UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
2100 RENAISSANCE BOULEVARD, SUITE 100
KING OF PRUSSIA, PENNSYLVANIA 19406-2713

October 19, 2021

Mr. John J. Grabnar
Site Vice President
Energy Harbor Nuclear Corp.
Beaver Valley Power Station
P. O. Box 4 – Route 168
Shippingport, PA 15077-0004

SUBJECT: BEAVER VALLEY POWER STATION, UNITS 1 AND 2 – TEMPORARY INSTRUCTION 2515/194 INSPECTION REPORT 05000334/2021011 AND 05000412/2021011

Dear Mr. Grabnar:

On September 29, 2021, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Beaver Valley Power Station, Units 1 and 2 and discussed the results of this inspection with Mr. Mark Manoleras, Director Site Engineering, 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,

Glenn T. Dentel Digitally signed by Glenn T. Dentel Date: 2021.10.19 10:02:12 -04'00'

Glenn T. Dentel, Chief
Engineering Branch 2
Division of Operating Reactor Safety

Docket Nos. 05000334 and 05000412
License Nos. DPR-66 and NPF-73

Enclosure:
As stated

cc w/ encl: Distribution via LISTSERV®

SUBJECT: BEAVER VALLEY POWER STATION, UNITS 1 AND 2 – TEMPORARY INSTRUCTION 2515/194 INSPECTION REPORT 05000334/2021011 AND 05000412/2021011 DATED OCTOBER 19, 2021

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Numbers:	05000334 and 05000412
License Numbers:	DPR-66 and NPF-73
Report Numbers:	05000334/2021011 and 05000412/2021011
Enterprise Identifier:	I-2021-011-0017
Licensee:	Energy Harbor Nuclear Corporation
Facility:	Beaver Valley Power Station, Units 1 and 2
Location:	Shippingport, PA 15077
Inspection Dates:	September 13, 2021 to September 29, 2021
Inspectors:	C. Hobbs, Reactor Inspector D. Werkheiser, Senior Reactor Analyst
Approved By:	Glenn T. Dentel, Chief Engineering Branch 2 Division of Operating Reactor Safety

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting a Temporary Instruction 2515/194 inspection at Beaver Valley Power Station, Units 1 and 2, 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. However, all the inspection activities were performed onsite. 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)

The inspectors reviewed the licensee's implementation of the "Nuclear Energy Institute Voluntary Industry Initiative," (ADAMS Accession No. ML19163A176) dated June 6, 2019. This included reviewing how the licensee updated their licensing basis to reflect the need to protect against open phase conditions.

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) The switchyard power supply network for Beaver Valley Power Station (BVPS) consists of two parts: a 345 kV section and a 138 kV section. Each section is supplied by multiple offsite power transmission lines. Six 345 kV transmission lines connect to four 345 kV buses in the BVPS switchyard. Two auto-transformers step down power from 345 kV to 138 kV to supply power to two 138 kV buses. In addition, seven separate 138 kV offsite transmission lines supply power to each 138 kV switchyard bus. The two 138 kV switchyard buses are cross-connected to each other through switchyard power circuit breakers 80 and 90, which are normally closed.

Each BVPS unit is powered from offsite power by two system station service transformers (SSSTs), each powered from a different bus of the 138 kV switchyard. The two onsite SSSTs for each BVPS unit make up the two qualified General Design Criteria 17 (GDC 17) offsite power sources. Each SSST steps down power from 138 kV to 4 kV to supply power to four non-safety normal AC power buses for each BVPS unit. The onsite power distribution network is functionally the same for both BVPS units. For BVPS Unit 1, the 4 kV normal AC power buses are 1A, 1B, 1C, and 1D. For BVPS Unit 2, the 4 kV normal AC power buses are 2A, 2B, 2C, and 2D. For BVPS

Unit 1, normal AC power buses 1A and 1D supply power to two redundant Class 1E 4 kV emergency buses, 1AE and 1DF. For BVPS Unit 2, normal AC power buses 2A and 2D supply power to two redundant Class 1E 4 kV emergency buses, 2AE and 2DF.

All four normal AC power buses at each BVPS unit are also fed from the main unit generator (MUG), when the unit reactor is online, through two unit station service transformers (USSTs). For BVPS Unit 1, USST 1C feeds 4 kV normal power buses 1A and 1B, while USST 1D feeds BVPS Normal power buses 1C and 1D. For BVPS Unit 2, USST 2C feeds 4 kV normal power buses 2A and 2B, while USST 2D feeds BVPS normal power buses 2C and 2D. In the event of a reactor trip, the USST power supply to the 4kV normal power buses will de-energize, and a fast transfer of power to the SSST power supply will occur. The normal plant configuration for both BVPS units is operation with power supplied from the USSTs to the 4 kV normal AC power buses, with the SSSTs energized but unloaded. The alternate plant configuration of supplying power to the 4 kV normal AC power buses from the SSSTs is used much less frequently, during refueling outages (RFOs) when the reactor is tripped, and during emergent maintenance issues that occur while the reactor is online.

In addition, to being powered from the 4 kV normal AC bus power supply, the Class 1E 4 kV emergency bus power for all four emergency buses may also be supplied by an emergency diesel generator (EDG). In the event that all power is lost to the 4 kV emergency buses, the associated EDG will start and close its output breaker automatically. This will restore power to the emergency 4 kV bus, and any emergency safety feature (ESF) loads powered from the 4 kV emergency bus.

BVPS selected the Open Phase Condition (OPC) detection system designed and manufactured by Power System Sentinel Technologies, LLC (PSSTech). The OPC protection system is designed to protect a SSST offsite power source from a single or double OPC by monitoring the transformer primary side neutral current with a single protection relay manufactured by Schweitzer Engineering Laboratories, Inc. (SEL).

BVPS has elected to enable the alarm feature only of the OPC protection system, and keep the automatic trip feature of the system disabled. Operator manual action will be used to separate a SSST with an OPC present, from the onsite electrical power distribution network.

INSPECTION RESULTS

Observation: Temporary Instruction 2515/194 - Section 03.01 (a) Results	2515/194
Based on discussions with Energy Harbor staff, review of design documentation, and walkdowns of installed OPC equipment, the inspectors assessed whether BVPS is implementing the guidance specified in the NEI Voluntary Industry Initiative on Open Phase Condition. The inspectors verified the following criteria: <u>Detection, Alarms and General Criteria:</u> 03.01 (a)(1) - OPCs are detected and alarmed in the control room. 03.01 (a)(2) - In scenarios where automatic detection may not be possible due to very low or no load conditions, or when transformers are in a standby mode, detection will occur as soon as loads are transferred to the standby source. Additionally, where detection is not reliable,	

BVPS has established monitoring requirements on a per shift basis, to look for evidence of an OPC.

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

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

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.

03.01 (a)(6) - Open Phase Isolation System (OPIS) detection and alarm components are maintained in accordance with station procedures or maintenance program, and periodic tests, calibrations, setpoint verifications, or inspections have been established.

The inspectors noted no exceptions to TI-194 Section 03.01 (a).

Observation: Temporary Instruction 2515/194 - Section 03.01 (c) Exception	2515/194

Use of the Risk Informed Evaluation Method:

BVPS has elected to implement manual actions in lieu of automatic protection to identify, isolate, and mitigate the impact of potential OPCs. The inspectors reviewed the probabilistic risk assessment (PRA), operation procedures (including a simulator demonstration), and training material provided by BVPS.

The inspectors determined that the evaluation, actions, and training for the plant normal electrical configuration when powered from the main generator (USSTs) was adequately evaluated and implemented. However, the inspectors determined that BVPS has not appropriately implemented the Nuclear Energy Institute Voluntary Industry Initiative on Open Phase Condition (NEI VII), nor adequately addressed potential OPCs for more risk-significant conditions. Specifically, the plant electrical configuration when a unit is powered from offsite power (SSSTs) was not appropriately assessed with respect to PRA and human reliability of necessary manual actions to isolate the OPC, as well as potential recovery of AC sources and equipment, including supporting procedure changes and operator training.

Though this is not the normal at-power line-up, this electrical configuration is allowed and unrestricted by technical specification, and this flexibility has been employed by BVPS to facilitate emergent issues online. In this configuration, since both 138 kV switchyard buses are cross-tied, a single OPC is postulated to result in the loss of both emergency 4 kV safety buses. The inspectors determined that the incomplete review by BVPS results in an inadequate risk-informed evaluation and does not demonstrate that operator manual actions will be sufficient to mitigate the impact of an OPC in lieu of automatic actions. In addition, the BVPS risk informed evaluation for OPC is not in accordance with Nuclear Energy Institute 19-02 (NEI 19-02), Guidance for Assessing Open Phase Condition Implementation Using Risk Insights, Revision 0, issued in June 2019, and Attachment 1 of the NEI VII, Revision 3, also issued in June 2019.

Since BVPS's OPC evaluation is incomplete, Section 03.01 (c) of NRC Temporary Instruction 194 is an exception in its entirety, as the inspectors were not able to verify whether BVPS

adequality addressed the OPC design vulnerability issue by implementing operator manual actions for configurations when offsite sources are powering the emergency safety buses.

BVPS has entered these issues into their corrective action program as CR-2021-07105 and CR-2021-07280.

EXIT MEETINGS AND DEBRIEFS

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

- On September 29, 2021, the inspectors presented the Temporary Instruction 2515/194 Inspection results to Mr. Mark Manoleras, Director Site Engineering, and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
2515/194	Calculations	2701.140-000-002	Beaver Valley Open Phase Detection Scheme Conceptual Study (MPR-4151)	Revision 2
		2701.140-000-003	Beaver Valley Main Transformer Model for Open Phase Analysis (CALC-0321-0078-01)	Revision 0
		2701.140-000-009	Beaver Valley ESF Buses Protective Relays (CALC-0321-1404-09)	Revision 0
	Corrective Action Documents	CR-2020-00263		
		CR-2020-00585		
		CR-2020-00586		
		CR-2020-00708		
		CR-2020-00732		
	Corrective Action Documents Resulting from Inspection	CR-2021-06469		
		CR-2021-06842		
		CR-2021-06848		
		CR-2021-06851		
		CR-2021-06891		
		CR-2021-06926		
		CR-2021-06998		
		CR-2021-07105		
		CR-2021-07280		
	Drawings	8965-RE-1BJ-9	Beaver Valley Substation Key Interlock Diagram 138 kV and 345 kV Switchyard	Revision 9
		BVPS Unit 1 UFSAR Figure 8.3-1	Electrical Interconnections Switchyard - Power Station	Revision 18
	Engineering Evaluations	PRA-BV3-20-002-R00	BVPS Open Phase Condition PRA Analysis	Revision 0
	Miscellaneous	BVPS U1 UFSAR	Beaver Valley Power Station Unit 1 Updated Final Safety Analysis Report	Revision 31
		BVPS U2 UFSAR	Beaver Valley Power Station Unit 2 Updated Final Safety Analysis Report	Revision 24
		BVPS UFSAR	ECP 15-0059 - BVPS Unit 1 Open Phase Detection System	10/02/2018

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		change notice 15-178		
		BVPS UFSAR change notice 15-187	ECP 15-0060 - BVPS Unit 2 Open Phase Detection System	04/02/2020
		LER 2007-002-00	Beaver Valley Unit 1 Undetected Loss of 138 kV 'A' Phase to System Station Service Transformer Leads to Condition Prohibited by Plant Technical Specification	01/25/2008
		LER 2013-003-00	Beaver Valley Unit 1 Turbine Trip and Subsequent Manual Reactor Trip due to 4 kV Cable Fault	01/06/2014
		NEI 19-02	Guidance for Assessing Open Phase Condition Implementation Using Risk Insights	Revision 0
		NEI VII	Nuclear Energy Institute Voluntary Industry Initiative on Open Phase Condition	Revision 3
	Procedures	1OM-36.4.AFY	System Station Service Transformer 1B Open Phase Alarm	Revision 1
		1OM-36.4.AFZ	System Station Service Transformer 1A Open Phase Alarm	Revision 0
		2OM-36.4.AFK	System Station Service Transformer 2A Open Phase Alarm	Revision 0
		2OM-36.4.AFL	System Station Service Transformer 2B Open Phase Alarm	Revision 1