

RS-21-102

10 CFR 50.46

September 29, 2021

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

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station

Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 9, 2020

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 Clinton Power Station, Unit 1. The attachments describe the changes in accumulated peak cladding temperature 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 Mr. Kenneth M. Nicely at (630) 657-2803.

Respectfully,



Patrick R. Simpson
Sr. Manager Licensing
Exelon Generation Company, LLC

Attachments:

1. 10 CFR 50.46 Report
2. 10 CFR 50.46 Report Assessment Notes

cc: NRC Regional Administrator, Region III
NRC Senior Resident Inspector, Clinton Power Station

ATTACHMENT 1
Clinton Power Station, Unit 1 | SAFER/GESTR-LOCA | GNF2 Fuel
10 CFR 50.46 Report

PLANT NAME: Clinton Power Station, Unit 1
ECCS EVALUATION MODEL: SAFER/GESTR-LOCA
EVALUATION MODEL VENDOR: GNF/GEH
REPORT REVISION DATE: September 29, 2021
CURRENT OPERATING CYCLE: 20

ANALYSIS OF RECORD CALCULATIONS

1. GEH Report 0000-0121-9100-R0, Clinton Power Station, GNF2 ECCS-LOCA Evaluation, October 2011

Fuel Analyzed in Calculation and in Operation: GNF2¹

Limiting Fuel Type: GNF2

Limiting Single Failure: High Pressure Core Spray Diesel Generator

Limiting Break Size/Location: Double-Ended Guillotine Break of Recirculation-Pump Suction Piping

Reference Peak Cladding Temperature (PCT): 1880 °F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS:

10 CFR 50.46 report dated October 26, 2012 (Note 1)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated October 25, 2013 (Note 2)	$\Delta PCT = 40\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated October 24, 2014 (Note 3)	$\Delta PCT = -15\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated October 23, 2015 (Note 4)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated October 21, 2016 (Note 5)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated October 18, 2017 (Note 6)	$\Delta PCT = 30\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated October 18, 2018 (Note 7)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated October 10, 2019 (Note 8)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated October 9, 2020 (Note 9)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Net PCT	1935 °F

¹ Clinton Power Station (CPS) Cycle 20 operation is utilizing IronClad and ARMOR Accident Tolerant Fuel (ATF) Lead Test Rods (LTRs). As documented in GNF Report 005N2294 Rev. 1, these LTRs and LTAs are similar to the existing GNF2 fuel type in use at CPS and their LOCA response is bounded by the Reference 1 analysis.

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Clinton Power Station, Unit 1 | SAFER/GESTR-LOCA | GNF2 Fuel
10 CFR 50.46 Report

B. CURRENT LOCA MODEL ASSESSMENTS:

Notification 2021-01 (Note 10)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Notification 2021-02 (Note 10)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Total PCT change from current assessments	$\Sigma \Delta PCT = 0\text{ }^{\circ}\text{F}$
Cumulative PCT change from current assessments	$\Sigma \Delta PCT = 0\text{ }^{\circ}\text{F}$
Net PCT	1935 °F

ATTACHMENT 2
Clinton Power Station, Unit 1
10 CFR 50.46 Report Assessment Notes

1. Prior LOCA Model Assessment (2012)

The referenced letter reported that the GNF2 fuel design was introduced into the Clinton Power Station (CPS) core during the Reload 13 (Cycle 14) outage. There were no Emergency Core Cooling System (ECCS) related changes or modifications that affected the assumptions in the CPS Loss-of-Coolant Accident (LOCA) analysis of record.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 26, 2012]

2. Prior LOCA Model Assessment (2013)

To address inaccuracies in thermal conductivity degradation, GEH replaced the GESTR-LOCA model with a newer model, PRIME. The dominant Peak Cladding Temperature (PCT) effect is from the PRIME thermal conductivity which produces 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 were performed with the PRIME model. The CPS ECCS-LOCA analysis methodology remains GESTR based, and it will not be PRIME based until the ECCS-LOCA analysis is re-performed using PRIME. The notification resulted in a +40 °F PCT impact to GNF2 fuel.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 25, 2013]

3. Prior LOCA Model Assessment (2014)

The referenced letter identified four vendor notifications.

- The first notification addressed several accumulated updates to the SAFER04A model. These code maintenance changes had an individually and collectively insignificant effect on calculated PCT.
- The second notification corrected a logic error that was isolated, occurring with an indication that the expected system mass diverges from the calculated actual system mass. This error affects the ECCS flow credited as reaching the core. Correction of this error did not impact the PCT 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 can create 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 -15 °F to GNF2.

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- The fourth notification addressed an incorrect pressure head representation when defining the counter current flow limitation. Correction of this error did not impact the PCT for GNF2 fuel.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 24, 2014]

4. Prior LOCA Model Assessment (2015)

Per the referenced letter, no vendor notifications of ECCS model errors/changes applicable to CPS were issued. There were no ECCS related changes or modifications at CPS that affect the LOCA analysis of record.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 23, 2015]

5. Prior LOCA Model Assessment (2016)

Per the referenced letter, no vendor notifications of ECCS model errors/changes applicable to CPS were issued. There were no ECCS related changes or modifications at CPS that affect the LOCA analysis of record.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 21, 2016]

6. Prior LOCA Model Assessment (2017)

Per the referenced letter, there were two vendor notifications of ECCS model errors/changes applicable to CPS.

- The first notification identifies that GNF2 leakage flow paths between the bundle and the bypass were incorrectly modeled. The correction to the model had an impact of +30 °F.
- The second notification identifies that fuel rod plenum region was not modeled consistent with GNF2's 10 x 10 design. Plenum inputs were updated to reflect the current design with a 0 °F impact to PCT.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 18, 2017]

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7. Prior LOCA Model Assessment (2018)

Per the referenced letter, no vendor notifications of ECCS model errors/changes applicable to CPS were issued. There were no ECCS related changes or modifications at CPS that affect the LOCA analysis of record.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 18, 2018]

8. Prior LOCA Model Assessment (2019)

Per the referenced letter, no vendor notifications of ECCS model errors/changes applicable to CPS were issued. There were no ECCS related changes or modifications at CPS that affect the LOCA analysis of record.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 10, 2019]

9. Prior LOCA Model Assessment (2020)

Per the referenced letter, there were two vendor notifications of ECCS model errors/changes applicable to CPS.

- Notification 2019-05 identified that the upper and lower limits for the SAFER code forward and backward bypass leakage were coded incorrectly for the control rod guide tube to control rod drive housing interface backward leakage path. The error was estimated to have a zero-degree impact upon the GNF2 licensing basis PCT.
- Notification 2020-01 identified that the PRIME code contained errors in irradiation growth after a breakaway neutron fluence, thermal conductivity applied to the zirconium barrier for cladding temperature drop, and gap conductance during pellet-cladding gap closure. The errors were estimated to have a zero-degree impact upon the GNF2 licensing basis PCT.

[Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Annual Report of Emergency Core Cooling System Evaluation Model Changes and Errors for Clinton Power Station," dated October 9, 2020]

10. Current LOCA Model Assessment (2021)

Notification 2021-01 identifies an error in the fuel rod stress and perforation model due to an incorrect value used for the fuel pellet to plenum spring conductance input. The error was a result of an incorrect conversion from SI units in preparing the input for SAFER analyses. The error was estimated to have a zero degree impact upon the GNF2 PCT.

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Notification 2021-02 identifies an error in the inner cladding surface roughness value in the gap conductance model. An inconsistency was identified between the roughness value used in the fuel performance model PRIME and the input to the SAFER and TRACG calculations. The error was estimated to have a zero degree impact upon the GNF2 PCT.

CPS Cycle 20 operation is utilizing IronClad and ARMOR Accident Tolerant Fuel (ATF) Lead Test Rods (LTRs). These LTRs and LTAs are similar to the existing GNF2 fuel type in use at CPS and their LOCA response is bounded by the standard GNF2 fuel analyzed in the analyses of record.

[Reference: GNF Report 005N2294 Rev. 1, "Technical Evaluation Report to Support ARMOR and IronClad Lead Test Assemblies at Clinton Power Station," dated August 2019]