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10 CFR 50.46

November 23, 2011

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

Limerick Generating Station, Units 1 and 2
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 David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated November 24, 2010

2) GE Hitachi Nuclear Energy 10 CFR 50.46 Notification Letter 2011-02 for Limerick Generating Station, Units 1 and 2, "Impact of database error for heat deposition on the Peak Cladding Temperature (PCT) for 10x10 fuel bundles," July 20, 2011

3) GE Hitachi Nuclear Energy 10 CFR 50.46 Notification Letter 2011-03 for Limerick Generating Station, Units 1 and 2, "Impact of updated formulation for gamma heat deposition to channel wall for 9x9 and 10x10 fuel bundles," July 20, 2011

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 50.46 Report for LGS, Units 1 and 2 (Reference 1) provided the cumulative Peak Cladding Temperature (PCT) errors for the most recent fuel designs through November 24, 2010.

Since the Reference 1 report was issued, two vendor notifications of Emergency Core Cooling System (ECCS) model error/changes that are applicable to LGS, Units 1 and 2 have been issued (References 2 and 3). Also, no ECCS-related changes or modifications have occurred at LGS, Units 1 and 2 that affect the assumptions of the ECCS analyses. It should also be noted that since the last annual report (Reference 1), the GNF2 fuel design has been introduced into the LGS Unit 2 core.

The vendor notifications are summarized below:

1) Notification 2011-02: Impact of database error for heat deposition on the Peak Cladding Temperature (PCT) for 10x10 fuel bundles (Reference 2)

   A discovery was made regarding input coefficients used to direct the deposition of gamma radiation energy produced by fuel. These input coefficients determine whether the gamma radiation would heat the fuel rod, cladding, channel, or control rod structure materials. The input caused the heat deposited in the fuel channel (post scram) to be over-predicted and

the corresponding heat to the fuel to be under-predicted. This effect was seen to be non-conservative. The error only applies to 10x10 fuel. This error impacted both the GE14 and GNF2 fuel PCT by 45°F.

2) Notification 2011-03: Impact of updated formulation for gamma heat deposition to channel wall for 9x9 and 10x10 fuel bundles (Reference 3)

   In the input formulation for SAFER, input coefficients are used to direct the deposition of gamma and neutron radiation energy produced by fuel fissions and decay heat. These input coefficients determine whether it would heat the fuel rod, cladding, channel, or control rod structural materials. While investigating an input anomaly regarding energy deposition, the formulation of these terms was examined. The contribution of heat from gamma ray absorption by the channel was found to have been minimized. The method had been simplified such that initially all the energy was assumed to be deposited in the fuel rods prior to a LOCA and then adjusted such that the correct heat deposition was applied after the scram. This modeling was concluded to be potentially non-conservative, as not accounting for this small fraction of total power generation outside the fuel rod would tend to suppress the hot bundle power required to meet the initial operating Peak Linear Heat Generation Rate (PLHGR). Further, there is a small effect on the initial conditions for the balance of the core as these are set in relation to the hot bundle condition. This error impacted both the GE14 and GNF2 fuel PCT by 5°F.

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.

If you have any questions, please contact Tom Loomis at 610-765-5510.

Respectfully,

Michael D. Jesse
Director - 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, 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 23, 2011

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: 11/23/11
CURRENT OPERATING CYCLE: 14

ANALYSIS OF RECORD

Evaluation Model:

1. NEDC-23785-1-PA Rev. 1, "The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-Of-Coolant Accident Volume II, SAFER – Long Term Inventory Model for BWR Loss-Of-Coolant Analysis," October 1984.

2. NEDC-30996P-A, "SAFER Model for Evaluation of Loss-of-Coolant Accidents for Jet Pump and Non-jet Pump Plants, Volume I, SAFER – Long Term Inventory Model for BWR Loss-of-Coolant Analysis," October 1987.

3. NEDC-32950P, "Compilation of Improvements to GENE's SAFER ECCS-LOCA Evaluation Model," January 2000.

4. NEDC-23785-1-PA Rev. 1, "The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-Of-Coolant Accident Volume III, SAFER/GESTR Application Methodology," October 1984.
   (Jet Pump Plant – SAFER)

Calculations:

1. "Limerick Generating Station, Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," NEDC-32170P, Rev. 2, May 1995.

2. "Limerick Generating Station Units 1 and 2 ECCS-LOCA Evaluation for GE14," GE-NE-J1103793-09-01P, March 2001.

3. Letter from C. P. Bott to R. M. Butrovich, "Limerick Units 1 and 2 SAFER/GESTR Analysis with GE13 Fuel," July 20, 1995.

Fuel Analyzed in Calculations: P8x8R, GE9, GE11/13 and GE14
Limiting Fuel Type: GE14 (note: P8x8R, GE9 and GE11/13 are no longer in operation and are not considered for defining the limiting fuel type)
Limiting Single Failure: Div 2 DC Power Source
Limiting Break Size and Location: Double-Ended Guillotine in a Recirculation Suction Pipe

Reference Peak Cladding Temperature (PCT) - GE14 PCT = 1670°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 Report dated December 18, 2002 (See Note 1)	GE14 ΔPCT = 10°F
10 CFR 50.46 Report dated December 16, 2003 (See Note 2)	GE14 ΔPCT = -5°F
10 CFR 50.46 Report dated December 03, 2004 (See Note 3)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated December 01, 2005 (See Note 4)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated December 01, 2006 (See Note 5)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated November 30, 2007 (See Note 6)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated November 24, 2008 (See Note 7)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated November 24, 2009 (See Note 8)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated November 24, 2010 (See Note 9)	GE14 ΔPCT = 0°F
Net PCT (GE14)	**1675°F**

B. CURRENT LOCA MODEL ASSESSMENTS

Heat Deposition Database Error (See Note 10)	GE14 ΔPCT = 45°F
Gamma Heat Deposition Error (See Note 10)	GE14 ΔPCT = 5°F
Total PCT change from current assessments (GE14)	$\sum\Delta PCT = 50°F$
Cumulative PCT change from current assessments (GE14)	$\sum \lvert \Delta PCT \rvert = 50°F$
Net PCT (GE14)	**1725°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 23, 2011

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: 11/23/11
CURRENT OPERATING CYCLE: 12

ANALYSIS OF RECORD

Evaluation Model:

1. NEDC-23785-1-PA Rev. 1, "The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-Of-Coolant Accident Volume II, SAFER – Long Term Inventory Model for BWR Loss-Of-Coolant Analysis," October 1984.

2. NEDC-30996P-A, "SAFER Model for Evaluation of Loss-of-Coolant Accidents for Jet Pump and Non-jet Pump Plants, Volume I, SAFER – Long Term Inventory Model for BWR Loss-of-Coolant Analysis," October 1987.

3. NEDC-32950P, "Compilation of Improvements to GENE's SAFER ECCS-LOCA Evaluation Model," January 2000.

4. NEDC-23785-1-PA Rev. 1, "The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-Of-Coolant Accident Volume III, SAFER/GESTR Application Methodology," October 1984.
   (Jet Pump Plant – SAFER)

Calculations:

1. "Limerick Generating Station, Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," NEDC-32170P, Rev. 2, May 1995.

2. "Limerick Generating Station Units 1 and 2 ECCS-LOCA Evaluation for GE14," GE-NE-J1103793-09-01P, March 2001.

3. Letter from C. P. Bott to R. M. Butrovich, "Limerick Units 1 and 2 SAFER/GESTR Analysis with GE13 Fuel," July 20, 1995.

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

Fuel Analyzed in Calculations: P8x8R, GE9, GE11/13, GE14 and GNF2
Limiting Fuel Type: GNF2 (note: P8x8R, GE9 and GE11/13 are no longer in operation and are not considered for defining the limiting fuel type)
Limiting Single Failure (GE14/GNF2): Div 2 DC Power Source
Limiting Break Size and Location (GE14/GNF2): Double-Ended Guillotine in a Recirculation Suction Pipe
Reference Peak Cladding Temperature (PCT) - GE14 PCT = 1670°F
Reference Peak Cladding Temperature (PCT) - GNF2 PCT = 1880°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 Report dated December 18, 2002 (See Note 1)	GE14 ΔPCT = 10°F
10 CFR 50.46 Report dated December 16, 2003 (See Note 2)	GE14 ΔPCT = -5°F
10 CFR 50.46 Report dated December 3, 2004 (See Note 3)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated December 1, 2005 (See Note 4)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated December 1, 2006 (See Note 5)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated November 30, 2007 (See Note 6)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated November 24, 2008 (See Note 7)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated November 24, 2009 (See Note 8)	GE14 ΔPCT = 0°F
10 CFR 50.46 Report dated November 24, 2010 (See Note 9)	GE14 ΔPCT = 0°F
Net PCT (GE14)	**1675°F**

B. CURRENT LOCA MODEL ASSESSMENTS

Heat Deposition Database Error (See Note 10)	GE14/GNF2 ΔPCT = 45°F
Gamma Heat Deposition Error (See Note 10)	GE14/GNF2 ΔPCT = 5°F
Total PCT change from current assessments (GE14)	$\sum\Delta PCT = 50°F$
Total PCT change from current assessments (GNF2)	$\sum\Delta PCT = 50°F$
Cumulative PCT change from current assessments (GE14)	$\sum \lvert\Delta PCT\rvert = 50°F$
Cumulative PCT change from current assessments (GNF2)	$\sum \lvert\Delta PCT\rvert = 50°F$
Net PCT (GE14)	**1725°F**
Net PCT (GNF2)	**1930°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

Assessment Notes

Limerick Generating Station, Units 1 and 2

1. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. This letter reported GE LOCA errors related to a SAFER core spray sparger elevation error and a SAFER bulk water level error. The PCT impact for the new errors was determined to be 15°F and -5°F, respectively, for GE14 fuel. The total PCT impact of these errors was determined to be 10°F for GE14 fuel.

[Reference: Letter from Michael P. Gallagher (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Reporting Requirements," dated December 18, 2002.]

2. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. This letter reported a GE LOCA error related to a SAFER Level/Volume Table error. The PCT impact for the new error was determined to be -5°F for GE14 fuel.

[Reference: Letter from Michael P. Gallagher (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Reporting Requirements," dated December 16, 2003.]

3. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. This letter reported GE LOCA errors related to a GESTR file interpolation error, a SAFER computer platform change, a WEVOL S1 volume error, a SAFER separator pressure drop error and a new heat source. The PCT impact for the new errors was determined to be 0°F for each error. The total PCT impact of these errors on GE14 fuel was determined to be 0°F.

[Reference: Letter from Michael P. Gallagher (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated December 3, 2004.]

4. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. There were no errors reported for the 2005 reporting period.

[Reference: Letter from Pamela B. Cowan (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated December 1, 2005.]

5. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. This letter reported a newly discovered sensitivity to the assumed axial power shape for small break LOCA cases. This sensitivity may result in higher calculated PCT values for top-peaked axial power shapes. Due to this sensitivity, the calculated small break PCT for Limerick was higher than the previously calculated value. However, the Licensing Basis PCT (based on large break)

remained the same. Therefore the PCT impact of the new power shape sensitivity was determined to be 0°F for GE14 fuel.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated December 1, 2006.]

6. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. There were no errors reported for the 2007 reporting period.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated November 30, 2007.]

7. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. There were no errors reported for the 2008 reporting period.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated November 24, 2008.]

8. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. There were no errors reported for the 2009 reporting period.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated November 24, 2009.]

9. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Units 1 and 2. There were no errors reported for the 2010 reporting period.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated November 24, 2010.]

10. Current LOCA Assessment

Since the last annual report (see Note 9), the GNF2 fuel design has been introduced into the Limerick Unit 2 core. The assessment notes above (Notes 1-9) are not applicable to GNF2 fuel. Also, since the last annual report, two vendor notifications of Emergency Core Cooling System (ECCS) model error/changes for GE14 and GNF2 fuel that are applicable to Limerick were issued. No ECCS-related changes or modifications have occurred at Limerick that affect the assumptions of the ECCS analyses. The errors/changes are summarized below:

The error identified in Reference 1 involves the way input coefficients are used to direct the deposition of gamma radiation energy produced by the fuel. Correction of this error results in a PCT increase of 45°F for both the GE14 fuel and GNF2 fuel.

The error identified in Reference 2 involves 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 results in a PCT increase of 5°F for both the GE14 fuel and GNF2 fuel.

[Reference 1: GE Hitachi Nuclear Energy 10 CFR 50.46 Notification Letter 2011-02 for Limerick Generating Station, Units 1 and 2, "Impact of database error for heat deposition on the Peak Cladding Temperature (PCT) for 10x10 fuel bundles," July 20, 2011]

[Reference 2: GE Hitachi Nuclear Energy 10 CFR 50.46 Notification Letter 2011-03 for Limerick Generating Station, Units 1 and 2, "Impact of updated formulation for gamma heat deposition to channel wall for 9x9 and 10x10 fuel bundles," July 20, 2011]