



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

August 6, 2019

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

SUBJECT: LIMERICK GENERATING STATION, UNITS 1 AND 2 – INTEGRATED
INSPECTION REPORT 05000352/2019002 AND 05000353/2019002

Dear Mr. Hanson:

On June 30, 2019, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Limerick Generating Station, Units 1 and 2. On July 23, 2019, the NRC inspectors discussed the results of this inspection with Mr. Marty Bonifanti, Director of Organizational Performance and Learning, and other members of your staff. The results of this inspection are documented in the enclosed report.

Two findings of very low safety significance (Green) are documented in this report. One of these findings involved violations of NRC requirements. We are treating this violation as a non-cited violation (NCV) consistent with Section 2.3.2.a of the Enforcement Policy.

If you contest the violation or significance or severity of the violation documented in this inspection report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region I; the Director, Office of Enforcement; and the NRC Resident Inspector at Limerick.

If you disagree with a cross-cutting aspect assignment or a finding not associated with a regulatory requirement in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region I; and the NRC Resident Inspector at Limerick.

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/

Jonathan E. Greives, Chief
Reactor Projects Branch 4
Division of Reactor Projects

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

Enclosure:
As stated

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INSPECTION REPORT 05000352/2019002 AND 05000353/2019002 DATED
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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: 05000352/2019002 and 05000353/2019002

Enterprise Identifier: I-2019-002-0054

Licensee: Exelon Generation Company, LLC

Facility: Limerick Generating Station, Units 1 and 2

Location: Sanatoga, PA 19464

Inspection Dates: April 1, 2019 to June 30, 2019

Inspectors: S. Rutenkroger, Senior Resident Inspector
D. Beacon, Resident Inspector
S. Haney, Resident Inspector
S. Obadina, Resident Inspector
H. Anagnostopoulos, Senior Health Physicist
T. Setzer, Senior Operations Engineer
D. Werkheiser, Senior Reactor Inspector
J. Kulp, Senior Reactor Inspector

Approved By: Jonathan E. Greives, Chief
Reactor Projects Branch 4
Division of Reactor Projects

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting an integrated 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

Waterbox Manway was not Closed Causing Internal Flooding			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green FIN 05000353/2019002-01 Open/Closed	[H.12] - Avoid Complacency	71111.06
A self-revealing Green finding was identified due to internal flooding on May 5, 2019. Specifically, a work order instruction to reinstall a manway on the Unit 2 main condenser waterbox was not performed which caused flooding in the condenser area and the condensate pump pit.			

Tagging Error Leads to Inoperability of the 'B' CREFAS system			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Barrier Integrity	Green NCV 05000352,05000353/2019002-02 Open/Closed	[H.12] - Avoid Complacency	71152
A self-revealing Green non-cited violation (NCV) of Limerick Generating Station Technical Specification 6.8, "Procedures and Programs," was identified on February 21, 2018, when Exelon failed to properly implement procedure OP-MA-109-101, "Clearance and Tagging," step 7.1.4, to ensure that the effects on the systems and components outside of the zone of protection were identified and acceptable or properly dispositioned. Specifically, while opening breaker 10-Y164-3 during a tagout for relay replacements in the Auxiliary Equipment Room HVAC system, the inlet and outlet dampers to the 'B' main control room HVAC supply fan unexpectedly failed closed, which resulted in unplanned inoperability of the 'B' control room emergency fresh air system (CREFAS).			

Additional Tracking Items

None.

PLANT STATUS

Unit 1 began the inspection period at rated thermal power. On May 31, 2019, the unit was down powered to 63 percent for a pre-summer load drop for planned activities such as waterbox cleaning and main turbine valve testing. The unit was returned to rated thermal power on June 2, 2019, and remained at or near rated thermal power for the remainder of the inspection period.

Unit 2 began the inspection period near rated thermal power in coastdown. On April 14, 2019, the unit was down powered and then shut down on April 15, 2019, for a planned refueling outage. The unit was restarted on May 2, 2019, and returned to near rated thermal power on May 7, 2019. On May 21, 2019, the unit was down powered to 63 percent for main turbine valve testing and steam line repairs. The unit was returned to rated thermal power on May 22, 2019. On May 26, 2019, an unplanned down power to 30 percent and transition to single loop operations occurred due to a trip of the '2B' adjustable speed drive (ASD) system and associated trip of the '2B' reactor recirculation pump. The unit was returned to two loop operation and rated thermal power on May 27, 2019, following repairs to the ASD. On May 29, 2019, the unit was down powered to 65 percent for steam line leak repairs and control rod pattern adjustment. The unit was returned to rated thermal power on May 30, 2019. On June 4, 2019, a reactor scram was manually inserted due to degraded main condenser vacuum caused by a loss of power to equipment in the main condenser offgas system. The unit was restarted on June 6, 2019, and returned to rated thermal power on June 8, 2019, and remained at or near rated thermal power for the remainder of the inspection period.

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 performed plant status activities described in IMC 2515, Appendix D, "Plant Status," and conducted routine reviews using IP 71152, "Problem Identification and Resolution." 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.

REACTOR SAFETY

71111.01 - Adverse Weather Protection

Summer Readiness Sample (IP Section 03.01) (1 Sample)

- (1) The inspectors evaluated summer readiness of offsite and alternate alternating current power systems on June 28, 2019

71111.04 - Equipment Alignment

Partial Walkdown Sample (IP Section 03.01) (5 Samples)

The inspectors evaluated system configurations during partial walkdowns of the following systems/trains:

- (1) Unit 1 'A' residual heat removal (RHR) on April 4, 2019
- (2) Unit 2 'A' and 'C' RHR on April 16, 2019
- (3) 'D21' and 'D23' emergency diesel generators on April 22 and 23, 2019
- (4) Unit 2 reactor core isolation cooling (RCIC) on May 15, 2019
- (5) Unit Common 'A' control enclosure chiller on June 28, 2019

71111.04S - Equipment Alignment

Complete Walkdown Sample (IP Section 03.02) (1 Sample)

- (1) The inspectors evaluated system configurations during a complete walkdown of the Unit 2 core spray system on April 9, 2019

71111.05A - Fire Protection (Annual)

Annual Inspection (IP Section 03.02) (1 Sample)

- (1) The inspectors evaluated fire brigade performance on May 15, 2019

71111.05Q - Fire Protection

Quarterly Inspection (IP Section 03.01) (5 Samples)

The inspectors evaluated fire protection program implementation in the following selected areas:

- (1) Fire area 84, Unit 2 'D23' emergency diesel generator and fuel oil-lube oil tank room, on April 11, 2019
- (2) Fire area 61, Unit 2 'A' core spray pump room, on April 27, 2019
- (3) Fire area 53, Unit 2 drywell area, on April 29, 2019
- (4) Fire area 70, Unit 2 standby liquid control and general equipment areas, on May 14, 2019
- (5) Fire area 1, Common (Unit 1 & 2) recombine compartments, condensate backwash compartments, control room chiller and cooling water heat exchanger areas, on May 20, 2019

71111.06 - Flood Protection Measures

Inspection Activities - Internal Flooding (IP Section 02.02a.) (1 Sample)

The inspectors evaluated internal flooding mitigation protections in the:

- (1) Unit 2 condensate pump pit and turbine building lower elevations

71111.08G - Inservice Inspection Activities (BWR)

BWR Inservice Inspection Activities Sample - Nondestructive Examination and Welding Activities (IP Section 03.01) (1 Sample)

- (1) The inspectors verified that the reactor coolant system boundary, reactor vessel internals, risk-significant piping system boundaries, and containment boundary are appropriately monitored for degradation and that repairs and replacements were appropriately fabricated, examined, and accepted by reviewing the following activities during the Unit 2 refueling outage (2R15) from April 22, 2019 to April 25, 2019.

03.01.a - Nondestructive Examination and Welding Activities

1. Non-Destructive Examinations
 - a. Enhanced Visual Examination (EVT-1) of Jet Pump 6 Riser Upper Leaf to Reactor Pressure Vessel Pad Weld (RB-1A)
 - b. Ultrasonic Examination of Reactor Pressure Vessel Bottom Head Meridional Weld "DF"
 - c. Radiographic examination of Reactor Water Cleanup System Field Welds 12, 13, and 30 (DBB-205-01 FW-12, FW-13, and FW-30)
 - d. Dye Penetrant Examination of Reactor Water Cleanup System Socket Weld W-1 (SP-DBB-205-001F)
 - e. Phased Array Ultrasonic Examination of Reactor Pressure Vessel Instrumentation Nozzle N-16D
 - f. Visual Examination (VT-3) of Suppression Pool Columns at 0, 30, and 60 degrees
2. Relevant indications analytically evaluated and accepted for continued service from previous outage
 - a. Document and examination review of relevant indication on reactor vessel nozzle N-16D accepted for continued service via analysis during 2R14 refueling outage and reexamined during the 2R15 refueling outage
3. Pressure boundary welds
 - a. Work Order 4750253, Reactor Water Cleanup System Piping Replacement, Field Welds 12, 13, and 30 and socket weld W-1

71111.11Q - Licensed Operator Requalification Program and Licensed Operator Performance

Licensed Operator Performance in the Actual Plant/Main Control Room (IP Section 03.01) (2 Samples)

- (1) The inspectors observed control room activities associated with the refueling outage and shutdown of Unit 2 on April 15, 2019
- (2) The inspectors observed control room activities associated with the refueling outage, startup, and approach to critical for Unit 2 on May 2–3, 2019

Licensed Operator Requalification Training/Examinations (IP Section 03.02) (1 Sample)

- (1) The inspectors observed and evaluated licensed operator requalification training on May 13, 2019

71111.12 - Maintenance Effectiveness

Quality Control (IP Section 02.02) (1 Sample)

The inspectors evaluated maintenance and quality control activities associated with the following equipment performance activities:

- (1) Unit 2 'H' SRV replacement during forced outage on June 5, 2019

Routine Maintenance Effectiveness Inspection (IP Section 02.01) (2 Samples)

The inspectors evaluated the effectiveness of routine maintenance activities associated with the following equipment and/or safety significant functions:

- (1) Unit 2 high-pressure coolant injection (HPCI) on June 20, 2019
- (2) Unit 1 and 2 emergency diesel generators on June 26, 2019

71111.13 - Maintenance Risk Assessments and Emergent Work Control

Risk Assessment and Management Sample (IP Section 03.01) (5 Samples)

The inspectors evaluated the risk assessments for the following planned and emergent work activities:

- (1) Unit 1 RCIC barometric condenser vacuum pump maintenance on April 1, 2019
- (2) Unit 2 RHR 'B' loop unavailable (yellow risk) due to Division 2 and 4 work on April 16, 2019
- (3) Unit 2 yellow risk due to 'D24' loss of offsite power/loss of coolant accident testing on April 25, 2019
- (4) Unit 2 RCIC steam line differential pressure calibration/functional test (yellow risk) on May 29, 2019
- (5) Unit 2 elevated risk due to 2D RHR full flow return valve testing on June 20, 2019

71111.15 - Operability Determinations and Functionality Assessments

Operability Determination or Functionality Assessment (IP Section 02.02) (6 Samples)

The inspectors evaluated the following operability determinations and functionality assessments:

- (1) IR 4235302, emergency diesel generator 'D24' fuel oil post receipt analysis identified particulate concentration outside of specification on April 1, 2019
- (2) IR 4237119, Unit 1 HPCI steam admission valve leakby on April 7, 2019
- (3) IR 4237803, reactor water level transmitter LT-042-216 for refueling found high out of calibration due to zero drift on April 9, 2019

- (4) IR 4237808, reactor water level transmitter LT-042-217 for refueling found out of calibration on April 9, 2019
- (5) IR 4238823, 'D23' fuel oil storage tank sample contained metallic foreign material on April 11, 2019
- (6) IR 4255002, D12 #6 fuel injectors failed pop test on June 6, 2019

71111.18 - Plant Modifications

Temporary Modifications and/or Permanent Modifications (IP Section 03.01 and/or 03.02) (2 Samples)

The inspectors evaluated the following temporary or permanent modifications:

- (1) Engineering Change Request 627176 – Unit 2 Hotwell Level Oscillations Temporary Configuration Change Package on June 21, 2019
- (2) Engineering Change Request 621675 – Anti-Vibration Solution for Jet Pumps on June 25, 2019

71111.19 - Post-Maintenance Testing

Post Maintenance Test Sample (IP Section 03.01) (10 Samples)

The inspectors evaluated the following post maintenance tests:

- (1) Unit 1 RCIC vacuum pump replacement and post maintenance testing on April 3, 2019
- (2) Unit 2 source range monitor 'A' drawer replacement on April 3, 2019
- (3) Unit 1 A standby liquid control squib valve replacement and post maintenance testing on April 10, 2019
- (4) Unit 2 source range monitor 'A' inboard connector '20JX100A' replacement on April 22, 2019
- (5) Unit 2 control rod stroke time testing in preparation for startup activities during the refueling outage on May 2, 2019
- (6) Unit 2 HPCI operability verification associated with startup activities during the refueling outage on May 3, 2019
- (7) Unit 2 jet pump operability verification associated with startup activities during the refueling outage on May 9, 2019
- (8) Unit 1 'D' RHR pump upper motor bearing lube oil replacement and motor oil cooler flush on May 21, 2019
- (9) Unit 2 implementation of average power range monitor channels' single-loop flow-biased alarm and trip setpoints on May 26, 2019
- (10) Unit 2 replacement of 2B adjustable speed drive power cells on May 27, 2019

71111.20 - Refueling and Other Outage Activities

Refueling/Other Outage Sample (IP Section 03.01) (2 Samples)

- (1) The inspectors evaluated Unit 2 refueling outage activities from April 15 to May 5, 2019
- (2) The inspectors evaluated Unit 2 forced outage 2F55 activities from June 4 to 8, 2019

71111.22 - Surveillance Testing

The inspectors evaluated the following surveillance tests:

Containment Isolation Valve Testing (IP Section 03.01) (2 Samples)

- (1) ST-4-LLR-001-2, Unit 2 local leak rate testing program and accountability test during refueling outage 2R15 on April 25, 2019
- (2) ST-6-041-202-2, Unit 2 main steam isolation valve cold shutdown valve test on April 25, 2019

Surveillance Tests (other) (IP Section 03.01) (5 Samples)

- (1) RT-6-053-311-2, Unit 2 fuel pool cooling heat exchanger heat transfer test on March 27 and 28, 2019
- (2) ST-6-092-311-2, 'D21' emergency diesel generator slow start on April 2, 2019
- (3) ST-6-092-780-2, Unit 2 diesel generator simultaneous startup test on April 27, 2019
- (4) ST-2-088-320-1, Unit 1 remote shutdown system RCIC operability test on May 15, 2019
- (5) ST-6-051-233-2, 'C' RHR pump, valve, and flow test on May 19, 2019

RADIATION SAFETY

71124.01 - Radiological Hazard Assessment and Exposure Controls

Contamination and Radioactive Material Control (IP Section 02.03) (1 Sample)

The inspectors evaluated licensee processes for monitoring and controlling contamination and radioactive material.

- (1) The inspectors observed the monitoring of potentially contaminated material leaving the radiological controlled area and inspected the methods and radiation monitoring instrumentation used for control, survey, and release of that material. The inspectors selected several sealed sources from inventory records and assessed whether the sources were accounted for and were tested for loose surface contamination. The inspectors evaluated whether any recent transactions involving nationally tracked sources were reported in accordance with requirements.

High Radiation Area and Very High Radiation Area Controls (IP Section 02.05) (1 Sample)

- (1) The inspectors reviewed the procedures and controls for high radiation areas, very high radiation areas, and radiological transient areas in the plant.

Instructions to Workers (IP Section 02.02) (1 Sample)

The inspectors evaluated instructions to workers including radiation work permits used to access high radiation areas.

- (1) The inspectors reviewed high radiation area work permit controls and use; reviewed electronic alarming dosimeter alarms and setpoints; observed worker briefings on radiological conditions; and observed containers of radioactive materials and

assessed whether the containers were labeled and controlled in accordance with requirements.

Radiation Worker Performance and Radiation Protection Technician Proficiency (IP Section 02.06) (1 Sample)

- (1) The inspectors evaluated radiation worker performance with respect to radiation protection work permit requirements. The inspectors evaluated radiation protection technicians in their performance of radiation surveys and in providing radiological job coverage.

Radiological Hazard Assessment (IP Section 02.01) (1 Sample)

The inspectors evaluated radiological hazards assessments and controls.

- (1) The inspectors conducted independent radiation measurements during walkdowns of the facility and reviewed:
 - 1. The radiological survey program
 - 2. Any changes to plant operations since the last inspection
 - 3. Recent plant radiation surveys for radiological work activities
 - 4. Air sampling and analysis
 - 5. Continuous air monitor use

Radiological Hazards Control and Work Coverage (IP Section 02.04) (1 Sample)

The inspectors evaluated in-plant radiological conditions during facility walkdowns and observation of radiological work activities.

- (1) The inspectors evaluated in-plant radiological conditions and performed independent radiation measurements during facility walkdowns and observation of radiological work activities. The inspectors assessed whether posted surveys; radiation work permits; worker radiological briefings and radiation protection job coverage; the use of continuous air monitoring, air sampling and engineering controls; and dosimetry monitoring were consistent with the present conditions. The inspectors examined the control of highly activated or contaminated materials stored within the spent fuel pool and the posting and physical controls for selected high radiation areas, locked high radiation areas, and very high radiation areas.

OTHER ACTIVITIES – BASELINE

71151 - Performance Indicator Verification

The inspectors verified Exelon's performance indicator submittals listed below for the period April 1, 2018, through March 31, 2019:

MS05: Safety System Functional Failures (SSFFs) Sample (IP Section 02.04) (2 Samples)

- (1) Unit 1 safety system functional failures
- (2) Unit 2 safety system functional failures

MS06: Emergency AC Power Systems (IP Section 02.05) (2 Samples)

- (1) Unit 1 emergency alternating current power
- (2) Unit 2 emergency alternating current power

71152 - Problem Identification and Resolution

Annual Follow-up of Selected Issues (IP Section 02.03) (2 Samples)

The inspectors reviewed the licensee's implementation of its corrective action program related to the following issues:

- (1) Unit 1 automatic scram during control valve testing while shutdown as documented in IR 4126850
- (2) Tagging error and resulting loss of operability of the 'B' CREFAS system on February 21, 2018

Semiannual Trend Review (IP Section 02.02) (1 Sample)

- (1) The inspectors reviewed the licensee's corrective action program for potential adverse trends that might be indicative of a more significant safety issue

71153 - Followup of Events and Notices of Enforcement Discretion

Event Followup (IP Section 03.01) (2 Samples)

- (1) Unplanned downpower and single loop operation of Unit 2 due to a trip of the 'B' reactor recirculation pump caused by an electrical fault in the '2B' ASD power supply on May 26, 2019
- (2) Manual trip of Unit 2 due to degraded condenser vacuum resulting from loss of a non-safety-related 480 Volt motor control center on June 4, 2019

INSPECTION RESULTS

Waterbox Manway was not Closed Causing Internal Flooding			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green FIN 05000353/2019002-01 Open/Closed	[H.12] - Avoid Complacency	71111.06
A self-revealing Green finding was identified due to internal flooding on May 5, 2019. Specifically, a work order instruction to reinstall a manway on the Unit 2 main condenser waterbox was not performed which caused flooding in the condenser area and the condensate pump pit.			
<u>Description:</u> On May 5, 2019, Limerick Generating Station Unit 2 was starting up from refueling outage 2R15, operating at about 20 percent reactor power, and restoring systems to normal operation. Shortly following operators opening the inlet valve for the 'C' main condenser waterbox, condenser area flood alarms were received on Unit 2. After acknowledging the alarm, reactor operators closed the inlet valve, and equipment operators			

were dispatched. Flooding of about a foot was identified in the condenser area. Later, equipment alarms were received associated with the condensate pump pit. Operations personnel identified flooding in the room. Exelon personnel installed a portable pump that maintained the water level below a depth of about 32 inches. Exelon later determined the flood height of concern within the condensate pump pit was about 100 inches based on potential water intrusion into the condensate pump motors' lower motor bearing oil reservoirs.

Exelon determined that Work Order 4702426, 'C' - Circ Water Loop Outage Condenser Maintenance, task 23, 'C' Loop-HP, IP, LP Closing Waterboxes 'C' Loop, was not properly performed. A technician directed the work tasks to reinstall the manways on the 'C' loop to multiple personnel without providing specific directions or guidance. Then, when personnel reported back that manways were closed, the technician signed the tasks as complete without verifying closure in the field. The '2C' high pressure (turbine) south side manway was left open, and as a result, when operators opened the 'C' waterbox inlet valve, the waterbox filled and water flowed into the condenser area. Exelon reviewed the drain system and determined the floor drains of the condenser area and condensate pump pit were connected. The drains join common headers which drain to respective sumps. These headers are not common with other areas of the plant. The flow rate from the headers to the sumps was unable to drain quickly enough which resulted in backflow into the condensate pump pit which is at a lower elevation than the lowest condenser area level.

The inspectors walked down the condensate pump pit and areas adjacent to the condenser bay and verified field conditions and plant responses using procedures and drawings. The inspectors also interviewed operations, maintenance, and engineering personnel and confirmed the work order instructions required closing the 'C' waterbox manways.

Corrective Actions: Exelon ensured all manways were properly closed, drained the remaining water from the affected areas, ensured wetted equipment was sufficiently dried, and resolved a subsequent balance of plant battery ground. Exelon conducted a human error review board and initiated an evaluation of the event to address underlying causes.

Corrective Action References: IR 4246432

Performance Assessment:

Performance Deficiency: The failure to implement a work order instruction to reinstall a manway on the Unit 2 main condenser waterbox which caused flooding in the condenser bay and condensate pump pit was reasonably within Exelon's ability to foresee and correct and should have been prevented and therefore was a performance deficiency.

Screening: The inspectors determined the performance deficiency was more than minor because it was associated with the Protection Against External Factors attribute of the Initiating Events cornerstone. Specifically, the finding was associated with internal flooding and affected the initiating events objective to limit the likelihood of events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. The finding introduced a potential to adversely impact all three condensate pumps.

Significance: The inspectors assessed the significance of the finding using Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." As directed by IMC 0609, Appendix A, Exhibit 1, section E, a detailed risk assessment was required since the finding impacted the frequency of internal flooding events. The evaluation was conducted using the Limerick SPAR Model version 8.19, to evaluate the risk associated for a finding resulting in

turbine building enclosure flood (FLI-TE). Since the finding resulted in an initiating event, the guidance from the Risk Assessment of Operation Events Handbook, Volume 1, Section 8, were utilized. The dominant accident sequence was a turbine building enclosure flood, resulting in a loss of main feedwater and the condenser, along with a failure of high pressure injection and the failure to depressurize the reactor to permit low pressure injection. The source of the flooding into the condenser area was secured from the control room in approximately 3 minutes. The time Exelon had to mitigate the flooding in the condensate pump pit that resulted from the open manway before adversely impacting the condensate pumps, resulting in the loss of feedwater, was estimated to be approximately 3 hours. Due to the alarms and the operations crew conducting startup evolutions, the resulting flooding condition was easily recognized, and the actions to mitigate the flooding within the condensate pump pit were simple with more than adequate time available. Based on these inputs, the estimated change in core damage was substantially less than 1E-6 and was determined to be of very low safety significance, Green. A review of the potential for the finding to result in a large early release was also considered. The unit was in the process of starting up after a planned refueling outage and was at approximately 20% power, and the nature of the finding limited further power ascension. Given these conditions, decay heat was very low. Considering the lower decay heat, the ability to provide high pressure makeup could have considered more realistic reduced mission times and consequently considered lower failure to run probabilities and control rod drive pump injection. Given these considerations, the risk from a large early release was determined to be insignificant.

Cross-Cutting Aspect: H.12 - Avoid Complacency: Individuals recognize and plan for the possibility of mistakes, latent issues, and inherent risk, even while expecting successful outcomes. Individuals implement appropriate error reduction tools. Specifically, the technicians performing the work assumed sufficient knowledge existed, did not use self or peer checking tools, and did not ensure thorough communications and common understanding of conditions with respect to closing the manways.

Enforcement: Inspectors did not identify a violation of regulatory requirements associated with this finding.

Observation: Unit 1 Auto Scram during Control Valve Testing while Shutdown as documented in IR 4126850	71152
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The inspectors reviewed the cause analysis, the corrective actions taken and planned, and the extent of condition. The inspectors noted that, though the digital electro-hydraulic control systems are identical and the software versions between Unit 1 and Unit 2 are the same, the test methodology and sequence are dissimilar. A near-term corrective action was initiated to revise the Unit 1 test procedures to be consistent with Unit 2 procedures. This is based on Unit 1 installation in 2014 with a previous software / feature version. An approved engineering change (ECR 15-00258) brings Unit 1, Unit 2, and simulator software version into alignment. This was also identified by the causal evaluation in AR 4126850 with actions to identify and reconcile unit differences (ACIT 2733712-88/10, MREQ 4124803-46 through 50). Exelon also noted, during an operating experience review, that a 2014 Unit 1 event was caused by an inadequate cross-discipline review for a digital system and implemented additional corrective actions to require these reviews for non-editorial revisions for digital control systems. Exelon's effectiveness review (4126850-16) indicates corrective actions have been effective in that regard. In general, the inspectors concluded that the cause analysis was thorough, the extent of condition was reasonable, and the corrective actions were effective.

Observation: 71152 Semiannual Trend Review	71152
<p>The inspectors performed a semi-annual review of site issues to identify trends that might indicate the existence of more significant safety concerns. As part of this review, the inspectors included repetitive or closely-related issues documented by Exelon in the corrective action program database, trend reports, site performance indicators, major equipment problem lists, system health reports, maintenance rule assessments, and maintenance or corrective action program backlogs. The inspectors also reviewed how Exelon's corrective action program evaluated and responded to individual issues identified by the NRC inspectors during routine plant walkdowns and daily condition report reviews.</p> <p>In particular, the inspectors reviewed and assessed recent issues with emergency diesel generators to assess the potential for a trend. In addition, the inspectors reviewed two findings documented in this inspection report having the same cross-cutting aspect, H.12, Avoid Complacency. The inspectors discussed the issues with site personnel and ensured Exelon's corrective actions included extent of condition actions to proactively prevent adverse trends. For example, an evaluation performed for an emergency diesel issue determined that a replaced signal generator produced degraded output voltage which caused the issue. The inspectors inquired whether actions were planned to measure the signal generator output voltages on remaining emergency diesel generators. Exelon had not planned such an activity, but as a result of the inspectors' question, Exelon personnel initiated action to perform measurements during future planned system outages.</p> <p>Regarding potential complacency, the inspectors discussed planned site-wide actions with Exelon personnel to address potential site trends, such as special briefings and stand-downs. The inspectors determined Exelon's actions were proactive and appropriate. However, the inspectors did not identify an adverse trend that might indicate the existence of a more significant safety concern during this semi-annual period.</p>	

Observation: Procedure Weakness in PI-AA-120, "Issue Identification and Screening Process."	71152
<p>The inspectors identified one weakness in Exelon procedure PI-AA-120, "Issue Identification and Screening Process," Revision 8. Specifically, Attachment 2 to the procedure cites several "Operational Execution – Reg/Nuclear Safety" examples that would meet the definition of a Significance Level 2 AR. Among these examples is stated to be a "Level 1 Clearance and Tagging Event as defined in Reference 6.28." The inspectors noted that there is no Reference 6.28 located in the procedure reference section of PI-AA-120. Exelon wrote AR 4240047 to create a tracking assignment which will revise this discrepancy on a future revision. The inspectors determined that this was not a violation of regulatory requirements and despite the error, Exelon correctly screened the clearance and tagging error AR and assigned it the appropriate significance level.</p>	

Minor Violation	71152
<p>Minor Violation: Exelon failed to properly revise a surveillance test procedure for Unit 1 main turbine valve testing (ST-6-001-766-1, Revision 20) contrary to the requirements of Technical Specification 6.8.1.a. Specifically, a technical error associated with the revised surveillance test procedure introduced an incompatible test sequence for plant test conditions; mainly the reinstatement of the Reactor Water Level 8 trip, which resulted in a full reactor protective system scram on April 14, 2018, during refueling outage 1R17. Exelon subsequently identified that the procedure was revised without a cross-discipline review and missed the opportunity to identify the error during the revision. This issue and causal evaluation is</p>	

documented in AR 4126850. The procedure was revised (Revision 21) to electrically defeat the Reactor Water Level 8 trip during the test until the procedure can be revised to match the sequence and methodology used in Unit 2 (PCRA 2686137-68) before the next performance in refueling outage 1R18.

Screening: The inspectors determined the performance deficiency was minor. Exelon's failure to properly revise and implement the surveillance test procedure is a performance deficiency. The inspectors evaluated the significance in accordance with IMC 0612, Appendix B, "Issue Screening," and IMC 0612, Appendix E, "Examples of Minor Issues." The inspectors determined that this issue was not more than minor, because the erroneous test procedure was specific to shutdown plant conditions and that there was no impact on safety equipment and caused no safety consequences. This violation similar to example 2.g in IMC 0612, Appendix E.

Enforcement: Technical Specification 6.8.1.a requires, in part, that written procedures shall be maintained for applicable procedures in Appendix A of Regulatory Guide 1.33, Revision 2. Regulatory Guide 1.33, Appendix A, Section 8 specifies Surveillance Test procedures as required by technical specifications. Contrary to the above, from April 11, 2018, when Revision 20 was implemented, to April 14, 2018, Exelon failed to properly maintain a surveillance test procedure for Unit 1 main turbine valve testing (ST-6-001-766-1, Revision 20). Specifically, a technical error associated with the revised surveillance test procedure introduced an incompatible test sequence for plant test conditions; mainly the reinstatement of the Reactor Water Level 8 trip, which resulted in a full reactor protective system scram on April 14, 2018, during refueling outage 1R17. Exelon entered the issue into the corrective action program as IR 4126850, corrected the procedure, and satisfactorily completed the surveillance test. This failure to comply with Technical Specification 6.8.1.a constitutes a minor violation that is not subject to enforcement action in accordance with the NRC's Enforcement Policy.

Tagging Error Leads to Inoperability of the 'B' CREFAS system			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Barrier Integrity	Green NCV 05000352,05000353/2019002-02 Open/Closed	[H.12] - Avoid Complacency	71152
A self-revealing Green NCV of Limerick Generating Station Technical Specification 6.8, "Procedures and Programs," was identified on February 21, 2018, when Exelon failed to properly implement procedure OP-MA-109-101, "Clearance and Tagging," step 7.1.4, to ensure that the effects on the systems and components outside of the zone of protection were identified and acceptable or properly dispositioned. Specifically, while opening breaker 10-Y164-3 during a tagout for relay replacements in the Auxiliary Equipment Room HVAC system, the inlet and outlet dampers to the 'B' main control room HVAC supply fan unexpectedly failed closed, which resulted in unplanned inoperability of the 'B' CREFAS system.			
<u>Description:</u> On February 21, 2018, Exelon operators began hanging tagout 17-0-078-0011 for maintenance involving the replacement of relays in the Auxiliary Equipment Room HVAC system. Included in the tagout was the application of tag serial number 11756, which involved placing circuit breaker 10-Y164-3 in the OFF position. After placing this breaker in			

the OFF position, the main control room received unexpected alarms associated with the 'B' main control room HVAC system.

Control room operators responded to the alarms and determined that placing 10-Y164-3 in the OFF position removed power to components in the 'B' main control room HVAC system. Specifically, this circuit feeds both the Auxiliary Equipment Room air dampers and the control room HVAC air dampers. Losing power to the control room HVAC air dampers was unexpected, as this effect was not noted in the tagout or discussed before the tagout was applied. This caused both the inlet and outlet dampers (HD-078-026B and 027B) to the 'B' main control room HVAC supply fan to fail closed.

The closure of the dampers rendered the 'B' CREFAS system inoperable and unavailable for both Units 1 and 2. As a result, on February 21, 2018, at 0250, operators declared the 'B' CREFAS inoperable per Limerick Generating Station Technical Specification 3.7.2. Operators were briefed for tagout removal and at 0325, the 'B' CREFAS system was declared operable after 10-Y164-3 was restored to the ON position.

The CREFAS system provides filtration of control room fresh air during a high radiation condition. It also filters recirculated control room air during a chlorine isolation or offsite toxic chemical release. The system is activated automatically by detection of radiation or chlorine, or manually upon detection of toxic chemicals. Additionally, the CREFAS system maintains a positive pressure in the main control room during the radiation isolation mode of operation.

During the tagout development in 2017, the writer failed to ensure that the components outside of the zone of protection, specifically the control room HVAC system dampers, were identified or properly dispositioned, as required in Exelon procedure OP-MA-109-101, "Clearance and Tagging," step 7.1.4.

Corrective Actions: Immediate corrective actions included restoring 10-Y164-3 to the ON position and subsequently declaring 'B' CREFAS operable. Additionally, Exelon entered the issue into the corrective action program, conducted a human performance review board, distributed a communication to employees, removed the qualifications of the individuals involved, reset department clocks, conducted a stand down, and performed an extent of condition review for tagouts already written for future workweeks. The evaluation performed by Exelon revealed that tagout 17-0-078-011 was originally written in 2017 to support work while the 'B' CREFAS system was in a planned system outage window. As a result, the tagout did not consider the limiting condition for operation or system impact to the 'B' CREFAS system. Additionally, both the tagout writer and the senior reactor operator confirmer missed a second entry on the electrical prints that showed the main control room dampers as affected loads powered from 10-Y164-3.

Corrective Action References: AR 04106334

Performance Assessment:

Performance Deficiency: The inspectors determined that the failure to implement Exelon procedure OP-MA-109-101, "Clearance and Tagging," step 7.1.4, to ensure that the effects on the systems and components outside of the zone of protection were identified and acceptable or properly dispositioned was a performance deficiency that was reasonably within Exelon's ability to foresee and correct and should have been prevented.

Screening: The inspectors determined the performance deficiency was more than minor because it was associated with the Human Performance attribute of the Barrier Integrity cornerstone. Specifically, it adversely affected the cornerstone objective to provide reasonable assurance that physical design barriers (fuel cladding, reactor coolant system, and containment) protect the public from radionuclide releases caused by accidents or events. Control Room/Auxiliary/Reactor Building or Spent Fuel Pool Building areas are considered subsections within the Barrier Integrity cornerstone in accordance with NRC IMC 0609, Appendix A.

Significance: The inspectors assessed the significance of the finding using Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." Additionally, the inspectors assessed the significance of the finding using IMC 0609, Attachment 4, "Initial Characterization of Findings." In accordance with Exhibit 3 of IMC 0609, Appendix A, "Barrier Integrity Screening Questions," the inspectors determined that the finding was of very low safety significance (Green) because the finding did not represent a degradation of the barrier function of the control room against smoke or a toxic atmosphere.

Cross-Cutting Aspect: H.12 - Avoid Complacency: Individuals recognize and plan for the possibility of mistakes, latent issues, and inherent risk, even while expecting successful outcomes. Individuals implement appropriate error reduction tools. The inspectors determined this finding had a cross-cutting aspect in the area of Human Performance, Avoid Complacency, because Exelon personnel did not plan for the possibility of mistakes or implement appropriate error reduction tools when tagout 17-0-078-011 was written and implemented. [H.12]

Enforcement:

Violation: Limerick Generating Station Technical Specification 6.8, "Procedures and Programs," requires, in part, that written procedures shall be established, implemented, and maintained covering the applicable procedures recommended in Appendix A of Regulatory Guide 1.33, Revision 2, February 1978. Regulatory Guide 1.33, Revision 2, Appendix A, February 1978, recommends administrative activities, including equipment control (e.g., locking and tagging), be covered by written procedures.

Exelon Procedure OP-MA-109-101, "Clearance and Tagging," Revision 22, Section 7, "Development Standards," step 7.1.4 states, "Tagout impacts must be evaluated to ensure that the effects on the systems and components outside of the zone of protection are identified and acceptable or properly dispositioned (i.e., evaluate effect of work on fire systems such as CO₂ / Halon injection or deluge systems)."

Contrary to the above, on February 21, 2018, Exelon failed to implement a procedure required by Technical Specification 6.8 when tagout 17-0-078-0011 was hung and resulted in the inoperability of a system outside of the zone of protection. Specifically, the tagout writers failed to identify that the 'B' CREFAS system would become inoperable due to the tagout, which when implemented opened a 120 VAC panel feed and caused the inlet and outlet dampers to the 'B' main control room HVAC supply fan to lose power and fail closed.

Enforcement Action: This violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy.

EXIT MEETINGS AND DEBRIEFS

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

- On April 22, 2019, the inspectors presented the Exit meeting for PI&R sample on tagging error and resulting loss of operability for 'B' CREFAS to Mr. Brian Trimble and other members of the licensee staff.
- On May 30, 2019, the inspectors presented the annual problem identification and resolution sample associated with the Unit 1 auto scram during control valve testing as documented in IR 4126850 to Mr. George Budock and other members of the licensee staff.
- On July 23, 2019, the inspectors presented the integrated inspection results to Mr. Marty Bonifanti, Director of Organizational Performance and Learning, and other members of the licensee staff.

THIRD PARTY REVIEWS

Inspectors reviewed Institute on Nuclear Power Operations reports that were issued during the inspection period.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.04	Procedures	1S51.1.A (COL-1)	Equipment Alignment for Automatic Operation of the RHR system in the LPCI Mode – “A” subsystem	Revision 21
71111.04S		2S52.1.A (COL-1)	Equipment Alignment for core spray loop ‘A’ operation	Revision 7
		2S52.1.A (COL-2)	Equipment Alignment for core spray loop ‘B’ operation	Revision 8
		S52.1.A	Core Spray Setup for Service Operation	Revision 0
		S52.9.A	Routine inspection of the core spray system	Revision 19
71111.05A	Miscellaneous	Fire Drill Scenario No.: F-R-207	Unit 1, Reactor Enclosure Cooling Water Heat Exchanger Area Rooms 207 and 210 (EL 201)	
		OP-AA-201-003 Attachment 1	Fire Drill Record	completed May 15, 2019
		F-R-207	Unit 1 Reactor Enclosure Cooling Water Heat Exchanger Area Rooms 207 and 210 (EL 201)	Revision 9
		OP-AA-201-003	Fire Drill Performance	Revision 17
		ST-6-022-551-0	Fire Drill	Revision 13
71111.05Q		F-R-473	Unit 2, Drywell Area (EI 237)	Revision 7
	Procedures	OP-AA-201-008	Pre-Fire Plan Manual	Revision 4
		OP-LG-201-008	Limerick Generating Station Fire Protection (F) Pre-Fire Plan Strategies	Revision 5
71111.06		4246432		
	Corrective Action Documents	SE-4	Flood	Revision 7
		SE-4-2	Turbine/Control Enclosure Flooding	Revision 2
	Work Orders	4702426		
71111.11Q	Procedures	GP-2	Normal Plant Startup	Revision 174
		GP-3	Normal Plant Shutdown	Revision 166
71111.15	Corrective Action Documents	3997676		
		4235302		
		4237119		
		4237803		
		4237808		

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.19	Miscellaneous	L-S-07	Diesel Generator and Auxiliary Systems	Revision 15
		LR-M-20	License Renewal Boundary Drawing Fuel & Diesel Oil Storage & Transfer (Fuel Oil & Transfer System Unit 2)	Revision 1
		M20-6	Sizing of Diesel Oil Transfer Pumps	Revision 2
	Procedures	2S92.1.N (COL-4)	Equipment Alignment for 2D Diesel Generator Operation	Revision 22
		RT-2-042-400-2	Reactor Vessel Level Indication - Refuel; Calibration Test (LT-42-216, LT-42-217)	Revision 10
		S92.8.B	Alternative Fuel Oil Sampling Method	Revision 7
		ST-4-020-961-2	D21 Diesel Fuel Oil Storage and Transfer System Buried Pipe and Storage Tank 2A-T527 Pressure Decay Test	Revision 5
		ST-6-092-311-1	D11 Diesel Generator Slow Start Operability Test Run	Revision 103
	Work Orders	4279657		
		4626423		
		R1255537		
	Procedures	RT-6-047-760-1	Control Rod Stroke Timing	Revision 19
		S43.10.A	Operation of ASD in Open Loop Test Mode (OLTM)	Revision 3
		ST-2-074-400-2	SRM A Calibration Test	Revision 13
		ST-2-074-526-2	Implementation and Restoration of APRM 1 Single Loop Flow Biased STP Setpoints	Revision 6
		ST-2-074-527-2	Implementation and Restoration of APRM 2 Single Loop Flow Biased STP Setpoints	Revision 6
		ST-2-074-528-2	Implementation and Restoration of APRM 3 Single Loop Flow Biased STP Setpoints	Revision 6
		ST-2-074-529-2	Implementation and Restoration of APRM 4 Single Loop Flow Biased STP Setpoints	Revision 6
		ST-6-043-320-2	Jet Pump Operability Verification	Revision 35
		ST-6-048-230-1		
		ST-6-055-321-2	HPCI Operability Verification	Revision 26
	Work Orders	04702431		
		4261998		
		4696704		
		4696708		
		4696712		

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		4762224		
		4863902		
		4865490		
71111.22	Procedures	ST-6-092-311-2	D21 Diesel Generator Slow Start Operability Test Run	
		ST-6-092-780-2	Unit 2 Diesel Generator Simultaneous Startup Test	
71152	Corrective Action Documents	020559868		
		04126850		
		4106334	Unanticipated Response During Tagout Application	0
		4240047	Inaccurate Reference in PI-AA-120	0
	Engineering Changes	ECR 15-00258	ECR Required for U1 DEHC Project Reconciliation	Revision 1
	Miscellaneous	02733712-88/10	Operations to perform review of critical tests, to identify and correct any U1/U2 differences	Revision 0
		17-0-078-0011	Maintenance Tagout	0
		Control Room Logs	Feb 21, 2018 Control Room Logs	0
		EFR 04126850		
		LGSOPS0078	LGS Operations Initial Training - Control Enclosure Ventilation and Chilled Water System	3
		PCRA 2686137-68		
		Regulatory Guide 1.33	Quality Assurance Program Requirements	2, Feb 1978
		SO-18-036	Unit 1 DEHC Scram Lessons Learned	
		THU Alert	IR 4106334, 02/21/18 Tagging Error	February 21, 2018
	Procedures	OP-AA-109-101-1001	Clearance and Tagging Performance Management Process	8
		OP-AA-109-101-1001	Clearance and Tagging Performance Management Process	10
		OP-MA-109-101	Clearance and Tagging	22
		PI-AA-120	Issue Identification and Screening Process	8
		PI-AA-125	Corrective Action Program (CAP) Procedure	6

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		ST-6-001-766-1	Main Turbine Control Valve Exercise & RPS Channel Functional Test, OPCON 4,5	Revision 20
		ST-6-001-766-1	Main Turbine Control Valve Exercise & RPS Channel Functional Test, OPCON 4,5	Revision 21
		ST-6-001-766-1	Main Turbine Control Valve Exercise & RPS Channel Functional Test, OPCON 4,5	Aborted 4/14/18
		ST-6-001-766-1	Main Turbine Control Valve Exercise & RPS Channel Functional Test, OPCON 4,5	Completed 4/15/19
		ST-6-001-766-2	Main Turbine Control Valve Exercise & RPS Channel Functional Test, OPCON 4,5	Completed 5/2/19
		ST-6-001-766-2	Main Turbine Control Valve Exercise & RPS Channel Functional Test, OPCON 4,5	Revision 22
	Work Orders	04311206 04773275 04638972-01		
71153	Corrective Action Documents	4254025		
	Procedures	E-D214	Loss of D214 Safeguard Load Center	Revision 10
		E-D214-G-D	Loss of MCC D214-G-D	Revision 15