



4300 Winfield Road  
Warrenville, IL 60555  
630 657 2000 Office

RS-22-067

10 CFR 50.46

May 4, 2023

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

Quad Cities Nuclear Power Station, Units 1 and 2  
Renewed Facility Operating License Nos. DPR-29 and DPR-30  
NRC Docket Nos. 50-254 and 50-265

Subject: 10 CFR 50.46 Annual Report

Reference: Letter RS-22-059 from P. R. Simpson (Constellation Energy Generation, LLC) to  
U.S. NRC, "10 CFR 50.46 Annual Report," dated May 4, 2022

This letter provides the annual report required by 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," for Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. The attachments describe the changes in accumulated peak cladding temperature (PCT) since the previous annual report submitted in the referenced letter.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Ms. Rebecca L. Steinman at (630) 657-2831.

Respectfully,

A handwritten signature in black ink that reads "Patrick R. Simpson".

Patrick R. Simpson  
Sr. Manager Licensing  
Constellation Energy Generation, LLC

Attachments:

1. Quad Cities Nuclear Power Station Unit 1, 10 CFR 50.46 Report (Framatome Fuel)
2. Quad Cities Nuclear Power Station Unit 2, 10 CFR 50.46 Report (Framatome Fuel)
3. Quad Cities Nuclear Power Station Unit 1, 10 CFR 50.46 Report (GE Hitachi Fuel)
4. Quad Cities Nuclear Power Station Units 1 and 2, 10 CFR 50.46 Report Assessment Notes

cc: NRC Regional Administrator, Region III  
NRC Senior Resident Inspector, Quad Cities Nuclear Power Station

**ATTACHMENT 1**  
**Quad Cities Nuclear Power Station Unit 1,**  
**10 CFR 50.46 Report (Framatome Fuel) – ATRIUM 10XM**

PLANT NAME: Quad Cities Unit 1  
 ECCS EVALUATION MODEL: EXEM BWR-2000  
 REPORT REVISION DATE: 05/04/2023  
 CURRENT OPERATING CYCLE: 28

**ANALYSIS OF RECORD**

Evaluation Model: "EXEM BWR-2000 ECCS Evaluation Model," EMF-2361(P)(A)  
 Revision 0, May 2021

- Calculations:
1. "Quad Cities 1 and 2 ATRIUM 10XM Break Spectrum with Decreased ADS Flow," ANP-3794P, Revision 0, September 2019
  2. "Quad Cities Units 1 and 2 ATRIUM 10XM LOCA-ECCS Analysis MAPLHGR Limits with Increased ADS Flow," ANP-3795P, Revision 0, October 2019
  3. "Quad Cities Unit 1 Cycle 27 Reload Safety Analysis," ANP-3896P, Revision 0, January 2021

Fuel Analyzed in Calculation: ATRIUM 10XM  
 Limiting Fuel Type: ATRIUM 10XM  
 Limiting Single Failure: High Pressure Coolant Injection  
 Limiting Break Size and Location: 0.12 ft<sup>2</sup> split break in the recirculation discharge line

Reference Peak Cladding Temperature (PCT): PCT = 2139°F

**MARGIN ALLOCATION**

**A. PRIOR LOCA MODEL ASSESSMENTS**

10 CFR 50.46 Report dated May 4, 2021 (See Note 2)	$\Delta PCT = 0^\circ F$
10 CFR 50.46 Report dated May 4, 2022 (See Note 3)	$\Delta PCT = 0^\circ F$
<b>Net PCT</b>	<b>2139°F</b>

**B. CURRENT LOCA MODEL ASSESSMENTS**

None (See Note 4)	$\Delta PCT = 0^\circ F$
Total PCT change from current assessments	$\sum \Delta PCT = 0^\circ F$
Cumulative PCT change from current assessments	$\sum  \Delta PCT  = 0^\circ F$
<b>Net PCT</b>	<b>2139°F</b>

**ATTACHMENT 2**  
**Quad Cities Nuclear Power Station Unit 2,**  
**10 CFR 50.46 Report (Framatome Fuel) – ATRIUM 10XM**

PLANT NAME: Quad Cities Unit 2  
 ECCS EVALUATION MODEL: EXEM BWR-2000  
 REPORT REVISION DATE: 05/04/2023  
 CURRENT OPERATING CYCLE: 27

**ANALYSIS OF RECORD**

Evaluation Model: "EXEM BWR-2000 ECCS Evaluation Model," EMF-2361(P)(A)  
 Revision 0, May 2021

- Calculations:
1. "Quad Cities 1 and 2 ATRIUM 10XM Break Spectrum with Decreased ADS Flow," ANP-3794P, Revision 0, September 2019
  2. "Quad Cities Units 1 and 2 ATRIUM 10XM LOCA-ECCS Analysis MAPLHGR Limits with Increased ADS Flow," ANP-3795P, Revision 0, October 2019
  3. "Quad Cities Unit 2 Cycle 27 Reload Safety Analysis," ANP-3976P, Revision 0, January 2022

Fuel Analyzed in Calculation: ATRIUM 10XM  
 Limiting Fuel Type: ATRIUM 10XM  
 Limiting Single Failure: High Pressure Coolant Injection  
 Limiting Break Size and Location: 0.12 ft<sup>2</sup> split break in the recirculation discharge line

Reference Peak Cladding Temperature (PCT): PCT = 2139°F

**MARGIN ALLOCATION**

**A. PRIOR LOCA MODEL ASSESSMENTS**

10 CFR 50.46 Report dated May 4, 2020 (See Note 1)	$\Delta PCT = 0^\circ F$
10 CFR 50.46 Report dated May 4, 2021 (See Note 2)	$\Delta PCT = 0^\circ F$
10 CFR 50.46 Report dated May 4, 2021 (See Note 3)	$\Delta PCT = 0^\circ F$
<b>Net PCT</b>	<b>2139°F</b>

**B. CURRENT LOCA MODEL ASSESSMENTS**

None (See Note 4)	$\Delta PCT = 0^\circ F$
Total PCT change from current assessments	$\sum \Delta PCT = 0^\circ F$
Cumulative PCT change from current assessments	$\sum  \Delta PCT  = 0^\circ F$
<b>Net PCT</b>	<b>2139°F</b>

**ATTACHMENT 3**  
**Quad Cities Nuclear Power Station Unit 1,**  
**10 CFR 50.46 Report (GE Hitachi Fuel) – GNF3**

PLANT NAME: Quad Cities Unit 1  
 ECCS EVALUATION MODEL: SAFER/PRIME  
 REPORT REVISION DATE: 05/04/2023  
 CURRENT OPERATING CYCLE: 28

**ANALYSIS OF RECORD**

Calculation: "Quad Cities Nuclear Power Station (QCNPS) Units 1 and 2 GNF3  
 ECCS-LOCA Evaluation," GEH Report 006N1118, Revision 0,  
 July 2022

Fuel Analyzed in Calculation: GNF3  
 Limiting Fuel Type: GNF3  
 Limiting Single Failure: Diesel Generator Failure  
 Limiting Break Size and Location: Double-ended guillotine break of recirculation pump  
 suction piping

Reference Peak Cladding Temperature (PCT): PCT = 2170°F

**MARGIN ALLOCATION**

**A. PRIOR LOCA MODEL ASSESSMENTS**

No prior LOCA model assessments are applicable since this is the first time the reference Analysis of Record is being reported (See Note 4)	$\Delta PCT = N/A$
<b>Net PCT</b>	<b>2170°F</b>

**B. CURRENT LOCA MODEL ASSESSMENTS**

Total PCT change from current assessments	$\sum \Delta PCT = N/A$
Cumulative PCT change from current assessments	$\sum  \Delta PCT  = N/A$
<b>Net PCT</b>	<b>2170°F</b>

**ATTACHMENT 4**  
**Quad Cities Nuclear Power Station Units 1 and 2,**  
**10 CFR 50.46 Report Assessment Notes**

**1. Prior Loss-of-Coolant Accident (LOCA) Assessment**

A new calculation of the Framatome EXEM BWR-2000 Evaluation Model was implemented for QCNPS Unit 2.

There were two assessments to the Framatome EXEM BWR-2000 Evaluation Model that applied to the QCNPS Unit 2 analyses. The first assessment was a coding issue in the RODEX4 thermal-mechanical code interpolation process of the RODEX4 Pellet-Cladding Mechanical Interaction routine with an estimated impact on PCT of +1°F. The second assessment was that some of the RODEX2-2a inputs associated with the fuel rod geometry were not being appropriately prepared with an estimated impact on PCT of -1°F.

Lastly, no ECCS-related changes or modifications occurred at QCNPS Unit 2 that affected the assumptions to any of the LOCA AORs.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "10 CFR 50.46 Annual Report," dated May 4, 2020]

**2. Prior LOCA Assessment**

A new calculation of the Framatome EXEM BWR-2000 Evaluation Model has been performed for QCNPS Unit 1 with a limiting Peak Clad Temperature of 2139°F. This referenced Peak Clad Temperature is an increase of 40°F from the previously reported referenced Peak Clad Temperature. This calculation incorporates all previous errors and impacts to the LOCA model except for the RODEX2-2a input error discussed in Note 1. The previously discussed impact of 0°F to the limiting Peak Clad Temperature remains valid. Overall, the implementation of this new calculation along with the one impact represents an increase of the Peak Clad Temperature of +40°F from the previously reported limiting Peak Clad Temperature which is below the |50°F| threshold for 30 day 10 CFR 50.46 reporting requirements. Implementation of this new calculation supersedes that previously applied and references to the previous calculation are removed from this report.

There were no new changes, error corrections or enhancements to the Framatome EXEM BWR-2000 Evaluation Model for QCNPS Unit 2.

Lastly, no ECCS-related changes or modifications occurred at QCNPS Units 1 and 2 that affected the assumptions to any of the LOCA Analyses of Record (AORs).

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "10 CFR 50.46 Annual Report," dated May 4, 2021]

**3. Prior LOCA Assessment**

There were two new changes to the Framatome EXEM BWR-2000 Evaluation Model for QCNPS Units 1 and 2. The utilization of the RDS2\_2\_RDX4 code created two changes impacting the effects of exposure-dependent thermal conductivity degradation (TCD) of the EXEM BWR-2000 LOCA methodology.

**ATTACHMENT 4**  
**Quad Cities Nuclear Power Station Units 1 and 2,**  
**10 CFR 50.46 Report Assessment Notes**

1. The RDX2\_2\_RDX4 code corrected the input conversion process for the cladding and pellet roughness values. The assessment showed that the estimated impact on PCT of this RDX2\_2\_RDX4 coding adjustment is +1°F.
2. The calculation of the TCD multiplication factor is based on the ratio of pellet temperatures. As part of the implementation of RDX2\_2\_RDX4, the process was modified to use pellet temperatures in degrees Rankine instead of degrees Fahrenheit. The assessment showed the estimated impact on PCT of using degrees Rankine to calculate the TCD factor is -1°F.

The overall impact of these changes was 0°F with an absolute value of both changes being 2°F. Lastly, no ECCS-related changes or modifications occurred at QCNPS Units 1 and 2 that affected the assumptions to any of the LOCA AORs.

[Reference: Letter from P. R. Simpson (Constellation Energy Generation, LLC) to U.S. NRC, "10 CFR 50.46 Annual Report," dated May 4, 2022]

**4. Current LOCA Assessment**

The new GE Hitachi SAFER/PRIME Evaluation Model and calculation has been implemented for QCNPS Unit 1 for the fresh fuel of GNF3 loaded into the Cycle 28 core. This model reports a limiting PCT of 2170°F and has no additional PCT impacts or estimates.

It was recently discovered that a change in 2011 was made to the decay heat (DH) input used in nominal calculations for the SAFER evaluation model. The updated DH model is a best estimate decay heat curve based on the 1979 ANS 5.1 standard and considers Service Information Letter (SIL) 636. This change was discovered during review of GNF3 new fuel introduction activities. Additional vendor assessments estimated an impact of 0°F upon GNF2 PCT. This change was already incorporated into the initial GNF3 LOCA evaluation and therefore has no impact on the GNF3 LOCA AOR.

There were no new changes, error corrections or enhancements to the Framatome EXEM BWR-2000 Evaluation Model for QCNPS Units 1 and 2.

Lastly, no ECCS-related changes or modifications occurred at QCNPS Units 1 and 2 that affected the assumptions to any of the LOCA AORs.