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

January 31, 2022

Mr. Terry Brown
Site Vice President
Energy Harbor Nuclear Corp.
Davis-Besse Nuclear Power Station
5501 N. State Rte. 2, Mail Stop A–DB–3080
Oak Harbor, OH 43449–9760

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION – 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 05000346/2021012

Dear Mr. Brown:

On December 22, 2021, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Davis-Besse Nuclear Power Station and discussed the results of this inspection with Mr. D. Huey, General Plant Manager 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,

Richard A Skokowski Signed by Skokowski, Richard on 01/31/22

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

Docket No. 05000346
License No. NPF-3

Enclosure:
As stated

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Letter to Terry Brown from Richard A. Skokowski dated January 31, 2022.

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION – 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 05000346/2021012

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Number:	05000346
License Number:	NPF-3
Report Number:	05000346/2021012
Enterprise Identifier:	I-2021-012-0021
Licensee:	Energy Harbor Nuclear Corp.
Facility:	Davis-Besse Nuclear Power Station
Location:	Oak Harbor, OH
Inspection Dates:	November 29, 2021 to December 03, 2021
Inspectors:	I. Hafeez, Reactor Inspector L. Kozak, Senior Reactor Analyst
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 Davis-Besse Nuclear Power Station, 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 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) Offsite power at Davis-Besse is provided by a 345 Kv switchyard located in the owner-controlled area adjacent to the plant. The switchyard is designed with two electrical buses that are connected to four offsite sources via overhead transmission lines. Offsite power is connected to the plant via two startup transformers (identified as SU X01 and SU X02 in the remainder of this document). Each startup transformer is connected to a bus in the switchyard via overhead lines (SU X01 from J BUS and SU X02 from K BUS).

New monitoring equipment was added at each startup transformer to detect when an OPC exists on the feed to the transformer from the 345 Kv switchyard. Davis-Besse selected a system designed and manufactured by Power System Sentinel Technologies, LLC, (PSSTech) to detect an OPC. The open phase detection system is designed to inform control room staff that offsite power sources are experiencing a loss of phase condition. The open phase detection system interfaces with existing startup transformer alarm circuitry.

Each startup transformer provides power for startup, shutdown and post-shutdown requirements. The startup transformer will also serve as a reserve power source for station auxiliaries in the event of a failure of the supply to the Unit Auxiliary (herein described as UA) power transformer. During startup, shutdown and post-shutdown, each bus (A and B) is feed from one of the 13.8Kv secondary windings of either SU X01 or SU X02.

During normal operations, the primary side of the UA transformer is connected to the generator via isolated phase buses. Secondary windings of the UA transformer feed 13.8Kv buses A and B, and these buses supply electrical power to station auxiliaries. Additionally, these buses feed the safety-related buses via bus tie transformers. Normal alignment for SU X01 and SU X02 is with secondary side breakers open (i.e., stand-by mode).

The transfer of electrical power to a 13.8kv bus can be either manual or automatic. Manual transfer is initiated by the operators from either the control room or the switchgear room. Automatic transfer is initiated by the action of generator or transformer protective relays.

Power supplied to the safety-related 4160 volt system is provided via two bus tie transformers (AC and BD) which step down the voltage from 13.8kV to 4160 volts. Two essential (safety-related) buses, C1 and D1, provide power to engineered safety features (ESF) equipment for safe shutdown. The normal alignment is C1 being powered from A bus, via the AC bus tie transformer and D1 being powered from B bus, via the BD bus tie transformer.

In lieu of automatic open phase protective actions, Davis-Besse uses a risk-informed method. This method utilizes an alarm to inform control room staff and relies on proper operator actions to diagnose and respond to an OPC. At the end of this inspection, the PSSTech systems were monitoring the associated power sources and would provide main control room annunciation if a loss of one- or two-phase

conditions was detected or if the open phase detection system detects a problem via self-diagnostic function, an alarm signal is sent to the control room.

INSPECTION RESULTS

Observation: Temporary Instruction 2515/194-03.01 Voluntary Industry Initiative	2515/194

Based on discussions with Davis-Besse staff, review of design and testing documentation, and walkdowns of installed equipment, the inspectors had reasonable assurance that Davis-Besse is appropriately implementing, with noted exceptions discussed below, the voluntary industry initiative at the Davis-Besse Nuclear Power Station. The inspectors verified the following 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)] 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 offsite power source. Licensees have 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)] The Updated Final Safety Analysis Report was updated to discuss the design features and analyses related to the effects of any OPC design vulnerability.

(6) [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.

<u>Use of Risk-Informed Evaluation Method</u>

(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)] [03.01(c)(4)] Sensitivity analyses used in the licensee's probabilistic risk analysis (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 licensee's 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: Inspector Identified Method 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 Davis-Besse was designed with an active trip function. The implementation of this design is characterized as a hybrid design due to the licensees' choice not to use this trip function. The design for this system was previously reviewed during a pilot phase by NRR. At the time of that review, the decision not to use the trip function had not been made.

When an OPC exists and is detected, alarms annunciate in the control room. The licensees' procedure DB-OP-06313, direct control room staff to confirm an OPC exists on X01 or X02. This is accomplished by visual inspections of transformers and switchyard conducted in the field. Additional indications that aid the CTRM staff in confirming an OPC exists are be obtained by checking voltages on the cubicles for the 4160v and 13.8kV buses. The inspector noted that procedures lacked acceptance criteria for expected voltage at these locations.

[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 - Davis-Besse has not, as yet, developed preventative maintenance (PM) guidance at the level of detail needed for the site to implement the vendor recommended PMs for the OPC relays. At the time of this inspection, the licensee had not trained their staff to perform these first time PMs. Alternately, vendor resources have not yet been aligned as an alternate to plant resources. The licensee initiated CR-2021-09278, "Resources not Established for Performance of Calibration/Alarm testing for Open Phase Systems," to

evaluate the need to work with PSSTech vendor to identify the PM requirements and generate PM procedures.

[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 do not identify the proper voltage indication to validate the OPC at cubicles for the 4160v and 13.8kV buses. The inspectors discussed this potential issue with the licensee and the licensee agreed that the current procedure did not specifically address ESF bus voltage. The inspector noted that various alarm response procedures did not provide Operations personnel specific voltage values to be considered when diagnosing potential OPCs. Additionally, some analysis still needs to be done to identify appropriate acceptance criteria due to the range of possible voltages. The licensee initiated CR-2021-09282, "DB-OP-06313 Procedure Enhancement Observation for Open Phase Condition," to address weaknesses identified in alarm response procedures.

EXIT MEETINGS AND DEBRIEFS

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

- On December 22, 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. D. Huey, General Plant Manager and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
2515/194	Drawings	6E550-11	345KV Switchyard One Line Diagram Relay and Metering (Bay 1-4)	AE
		E-1 SH. 1	A.C. Electrical System One Line Diagram	39
		E-2 Sh. 1	25KV & 13.8KV Metering and Relaying One Line Diagram	15
		E-21 SH. 1	13.8KV Relay and Metering Three Line Diagram Bus-A	19
		E-22 SH.1	4.16KV Relay and Metering Three Line Diagram Bus-C1 & C2	32
	Procedures	DB-OP-02001	Electrical Distribution Alarm Panel 1 Annunciators	42
		DB-OP-02101	Startup Transformer 01 Alarm Panel 101 Annunciators	07
		DB-OP-06313	Station Transformer Auxiliaries System Procedure	43
		DB-OP-06314	13.8KV Buses Switching Procedure	18
		DB-SC-03023	Off-Site AC Sources Lined up and Available	35
		MPR-3892	Davis-Besse Startup Transformer Open Phase Evaluation	0