

10CFR50.46

December 3, 2004

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

Reference: 1. 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

2. GE Letter, 10 CFR 50.46 Notification Letter, 2003-05, May 13, 2004

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 Limerick Generating Station, Units 1 and 2 (Reference 1) provided the cumulative Peak Cladding Temperature (PCT) errors for the most recent fuel designs through December 16, 2003. However, this letter did not report all vendor 50.46 notifications to date that resulted in zero (0°F) PCT impact. These 50.46 notifications are now reported. In addition, GE reported that a new heat source term has been postulated (Reference 2). This heat source involves the recombination of hydrogen and oxygen within the fuel bundle during the core heatup. The additional heat will raise the temperature of the steam heat sink in the bundle, resulting in a potential increase in the peak cladding temperature and local oxidation. The current Loss-of-Coolant Accident (LOCA) evaluation models do not include this new heat source.

Two attachments are included with this letter that provide the current Limerick Generating Station, 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

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Large Break Loss of Coolant Accident (LOCA) analysis evaluations for Limerick Generating Station, 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 P. Gallagher
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

cc: S. J. Collins, USNRC Administrator, Region I
T. Tate, USNRC Project Manager, LGS
S. Hansell, USNRC Senior Resident Inspector, LGS

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 4, 2004

**Peak Cladding Temperature Rack-Up Sheet
Limerick Generating Station, Unit 1**

PLANT NAME: Limerick Generating Station, Unit 1
ECCS EVALUATION MODEL: SAFER/GESTR-LOCA
REPORT REVISION DATE: 11/04/04
CURRENT OPERATING CYCLE: 11

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, 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 and GE9 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) - GE11/13

PCT = 1605°F

Reference Peak Cladding Temperature (PCT) - GE14

PCT = 1670°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 Report dated December 16, 1996 (See Note 1) (GE11/13 only)	GE11/13 Δ PCT = 45°F
10 CFR 50.46 Report dated November 4, 1998 (See Note 2) (GE11/13 only)	GE11/13 Δ PCT = -5°F
10 CFR 50.46 Report dated July 22, 1999 (See Note 3) (GE11/13 only)	GE11/13 Δ PCT = 0°F
10 CFR 50.46 Report dated December 18, 2000 (See Note 4) (GE11/13 only)	GE11/13 Δ PCT = -5°F
10 CFR 50.46 Report dated June 4, 2001 (See Note 5) (GE11/13 only)	GE11/13 Δ PCT = 5°F
10 CFR 50.46 Report dated December 18, 2002 (See Note 6)	GE11/13 Δ PCT = -5°F GE14 Δ PCT = 10°F
10 CFR 50.46 Report dated December 16, 2003 (See Note 7)	GE11/13 Δ PCT = -5°F GE14 Δ PCT = -5°F
Net PCT (GE11/13)	1635 °F
Net PCT (GE14)	1675 °F

B. CURRENT LOCA MODEL ASSESSMENTS

GE LOCA Model Change due to GESTR File Interpolation Error (See Note 8) (GE11/13 only)	GE11/13 Δ PCT = 0°F
GE LOCA Model Change due to SAFER Computer Platform Change (See Note 9) (GE11/13 only)	GE11/13 Δ PCT = 0°F
GE LOCA Model Change due to WEVOL S1 Volume Error (See Note 10)	GE11/13 Δ PCT = 0°F GE14 Δ PCT = 0°F
GE LOCA Model Change due to SAFER Separator Pressure Drop (See Note 11)	GE11/13 Δ PCT = 0°F GE14 Δ PCT = 0°F
GE LOCA Model Change due to New Heat Source (See Note 12)	GE11/13 Δ PCT = 0°F GE14 Δ PCT = 0°F
Total PCT change from current assessments (GE11/13)	$\Sigma \Delta$ PCT = 0°F
Total PCT change from current assessments (GE14)	$\Sigma \Delta$ PCT = 0°F
Cumulative PCT change from current assessments (GE11/13)	$\Sigma \Delta$ PCT = 0°F
Cumulative PCT change from current assessments (GE14)	$\Sigma \Delta$ PCT = 0°F
Net PCT (GE11/13)	1635 °F
Net PCT (GE14)	1675 °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 4, 2004

**Peak Cladding Temperature Rack-Up Sheet
Limerick Generating Station, Unit 2**

PLANT NAME: Limerick Generating Station, Unit 2
ECCS EVALUATION MODEL: SAFER/GESTR-LOCA
REPORT REVISION DATE: 11/04/04
CURRENT OPERATING CYCLE: 08

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.
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(Jet Pump Plant – SAFER)

Calculations:

1. "Limerick Generating Station, Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," NEDC-32170P, 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 and GE9 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) - GE11/13

PCT = 1605°F

Reference Peak Cladding Temperature (PCT) - GE14

PCT = 1670°F

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10 CFR 50.46 Report dated July 22, 1999 (See Note 3) (GE11/13 only)	GE11/13 Δ PCT = 0°F
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10 CFR 50.46 Report dated December 18, 2002 (See Note 6)	GE11/13 Δ PCT = -5°F GE14 Δ PCT = 10°F
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GE LOCA Model Change due to SAFER Separator Pressure Drop (See Note 11)	GE11/13 Δ PCT = 0°F GE14 Δ PCT = 0°F
GE LOCA Model Change due to New Heat Source (See Note 12)	GE11/13 Δ PCT = 0°F GE14 Δ PCT = 0°F
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Total PCT change from current assessments (GE14)	$\Sigma \Delta$ PCT = 0°F
Cumulative PCT change from current assessments (GE11/13)	$\Sigma \Delta$ PCT = 0°F
Cumulative PCT change from current assessments (GE14)	$\Sigma \Delta$ PCT = 0°F
Net PCT (GE11/13)	1635 °F
Net PCT (GE14)	1675 °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

1. Prior LOCA Assessment

The referenced letter provided the total accumulation of peak clad temperature (PCT) changes or errors determined since the original 1995 SAFER analysis for Limerick Generating Station, Units 1 and 2. This letter reported that since 1988, GE had been compiling changes and errors and provided that information to the NRC and licensees on an annual basis. The PCT impact for these errors for GE11/13 fuel was determined to be 45⁰F.

[Reference: Letter from G. A. Hunger (PECO Nuclear) to U.S. NRC, "Limerick Generating Station, Units 1 and 2 10 CFR 50.46 Reporting Requirements," dated December 16, 1996.]

2. Prior LOCA Assessment

The referenced letter provided clarification of the previous Limerick 50.46 report (see Note 1). This letter reported the previous GE LOCA errors to be related to SAFER omission of the bottom head drain and incorrect number of fuel rods error. This letter also reported that one of the errors contributing to the reported 45⁰F PCT impact in the previous Limerick Generating Station, Units 1 and 2 50.46 report (see Note 1) was actually corrected in the base analysis and identified a correction of -5⁰F PCT. This letter constituted a 30 day report. The PCT impact for the correction for GE11/13 fuel was determined to be -5⁰F.

[Reference: Letter from G. D. Edwards (PECO Nuclear) to U.S. NRC, "Limerick Generating Station, Units 1 and 2 10 CFR 50.46 Reporting Requirements," dated November 4, 1998.]

3. Prior LOCA Assessment

The referenced letter reported a GE LOCA error related to SAFER CCFL at the upper spacer. This error was reported to be not applicable to GE11 and later fuel types. This letter constituted a 30 day report. The PCT impact for the new error for GE11/13 fuel was determined to be 0⁰F.

[Reference: Letter from J. A. Hutton (PECO Nuclear) to U.S. NRC, "Limerick Generating Station, Units 1 and 2 - Peach Bottom Atomic Power Station, Units 2 and 3 10 CFR 50.46 Reporting Requirements," dated July 22, 1999.]

4. Prior LOCA Assessment

The referenced letter reported a GE LOCA error related to SAFER time steps. The PCT impact for the new error was determined to be -5⁰F for GE11/13 fuel.

[Reference: Letter from J. A. Hutton (PECO Nuclear) to U.S. NRC, "Limerick Generating Station, Units 1 and 2 Peach Bottom Atomic Power Station, Units 2 and 3 10 CFR 50.46 Reporting Requirements," dated December 18, 2000.]

5. Prior LOCA Assessment

The referenced letter reported the introduction of GE14 fuel at Limerick and the associated GE14 baseline PCT. The GE14 PCT (1670⁰F) bounds the GE11/13 fuel. The referenced letter also reported a GE LOCA error related to a SAFER pressure rate

error. The PCT impact for this new error was determined to be 5⁰F. This PCT error applied only to the GE11/13 fuel types. This letter constituted a 30 day report. The total PCT impact of this error on GE11/13 fuel was determined to be 5⁰F.

[Reference: Letter from J. A. Hutton (PECO Nuclear) to U.S. NRC, "Limerick Generating Station, Units 1 and 2 10 CFR 50.46 Reporting Requirements," dated June 4, 2001.]

6. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Limerick Generating Station, 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 0⁰F and -5⁰F, respectively, for GE11/13 fuel and 15⁰F and -5⁰F, respectively, for GE14 fuel. The total PCT impact of these errors was determined to be -5⁰F for GE11/13 fuel and 10⁰F for GE14 fuel. The GE14 PCT continues to bound the GE11/13 PCT.

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

7. Prior LOCA Assessment

The referenced letter provided an annual 50.46 report for Limerick Generating Station, 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 -5⁰F for both GE11/13 fuel and GE14 fuel. The GE14 PCT continues to bound the GE11/13 PCT.

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

8. Current LOCA Assessment

GE reported a GESTR Input File Interpolation Error. This results in an error in the initial gap conductance for cases at or beyond the knee in the LHGR curve. Due to this error, the initial gap conductance used in the SAFER calculations was slightly lower than it should have been. GE determined the PCT impact of this error to be negligible for GE11/13 fuel and not applicable to GE14 fuel.

[Reference: GE 10 CFR 50.46 Notification Letter, 2002-03, August 26, 2002.]

9. Current LOCA Assessment

GE reported that the LOCA evaluation code SAFER04 has been migrated from the VAX computer platform (SAFER04V) to the Alpha computer platform (SAFER04A). The change in computer platform may result in a change in the calculated peak cladding temperature (PCT) due to changes in the processor word size and FORTRAN compiler characteristics. GE determined that the PCT impact of this error to be negligible for GE11/13 fuel and not applicable to GE14 fuel.

[Reference: GE 10 CFR 50.46 Notification Letter, 2002-04, August 26, 2002.]

10. Current LOCA Assessment

GE reported that an error was found in the WEVOL code, which affects the calculated vessel volume in the downcomer region. The free volume in the region of the shroud head is calculated incorrectly. The code did not properly account for the volume of the standpipes inside the shroud head thickness. This resulted in the value for the free volume in the downcomer being too small by 4-10 ft³. GE determined that the PCT impact of this error to be negligible for GE11/13 fuel and GE14 fuel.

[Reference: GE 10 CFR 50.46 Notification Letter, 2002-05, August 26, 2002.]

11. Current LOCA Assessment

GE reported that an error was found in the SAFER Initial Separator Pressure Drop due to an error in the specified separator loss coefficient. GE determined that the PCT impact of this error to be negligible for GE11/13 fuel and GE14 fuel.

[Reference: GE 10 CFR 50.46 Notification Letter, 2003-03, May 6, 2003.]

12. Current LOCA Assessment

GE has postulated a new heat source applicable to LOCA event. This heat source is due to recombination of hydrogen and excess oxygen drawn into the vessel from containment during core heatup. The oxygen enters the vessel either as a dissolved gas in the ECCS water or through the break when the vessel fully depressurizes and draws the containment non-condensable gases back into the vessel. The current LOCA evaluation model does not account for the effect of this heat source, which has potential to raise the steam temperature while leading to an increase in PCT and local oxidation. GE has evaluated the effect of this additional heat source for the jet pump plants similar to Limerick Generating Station, Units 1 and 2 and determined that the impact is insignificant, because the oxygen from containment enters the vessel after the core is reflooded for the jet pump plants. Therefore, the PCT impact for all fuel types is zero and the effect on local oxidation is negligible.

[Reference: GE 10 CR 50.46 Notification Letter, 2003-05, May 13, 2004.]