. These failures resulted in a sudden increase in oil leakage on March 22, 2016, extending the unavailability of HPCI during a maintenance window and causing a loss of safety function. The licensee documented the issue in the corrective action program (CAP) as CAP 1516361 prior to repairing the oil leak and restoring the HPCI safety function.

The inspectors determined that the licensee's failure to pre-plan and perform maintenance on safety-related equipment was a performance deficiency; the cause was reasonably within the licensee's ability to foresee and correct; and should have been prevented. The inspectors determined the issue was more than minor because it adversely impacted the Mitigating Systems Cornerstone attribute of Equipment Performance, and affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e., core damage). Specifically, improperly planned and performed 2005 maintenance initiated a crack in a safety-related HPCI oil pipe and, for numerous years, the licensee failed to perform maintenance to resolve repeated identification of HPCI oil leakage. These failures resulted in a sudden increase in oil leakage on March 22, 2016, extending the unavailability of HPCI during a maintenance window and causing a loss of safety function.

The inspectors applied IMC 0609, Attachment 4, and IMC 0609, Appendix A, Exhibit 2, Section A, for “Mitigating Systems” to screen this finding and determined a detailed risk evaluation was required because the finding represented a loss of system and/or function. Therefore, a coordinated effort between inspection staff and regional Senior Reactor Analysts (SRAs) was required to arrive at an appropriate risk evaluation for the degraded condition that resulted from the finding. The SRA used the Monticello Standardized Plant Analysis Risk (SPAR) model, version 8.24 for the detailed risk evaluation. This evaluation concluded that the HPCI system was degraded for over 10 years and significantly degraded for approximately 4 months. The system is risk-important and is used to mitigate many internal and external initiating events. The total delta CDF for the 121 day portion of the exposure period is 3.8E–6/yr., which is a finding of low to moderate safety significance (White). HPCI is an important high pressure injection system that is used to mitigate internal events, internal flooding, and internal fire events at Monticello.

The inspectors determined the contributing cause that provided the most insight into the performance deficiency was associated with the cross-cutting area of Human Performance, Conservative Bias because licensee individuals failed to use decision-making practices that emphasize prudent choices over those that are simply allowable [H.14]. Specifically, licensee Operations and Engineering management did not ensure entry into formal evaluation processes to address a potentially degraded condition for the HPCI oil leaks. (Section 1R15)

Licensee Identified Findings

None

REPORT DETAILS

Summary of Plant Status

With the exception of brief down-power maneuvers for planned surveillance testing, the Unit operated at full power for the inspection period, with the following exceptions: On June 4, 2016, power was reduced to approximately 75 percent for a control rod sequence exchange and turbine valve testing. Power was returned to 100 percent on June 5, 2016. On July 21, 2016, power was reduced to approximately 90 percent to maintain discharge canal temperatures. Power was returned to approximately 100 percent the same day.

1. REACTOR SAFETY

Cornerstone: Initiating Events, Mitigating Systems, Barrier Integrity, and Emergency Preparedness

1R15 Operability Determinations and Functionality Assessments (71111.15)

.1 Operability Evaluations

a. Inspection Scope

The inspectors reviewed the following issues:

- HPCI Oil Leakage

The inspectors selected this potential operability issue based on the risk significance of the associated components and systems. The inspectors evaluated the technical adequacy of the evaluation to ensure that TS operability was properly justified and the subject component or system remained available such that no unrecognized increase in risk occurred. The inspectors compared the operability and design criteria in the appropriate sections of the TSs and the USAR to the licensee's evaluations to determine whether the components or systems were operable. Where compensatory measures were required to maintain operability, the inspectors determined whether the measures in place would function as intended and were properly controlled. The inspectors determined, where appropriate, compliance with bounding limitations associated with the evaluations. Additionally, the inspectors reviewed a sampling of corrective action documents to verify that the licensee was identifying and correcting any deficiencies associated with operability evaluations. Documents reviewed are listed in the Attachment to this report.

This inspection constituted one operability evaluation sample as defined in IP 71111.15–05.

b. Findings

Failure to Plan and Perform Maintenance to Correct HPCI Oil Leak.

Introduction

A self-revealing, preliminary White finding, associated with an Apparent Violation (AV) of Technical Specification 5.4.1.a was identified for the licensee's failure to plan and perform maintenance affecting safety-related equipment in accordance with written documents appropriate to the circumstance as required by Regulatory Guide 1.33, Appendix A, Section 9, Procedures for Performing Maintenance. Specifically, improperly planned and performed pre-April 2005 maintenance initiated a crack in a safety-related HPCI oil pipe and, for numerous years, the licensee failed to perform maintenance to resolve repeated identification of HPCI oil leakage. These failures resulted in a sudden increase in oil leakage on March 22, 2016, extending the unavailability of HPCI during a maintenance window and causing a loss of safety function.

Description

Inspectors determined the licensee introduced a crack in safety-related HPCI oil piping during a pre-April 2005 'skill of the craft' work activity to tighten pipe unions and reduce/stop oil leakage. Licensee procedure 4 AWI–04.05.01 (Sections 4.1.7.D & 4.2.1) required, in part, maintenance of equipment to be scheduled, preplanned and performed in accordance with documents appropriate to the circumstances so as not to compromise the safety of the plant. The inspectors concluded the pre-April 2005 'skill of the craft' work activity did not plan/perform maintenance in accordance with documents appropriate to the circumstance and, as a result, caused a crack in the safety-related HPCI oil piping.

Inspector review of HPCI related work control and corrective action records revealed signs of oil leakage near the crack location were identified by the licensee on April 19, 2005. Specifically, work order 506331 documented the first known leak near the crack (pipe elbow near HPO–13) and characterized the leak as "1 drop every 20 seconds." From April 2005 until March 22, 2016, the licensee repeatedly identified HPCI oil leakage near the pipe crack, however maintenance was not performed to resolve the issue. Inspectors noted the following timeline of events related to HPCI oil leaks:

- April 19, 2005 – Work order 506331 documented "Past attempts to tighten unions have been unsuccessful" and written to fix new HPCI oil leaks since past tightening/repair work was performed via "skill of the craft". Leakage was quantified as 1 drop per 20 seconds on the pipe elbow near HPO–13;

- August 26, 2005 – Work order 507865 established to repair 1 drop/20 second oil leak on the pipe elbow near HPO–13 previously noted via work order 506331;

- March 14, 2006 (CAP 1018528) – HPCI turbine drive oil leaks identified after HPCI runs with leakage quantified as "about ½ quart total for a 1-1/2 hour run on 3/14/16." Operability deemed not a concern as the HPCI oil tank contains over 100 gallons. Closed to Work order 140390;

- May 15, 2007 – Engineering equivalency EC 9712 for HPCI lube oil piping material and fitting changes approved. Some changes were implemented but the extent of change or replacement is not fully known by licensee. Licensee believes the 'D port pilot cylinder' was not replaced at that time;

- March 20, 2013 – Work order 507865 converted to work order 140390 (Repair oil leaks on HPCI oil connections, including that identified via CAP 1018528). Work order 140390 subsequently was scoped into RFO26, Spring 2013;

- April 8, 2013 – Licensee removed work order 140390 from RFO26 via outage scope change justification that "repairing all of the oil leaks would require dissembling the entire HPCI lube oil system. It was felt that work would create more leaks than would be repaired…";

- April 9, 2013 – Work order 140390 was canceled with justification from subject matter experts that attempted repairs have a possibility of creating more leaks than repairing. Closure of the work order left no tracking mechanism for the HPCI oil leakage;

- April 9, 2013 to November 23, 2016 – Little change occurred in oil leak rate first identified on 8/26/2005;

- November 23–24, 2016 – HPCI initiation in response to a complicated scram. HPCI run time was 15.55 hours;

- January 9, 2016 (Work order 522095; CAP 1508130) – HPCI quarterly surveillance 0255–06–IA–1 completed satisfactorily but identified ~1 pint per hour oil leak at the piping inlet to valve HPO–13. Licensee recognized the leak rate was increased and initiated work request 121404 to address the observed leak;

- January 10, 2016 – Licensee Plant Status Report documented the HPCI oil leak observed at the pipe insert to valve HPO–13 and "schedule in the next HPCI work week." As part of post event investigation, the licensee determined this information was incorrect because the work to repair the leak was never entered into the next HPCI work week (March 2016), thereby giving some key stakeholders the wrong information about when the HPCI leak work would take place;

- January 13, 2016 – Work order 538444 was generated from work request 121404; the work was scheduled for June 20, 2016.

- February 10, 2016 – Operations questioned the Maintenance Planner regarding scheduling work order 538444 for June 20, 2016 in that they had noted HPCI oil pressures were lowering and were low in band. Operations requested re-evaluation of the June work order completion date and questioned how the work could get scoped into the earlier March 2016 work window;

- February 19–25, 2016 – Operations questioned Production and Engineering: "What would it take to get this into our window?" Regarding the HPCI oil leak and the March 2016 window, engineering recommended to properly plan work order 538444 since "Oil leaks can be tough to make better, and not worse without proper planning" and "The oil leak noted in work order 538444 isn't the cause of HPCI oil pressures trending low;

- March 16, 2016 (Work order 527641) – Operations weekly checklist 1047–02 identified three oil leaks during operation of the aux oil pump. CAP 1515945 was written quantifying downstream leakage near HPO–13 as 4 drops/second,

documented the leak rate had increased as compared to January 9, 2016, and considered the leakage as a minor housekeeping issue that did not impact the HPCI operability. Work request 123182 originated to address oil leaks and stipulated the oil leak should be fixed. Operations didn't enter the operational decision making issue process or escalate CAP 1515945 to prompt operability determination for a potentially degrading condition. CAP screening, system engineering, and maintenance didn't escalate correction of the leaks on the leak rate increase;

- March 17, 2016 – Engineering senior leaders questioned an Engineering Supervisor about CAP 1515945 documenting an increasing HPCI oil leak rate. The questioning went unanswered by the Engineering Supervisor prior to the 3/22/2016 steady stream leakage;

- March 19, 2016 – Plant Status change: HPCI oil leak observed at pipe inlet to valve HPO–13 schedule in the next HPCI work window;

- March 21, 2016 – HPCI maintenance window started but did not have any scheduled maintenance activities to address the documented HPCI oil leaks. Upon completion of work, approximately midnight the licensee performed procedure 1069, HPCI Flow Control System Dynamic Test Procedure as part of post maintenance testing. At the end of the 1069 test (~0100, 3/22/2016), the previously identified leak (CAP 1515945) went from 4 drops/sec to a steady stream (1/3 gpm). CAP 1516361 was initiated;

- March 22, 2016 – Significant HPCI oil leaks were repaired via work order 538444;

- March 24, 2016 – Engineering evaluation of the remaining leaks was completed and HPCI operability was restored.

Inspectors performed focused reviews on the events following the occurrence of substantial HPCI oil leakage. Specifically, on March 22, 2016, as part of HPCI post maintenance testing, a substantial oil leak was self-revealed during procedure 1069 (HPCI Flow Control System Dynamic Testing). The oil leak was large enough to require that HPCI remain inoperable based on a loss of ability to perform its safety function. Overall, the inspectors concluded that prior to March 22, 2016, the licensee had multiple opportunities to plan and perform maintenance to resolve the HPCI oil leakage resulting from the pipe crack initiated in prior to April 2005.

The inspectors further determined the licensee had awareness on two occurrences of increased HPCI pipe oil leakage beginning on January 9, 2016. Specifically, on January 9, 2016, while performing surveillance 0255–06–IA–1 for quarterly Technical Specification testing, the licensee identified an increased oil leak rate of 1 drop per 4 seconds (leakage rate since 2005 was approximately 1 drop per 20 seconds). The licensee determined the identified leakage did not affect the HPCI function, challenge the MSPI basis limiting operating mission time of 24 hours, and concluded it was a minor housekeeping issue. The licensee initiated work request 121404 to repair the leak. On March 16, 2016, while the licensee executed the 1047–02 weekly Operations Control Room Checklist, running only the HPCI Auxiliary Oil Pump, another oil leak rate increase (4 drops per second) was identified from the threaded pipe nipple connection between the pilot cylinder and the first elbow downstream of HPO–13 (HPCI Oil to CV Pilot

Cylinder valve). The licensee noted two other leaks and quantified the overall HPCI oil leakage as 5 drops per second with recognition of an increase when compared to the leak rate from January 9, 2016. The licensee performed an immediate operability evaluation concluding HPCI remained operable, classified the leakage as minor and a housekeeping issue, and Operations stipulated the oil leak should be fixed.

Inspectors reviewed the scope of the March 2016 maintenance work window and determined HPCI was taken out of service on March 21, 2016. Contrary to work control and corrective action documents initiated in response to the above described increases in oil leakage, the licensee failed to plan or perform any maintenance activities to resolve HPCI oil leakage during that maintenance work window. Upon completion of the maintenance window work scope, the licensee completed post maintenance testing per procedure 1069 (HPCI Flow Control System Dynamic Test Procedure). At the end of the March 22, 2016, Procedure 1069 test, the leak increased from 4 drops per second near HPO–13, to a steady stream estimated to be 1/3 gallons per minute. Subsequent licensee investigation determined the leak was a result of a threaded oil pipe fitting having an approximate 340 degree circumferential crack. The licensee documented this within its corrective action program (CAP 1516361), extended the HPCI unavailability window to execute repairs, determined the leak was a result of an oil pipe fitting having an approximate 340 degree circumferential crack, and concluded the issue constituted a loss of HPCI safety function.

Based on the loss of safety function, the inspectors conducted reviews focused on the exposure time when HPCI could not meet its intended PRA safety function prior to March 22, 2016. Focus was placed on the approximate preceding year. Inspectors determined HPCI operated as follows: March 21, 2015 (1.300 hours); March 22, 2015 (1.150 hours); May 29, 2015 (0.467 hours); June 2, 2015 (1.517 hours); June 23, 2015 (1.067 hours); September 22–23, 2015 (3.35 hours); November 23, 2015 (15.55 hours); January 9, 2016 (0.95 hours) and March 21–22, 2016 (1.183 hours). Based on this review, inspectors concluded HPCI was last capable to complete its 24 hour PRA mission sometime between March 22, 2015 and June15, 2015. Inspectors further concluded that a substantial HPCI operating time of 15.55 hours occurred on November 23, 2015. Due to this substantial operating duration, inspectors reviewed the licensee's Evaluation of HPCI Pump Lube Oil Piping Crack (0067–1607–RPT–007) to assess crack propagation both before and after November 23, 2015.

Inspector review of the evaluation determined the crack propagation appears to have progressed slowly due to low cycle fatigue up until November 23, 2015, when HPCI was required to run for 15.55 hours in response to a complicated unit scram. Based on licensee analysis, the inspectors determined HPCI demand operational conditions in response to the November 23, 2015, complicated scram changed the crack propagation from low to high cycle fatigue. Once the crack grew sufficiently large, further crack growth due to high cycle, low loads during steady pump operation likely occurred allowing steady state operation vibration loads to become a primary driver of rapid crack propagation. The crack propagated as such during the March 21–22, 2016, HPCI post maintenance testing.

Inspectors reviewed the licensee's root cause evaluation (RCE) and equipment cause evaluation (ECE) associated with CAP 1516361. The root cause evaluation investigated the assessment/prioritization of repair of known oil leaks on the HPCI system. Additionally, it evaluated how deficient conditions on critical equipment are assessed,

monitored, and escalated when further degradation occurs. The licensee concluded the root cause was that management and individuals were tolerant of leaks on the HPCI system and as a result station personnel failed to effectively advocate prompt repair of the HPCI oil leak. The equipment cause evaluation investigated the cause for the crack in the HPCI oil pipe nipple. The licensee concluded the most likely equipment cause was that the 'D' port pipe nipple was exposed to significant loads, sufficient to initiate a crack, from applied wrench torques during maintenance oil leak repair activities in 2005. Inspectors concluded in both cases, the licensee determinations of cause and contributing cause(s) for both the root and equipment cause evaluations was appropriate. Corrective actions resulting from these evaluations were on-going at the time of inspector review.

Inspectors also reviewed the immediate licensee actions which included an extent of condition and repairs of significant HPCI oil leaks, engineering evaluation of remaining leaks, and replacement of high stress susceptible piping and fittings prior to restoring HPCI to an operable status on March 24, 2016. Longer term corrective actions were also reviewed by the inspectors and included detailed fracture analysis of crack propagation for the impacted pipe nipple, completion of both a root cause and equipment cause evaluation, and development procedural guidance for a fluid leak management process.

Overall, the inspectors concluded that the licensee failed to pre-plan and perform maintenance activities in regard to HPCI oil leaks. Specifically, inadequate 2005 maintenance initiated a crack in a safety-related HPCI oil pipe and for numerous years, the licensee did not resolve repeated identification of HPCI oil leakage, including increased leakage in January and March 2016 even though oil leakage was repeatedly documented in both work control and corrective action documents. These failures resulted in a sudden increase in oil leakage during testing upon completion of a March 2016 maintenance work window, extending the work window and HPCI unavailability to execute repairs, and declaration of a HPCI loss of safety function on March 22, 2016.

Analysis

The inspectors determined that the licensee's failure to pre-plan and perform maintenance on safety-related equipment was a performance deficiency; the cause was reasonably within the licensee's ability to foresee and correct; and should have been prevented. The inspectors determined the issue was more than minor because it adversely impacted the Mitigating Systems Cornerstone attribute of Equipment Performance, and affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences (i.e., core damage). Specifically, improperly planned and performed 2005 maintenance initiated a crack in a safety-related HPCI oil pipe and, for numerous years, the licensee failed to perform maintenance to resolve repeated identification of HPCI oil leakage. These failures resulted in a sudden increase in oil leakage on March 22, 2016, extending the unavailability of HPCI during a maintenance work window and causing a loss of safety function.

The inspectors applied IMC 0609, Attachment 4, and IMC 0609, Appendix A, Exhibit 2, Section A, for "Mitigating Systems" to screen this finding and determined a detailed risk evaluation was required because the finding represented a loss of system and/or

function. Therefore, a coordinated effort between inspection staff and regional SRAs was required to arrive at an appropriate risk evaluation for the degraded condition that resulted from the finding.

The SRA used the Monticello Standardized Plant Analysis Risk (SPAR) model, version 8.24 for the detailed risk evaluation. The Monticello SPAR model contains internal and external event sequences. The internal flooding and external event models were developed based on information in the Monticello Individual Plant Examination (IPE)/Individual Plant Examination of External Events (IPEEE).

The following assumptions were made in the detailed risk evaluation:

1. The HPCI system was modeled as a failure to run by setting the basic event to "True".

2. The exposure time was determined in accordance with the NRC's Risk Assessment of Operational Events (RASP) Handbook, Volume 1, Section 2.5, for Component Run Failures. The exposure time starts when the component no longer had the capability to operate for the PRA mission time (i.e., 24 hours). The licensee provided a spreadsheet of HPCI run times back to January 2015. Based on this information, HPCI no longer had the ability to run for 24 hours as of approximately May 2015. The exposure time for the degraded condition is approximately 10 months.

3. Although HPCI could not run for the full 24 hour mission time for an exposure period of 10 months, HPCI ran for over 15 hours in November 2015 in response to a reactor trip event. Since HPCI had substantial capability to run until November, the SRA only fully quantified the risk for a period beginning after the 15 hour run, November 24, 2015, until HPCI was repaired and returned to service, March 24, 2016. This period of time is 121 days.

4. To quantify the risk for the portion of the exposure period where HPCI could not meet its 24 hour PRA mission but retained substantial capability, the SRA performed a sensitivity evaluation. The evaluation showed that if the 10 month exposure period were fully quantified the overall SDP result would be unchanged from the result obtained by quantifying only the 121 day portion of the exposure period.

5. For the 121 day quantified exposure period, HPCI was significantly degraded and could not run for more than approximately 2 hours before failure.

The risk contribution from internal events for an exposure period of 121 days is estimated to be a delta core damage frequency (CDF) of 1.6E–6/yr. The dominant sequence involves a loss of main feedwater, failure of all high pressure injection and the failure to depressurize the reactor. Other sequences that contribute to the internal event risk involve loss of offsite power and medium loss of coolant accident (LOCA) sequences.

The internal flooding risk contribution for an exposure period of 121 days is estimated to be a delta CDF of 6.3E–7/yr. The dominant sequence is a turbine building flood followed by the failure of high pressure injection systems, successful depressurization, and the failure to control reactor water level with low pressure systems.

The total delta CDF for a 121 day exposure period for internal events, including internal flooding, is estimated as a delta CDF of 2.2E–6/yr.

The SPAR model contains external events including fire, seismic, and high winds. The fire risk contribution for a 121 day exposure period is 1.6E–6/yr. The dominant sequence is a fire in the main control room followed by a failure of HPCI and the reactor core isolation cooling (RCIC) system and the failure to depressurize the reactor. A fire in the turbine building on elevation 911' also contributes to the risk. The seismic and high winds external events did not contribute significantly to the risk of the finding.

The SRA performed a sensitivity evaluation to estimate the change in risk for the full 10 month exposure period when HPCI could not complete its 24 hour mission. In this evaluation, for the portion of the exposure period that HPCI retained significant capability, the SRA changed the SPAR model to account for reduced decay and reactor make-up requirements if HPCI can run for some substantial period of time but not the full mission. The model change relaxed the control rod drive (CRD) system reactor inventory make-up success criteria for sequences in which HPCI and the reactor core isolation cooling system (RCIC) were failed. The new success criteria required only one CRD pump operation and no operator action as compared to the base SPAR model which required two CRD pumps and operator action to increase flow. For this same evaluation, the SRA solved the SPAR model excluding medium LOCA sequences. The SRA also assumed in the sensitivity evaluation that HPCI could successfully complete its medium LOCA mission if the system had the ability to run for many hours. The result of this sensitivity evaluation confirmed that the finding, if evaluated completely over the approximately 10 month exposure period, would not be greater than low to moderate safety significance (White), the same conclusion reached by fully quantifying only the 121 day exposure period, where HPCI was significantly degraded.

In summary, the HPCI system was degraded for over 10 years and significantly degraded for approximately 4 months. The system is risk-important and is used to mitigate many internal and external initiating events. The total delta CDF for the 121 day portion of the exposure period is 3.8E–6/yr., which is a finding of low to moderate safety significance (White). HPCI is an important high pressure injection system that is used to mitigate internal events, internal flooding, and internal fire events at Monticello.

The SRA reviewed the delta CDF results against the guidance of IMC 0609 Appendix H, "Containment Integrity Significance Determination Process" to determine if the finding caused a significant change in the large early release frequency (LERF). Monticello is a BWR with a Mark I containment. Applying the LERF factor for transients with the reactor coolant system at high pressure to the entire delta CDF results in a delta LERF of approximately 2.3E–6/yr. This is an overestimate because not all the sequences contribute to LERF and the LERF factors are known to be very conservative. The SRA concluded that the delta LERF would be below 1E–6/yr. if evaluated further which makes the LERF risk contribution no greater than the CDF risk contribution. The SRA further determined that CDF was the appropriate metric to use for the significance determination of this finding.

The inspectors determined the contributing cause that provided the most insight into the performance deficiency was associated with the cross-cutting area of Human Performance, Conservative Bias because licensee individuals failed to use decision-making practices that emphasize prudent choices over those that are simply

allowable [H.14]. Specifically, licensee Operations and Engineering management did not ensure entry into formal evaluation processes to address a potentially degraded condition for the HPCI oil leaks.

Enforcement

Technical Specification 5.4.1.a states, in part, that written procedures shall be established and implemented covering the applicable procedures recommended in Regulatory Guide 1.33, Revision 2, Appendix A, February 1978. NRC Regulatory Guide 1.33, Appendix A, Section 9, "Procedures for Performing Maintenance," Section A, addresses maintenance that can affect the performance of safety-related equipment are properly preplanned and performed in accordance with written procedures, documented instructions or drawings appropriate to the circumstances. Licensee procedure 4_AWI–04.05.01 (Sections 4.1.7.D & 4.2.1) requires maintenance of equipment to be scheduled, preplanned and performed in accordance with documents appropriate to the circumstances so as not to compromise the safety of the plant. Specifically, from 2005 to March 22, 2016, the licensee failed to properly utilize this procedure to preplan and perform, using the appropriate documents, work to repair the HPCI oil leaks. The inspectors concluded the improperly performed maintenance to repair the leak, introduced a crack into the safety-related HPCI oil piping.

Overall, from 2005 to March 22, 2016, the site missed multiple opportunities through its maintenance program to resolve HPCI oil leaks. Specifically, from April 2005 to March 22, 2016, the licensee performed numerous weekly equipment checks, quarterly pump and valve tests, and flow control dynamic tests, many of which identified oil leakage at, or near, the 'D' Port of the HPCI oil pilot cylinder. Additionally, the licensee had further opportunity to plan and perform maintenance to resolve oil leaks based on increased leakage rates identified on January 9 and March 16, 2016. Collectively, these failures led to a loss of HPCI safety function.

The licensee identified this issue in CAP 1516361. Corrective actions for this issue included immediate actions for an extent of condition and repairs on remaining HPCI oil leaks and high stress susceptible piping and fittings prior to restoring HPCI to an operable status. Longer term actions included conduct of both root and equipment cause evaluations. Lastly, the licensee established a corrective action to develop and institutionalize fluid leak management process guidance.
AV 05000263/2016010–01 (Failure to Plan and Perform Maintenance to Correct HPCI Oil Leak).

4OA6 Management Meetings

.1 Exit Meeting Summary

On September 1, 2016, the inspectors presented the inspection results to Mr. P. Gardner, Site Vice President, and other members of the licensee staff. The licensee acknowledged the issues presented. The inspectors confirmed that none of the potential report input discussed was considered proprietary.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee

P. Gardner, Site Vice President
K. Scott, Director Site Operations
H. Hanson, Jr., Plant Manager
M. Antony, Operations Manager
M. Lingenfelter, Director of Engineering
B. Olson, Maintenance Manager
A. Ward, Regulatory Affairs Manager
D. Bosnic, Director Regulatory & Business Support
T. Willemson, Risk Analyst
S. Sollom, Regulatory Affairs Engineer
R. Zyduck, Manager Fleet Nuclear Design Engineering

U.S. Nuclear Regulatory Commission

K. Riemer, Chief, Reactor Projects Branch 2
L. Kozak, Senior Reactor Analyst

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

05000263/2016010–01	AV	Failure to Plan and Perform maintenance to Correct HPCI Oil Leak (Section 1R15.1)

Closed

None

Discussed

None

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.

Section 1R15

- 0067–1607–RPT–007; Evaluation of HPCI Pump Lube Oil Piping Crack; June 23, 2016
- 0255–06–IA–1; HPCI Quarterly Pump and Valve Tests; Various Revisions
- 1047–02; Operations Control Room Checklist; Various Revisions
- 1069; HPCI Flow Control System Dynamic Test Procedure; Various Revisions
- 4_AWI–04.05.01; General Work Controls; Various Revisions
- B.03.02–04; Operations Manual – HPCI; Revision 48
- CAP 1018528; S–201, HPCI Drive Turbine Minor Oil Leaks
- CAP 1508130; HPCI Oil Leak Observed at Pipe Inlet to Valve HPO–13
- CAP 1515945; Oil Leaks on Threaded Connections Around HPO–13
- CAP 1516359; HPCI CV–2043 Not Closing, HPCI Drain Pot Bypass
- CAP 1516359; Prompt Operability Determination, CV–2043; March 25, 2016
- CAP 1516361; Equipment Cause Evaluation; June 10, 2016
- CAP 1516361; Maintenance Rule Functional Failure; March 22, 2016
- CAP 1516361; Past Operability Review–HPCI Oil Leak; July 7, 2016
- CAP 1516361; Repair HPCI Oil Leak to Restore HPCI Function
- CAP 1516361; Root Cause Evaluation – HPCI Oil Leak; Revision 1
- DBD–B.03.02; High Pressure Coolant Injection System; Revision 7
- EC9712; Engineering Equivalency; Revision 1
- FP–OP–OL–01; Operability/Functionality Determination; Revision 17
- FP–PA–ARP–01; CAP Action Request Process; Various Revisions
- HPCI Oil Leak Update Presentation; April 19, 2016
- HPCI Oil Leak Update Presentation; May 26, 2016
- Licensee Spreadsheet of HPCI Runs Times (January 2015 thru March 22, 2016); No Date
- NH–36249; P&ID (Steam Side) High Pressure Coolant Injection System; Revision 82
- NH–36249–1; HPCI Hydraulic Control & Lubrication System; Revision 77
- NH–36250; P&ID (Water Side) High Pressure Coolant Injection System; Revision 83
- Plant Response Evaluation – Scram 134; No Date
- QF1118; Outage Scope Change Request Scope Control – Repair Oil Leaks on HPCI Lube Oil Connections; April 5, 2013
- Technical Specifications Appendix A Section 1.1; Definitions, Amendment 179
- Technical Specifications Appendix A Section 5.5.10; Safety Function Determination Program (SFDP), Amendment 176
- Technical Specifications Bases Section 3.5.1; ECCS – Operating; Revision 41
- USAR–06.02; Section 6.2.4.1, High Pressure Coolant Injection System (HPCI) Design Basis; Revision 33
- USAR–06.02; Section 6.2.6, ECCS Performance Evaluation; Revision 33
- USAR–08.12; Section 8.12, Station Blackout; Revision 27
- USAR–14.7; Section 14.7.2.2.3, ECCS-LOCA Analysis Assumptions; Revision 31
- USAR–14.7; Section 14.7.2.3, ECCS Emergency Core Cooling System Performance; Revision 31
- Vibration Summary Report, – HPCI Lube Oil Piping; March 23, 2016

- WO 140390; Repair Oil Leaks on HPCI Lube Oil Piping; March 20, 2013
- WO 506331; Repair Oil Leaks on HPCI Lube Oil Connections; April 2005
- WO 507865; Oil Leak on Pipe Elbow Near HPO–13; August 26, 2005
- WO 522095; 0255–06–IA–1 HPCI Valve OP Test RX Rated Pressure; December 21, 2015
- WO 538444; HPCI Oil Leak Observed at Pipe Inlet to Valve HPO–13; March 22, 2016
- WR 121404; HPCI Oil Leak Observed at Pipe Inlet to Valve HPO–13; January 9, 2016
- WR 123182; Oil Leaks on Threaded Connections Around HPO–13; March 16, 2016

OTHER

- Monticello SPAR Model Revision 8.24
- FPRA-MT-FQ Monticello Fire PRA Quantification Notebook, Revision 3
- NSMPL-MI Revision 1 Monticello Individual Plant Examination of External Events
- PRA-MT-ET Monticello PRA Level 1 Accident Sequence (Event Tree Notebook) Revision 3.3
- PRA-MT-IF-AS Monticello Internal Flooding Accident Sequence Notebook Revision 3.3

LIST OF ACRONYMS USED

ADAMS	Agencywide Document Access Management System
CAP	Corrective Action Program
CDF	Core Damage Frequency
CFR	Code of Federal Regulations
HPCI	High Pressure Coolant Injection
IMC	Inspection Manual Chapter
IP	Inspection Procedure
IPEEE	Individual Plant Examination of External Events
LER	Licensee Event Report
LERF	Large Early Release Frequency
NRC	U.S. Nuclear Regulatory Commission
PARS	Publicly Available Records System
PM	Planned or Preventative Maintenance
RFO	Refueling Outage
SDP	Significance Determination Process
SP	Surveillance Procedure
SRA	Senior Risk Analyst
TS	Technical Specification
WO	Work Order

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Sincerely,

/RA/

Patrick L. Louden, Director
Division of Reactor Projects

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