



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

REGION I  
2100 RENAISSANCE BOULEVARD, SUITE 100  
KING OF PRUSSIA, PENNSYLVANIA 19406-2713

April 8, 2020

Mr. Eric Carr  
President and Chief Nuclear Officer  
PSEG Nuclear, LLC  
P.O. Box 236  
Hancock's Bridge, NJ 08038

SUBJECT: HOPE CREEK GENERATING STATION – REISSUED TEMPORARY  
INSTRUCTION 2515/194 REPORT 05000354/2020010

Dear Mr. Carr:

The U.S. Nuclear Regulatory Commission (NRC) identified two technical corrections in NRC Temporary Instruction 2515/194 Inspection Report 05000354/2020010, dated March 20, 2020, (ADAMS Accession No. ML20077M187). The switchyard inter-tie breaker between the Salem and Hope Creek switchyards described in the description of the plant electrical distribution system is a normally closed breaker versus a normally open breaker as described in the original issue of this report. In addition, the 500 kV Open Phase Protection system installed in the Hope Creek switchyard has no active trip feature installed, and operates in alarm and detection mode only. The description of this feature was also corrected in the electrical distribution system of the report. As a result of these two corrections, this report is being re-issued in its entirety. Neither of these corrections has any effect on the assessment outcomes described in the original report, or this reissued report.

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,

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X /RA/

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Signed by: Glenn T. Dentel

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

E. Carr

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Docket No. 05000354  
License No. NPF-57

Enclosure:  
As stated

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INSTRUCTION 2515/194 REPORT 05000354/2020010 DATED APRIL 8, 2020

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**U.S. NUCLEAR REGULATORY COMMISSION  
Inspection Report**

Docket Number: 05000354

License Number: NPF-57

Report Number: 05000354/2020010

Enterprise Identifier: I-2020-010-0012

Licensee: PSEG Nuclear, LLC

Facility: Hope Creek Generating Station

Location: Hancock's Bridge, NJ 08038

Inspection Dates: March 2, 2020 to March 5, 2020

Inspectors: C. Hobbs, Reactor Inspector  
J. Patel, Senior Resident Inspector

Approved By: Glenn T. Dentel, 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 Temporary Instruction 2515/194 at Hope Creek Generating 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.

## 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. ML15075A454) dated March 16, 2015. 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) Hope Creek electrical power distribution system is divided into four voltage levels: 500 kV, 13 kV, 7 kV, and 4kV. The offsite electrical power system consists of the 500 kV and 13 kV voltage levels which are contained inside the Hope Creek switchyard, while the onsite electrical power distribution system consists of the 7 kV system and the 4 kV system, outside of the Hope Creek switchyard. Electrical power enters the Hope Creek switchyard at the 500 kV system which consists of a 500 kV ring bus with two separate offsite power transmission lines supplying power to different sections of the 500 kV ring bus. In addition, there is a third connection which is an inter-tie to the Salem 500 kV switchyard that is normally closed. The 500 kV ring bus supplies power to four Station Power Transformers (SPTs) which step the voltage down to 13 kV. There are eight Station Service Transformers (SSTs) which then step down the voltage to either 7 kV or 4 kV. Two SSTs supply two 7.2 kV buses that supply large auxiliary loads such as motor generator sets for reactor recirculation pumps and condensate pumps. Two SSTs supply power to four vital 4 kV buses that supply power to Engineered Safeguard Features (ESF) 480 V loads that are necessary for safe shutdown of the nuclear unit. The other four SSTs supply power to various non-vital 4 kV buses. The plant electrical distribution is such that each vital and non-vital 4 kV bus is supplied from two SSTs, so that there is a redundant power source to each 4 kV bus in the electrical distribution system. Normal configuration is for 500 kV SPT T1 to feed 13 kV SST 1BX501 which is the normal source of power for 4 kV vital buses 10A402 and 10A404, and the alternate source of power for 4 kV vital buses 10A401 and 10A403. 500 kV SPT T4 normally feeds 13 kV SST 1AX501 which is the normal source of power for 4 kV vital buses 10A401 and 10A403 and the alternate source of power for 4 kV vital buses 10A402 and 10A404.

In the event the normal source of offsite power is lost to the SST supplying any non-vital 7kV or 4 kV bus, an automatic transfer will occur to the alternate SST power source. In the event the normal source of offsite power is lost to either individual SST 1AX501 or 1BX501 supplying the vital 4 kV buses, an automatic transfer will occur to the alternate 13 kV SST. Each 4 kV vital bus is equipped with a standby diesel generator that is capable of automatically starting and sequencing onto its respective 4 kV vital bus within 10 seconds. In the event both sources of offsite power are lost to a vital 4 kV bus, its respective standby diesel generator will start and sequence onto its respective 4 kV vital bus. For safe plant shutdown, three out of the four 4 kV vital buses are necessary. The extra fourth 4 kV vital bus is for redundancy.

The Open Phase Protection (OPP) system utilized at Hope Creek consists of a hybrid design with protection at both the 500 kV level and protection at the 13 kV level. At the 500 kV level, the OPP system utilizes the Power Systems Sentinel Technologies, LLC (PSSTech) design. This design consists of a neutral current injection method, in which a small neutral current is injected to the primary (high) side neutral bushing. Changes in the neutral impedance are then monitored to determine if an open phase condition exists. This method of protection is designed to work in both high and low transformer loading conditions. At Hope Creek Generating Station, each PSSTech system control cabinet contains single channel protection, with one Schweitzer Engineering Laboratories (SEL) protection relay. One PSSTech system control cabinet is installed at each of the four 500 kV transformers (SPTs T1, T2, T3, and T4) in the Hope Creek switchyard. At the time of inspection, the PSSTech system was functioning in alarm only mode and has no automatic trip function.

At the 13 kV level, OPP is provided by SEL-751 multifunction negative sequence relays (59Q) that monitor each vital 4 kV bus infeed through potential transformers; eight relays total, four for SST 1AX501, and four for SST 1BX501. In order to actuate the lockout relay for one of the two SSTs, each group of four relays must have an active trip signal on two of the 59Q relays, in a one-out-of-two-taken-twice coincidence logic. This coincidence relay logic prevents spurious actuations of the active trip portion of the system. Relay settings have been adjusted to account for normal system grid imbalance. If the coincidence logic is met, the SST lockout relay will transfer to the alternate in-feed for the respective 4 kV bus. At the time of the inspection, the 59Q relays were operating in alarm function only, with the active trip feature disabled by the opening of knife switches located next to the relays.

## INSPECTION RESULTS

Detection, Alarms, General, and Protective Actions Criteria	2515/194
Based on discussion with PSEG staff, review of design and testing documentation, and walkdowns of installed equipment, the inspectors had reasonable assurance that PSEG is appropriately implementing, with noted exceptions discussed below, the Voluntary Industry Initiative at Hope Creek Generating Station. The inspectors determined that:	
03.01(a)(1) Open Phase Conditions are detected and alarmed in the main control room at Hope Creek Generating Station.	
03.01(a)(2) Open Phase Condition detection circuits are sensitive enough to identify an OPC for all credited transformer loading conditions (high and low loading). In addition, enhanced	

monitoring criteria have been proceduralized for taking an OPP PSST panel out of service, as well as for non-functional SEL-751 relays.

03.01(a)(3) Open Phase Condition design schemes minimize misoperation and spurious operation in the range of voltage unbalance normally expected in the transmission system. Misoperation and spurious operation have been accounted for in calculation, implemented through protective relay settings and utilization of coincidence logic at the 4 kV level for protection against OPC at the 13 kV level.

03.01(a)(4) No Class-1E circuits were replaced with non-Class-1E circuits during the implementation of the OPC modification.

03.01(a)(5) The Hope Creek UFSAR was updated to discuss the design features and protection schemes for the OPP system under UFSAR change notice 18-003.

03.01(b)(1) Hope Creek Generating Station has determined that an OPC is a credible failure and has installed an Open Phase Protection system.

03.01(b)(2) With an OPC occurrence and no accident condition signal present, an OPC will not adversely affect the function of important-to-safety SSCs. The OPP system at Hope Creek is designed to actuate an existing transformer lockout relay at the 13 kV level if the active trip feature of the system is enabled. The trip function, if enabled, would provide an additional input to the associated transformer lockout relays, however, the credited plant response is unaffected and will be the same regardless of the conditions that generated the lockout of the transformer.

No findings were identified.

Protective Actions Exceptions	2515/194
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03.01(b)(3) With an OPC occurrence and an accident condition signal present, the inspectors could not verify that automatic detection and actuation will transfer loads as required to mitigate postulated accidents to an alternate source and ensure safety functions are preserved. At the time of the inspection, the OPP system at Hope Creek was operating in alarm mode only with the active trip features of the system disabled. Alarm response procedures are in place to have operators manually transfer the 4 kV bus to the alternate in-feed if it is determined that an OPC exists. The OPP system was still in the 24 month monitoring period described in the Nuclear Energy Institute (NEI) Voluntary Industry Initiative (VII). The monitoring period is scheduled to end in December 2020, at which time the station will decide to enable active trip features of the system or adopt the risk informed operator manual action methodology described in NEI technical report 19-02. This exception was documented in NOTF 20846124.

03.01(b)(4) Periodic tests, calibrations, and setpoint verifications had not been established for the OPP system at the time of the inspection. This exception was identified in the station self-assessment conducted prior to the start of the inspection and documented in NOTFs 20845340 and 20846125.



## **EXIT MEETINGS AND DEBRIEFS**

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

- On March 5, 2020, the inspectors presented the Temporary Instruction 2515/194 results to Mr. Steven Poorman, Plant Manager and other members of the licensee staff.

**DOCUMENTS REVIEWED**

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
2515/194	Calculations	E-15.17	Hope Creek Open Phase Protection Analysis	0
		E-15.19(Q)	Hope Creek 1E Motor Operability Analysis for Unbalanced Voltage	0
	Corrective Action Documents	NOTFs 20844710, 20840066, 20840428, 20840429, 20844603, 20845002, 20845013, 20845014		
		Corrective Action Documents Resulting from Inspection	NOTFs 20845340, 20846124, 20846125	
	Drawings	E-0001-0 (Q)-25	Hope Creek Generating Station - Single Line Diagram	25
		E-0046-1-8	Hope Creek Generating Station - Schematic Meter & Relay Diagram - 4.16 kV Class 1E Station Power System Switchgears 10A401 & 10A403	8
		E-0047-1-7	Hope Creek Generating Station - Schematic Meter & Relay Diagram - 4.16 kV Class 1E Station Power System Switchgears 10A402 & 10A404	7
	Engineering Changes	HCN 18-003	Hope Creek UFSAR change notice for Open Phase Condition protection system	01/10/18
	Engineering Evaluations	DCP 80119206	50.59 Review Hope Creek Unit 1 Open Phase Protection	0
	Procedures	HC.OP-AR.ZZ-0015(Q)	Window Location E1-C4 - 500 kV System Open Phase	33
		HC.OP-AR.ZZ-0016(Q)	Window Location E3-F1 - 4.16 kV System Open Phase Trip	15
		HC.OP-DL.ZZ-	Hope Creek Control Console Log 3 - Condition 1, 2, and 3	94

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		0003(Q)		
		HC.OP-DL.ZZ-0006-F1	Hope Creek Auxiliary Building Log 6	30
		HC.OP-DL.ZZ-0007-F1	Hope Creek Switchyard Log 7	22
		HC.OP-SO.PB-0001(Q)	Hope Creek 4.16 kV System Operation	29