UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

September 29, 2021

Mr. Thomas Conboy
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 OF TEMPORARY INSTRUCTION 2515/194, INSPECTION OF THE LICENSEE'S IMPLEMENTATION OF INDUSTRY INITIATIVE ASSOCIATED WITH THE OPEN PHASE CONDITION DESIGN VULNERABILITIES IN ELECTRIC POWER SYSTEMS (NRC BULLETIN 2012-01) REPORT 05000263/2021011

Dear Mr. Conboy:

On August 16, 2021, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Monticello Nuclear Generating Plant. On August 16, 2021, the NRC inspectors discussed the results of this inspection with Mr. K. Nyberg, Director of Site Performance and other members of your staff. The results of this inspection are documented in the enclosed report.

No findings or violations of more than minor significance were identified during this inspection.

This letter, its enclosure, and your response (if any) will be made available for public inspection and copying at http://www.nrc.gov/reading-rm/adams.html and at the NRC Public Document Room in accordance with Title 10 of the *Code of Federal Regulations* 2.390, "Public Inspections, Exemptions, Requests for Withholding."

Sincerely,

Signed by Skokowski, Richard
on 09/29/21

Richard A. Skokowski, Chief
Engineering Branch 3
Division of Reactor Safety

Docket No. 05000263
License No. DPR-22

Enclosure:
As stated

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Letter to Thomas Conboy from Richard A. Skokowski dated September 29, 2021.

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Number:	05000263
License Number:	DPR-22
Report Number:	05000263/2021011
Enterprise Identifier:	I-2021-011-0045
Licensee:	Northern States Power Company, Minnesota
Facility:	Monticello Nuclear Generating Plant
Location:	Monticello, MN
Inspection Dates:	June 21, 2021 to June 25, 2021
Inspectors:	I. Hafeez, Reactor Inspector
Approved By:	Richard A. Skokowski, Chief Engineering Branch 3 Division of Reactor Safety

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting an NRC Inspection of Temporary Instruction 2515/194, Inspection of the Licensee's Implementation of Industry Initiative associated with the Open Phase Condition Design Vulnerabilities in Electric Power Systems (NRC Bulletin 2012-01) at Monticello Nuclear Generating Plant, in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to https://www.nrc.gov/reactors/operating/oversight.html for more information.

List of Findings and Violations

No findings or violations of more than minor significance were identified.

Additional Tracking Items

None.

INSPECTION SCOPES

Inspections were conducted using the appropriate portions of the inspection procedures (IPs) in effect at the beginning of the inspection unless otherwise noted. Currently approved IPs with their attached revision histories are located on the public website at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/index.html. Samples were declared complete when the IP requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, "Light-Water Reactor Inspection Program - Operations Phase." The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards. Starting on March 20, 2020, in response to the National Emergency declared by the President of the United States on the public health risks of the coronavirus (COVID-19), inspectors were directed to begin telework. In addition, regional baseline inspections were evaluated to determine if all or a portion of the objectives and requirements stated in the IP could be performed remotely. If the inspections could be performed remotely, they were conducted per the applicable IP. In some cases, portions of an IP were completed remotely and on site. The inspections documented below met the objectives and requirements for completion of the IP.

OTHER ACTIVITIES – TEMPORARY INSTRUCTIONS, INFREQUENT AND ABNORMAL

2515/194 - Inspection of the Licensee's Implementation of Industry Initiative Associated with the Open Phase Condition Design Vulnerabilities in Electric Power Systems (NRC Bulletin 2012-01)

This inspection was conducted using Temporary Instruction 2515/194 (ADAMS Accession No. ML20230A328), dated August 18, 2020. The inspectors reviewed the licensee's implementation of Nuclear Energy Institute voluntary industry initiative in compliance with Commission guidance. The inspectors discussed the impacts of open phase conditions (OPCs) on the licensee's electrical system design, the ability to detect and alarm OPCs on station transformers, and ongoing implementation of training and updates to operating procedures with plant staff. The inspector reviewed licensee and vendor documentation, and performed system walkdowns to verify that the installed equipment was supported by the design documentation. The inspector verified that the licensee had completed the installation and testing of equipment (with the exception of the tripping functions), installed and tested alarming circuits both local and in the control room, and analyzed potential impacts associated with the design implementation on the current licensing basis. The inspectors also reviewed licensee analysis and calculations, and performed distribution system and switchyard equipment walkdowns.

The objective of Temporary Instruction 2515/194 is to verify that licensees have appropriately implemented the Nuclear Energy Institute voluntary industry initiative (ADAMS Accession No. ML19163A176), dated June 6, 2019, including updating their licensing basis to reflect the need to protect against OPCs. For sites that are implementing the risk-informed evaluation method to demonstrate that Operator Manual Actions (OMAs) will be sufficient to mitigate the impact of an OPC, in lieu of TI Section 03.01.b (automatic protective actions), TI Section 03.01.c will be performed.

Inspection of the Licensee's Implementation of Industry Initiative Associated with the Open Phase Condition Design Vulnerabilities in Electric Power Systems (NRC Bulletin 2012-01) (1 Sample)

(1) Xcel Energy, selected the open phase detection system designed and manufactured by Power System Sentinel Technologies, LLC, (PSSTech) as the design vendor for the OPC system at Monticello Nuclear Generating Plant. The open phase protection (OPP) system is designed to protect the off-site power sources from a loss of phase condition. The high side component of the activity installed PSSTech Neutral Injection and Current Monitoring Open Phase Protection System cabinets to detect an OPC. Relays which are located on the high voltage side (345kV) of 2RS and (115kV)1R and were not installed on 1AR transformer. The PSSTechs system was installed in the "Detect" mode of operation. The trip function was bypassed and will remain disabled. The PSSTech system was monitoring and would alarm in the Main Control Room (MCR). The OPC relays monitors/detect an OPC, which is defined as one or two phases, with or without a ground for the OPC or low load conditions is detected.

The low side component of the activity installed four sets of ABB model 60Q Negative Sequence Overvoltage relays at 4KV buses Bus-13 and Bus-14 and on the 1AR secondary feeds at Bus-15 and Bus-16. These 60Q relays are used to detect unbalance in three-phase voltage during an OPC. If 1AR feed breakers 152-511 and 152-610 are not closed when the relays trip, the logic will provide a control room alarm and block the automatic essential bus transfer to the 1 AR transformer.

In lieu of automatic open phase protective actions, Xcel Energy uses the risk-informed method, which utilizes an alarm only strategy which relies on proper operator actions to diagnose and respond to an OPC. At the end of this inspection the PSSTech system and 60Q relays were monitoring the associated power sources and would provide MCR annunciation if a loss of one or two phase conditions was detected or if a relay was non-functional.

INSPECTION RESULTS

Observation: Temporary Instruction 2515/194-03.01 Voluntary Industry Initiative	2515/194
Based on discussions with Monticello staff, review of design and testing documentation, and walkdowns of installed equipment, the inspectors had reasonable assurance that Monticello is appropriately implementing, with a noted exceptions discussed below, the voluntary industry initiative at the Monticello Nuclear Generating Plant. The inspectors verified the following criteria: (1) [03.01(a)(1)] OPCs are detected will be alarmed in the Main Control Room (MCR) common annunciator panel. (2) [03.01(a)(2)] Detection circuits are sensitive enough to identify an OPC for credited loading conditions (i.e., high and low loading). See next section for inspector identified exceptions. (3) [03.01(a)(3)] The OPC design and protective schemes minimize misoperation or spurious action in the range of voltage unbalance normally expected in the transmission system that could cause separation from an operable off-site power source. Additionally,	

Monticello has demonstrated that the actuation circuit design does not result in lower overall plant operation reliability.

(4) [03.01(a)(4)] No Class-1E circuits were replaced with non-Class-1E circuits in this design.

(5) [03.01(a)(6)] Identify if Open Phase Isolation System (OPIS) detection and alarm components are maintained in accordance with station procedures or maintenance program, and that periodic tests, calibrations, setpoint verifications, or inspections (as applicable) have been established. See next section for inspector identified exceptions.

(6) [03.01(a)(5)] The Updated Final Safety Analysis Report was updated to discuss the design features and analyses related to the effects of any OPC design vulnerability.

Use of Risk-Informed Evaluation Method

(1) [03.01(c)(1)] The plant configuration matched the changes made to the probabilistic risk assessment model to address an OPC, and the logic of the probabilistic risk assessment model changes is sound.

(2) [03.01(c)(2)] Review the procedure(s) and operator actions required to respond to an OPC alarm and potential equipment trip, with an operator walkthrough and simulator demonstration if possible (during the walkthrough, verify that the procedure which validates that the OPC alarm is legitimate would identify the proper indication to validate the OPCs at all possible locations). See next section for inspector identified exceptions.

(3) [03.01(c)(3)] Observations associated with procedures and operator actions required to respond to an OPC alarm and potential equipment trip match the Human Reliability Analysis (HRA).

(4) [03.01(c)(4)] Review the assumptions listed in the NEI 19-02 (Appendix A) evaluation and the sensitivity analyses listed in Section 5 of the evaluation. Verify the assumptions, focusing additional attention on any assumption that causes the sensitivity analysis to exceed the risk threshold defined in the NEI 19-02 evaluation. See next section for inspector identified exceptions.

(5) [03.01(c)(5)] Assumptions, procedures, and operator actions specified in the Monticello NEI 19-02 analysis are consistent with the plant-specific design and licensing basis, including:

(a) Initiating events considered in the analysis.
(b) Boundary conditions specified in Attachment 1 of the NEI Voluntary Industry Initiative, Revision 3.
(c) Operating procedures for steps taken to recover equipment assumed tripped, locked out, or damaged due to an OPC.
(d) Where recovery was assumed in the PRA analysis for tripped electric equipment, restoration of the equipment was based on analyses that demonstrate that automatic isolation trips did not result in equipment damage.

Observation: Use of Risk-Informed Evaluation Method Exceptions	2515/194

[03.01(a)(2)] - Detection circuits are sensitive enough to identify an OPC for credited loading conditions (i.e., high and low loading).

Exception - The OPP system utilized at Monticello consists of a hybrid design with protection at both the (345kV)2RS and (115kV)1R high side which utilizes the Power Systems Sentinel Technologies, LLC (PSSTech) design. It was one of the designs for pilot inspection performed by NRR. At the 4 kV level, OPP is provided by four sets of ABB model 60Q Negative Sequence Overvoltage relays at 4KV buses Bus-13 and Bus-14 and on the 1AR secondary feeds at Bus-15 and Bus-16. The 60Q Negative Sequence Overvoltage relay setpoints set to actuate before damage to safety related equipment or tripping of their electrical protective devices would occur. Also, OPCs on transformers 10 and 1ARS resulting in significant unbalance will be detected by the 60Q relays that provide monitoring and protection downstream of these transformers. This 4kv portion of the design has not been part of the pilot inspections performed by NRR, however, regional inspector has reviewed the relay setting against the (BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3; SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2; WATTS BAR NUCLEAR PLANT,UNITS 1 AND 2 - ISSUANCE OF AMENDMENT NOS. 309, 332, 292, 345, 339,128, AND 31 REGARDING UNBALANCED VOLTAGE PROTECTION(EPID L-2017-LLA-0391)), and found they are similar to the Monticello's and found that these designs adequately was consistent with the NEI VII guidance. Additionally, where automatic detection is not reliable, Monticello has established monitoring requirements on a per shift basis, to look for evidence of an OPC and Operator rounds procedures have been revised to inspect the integrity of electrical connections on all transformers, including transformer 10 and 1ARS once per shift. These actions are intended to identify any OPCs present on transformers 10 and 1ARS.

[03.01(a)(6)] - Identify if OPIS detection and alarm components are maintained in accordance with station procedures or maintenance program, and that periodic tests, calibrations, setpoint verifications, or inspections (as applicable) have been established.

Exception – Monticello has not developed any preventative maintenance activities for the OPC relays. At the time of this inspection, the licensee had not established a functional test schedule which includes testing the relay metering function (sensing circuit is continuous) and verifying relay settings against calculated values. The licensee had not established a periodic setpoint calibrations testing schedule to verify relay performance is within tolerances assumed within supporting analyses.

[03.01(c)(2)] - Review the procedure(s) and operator actions required to respond to an OPC alarm and potential equipment trip, with an operator walkthrough and simulator demonstration if possible (during the walkthrough, verify that the procedure which validates that the OPC alarm is legitimate would identify the proper indication to validate the OPCs at all possible locations).

Exception - The procedures which validate that an OPC alarm would identify the proper voltage indication to validate the OPC at all ESF buses. The inspectors discussed this potential outcome with the licensee and the licensee agreed that the current design analysis did not specifically address ESF bus voltage. Additionally, the licensee initiated IR 501000053443, “Open Phase Procedure Enhancements,” to address weaknesses identified in alarm response procedures. The inspector noted that various alarm response procedures did not provide Operations personnel specific voltage values should be considered to provide enhanced guidance for the Operators when diagnosing potential

OPCs.

[03.01(c)(4)] - Review the assumptions listed in the NEI 19-02 (Appendix A) evaluation and the sensitivity analyses listed in Section 5 of the evaluation. Verify the assumptions, focusing additional attention on any assumption that causes the sensitivity analysis to exceed the risk threshold defined in the NEI 19-02 evaluation.

Exception - Sensitivity analyses used in the Monticello PRA analysis for using OMAs in lieu of OPC automatic protective relay actuation, did not exceed the thresholds defined in the NEI 19-02 guidance document for delta Core Damage Frequency (CDF) or delta Large Early Release Frequency (LERF). However, NEI 19-02, "Guidance for Assessing Open Phase Condition Implementation Using Risk Insights," recommends several sensitivity studies to be performed to understand the impact of key contributors to the risk evaluation results after the base increase in risk calculation is performed. The AC power recovery sensitivity was inadvertently missed when developing the PRA analysis (PRA-CALC-MT-19-012 Rev1). This issue was identified by the NRC inspectors during the OPC inspection. The licensee performed the sensitivity evaluation and discussed the results with the inspectors. The sensitivity evaluation also did not exceed the thresholds defined in the NEI guidance.

EXIT MEETINGS AND DEBRIEFS

The inspectors verified no proprietary information was retained or documented in this report.

- On August 16, 2021, the inspectors presented the NRC Inspection of Temporary Instruction 2515/194, Inspection of the Licensee's Implementation of Industry Initiative associated with the Open Phase Condition Design Vulnerabilities in Electric Power Systems (NRC Bulletin 2012-01) results to Mr. K. Nyberg, Director of Site Performance and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
2515/194	Calculations	0067-0082-CALC-003	60Q Relay Analytical Limits	01
	Corrective Action Documents Resulting from Inspection	501000053425	NEI 19-02,"Guidance for Assessing Open Phase Condition Implementation Using Risk Insights"	06/22/2021
		501000053443	Potential Procedure Enhancement	06/22/2021
	Drawings	NE-36399-9	Essential Bus Transfer Circuits-Div. 1	79
		NE-36858-2	Schematic Meter & Relay Diagram #1AR Reserve Power Transformer	82
		NE-36858-4	#1AR Reserve Transformer Secondary ACB 152-511 Control	80
		NE-93194-3	No. 1 Unit 4.16KV Sta. Auxiliary	82
		NF-36177	Single Line Meter and Relay Diagram 4160 Volt System Buses #13,#14,#15 & #16	85
	Engineering Changes	EC26181	Address Single Open Phase Vulnerability	00
	Miscellaneous	613000002735	Open Phase 60Q Relay PM	03/12/2021
		613000002781	Add 2RS and 1R Open-Phase Prot PM's	03/29/2021
	Procedures	8153	Power Division II 250VDC Battery Chargers From #13 Diesel, Security Diesel or Portable Generator	07
		B.09.10-05	125 VDC Startup	36
		C.4-B.09.06.D	Non-Essential Bus Abnormal Phase Voltage	09
		C.6-008-A-03	345KV & 115KV Yard Trouble	05
		C.6-008-B-25	#13/#14 4160V Bus Phase Voltage Unbalance	04
		C.6-008-C-01	1AR Trans Trouble	05
		C.6-008-C-05	No. 1R Res Trans Trouble	06
		C.6-514-A-25	PSSTECH OPP	02