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

October 27, 2021

Mr. Christopher P. Domingos
Site Vice President
Prairie Island Nuclear Generating Plant
Northern States Power Company, Minnesota
1717 Wakonade Drive East
Welch, MN 55089-9642

SUBJECT: PRAIRIE ISLAND 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 05000282/2021012 AND 05000306/2021012

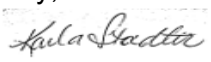
Dear Mr. Domingos:

On September 30, 2021, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Prairie Island Nuclear Generating Plant and discussed the results of this inspection with you 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 Stoedter, Karla
on 10/27/21

Karla K. Stoedter, Chief
Engineering Branch 2
Division of Reactor Safety

Docket Nos. 05000282 and 05000306
License Nos. DPR-42 and DPR-60

Enclosure:
As stated

cc w/ encl: Distribution via LISTSERV®

Letter to Christopher P. Domingos from Karla K. Stoedter dated October 27, 2021.

SUBJECT: PRAIRIE ISLAND 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 05000282/2021012 AND 05000306/2021012

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Numbers:	05000282 and 05000306
License Numbers:	DPR-42 and DPR-60
Report Numbers:	05000282/2021012 and 05000306/2021012
Enterprise Identifier:	I-2021-012-0025
Licensee:	Northern States Power Company
Facility:	Prairie Island Nuclear Generating Plant
Location:	Welch, MN
Inspection Dates:	August 23, 2021 to August 27, 2021
Inspectors:	I. Hafeez, Reactor Inspector D. Werkheiser, Senior Reactor Analyst
Approved By:	Karla K. Stoedter, Chief Engineering Branch 2 Division of Reactor Safety

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting a NRC inspection at Prairie Island 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 the Nuclear Energy Institute's 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 the installed equipment was supported by the design documentation. The inspectors verified 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 in addition to performing 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 implementing the risk-informed evaluation method to demonstrate operator manual actions 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) for installation at the Prairie Island Nuclear Generating Plant. The open phase protection system is designed to protect the offsite power sources from a loss of phase condition. The transformer high voltage side component of the activity installed PSSTech Neutral Injection and Current Monitoring Open Phase Protection (OPP) System cabinets to detect an open phase condition (OPC). Relays are located on the high voltage side of offsite power transformers (345kV) 2RS, CT1 and (161kV) 1R. Since the 10 Bank auto-transformer cannot support direct OPC detection by its design, an Emergency Response Computer System (ERCS) alarm measuring current imbalance indicative of an OPC has been installed. The PSSTechs were in the "Detect" mode of operation. The trip function was bypassed and will remain disabled as Prairie Island has elected to implement the risk-informed evolution method to isolate an OPC. The PSSTech system was monitoring and would alarm in the Main Control Room (MCR). The OPC relays monitor/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.

At the 4KV level side component of the activity installed six (6) 60Q ABB phase unbalance negative sequence overvoltage relays and three (3) ABB 27N undervoltage relays per source breaker at the 4KV safeguards buses that will be used to detect, alarm and trip the associated source breaker for Buses 15, 16, 25 and 26. Two (2) 60Q relays with different settings will be used to detect an OPC event. The 27N undervoltage relays are placed in series with a low-low set permissive 60Q relay to ensure that the safety related MCC 120V contactors for all of the automatically actuated safety related loads required have adequate voltage to pickup based on accident signals and/or process conditions. Upon an OPC event, the system is designed such that the source breaker feeding the bus will trip and the bus will transfer to the alternate source. If the alternate source is not available the bus will transfer to the diesel generator. Transfers will be performed by the existing load sequencer logic. The lockout relay will be used to trip the source breaker and require manual action to be taken to reset the circuit.

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 and 27N 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 the Prairie Island staff, review of design and testing documentation, and walkdowns of installed equipment, the inspectors had reasonable assurance Prairie Island is appropriately implementing, with noted exceptions discussed in this report, the voluntary industry initiative at the Prairie Island Nuclear Generating Plant. The inspectors verified the following criteria:

Detection, Alarms, and General Criteria

(1) [03.01(a)(1)] Open phase conditions (OPCs) are detected will be alarmed in the Main Control Room (MCR) common annunciator panel.
(2) [03.01(a)(2)] See in table titled “Detection, Alarms, and General Criteria Exceptions” 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 offsite power source. Additionally, Prairie Island 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)(5)] See in table titled “Detection, Alarms, and General Criteria Exceptions” for inspector identified exceptions.
(6) [03.01(a)(6)] See in table titled “Detection, Alarms, and General Criteria Exceptions” for inspector identified exceptions.

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)] The procedures which validate that an OPC alarm would identify the proper indication to validate the OPC at all possible locations.
(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)] Sensitivity analyses used in the Prairie Island PRA analysis for using Operator Manual Actions (OMAs) in leu 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).
(5) [03.01(c)(5)] Assumptions, procedures, and operator actions specified in the Prairie Island 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: Detection, Alarms, and General Criteria Exceptions	2515/194

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

Exception – The Open Phase Protection (OPP) system utilized at Prairie Island consists of a hybrid design with protection that detect at the high sides of the 1R, 2RS, and CT1 transformers which utilizes the Power Systems Sentinel Technologies, LLC (PSSTech) design (It was one of the designs for pilot inspection performed by NRR) and at the 10 Bank auto-transformer, which cannot support direct OPC detection by its design, an ERCS alarm measuring current imbalance indicative of an OPC has been installed (the design has not been part of the pilot inspections performed by NRR).

At the 4kV level, OPP is provided by six (6) 60Q ABB phase unbalance negative sequence overvoltage relays and three (3) ABB 27N undervoltage relays per source breaker at the 4KV safeguards buses that will be used to detect and trip the associated source breaker for Buses 15, 16, 25 and 26. The 60Q negative sequence overvoltage relay setpoints are set to actuate the relays before damage to safety related equipment or tripping of their electrical protective devices would occur. Also, OPCs on transformers 10 and CT12 resulting in significant unbalance will be detected by the 60Q relays that provide monitoring and protection downstream of these transformers. The 4kV portion of the design has not been part of the pilot inspections performed by NRR, however, regional inspectors have reviewed the relay settings 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 Prairie Island implementation. In addition, the inspectors found the alarm and protection design is consistent with the NEI VII guidance. Additionally, where automatic detection is not reliable, Prairie Island has established monitoring requirements on a per shift basis to look for evidence of an OPC. Operator rounds procedures have also been revised to inspect the integrity of electrical connections on all transformers, including transformer 10 and CT12 once per shift. These actions are intended to identify any OPCs present on transformers 10 and CT12.

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

Exception – Prairie Island updated their UFSAR to include information related to OPCs, but the revision did not reference any design analysis nor discuss design features, theory of operation for the OPC system, or list major components associated with the OPC equipment in any detail. The team reviewed the proposed changes and found that UFSAR discussion regarding OPC detection in section 8.3.3 lacked clarity. This is documented into the corrective action program as Condition Report 501000055453, "2021 OPC UFSAR Clarity."

[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.

Exception – Prairie Island has not developed any maintenance for the OPC relays. At the time of this inspection, the licensee had not established a functional test schedule which includes verifying the relay metering function (sensing circuit is continuous) and relay settings against expected values. The licensee had not established a periodic setpoint calibration testing schedule to verify relay performance is within tolerances assumed within supporting analyses. Additionally, the licensee initiated Condition Report 501000054943, "No PM Created for PSSTech XFMR cabinet," to evaluate the need to work with the vendor to identify the PM requirements and generate PM procedures.

EXIT MEETINGS AND DEBRIEFS

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

- On September 30, 2021, the inspectors presented the NRC inspection results to Christopher P. Domingos, Site Vice President and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
2515/194	Calculations	SPC-EA-007	4160 Volt Safeguards Bus Degraded Voltage Setpoint	2
	Corrective Action Documents Resulting from Inspection	501000054943	No PM created for PSSTech XFMR cabinet	08/10/2021
		501000055453	2021OPC USAR Clarity	08/25/2021
		501000055466	2021OPC: Revise PRA Calc Assumption	08/25/2021
	Drawings	NF-239270	Prairie Island Plant and Substation Operation Operating One Line Diagram	9
		NF-246124-1	Prairie Island Substation Metering & Relay Diagram 345KV	11
		NF-246124-4	Prairie Island Substation Metering & Relay Diagram 345-161-13.8KV	12
		NF-246124-5	Prairie Island Substation Metering & Relay Diagram 161KV	11
		NF-40831	Metering & Relay Diagram Cooling Tower Substation	76
		NX-267576-7	Unit 1: BOP Annunciator System Lamp Box Engraving Detail	4
		XH-2729-14	Front View 4.16KV Switchgear Bus 15 and 16 Logic Relay Cabinet 2	76
	Miscellaneous	PI-PRA-SY-AC	AC Power System Notebook	5.3
		V.SMN.19.008	Open Phase Isolation System (OPIS) Modification (PRA)	2
	Procedures	C47024	Bus 15 Load Sequencer Channel Alert	45
		C47041	Bus Neg Seq Volt Prot	32
		C47041AR47	CT1 Xfmr Open Phase Condition	32