Exelon Generation®

200 Exelon Way
Kennett Square, PA 19348
www.exeloncorp.com

10 CFR 50.46

November 6, 2017

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

Limerick Generating Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

Subject 10 CFR 50.46 Annual Report

References:
1. Letter from J. Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated November 4, 2016.
2. Letter from GE Hitachi Nuclear Energy (GEH) to Exelon, "10 CFR 50.46 Notification 2017-01, Limerick Generating Station," dated June 12, 2017.
3. Letter from GE Hitachi Nuclear Energy (GEH) to Exelon, "10 CFR 50.46 Notification 2017-02, Limerick Generating Station," dated August 2, 2017.

The purpose of this letter is to submit the 10 CFR 50.46 reporting information for Limerick Generating Station (LGS), Units 1 and 2. The most recent annual 10 CFR 50.46 Report for LGS, Units 1 and 2, (Reference 1) provided the cumulative Peak Cladding Temperature (PCT) errors for the most recent fuel design through November 4, 2016.

Since the Reference 1 report, two vendor notifications regarding Emergency Core Cooling System (ECCS) modeling changes/errors applicable to LGS, Units 1 and 2, have been issued (References 2 and 3). These notifications describe issues related to the improper modeling of lower tie plate leakage for the GNF2 fuel design and changes to modeling of the fuel rod plenum for 10x10 fuel. No ECCS-related changes or modifications have occurred at LGS that affect the assumptions of the ECCS analyses.

Three attachments are included with this letter that provide the current LGS, Units 1 and 2, 10 CFR 50.46 status. Attachments 1 and 2 ("Peak Cladding Temperature Rack-Up Sheet") provide updated information regarding the PCT for the limiting Loss of Coolant Accident (LOCA) analysis evaluations for LGS, Units 1 and 2, respectively. Attachment 3, "Assessment Notes," contains a detailed description for each change or error reported.

There are no regulatory commitments in this letter.

If you have any questions, please contact Glenn Stewart at 610-765-5529.

Respectfully,

D. P. Helker

David P. Helker
Manager - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Attachments:
1) Peak Cladding Temperature Rack-Up Sheet (Limerick Generating Station, Unit 1)
2) Peak Cladding Temperature Rack-Up Sheet (Limerick Generating Station, Unit 2)
3) Assessment Notes (Limerick Generating Station, Units 1 and 2)

cc: USNRC Region I, Regional Administrator
USNRC Senior Resident Inspector, LGS
USNRC Project Manager, LGS
R. R. Janati, Pennsylvania Bureau of Radiation Protection

ATTACHMENT 1

10 CFR 50.46
"Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors"

Report of the Emergency Core Cooling System Evaluation Model Changes and Errors

Assessments as of November 6, 2017

Peak Cladding Temperature Rack-Up Sheet

Limerick Generating Station, Unit 1

PLANT NAME: Limerick Unit 1
ECCS EVALUATION MODEL: SAFER/GESTR-LOCA
REPORT REVISION DATE: 11/6/17
CURRENT OPERATING CYCLE: 17

ANALYSIS OF RECORD CALCULATIONS

1. "Limerick Generating Station Units 1 and 2 GNF2 ECCS-LOCA Evaluation," 0000-0111-9078-R0, February 2011.

Fuels Analyzed in Calculations and in Operation: GNF2
Limiting Fuel Type: GNF2
Limiting Single Failure (GNF2): Battery Failure
Limiting Break Size and Location (GNF2): Double-Ended Guillotine in a Recirculation Suction Pipe

Reference Peak Cladding Temperature (PCT) – GNF2: 1880°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 Report dated November 23, 2011 (See Note 1)	GNF2 ΔPCT = 50°F
10 CFR 50.46 Report dated November 9, 2012 (See Note 2)	GNF2 ΔPCT = 0°F
10 CFR 50.46 Report dated December 12, 2012 (See Note 3)	GNF2 ΔPCT = 45°F
10 CFR 50.46 Report dated November 8, 2013 (See Note 4)	GNF2 ΔPCT = 0°F
10 CFR 50.46 Report dated November 7, 2014 (See Note 5)	GNF2 ΔPCT = 10°F
10 CFR 50.46 Report dated November 6, 2015 (See Note 6)	GNF2 ΔPCT = 0°F
10 CFR 50.46 Report dated November 4, 2016 (See Note 7)	GNF2 ΔPCT = 0°F
Net PCT (GNF2)	**1985 °F**

B. CURRENT LOCA MODEL ASSESSMENTS

GNF2 Lower Tie Plate Leakage (See Note 8)	GNF2 ΔPCT = 30°F
Fuel Rod Plenum Temperature Update (See Note 8)	GNF2 ΔPCT = 0°F
Total PCT change from current assessments (GNF2)	∑ΔPCT = 30 °F
Cumulative PCT change from current assessments (GNF2)	∑ |ΔPCT| = 30 °F
Net PCT (GNF2)	**2015 °F**

ATTACHMENT 2

10 CFR 50.46
"Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors"

Report of the Emergency Core Cooling System Evaluation Model Changes and Errors

Assessments as of November 6, 2017

Peak Cladding Temperature Rack-Up Sheet

Limerick Generating Station, Unit 2

PLANT NAME: Limerick Unit 2
ECCS EVALUATION MODEL: SAFER/GESTR-LOCA
REPORT REVISION DATE: 11/6/17
CURRENT OPERATING CYCLE: 15

ANALYSIS OF RECORD CALCULATIONS

1. "Limerick Generating Station Units 1 and 2 GNF2 ECCS-LOCA Evaluation," 0000-0111-9078-R0, February 2011.

Fuels Analyzed in Calculations and in Operation: GNF2
Limiting Fuel Type: GNF2
Limiting Single Failure (GNF2): Battery Failure
Limiting Break Size and Location (GNF2): Double-Ended Guillotine in a Recirculation Suction Pipe

Reference Peak Cladding Temperature (PCT) – GNF2: 1880°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 Report dated November 23, 2011 (See Note 1)	GNF2 ΔPCT = 50°F
10 CFR 50.46 Report dated November 9, 2012 (See Note 2)	GNF2 ΔPCT = 0°F
10 CFR 50.46 Report dated December 12, 2012 (See Note 3)	GNF2 ΔPCT = 45°F
10 CFR 50.46 Report dated November 8, 2013 (See Note 4)	GNF2 ΔPCT = 0°F
10 CFR 50.46 Report dated November 7, 2014 (See Note 5)	GNF2 ΔPCT = 10°F
10 CFR 50.46 Report dated November 6, 2015 (See Note 6)	GNF2 ΔPCT = 0°F
10 CFR 50.46 Report dated November 4, 2016 (See Note 7)	GNF2 ΔPCT = 0°F
Net PCT (GNF2)	**1985 °F**

B. CURRENT LOCA MODEL ASSESSMENTS

GNF2 Lower Tie Plate Leakage (See Note 8)	GNF2 ΔPCT = 30°F
Fuel Rod Plenum Temperature Update (See Note 8)	GNF2 ΔPCT = 0°F
Total PCT change from current assessments (GNF2)	∑ΔPCT = 30 °F
Cumulative PCT change from current assessments (GNF2)	∑ |ΔPCT| = 30 °F
Net PCT (GNF2)	**2015 °F**

Attachment 3

10 CFR 50.46
"Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors"

Report of the Emergency Core Cooling System Evaluation Model Changes and Errors

Assessments as of November 6, 2017

Assessment Notes

Limerick Generating Station, Units 1 and 2

1. Prior LOCA Assessment

   The referenced letter provided an annual 50.46 report for LGS, Units 1 and 2. The referenced letter discussed the introduction of the GNF2 fuel design to the Limerick Unit 2 core. Subsequent to the referenced letter, the GNF2 fuel design was introduced to the Unit 1 core and the errors discussed in this note also apply to Unit 1 (See Note 2).

   Also discussed in the referenced letter are two vendor notifications of Emergency Core Cooling System (ECCS) model error/changes for GNF2 fuel applicable to Limerick. The errors/changes are summarized below.

   The first error involved the way input coefficients were used to direct the deposition of gamma radiation energy produced by the fuel. Correction of this error resulted in a PCT increase of 45°F for GNF2 fuel.

   The second error involved the contribution of heat from gamma ray absorption by the channel. The gamma ray absorption by the channel was found to have been minimized. Correction of this error resulted in a PCT increase of 5°F for GNF2 fuel.

   [Reference: Letter from Michael D. Jesse (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, “10 CFR 50.46 Annual Report,” dated November 23, 2011.]

2. Prior LOCA Assessment

   The referenced letter provided an annual 50.46 report for LGS, Units 1 and 2. There were no errors reported for the 2012 reporting period.

   GNF2 fuel was introduced into the Unit 1 core during Reload 14 (Cycle 15) outage. The ECCS model error/changes discussed in Note 1 were applied to Unit 1 as Prior LOCA Model Assessments.

   [Reference: Letter from Michael D. Jesse (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, “10 CFR 50.46 Annual Report,” dated November 9, 2012.]

3. Prior LOCA Assessment

   The referenced letter provided a 50.46 report for LGS, Units 1 and 2. To address inaccuracies in fuel pellet thermal conductivity as a function of exposure, commonly referred to as thermal conductivity degradation (TCD), GEH replaced the GESTR-LOCA model with a newer model, PRIME. The most dominant effect impacting PCT is from the way the PRIME fuel properties treat thermal conductivity, which results in a higher fuel stored energy. The PCT impact identified in the referenced letter reflects the difference between the existing GESTR analysis PCT and a conservatively postulated PCT if the analysis was performed with the PRIME model. The ECCS-LOCA analysis methodology

remains GESTR based and will not be PRIME based until the ECCS-LOCA analysis is re-performed using PRIME.

[Reference: Letter from Michael D. Jesse (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, “10 CFR 50.46 30-Day Report,” dated December 12, 2012.]

4. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for LGS, Units 1 and 2. There were no errors reported for the 2013 reporting period.

[Reference: Letter from James Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, “10 CFR 50.46 Annual Report," dated November 8, 2013.]

5. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for LGS, Units 1 and 2. The referenced letter reported four vendor notifications that were received. The first notification addressed several accumulated updates to the SAFER04A model. The code maintenance changes had an individually and collectively insignificant effect on calculated peak cladding temperature. Correction of this error resulted in a 0°F PCT change for GNF2 fuel. The second notification was for a correction to a logic error that was isolated, occurring with an indication that the expected systems mass diverged from the calculated actual system mass. This error affected the ECCS flow credited as reaching the core. Correction of this error resulted in a 10°F PCT change for GNF2 fuel. The third notification addressed an error with the imposed minimum pressure differential (Δp) for droplet flow above a two-phase level in the core. This error could have offered an inappropriate steam cooling benefit above the core two phase level. To correct this error an explicit core Δp calculation was applied without regard to droplet condition resulting in a PCT of +20°F for GNF2 fuel. The fourth notification addressed an incorrect pressure head representation when defining the counter current flow limitation (CCFL). Correction of this error resulted in a -20°F PCT change for GNF2 fuel.

[Reference: Letter from James Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, “10 CFR 50.46 Annual Report," dated November 7, 2014.]

6. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for LGS, Units 1 and 2. There were no errors reported for the 2015 reporting period. The referenced letter notes that LGS Unit 2 has unloaded all bundles of the GE14 fuel type from the core.

[Reference: Letter from James Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, “10 CFR 50.46 Annual Report," dated November 6, 2015.]

7. Prior LOCA Assessment

The referenced letter notes that LGS Unit 1 has unloaded all bundles of the GE14 fuel type from the core. There were no errors reported for the 2016 reporting period.

[Reference: Letter from James Barstow (Exelon Generation Company, LLC) to U.S. NRC, “10 CFR 50.46 Annual Report," dated November 4, 2016.]

8. Current LOCA Assessment

Since the last LGS 10 CFR 50.46 Report two vendor notifications regarding Emergency Core Cooling System (ECCS) modeling changes/errors applicable to Limerick have been issued (Notification 2017-01 and 2017-02). These notifications described issues related to the improper modeling of lower tie plate leakage for the GNF2 fuel design and changes to modeling of the fuel rod plenum for 10x10 fuel, respectively. Correction of the 2017-01 error resulted in a PCT change of 30°F for GNF2 fuel. Correction of the 2017-02 error resulted in a PCT change of 0°F for GNF2 fuel.

[Reference: Letter from GE Hitachi Nuclear Energy (GEH) to Exelon, “10 CFR 50.46 Notification 2017-01, Limerick Generating Station,” dated June 12, 2017.]

[Reference: Letter from GE Hitachi Nuclear Energy (GEH) to Exelon, “10 CFR 50.46 Notification 2017-02, Limerick Generating Station,” dated August 2, 2017.]