Exelon Generation

10 CFR 50.73

LG-18-095
August 9, 2018

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Limerick Generating Station, Unit 2
Renewed Facility Operating License No. NPF-85
NRC Docket No. 50-353

Subject: LER 2017-004-01, Degraded Condition due to RPV Instrument Nozzle Leakage

Enclosed is a Licensee Event Report (LER) which addresses a degraded condition due to Reactor Pressure Vessel (RPV) instrument nozzle leakage identified during a refueling outage at Limerick Generating Station (LGS) Unit 2. This report removes a corrective action from the original referenced document.

This LER is being submitted pursuant to the requirements of 50.73(a)(2)(ii)(A) for a Degraded Condition.

There are no commitments contained in this letter.

If you have any questions, please contact Robert B. Dickinson at (610) 718-3400.

Respectfully,

Richard W. Libra
Vice President – Limerick Generating Station
Exelon Generation Company, LLC

cc: Administrator Region I, USNRC
USNRC Senior Resident Inspector, LGS

NRC FORM 366 (02-2018) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB: NO. 3150-0104 EXPIRES: 03/31/2020

LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

1. Facility Name	2. Docket Number	3. Page
Limerick Generating Station, Unit 2	05000353	1 OF 4

4. Title

Degraded Condition due to RPV Instrument Nozzle Leakage

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved	
Month	Day	Year	Year	Sequential Number	Rev No.	Month	Day	Year	Facility Name	Docket Number
05	08	2017	2017	- 004	- 01	8	9	2018	Facility Name	Docket Number

9. Operating Mode	11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: *(Check all that apply)*			
4	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☒ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. Power Level	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
00	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(ii)
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(iii)
		☐ 50.73(a)(2)(i)(C)	☐ Other (Specify in Abstract below or in NRC Form 366A)	

12. Licensee Contact for this LER

Licensee Contact	Telephone Number (Include Area Code)
Robert B. Dickinson, Manager - Regulatory Assurance	(610) 718-3400

13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable to ICES	Cause	System	Component	Manufacturer	Reportable to ICES
B	AC	NZL	C310	Y					

14. Supplemental Report Expected	15. Expected Submission Date	Month	Day	Year
☐ Yes (If yes, complete 15. Expected Submission Date) ☒ No				

Abstract (Limit to 1400 spaces, i.e., approximately 14 single-spaced typewritten lines)

On May 8, 2017, while Unit 2 was shut down for refueling outage 2R14, leakage was identified from a 2-inch Reactor Pressure Vessel (RPV) instrumentation nozzle (N-16D) during a RPV pressure test. The leakage amount was approximately one pint per minute. The leakage originated from the area where the nozzle penetrates the vessel wall. Prior to de-pressurizing, an extent of condition bare metal examination was conducted. No leakage was identified from any other instrument nozzles. A half nozzle repair was completed, consisting of replacing the outer portion of the existing nozzle with a new nozzle that was welded to the outside of the RPV. The safety significance of this event was minimal given the leakage was small, was found while the reactor was shut down, and would not have exceeded Technical Specification (TS) leakage limits for unidentified drywell leakage if it occurred during plant operation. Given the impact on the RPV boundary, this report is submitted in accordance with the requirements of 10 CFR 50.73 (a)(2)(ii)(A), which requires the reporting of any event or condition that resulted in the condition of the nuclear power plant, including its principal safety barriers, being seriously degraded.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

(See NUREG-1022, R.3 for instruction and guidance for completing this form http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Limerick Generating Station, Unit 2	05000353	2017	- 004	- 01

NARRATIVE

I. Unit Conditions Prior to the Event

Limerick Generating Station (LGS) Unit 2 was shut down for refueling outage 2R14 and in Operational Condition (OPCON) 4 at the time of the event. The condition was identified during the Reactor Pressure Vessel [RPV] pressure test.

II. Description of the Event

On May 8, 2017 at 0925, while LGS, Unit 2 was in cold shutdown for refueling, during the performance of the American Society of Mechanical Engineers (ASME) Leakage Testing of the RPV and associate piping, a through-wall leak was identified on an instrument nozzle [NZL], N-16D. The N-16D RPV penetration is an instrument nozzle located just below the Top-of-Active Fuel (TAF) at 280 degree azimuth on the vessel.

The leak was approximately one pint per minute. A visual examination detected active leakage at the nozzle interface (annular gap) with the RPV Outer Diameter (OD). The leak was discovered during the RPV Class 1 pressure boundary system leakage test that is performed each refueling outage in accordance with ASME Section XI, IWB- 2500, and station procedures. Based on the design, any leakage into the annulus region between the nozzle body and the RPV wall would likely be associated with a through-wall failure of the nozzle assembly, either at the nozzle body or at the RPV attachment weld.

Prior to de-pressurizing, an extent of condition bare metal, VT-2, examination of the N-11, N-12, and N-16 nozzles (9 total, not including the N-16D) was conducted on 5/8/17 to determine if any similarly constructed RPV nozzles exhibited leakage. No leakage was identified from any other instrument nozzles.

With the leakage confirmed to be originating from the N-16D nozzle assembly, a repair team was mobilized, consisting of station, corporate, and industry experts. The repair method was a half nozzle repair which consisted of replacing the outer portion of the existing nozzle with a new Inconel alloy 690 nozzle that was welded to the outside of the RPV versus the inside. The original RPV attachment weld and a remnant section of the original nozzle in which the through-wall failure occurred were effectively abandoned in place. The repair was completed on May 23, 2017 and the post-repair leakage test immediately followed, which validated the integrity of the repair and the RPV Class 1 pressure boundary.

On May 8, 2017, Emergency Notification System (ENS) # 52738 was made in accordance with 10 CFR 50.72 (b)(3)(ii)(A), for a degraded condition. Given the impact on the RPV boundary, this report is submitted in accordance with the requirements of 10 CFR 50.73 (a)(2)(ii)(A), which requires the reporting of any event or condition that resulted in the condition of the nuclear power plant, including its principal safety barriers, being seriously degraded.

III. Analysis of the Event

There was no actual safety consequence associated with this event. The potential safety consequence of this event was minimal, given the leakage was small and was found while the reactor

NARRATIVE

was shut down for refueling. Plant Technical Specification (TS) 3.4.3.2 requires monitoring of reactor coolant leakage. When leakage limits are exceeded, the TSs requires reactor shutdown. If any leakage did exist during previous plant operation, it did not exceed TS leakage limits.

Prior to depressurizing from the RPV pressure test, an extent of condition bare metal, VT-2, examination of the N-11, N-12, and N-16 nozzles (9 total, not including the N16D) was conducted on May 8, 2017 to determine if any similarly constructed RPV nozzles exhibited leakage. No leakage was identified.

There are 10 instrument nozzles, 1 Core Differential Pressure and Liquid Control Nozzle (N10), 185 control rod drive (CRD) penetrations, and 55 in-core monitor (ICM) penetrations that are attached to the RPV with similar partial penetration (J-groove) welds on each unit. Each of the RPV penetrations are inspected for leakage each refueling outage during the RPV Class 1 system leakage test. Based on the most recent Class 1 System Leakage Tests on both Units (Unit 1 2016 Refueling Outage and U2 2017 Refueling Outage), there are no other RPV partial penetration welds exhibiting evidence of similar leakage.

A failure assessment and flaw evaluation were completed prior to startup to demonstrate the acceptability of leaving the original partial penetration attachment weld, with a maximum postulated flaw, in place for one operating cycle.

IV. Cause of the Event

Investigation determined the most probable root cause to be Intergranular Stress Corrosion Cracking (IGSCC) originating from a defect in the Alloy 82 overlay cladding which created a creviced environment where cracking could initiate. Once initiated, the cracking most likely propagated through the Alloy 600 nozzle material or between the nozzle material and overlay to then contact the Alloy 182 j-groove weld material. From the j-groove weld, the cracking most likely continued radially through the root of the weld thus providing a path for reactor water to leak outside of the RPV.

V. Corrective Actions

The following corrective actions have been completed:

1. The degraded N-16D nozzle was partially removed to allow a half-nozzle repair to be installed. The half nozzle design was welded to the outer vessel wall, effectively moving the pressure boundary from the degraded nozzle to the new externally attached nozzle. The new half-nozzle assembly was fabricated from Inconel Alloy 690 and attached to the RPV with Inconel Alloy 52M weld metal. Both materials are considered IGSCC resistant. The repair was completed on May 23, 2017.
2. A failure assessment and flaw evaluation were completed prior to startup to demonstrate the acceptability of leaving the original partial penetration attachment weld, with a maximum postulated flaw, in place for one operating cycle.
3. A Relief Request was submitted to the NRC on May 15, 2017, since the defect in the N-16D nozzle would not be removed, and since a qualified technique to perform volumetric non-destructive examination (NDE) of the partial penetration weld for characterizing the flaw and

determining flaw growth in the specific configuration does not exist. The NRC verbally approved the Relief Request on May 17, 2017, prior to Unit 2 startup.

4. The Elastic Plastic Fracture Mechanics (EPFM) flaw evaluation was revised for the N-16D J-groove weld remnant to support continued operation through the end of plant life on Unit 2.
5. An additional NRC Relief Request was submitted for approval on May 4, 2018 to pursue continued operation with the existing N16D nozzle flaw through the remainder of plant life.
6. A bare metal visual exam (VT-2) of all Unit 1 WLI nozzles (N11, N12, and N16) at rated pressure was performed during Li1R17 (Spring 2018), which verified that no leakage exists on any of the similar Unit 1 nozzles.

The corrective action "an enhanced VT-1 inspection will be performed from the vessel ID on the Alloy 82 overlay of the remaining 9 instrument nozzles during the next Unit 2 Refueling Outage" has been removed. The present monitoring plan is consistent with other stations that have had similar events in the industry.

VI. Previous Similar Occurrences

There have been no previous similar occurrences of RPV instrument nozzle leakage at LGS.

VII. Component data:

System:	AC	Reactor Core System
Component:	NZL	Nozzle
Component number:		N-16D
Manufacturer:	C310	Chicago Bridge & Iron Co.
Model number:		Forging Lot No: 15612A