

August 19, 2011

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

Peach Bottom Atomic Power Station, Units 2 and 3
Renewed Facility Operating License Nos. DPR-44 and DPR-56
NRC Docket Nos. 50-277 and 50-278

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 August 20, 2010
 - 2) GE Hitachi Nuclear Energy 10 CFR 50.46 Notification Letter 2011-02 for Peach Bottom Atomic Power Station, Units 2 and 3, "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 Peach Bottom Atomic Power Station, Units 2 and 3, "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 transmit the 10 CFR 50.46 reporting information for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. The previous 50.46 report for PBAPS, Units 2 and 3 (Reference 1) provided the cumulative Peak Cladding Temperature (PCT) errors for the most recent fuel designs through August 20, 2010.

Since the referenced report was issued, two (2) vendor notifications of an Emergency Core Cooling System (ECCS) model error/change applicable to PBAPS, Units 2 and 3 have been issued. Also, no ECCS-related changes or modifications have occurred at PBAPS, Units 2 and 3 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 PBAPS 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

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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 the gamma and neutron radiation 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 the 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 provides the current 10 CFR 50.46 status for PBAPS, Units 2 and 3. Attachments 1 and 2, "Peak Cladding Temperature Rack-Up Sheet," provide information regarding the PCT for the limiting Loss of Coolant Accident (LOCA) analysis evaluations for PBAPS, Units 2 and 3, 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 (Peach Bottom Atomic Power Station, Unit 2)
2) Peak Cladding Temperature Rack-Up Sheet (Peach Bottom Atomic Power Station, Unit 3)
3) Assessment Notes

cc: USNRC Administrator, Region I
J. Hughey, USNRC Project Manager, PBAPS
S. Hansell, USNRC Senior Resident Inspector, PBAPS
R. R. Janati, Commonwealth of Pennsylvania
S. T. Gray, State of Maryland

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 August 19, 2011

Peak Cladding Temperature Rack-Up Sheet

Peach Bottom Atomic Power Station, Unit 2

**Report of the Emergency Core Cooling System
Evaluation Model Changes and Errors
Assessments as of August 19, 2011
Peak Cladding Temperature Rack-Up Sheet, PBAPS U2**

**Attachment 1
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PLANT NAME: Peach Bottom Unit 2
ECCS EVALUATION MODEL: SAFER/GESTR-LOCA
REPORT REVISION DATE: 08/19/11
CURRENT OPERATING CYCLE: 19

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. "Peach Bottom Atomic Power Station, Units 2 and 3 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," NEDC-32163P, January 1993.
2. "Peach Bottom Atomic Power Station ECCS-LOCA Evaluation for GE14," General Electric Company, GENE-J11-03716-09-02P, July 2000.
3. Errata & Addendum No. 1 to GENE-J11-03716-09-02P, "Peach Bottom Atomic Power Station ECCS-LOCA Evaluation for GE14," October 2007.
4. "Peach Bottom Atomic Power Station Units 2 & 3 GNF2 ECCS-LOCA Evaluation," GEH Report 0000-0100-8531-R1, March 2011.

Fuel Analyzed in Calculations: P8x8R, GE9, GE11/13, GE14 and GNF2

Limiting Fuel Type: GNF2 (Note: P8x8R, GE9 and GE11/GE13 are no longer in operation and are not considered for defining the limiting fuel type)

Limiting Single Failure: Battery Failure

Limiting Break Size and Location: 0.06 ft² Small Break in a Recirculation Discharge Pipe

Reference Peak Cladding Temperature (PCT) – GE14

PCT = 1450°F

Reference Peak Cladding Temperature (PCT) – GNF2

PCT = 1870°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 Report dated June 4, 2001 (See Note 1)	GE14 Δ PCT = 55°F
10 CFR 50.46 Report dated December 18, 2002 (See Note 2)	GE14 Δ PCT = 45°F
10 CFR 50.46 Report dated December 3, 2004 (See Note 3)	GE14 Δ PCT = 0°F
10 CFR 50.46 Report dated December 1, 2005 (See Note 4)	GE14 Δ PCT = 0°F
10 CFR 50.46 Report dated August 22, 2006 (See Note 5)	GE14 Δ PCT = 150°F
10 CFR 50.46 Report dated August 22, 2007 (See Note 6)	GE14 Δ PCT = 0°F
10 CFR 50.46 Report dated August 22, 2008 (See Note 7)	GE14 Δ PCT = 0°F
10 CFR 50.46 Report dated August 21, 2009 (See Note 8)	GE14 Δ PCT = 15°F
10 CFR 50.46 Report dated August 20, 2010 (See Note 9)	GE14 Δ PCT = 0°F
Net PCT (GE14)	1715°F

B. CURRENT LOCA MODEL ASSESSMENTS

Heat Deposition Database Error (See Note 10)	GE14/GNF2 Δ PCT = 45°F
Gamma Heat Deposition Error (See Note 10)	GE14/GNF2 Δ PCT = 5°F
Total PCT change from current assessments (GE14)	$\Sigma \Delta$ PCT = 50°F
Total PCT change from current assessments (GNF2)	$\Sigma \Delta$ PCT = 50°F
Cumulative PCT change from current assessments (GE14)	$\Sigma \Delta$ PCT = 50°F
Cumulative PCT change from current assessments (GNF2)	$\Sigma \Delta$ PCT = 50°F
Net PCT (GE14)	1765°F
Net PCT (GNF2)	1920°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 August 19, 2011

Peak Cladding Temperature Rack-Up Sheet

Peach Bottom Atomic Power Station, Unit 3

**Report of the Emergency Core Cooling System
Evaluation Model Changes and Errors
Assessments as of August 19, 2011
Peak Cladding Temperature Rack-Up Sheet, PBAPS U3**

**Attachment 2
Page 1 of 2**

PLANT NAME: Peach Bottom Unit 3
ECCS EVALUATION MODEL: SAFER/GESTR-LOCA
REPORT REVISION DATE: 08/19/11
CURRENT OPERATING CYCLE: 18

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. "Peach Bottom Atomic Power Station, Units 2 and 3 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," NEDC-32163P, January 1993.
2. "Peach Bottom Atomic Power Station ECCS-LOCA Evaluation for GE14," General Electric Company, GENE-J11-03716-09-02P, July 2000.
3. Errata & Addendum No. 1 to GENE-J11-03716-09-02P, "Peach Bottom Atomic Power Station ECCS-LOCA Evaluation for GE14," October 2007.

Fuel Analyzed in Calculations: P8x8R, GE9, GE11/13 and GE14

Limiting Fuel Type: GE14 (Note: P8x8R, GE9 and GE11/GE13 are no longer in operation and are not considered for defining the limiting fuel type)

Limiting Single Failure: Battery Failure

Limiting Break Size and Location: 0.08 ft² Small Break in a Recirculation Discharge Pipe

Reference Peak Cladding Temperature (PCT) – GE14

PCT = 1450°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 Report dated June 4, 2001 (See Note 1)	GE14 Δ PCT = 55°F
10 CFR 50.46 Report dated December 18, 2002 (See Note 2)	GE14 Δ PCT = 45°F
10 CFR 50.46 Report dated December 3, 2004 (See Note 3)	GE14 Δ PCT = 0°F
10 CFR 50.46 Report dated December 1, 2005 (See Note 4)	GE14 Δ PCT = 0°F
10 CFR 50.46 Report dated August 22, 2006 (See Note 5)	GE14 Δ PCT = 150°F
10 CFR 50.46 Report dated August 22, 2007 (See Note 6)	GE14 Δ PCT = 0°F
10 CFR 50.46 Report dated August 22, 2008 (See Note 7)	GE14 Δ PCT = 0°F
10 CFR 50.46 Report dated August 21, 2009 (See Note 8)	GE14 Δ PCT = 15°F
10 CFR 50.46 Report dated August 20, 2010 (See Note 9)	GE14 Δ PCT = 0°F
Net PCT (GE14)	1715°F

B. CURRENT LOCA MODEL ASSESSMENTS

Heat Deposition Database Error (See Note 10)	GE14 Δ PCT = 45°F
Gamma Heat Deposition Error (See Note 10)	GE14 Δ PCT = 5°F
Total PCT change from current assessments (GE14)	$\Sigma \Delta$ PCT = 50°F
Cumulative PCT change from current assessments (GE14)	$\Sigma \Delta$ PCT = 50°F
Net PCT (GE14)	1765°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

Peach Bottom Atomic Power Station, Units 2 and 3

1. Prior LOCA Assessment

The referenced letter reported two GE LOCA errors related to a SAFER condensation error and a SAFER pressure rate error. The PCT impact for the new errors was determined to be 45°F and 10°F, respectively. These PCT errors applied to all fuel types. This letter constituted a 30-Day report. The total PCT impact of these errors on GE14 fuel was determined to be 55°F.

[Reference: Letter from James A. Hutton (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Peach Bottom Atomic Power Station, Units 2 and 3 10 CFR 50.46 Reporting Requirements," dated June 4, 2001.]

2. Prior LOCA Assessment

The referenced letter provided the annual 50.46 report for Units 2 and 3. 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 40°F and 5°F, respectively. These PCT errors applied to all fuel types. The total PCT impact of these errors on GE14 fuel was determined to be 45°F.

[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.]

3. Prior LOCA Assessment

The referenced letter provided the annual 50.46 report for Units 2 and 3. 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 level/volume table 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 the annual 50.46 report for Units 2 and 3. This letter reported that no vendor 50.46 change/error notifications had been received since the last annual report. Therefore, the annual PCT change for GE14 fuel was reported as 0°F.

[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 a 30-day 50.46 report for Units 2 and 3. 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 PCT for Peach Bottom was higher than the previously calculated value. The PCT impact was determined to be 150°F for GE14 fuel. The 0.08 ft² Small Break in a Recirculation Discharge Pipe is the Licensing Basis PCT event for Peach Bottom for GE14 fuel.

[Reference: Letter from Pamela B. Cowan (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 30-Day Report," dated August 22, 2006.]

6. Prior LOCA Assessment

The referenced letter provided the annual 50.46 report for Units 2 and 3. This letter reported that no vendor 50.46 change/error notifications had been received since the last annual report. Therefore, the annual PCT change for GE14 fuel was reported as 0°F.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated August 22, 2007.]

7. Prior LOCA Assessment

The referenced letter provided the annual 50.46 report for Units 2 and 3. This letter reported that no vendor 50.46 change/error notifications had been received since the last annual report. Therefore, the annual PCT change for GE14 fuel was reported as 0°F.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated August 22, 2008.]

8. Prior LOCA Assessment

The referenced letter provided the annual 50.46 report for Units 2 and 3. This letter reported that GE/GNF identified a Steam Flow Induced Error (SFIE, or Bernouli Error) where water level could reach the bottom of the dryer and allow steam to bypass to the annulus. This bypass affects the L3 water level measurement, which relies on pressure taps in the annulus. Scram from the L3 level indication is conservatively modeled in the Small Break ECCS-LOCA analyses assuming Appendix K requirements. The DBA (large break) analyses are confirmed to be unaffected by the SFIE because the modeling relies on signals other than L3 for scram and ECCS response. The PCT impact for PBAPS GE14 fuel (small break limited) due to the SFIE was reported as 15°F.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated August 21, 2009.]

9. Prior LOCA Assessment

The referenced letter provided the annual 50.46 report for Units 2 and 3. This letter reported that no vendor 50.46 change/error notifications had been received since the last annual report. Therefore, the annual PCT change for GE14 fuel was reported as 0°F.

[Reference: Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "10 CFR 50.46 Annual Report," dated August 20, 2010.]

10. Current LOCA Assessment

Since the last annual report (see Note 9), the GNF2 fuel design has been introduced into the Peach Bottom 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 that are applicable to Peach Bottom were issued. No ECCS-related changes or modifications have occurred at Peach Bottom 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 Peach Bottom Atomic Power Station, Units 2 and 3, "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 Peach Bottom Atomic Power Station, Units 2 and 3, "Impact of updated formulation for gamma heat deposition to channel wall for 9x9 and 10x10 fuel bundles," July 20, 2011]