



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**

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

October 29, 2019

Mr. Bryan C. Hanson
Senior Vice President, Exelon Generation Company, LLC
President and Chief Nuclear Officer, Exelon Nuclear
Exelon Generation Co., LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: LIMERICK GENERATING STATION, UNITS 1 AND 2 – TEMPORARY
INSTRUCTION 2515/194 INSPECTION REPORT 05000352/2019012 AND
05000353/2019012

Dear Mr. Hanson:

On October 9, 2019, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Limerick Generating Station, Units 1 and 2 and discussed the results of this inspection with Mr. Frank Sturniolo, Site Vice President and other members of your staff. The results of this inspection are documented in the enclosed report.

The NRC inspectors did not identify any finding or violation of more than minor significance.

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 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding."

Sincerely,

/RA/

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

Docket Nos. 05000352 and 05000353
License Nos. NPF-39 and NPF-85

Enclosure:
As stated

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INSTRUCTION 2515/194 INSPECTION REPORT 05000352/2019012 AND
05000353/2019012 DATED OCTOBER 29, 2019

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Numbers: 05000352 and 05000353

License Numbers: NPF-39 and NPF-85

Report Numbers: 05000352/2019012 and 05000353/2019012

Enterprise Identifier: I-2019-012-0032

Licensee: Exelon Generation Co., LLC

Facility: Limerick Generating Station, Units 1 and 2

Location: Sanatoga, PA 19464

Inspection Dates: October 7, 2019 to October 9, 2019

Inspectors: S. Elkhiamy, Reactor Inspector
A. Patel, Senior Reactor Inspector

Observer: B. Pinson, Reactor 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 inspection at Limerick Generating 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

The inspection was conducted using Temporary Instruction 2515/194 (ADAMS Accession No. ML17137A416), effective November 1, 2017. The inspectors reviewed Exelon's implementation of the Nuclear Energy Institute's voluntary industry initiative in compliance with Commission guidance. The inspectors discussed Exelon's open phase condition system design and ongoing implementation plans with plant staff. The inspectors reviewed Exelon and vendor documentation, and performed system walkdowns to verify that the installed equipment was supported by the design documentation. Exelon had recently completed physical installation and the equipment was being operated in a monitoring mode with the trip functions disabled.

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 objective of Temporary Instruction 2515/194 is to verify that licensees have appropriately implemented the Nuclear Energy Institute Voluntary Industry Initiative (ADAMS Accession No. ML15075A454) dated March 16, 2015, including updating 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) Exelon selected the open phase detection system designed and manufactured by Schweitzer Engineering Laboratories (SEL), as the design vendor for the open phase condition system at Limerick Generating Station.

Limerick Generating Station has two independent offsite sources (220 kV and 500 kV) which provide power via the station auxiliary buses to the appropriate 4 kV safeguard buses through the 101 and 201 safeguard transformers. The open phase protection system is designed to protect the 220 kV and 500 kV offsite power sources from a loss of phase scenario. Four SEL relays (260A104 & 105 and 260A204 & 205) were installed to monitor, alarm, and provide a trip function on each of the 4 offsite source transformers: the 10 station auxiliary transformer (220 kV), 20 regulating transformer (500 kV), and the 101 & 201 safeguard transformers. The relays are wired to provide annunciation and configured to trip the associated power sources if a loss of phase condition is detected. The loss of phase detection relays for each transformer include main control room annunciation for either: a trip of either relay or a trouble alarm associated with the station located relays. The associated substation control house also has annunciation window panels that provide trip and trouble alarms for the relays.

At the end of this inspection the SEL system was in the "monitoring mode" of operation. The trip signal was isolated from the lockout relays by leaving test switches open to prevent the trip from occurring during monitoring mode. Exelon had originally scheduled transitioning the SEL system to full implementation (tripping functions enabled) in December 2019; however, Exelon now plans to pursue an alternate implementation (i.e. risk based, manual action) method to comply with the open phase detection initiative.

INSPECTION RESULTS

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| Temporary Instruction 2515/194-03.01 - Voluntary Industry Initiative | 2515/194 |
| <p>Based on discussions with licensee staff, review of design and testing documentation, and walkdowns of installed equipment, the inspectors had reasonable assurance the licensee is appropriately implementing, with noted exceptions discussed below, the voluntary industry initiative.</p> <p>The inspectors determined by design document review, walkdowns, staff discussions, and observation that:</p> <p><u>Detection, Alarms and General Criteria</u></p> <ol style="list-style-type: none"> 1. Open phase conditions will be detected and alarmed in the control room. 2. Detection circuits will be sensitive enough to identify an open phase condition for all credited loading conditions. 3. No Class 1E circuits were being replaced with non-Class 1E circuits in this design. <p><u>Protective Actions Criteria</u></p> <ol style="list-style-type: none"> 1. The identified transformers were susceptible to an open phase condition and the licensee was implementing design changes to mitigate the effects. 2. With an open phase condition present and no accident condition signal, the PCS2000 system would not adversely affect the function of important-to-safety systems, structures, or components. The licensee's open phase condition design solution added a set of additional tripping inputs in parallel with existing transformer isolation controls. This addition added a new tripping condition (open phase) to the previously analyzed electrical faults which result in isolation of the transformers. The credited plant response was unaffected and would be the same regardless of the conditions that generated the isolation of the transformer. <p>No findings were identified.</p> | |

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| Detection, Alarms and General Criteria Exceptions | 2515/194 |
| <p>(1) Exelon's design installation was essentially complete and Exelon had completed a monitoring period with the alarms in operation to ensure the open phase condition design and protective schemes would minimize misoperation or spurious actions in the range of voltage unbalance normally expected in the transmission system. Test switches in the system remained open, inhibiting the trip function of the open phase detection system, throughout the monitoring period and the onsite portion of this inspection.</p> <p>Exelon's ability to demonstrate that the actuation circuit design does not result in lower overall plant operation reliability requires the system to be in operation with final trip setpoints established. The inspectors were not able to fully verify this criterion with the trip inhibiting test switches in the open position. After discussions with Exelon staff, walkdown of control room panels where the open phase condition alarms had been connected, review of alarm response instructions, and review of design documentation, the inspectors had reasonable assurance that the actuation circuit design would not result in lower overall plant operation reliability. The inspectors did not identify any issues of concern.</p> <p>(2) The Updated Final Safety Analysis Report had been updated to include information related to open phase conditions; however, Exelon plans to pursue an alternate</p> | |

implementation method to comply with the open phase detection initiative, which may require further updates. The inspectors did not identify any issues of concern.

| Protective Actions Criteria Exceptions | 2515/194 |
|---|----------|
| <p>(1) With an open phase condition present and accident condition signal present, the SEL system would not adversely affect the function of the load shedding and Sequencing System to provide a means of disconnecting and sequencing of loads on the safety-related buses. Automatic detection and actuation of an open phase condition has been installed, although the automatic actuation has been bypassed. Exelon's operating procedures, once automatic detection has occurred, would allow operators to diagnose the condition and transfer to the non-affected offsite source or the onsite emergency power source. A loss of voltage caused by isolation of either offsite sources due to an open phase condition does not have an adverse effect on the availability of the non-affected offsite sources, or to the onsite emergency power source. The inspectors reviewed the operator manual actions and determined them to be adequate. The inspectors did not identify any issues of concern.</p> <p>(2) At the time of this inspection, Exelon had not finalized documentation for periodic tests, calibrations, setpoint verifications, or inspection procedures for open phase protection system equipment. Exelon plans on reviewing periodic testing when the modification is finalized. The new equipment is also subject to the requirements of the North American Electric Reliability Corporation protection and control standards for transmission and generation protection system maintenance and testing. The inspectors did not identify any issues of concern.</p> <p>Additionally, the Nuclear Energy Institute provided guidance associated with Industry Initiative on Open Phase Condition, Rev. 1, dated March 16, 2015. The guidance provided various requirements that were addressed as part of the new open phase system installed at Limerick Generating Station. Although not specifically required by the industry initiative, the inspectors noted that procedures have not been established to ensure compensatory actions are taken when equipment is taken out of service. Issue Report 04286033 was written to capture both the periodic testing and compensatory action requirements.</p> | |

EXIT MEETINGS AND DEBRIEFS

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

- On October 9, 2019, the inspectors presented the Temporary Instruction results to Mr. Frank Sturniolo, Site Vice President and other members of the licensee staff.

DOCUMENTS REVIEWED

| Inspection Procedure | Type | Designation | Description or Title | Revision or Date |
|----------------------|---|-------------|---|------------------|
| 2515/194 | Corrective Action Documents Resulting from Inspection | 04286033 | | |
| | Engineering Changes | EC618105 | EC to Enable Open Phase Detection Trip on 10, 101, 20 and 201 Xfmrs | 1 |
| | Operability Evaluations | 12-001 | Potential Design Vulnerability in Switchyard: Single Open Phase Detection | 21 |
| | Procedures | SE-17 | Loss of Single Phase from Offsite Source | 3 |