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RS-20-043

10 CFR 50.46

April 9, 2020

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

Braidwood Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and 50-457

Byron Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and 50-455

Subject: Annual 10 CFR 50.46 Report of Emergency Core Cooling System Evaluation
Model Changes and Errors

Reference: Letter from Patrick Simpson (Exelon Generation Company, LLC) to U.S. NRC,
"Annual 10 CFR 50.46 Report of Emergency Core Cooling System Evaluation
Model Changes and Errors," dated April 9, 2019

In accordance with 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," paragraph (a)(3)(ii), Exelon Generation Company, LLC, (EGC) is submitting the attached information to fulfill the annual reporting requirements for Braidwood and Byron Stations, Units 1 and 2. The attachments describe the changes in the evaluations associated with the accumulated peak cladding temperature (PCT) since the previous annual report submitted in the referenced letter.

There are no regulatory commitments contained in this submittal.

Should you have any questions concerning this letter, please contact Ms. Lisa Zurawski at (630) 657-2816.

Respectfully,

A handwritten signature in black ink, appearing to read "Dwi Murray", with a stylized flourish at the end.

Dwi Murray
Sr. Manager – Licensing
Exelon Generation Company, LLC

April 9, 2020
U.S. Nuclear Regulatory Commission
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Attachments: 1) Braidwood Station, Units 1 and 2 – 10 CFR 50.46 Report
 2) Byron Station, Units 1 and 2 – 10 CFR 50.46 Report
 3) Braidwood and Byron Stations, Units 1 and 2 – 10 CFR 50.46 Report
 Assessment Notes

cc: NRC Regional Administrator, Region III
 NRC Senior Resident Inspector, Braidwood Station
 NRC Senior Resident Inspector, Byron Station
 NRR Project Manager, Braidwood and Byron Stations
 Illinois Emergency Management Agency – Division of Nuclear Safety

Attachment 1
Braidwood Station, Units 1 and 2
10 CFR 50.46 Report

PLANT NAME: Braidwood Station Unit 1
 ECCS EVALUATION MODEL: Small Break Loss of Coolant Accident (SBLOCA)
 REPORT REVISION DATE: 04/09/20
 CURRENT OPERATING CYCLE: 22

ANALYSIS OF RECORD (AOR)

Evaluation Model: NOTRUMP
 Calculation: Westinghouse CN-LIS-00-208, December 2000
 Fuel: VANTAGE+ 17 x 17
 Limiting Fuel Type: VANTAGE+ 17 x 17
 Limiting Single Failure: Loss of one train of ECCS flow
 Limiting Break Size and Location: 2-inch Break in the Bottom of the Cold Leg
 Reference Peak Cladding Temperature (PCT) PCT = 1624.0°F

MARGIN ALLOCATION

A. PRIOR LOSS OF COOLANT ACCIDENT (LOCA) MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (Note 1)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 18, 2002 (Note 2)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 14, 2003 (Note 3)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 14, 2004 (Note 4)	$\Delta PCT = +35\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 14, 2005 (Note 5)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 14, 2006 (Note 6)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 13, 2007 (Note 7)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
30-Day 10 CFR 50.46 report dated June 22, 2007 (Note 9)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
30-Day 10 CFR 50.46 report dated November 19, 2007 (Note 10)	$\Delta PCT = +90\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 11, 2008 (Note 11)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2009 (Note 12)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 8, 2010 (Note 13)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2011 (Note 15)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2012 (Note 17)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 5, 2013 (Note 19)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2014 (Note 21)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2015 (Note 22)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2016 (Note 23)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2017 (Note 24)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2018 (Note 25)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2019 (Note 26)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT

PCT = 1749.0°F

Attachment 1
Braidwood Station, Units 1 and 2
10 CFR 50.46 Report

B. CURRENT LOCA MODEL ASSESSMENTS

None	$\Delta\text{PCT} = 0\text{ }^{\circ}\text{F}$
Total PCT change from current assessments	$\sum \Delta\text{PCT} = 0\text{ }^{\circ}\text{F}$
Cumulative PCT change from current assessments	$\sum \Delta\text{PCT} = 0\text{ }^{\circ}\text{F}$

NET PCT

PCT = 1749.0°F

Attachment 1
Braidwood Station, Units 1 and 2
10 CFR 50.46 Report

PLANT NAME: Braidwood Station Unit 1
 ECCS EVALUATION MODEL: Large Break Loss of Coolant Accident (LBLOCA)
 REPORT REVISION DATE: 04/09/20
 CURRENT OPERATING CYCLE: 22

AOR

Evaluation Model: ASTRUM (2004)
 Calculation: Westinghouse WCAP-16841-P, November 2007
 Fuel: VANTAGE+ 17 x 17
 Limiting Fuel Type: VANTAGE+ 17 x 17
 Limiting Single Failure: Loss of one train of ECCS flow
 Limiting Break Size and Location: Guillotine break in the Cold Leg
 Reference PCT PCT = 1913.0°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

30-Day 10 CFR 50.46 report dated March 15, 2011 (Note 14)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 6, 2011 (Note 15)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 6, 2012 (Note 17)	$\Delta PCT = 0^{\circ}F$
30-Day 10 CFR 50.46 report dated May 21, 2012 (Note 18)	$\Delta PCT = +44^{\circ}F$
10 CFR 50.46 report dated April 5, 2013 (Note 19)	$\Delta PCT = 0^{\circ}F$
30-Day 10 CFR 50.46 report dated February 27, 2014 (Note 20)	$\Delta PCT = +66^{\circ}F$
10 CFR 50.46 report dated April 7, 2014 (Note 21)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 7, 2015 (Note 22)	$\Delta PCT = +2^{\circ}F$
10 CFR 50.46 report dated April 7, 2016 (Note 23)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 7, 2017 (Note 24)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 9, 2018 (Note 25)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 9, 2019 (Note 26)	$\Delta PCT = 0^{\circ}F$

NET PCT

PCT = 2025.0°F

B. CURRENT LOCA MODEL ASSESSMENTS

Removal Of The Vessel Interfacial Heat Transfer Limit (Note 27)	$\Delta PCT = 0^{\circ}F$
General Code Maintenance (Note 27)	$\Delta PCT = 0^{\circ}F$
Total PCT change from current assessments	$\sum \Delta PCT = 0^{\circ}F$
Cumulative PCT change from current assessments	$\sum \Delta PCT = 0^{\circ}F$

NET PCT

PCT = 2025.0°F

Attachment 1
Braidwood Station, Units 1 and 2
10 CFR 50.46 Report

PLANT NAME: Braidwood Station Unit 2
 ECCS EVALUATION MODEL: Small Break Loss of Coolant Accident (SBLOCA)
 REPORT REVISION DATE: 04/09/20
 CURRENT OPERATING CYCLE: 21

AOR

Evaluation Model: NOTRUMP
 Calculation: Westinghouse CN-LIS-00-208, December 2000
 Fuel: VANTAGE+ 17 x 17
 Limiting Fuel Type: VANTAGE+ 17 x 17
 Limiting Single Failure: Loss of one train of ECCS flow
 Limiting Break Size and Location: 2-inch Break in the Bottom of the Cold Leg
 Reference PCT PCT = 1627.0°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (Note 1)	$\Delta PCT = +3\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 18, 2002 (Note 2)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 14, 2003 (Note 3)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 14, 2004 (Note 4)	$\Delta PCT = +35\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 14, 2005 (Note 5)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 14, 2006 (Note 6)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 13, 2007 (Note 7)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
30-Day 10 CFR 50.46 report dated June 22, 2007 (Note 9)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 11, 2008 (Note 11)	$\Delta PCT = +90\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2009 (Note 12)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 8, 2010 (Note 13)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2011 (Note 15)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2012 (Note 17)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 5, 2013 (Note 19)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2014 (Note 21)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2015 (Note 22)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2016 (Note 23)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2017 (Note 24)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2018 (Note 25)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2019 (Note 26)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT

PCT = 1755.0°F

Attachment 1
Braidwood Station, Units 1 and 2
10 CFR 50.46 Report

B. CURRENT LOCA MODEL ASSESSMENTS

None	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Total PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$
Cumulative PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT

PCT = 1755.0°F

Attachment 1
Braidwood Station, Units 1 and 2
10 CFR 50.46 Report

PLANT NAME: Braidwood Station Unit 2
 ECCS EVALUATION MODEL: Large Break Loss of Coolant Accident (LBLOCA)
 REPORT REVISION DATE: 04/09/20
 CURRENT OPERATING CYCLE: 21

AOR

Evaluation Model: ASTRUM (2004)
 Calculation: Westinghouse WCAP-16841-P, November 2007
 Fuel: VANTAGE+ 17 x 17
 Limiting Fuel Type: VANTAGE+ 17 x 17
 Limiting Single Failure: Loss of one train of ECCS flow
 Limiting Break Size and Location: Guillotine break in the Cold Leg
 Reference PCT PCT = 2041.0°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

30-Day 10 CFR 50.46 report dated March 15, 2011 (Note 14)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2011 (Note 15)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
30-Day 10 CFR 50.46 report dated March 19, 2012 (Note 16)	$\Delta PCT = -42\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2012 (Note 17)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 5, 2013 (Note 19)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2014 (Note 21)	$\Delta PCT = +46\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2015 (Note 22)	$\Delta PCT = +2\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2016 (Note 23)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2017 (Note 24)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2018 (Note 25)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2019 (Note 26)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT PCT = 2047.0°F

B. CURRENT LOCA MODEL ASSESSMENTS

Removal Of The Vessel Interfacial Heat Transfer Limit (Note 27)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
General Code Maintenance (Note 27)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Total PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$
Cumulative PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT PCT = 2047.0°F

Attachment 2
Byron Station, Units 1 and 2
10 CFR 50.46 Report

PLANT NAME: Byron Station Unit 1
 ECCS EVALUATION MODEL: Small Break Loss of Coolant Accident (SBLOCA)
 REPORT REVISION DATE: 04/09/20
 CURRENT OPERATING CYCLE: 24

ANALYSIS OF RECORD (AOR)

Evaluation Model: NOTRUMP
 Calculation: Westinghouse CN-LIS-00-208, December 2000
 Fuel: VANTAGE+ 17 x 17
 Limiting Fuel Type: VANTAGE+ 17 x 17
 Limiting Single Failure: Loss of one train of ECCS flow
 Limiting Break Size and Location: 2-inch Break in the Bottom of the Cold Leg
 Reference Peak Cladding Temperature (PCT) PCT = 1624.0°F

MARGIN ALLOCATION

A. PRIOR LOSS OF COOLANT ACCIDENT (LOCA) MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (Note 1)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 18, 2002 (Note 2)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 14, 2003 (Note 3)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 14, 2004 (Note 4)	$\Delta PCT = +35^{\circ}F$
10 CFR 50.46 report dated April 14, 2005 (Note 5)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 14, 2006 (Note 6)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 13, 2007 (Note 7)	$\Delta PCT = 0^{\circ}F$
30-Day 10 CFR 50.46 report dated June 22, 2007 (Note 9)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 11, 2008 (Note 11)	$\Delta PCT = +90^{\circ}F$
10 CFR 50.46 report dated April 9, 2009 (Note 12)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 8, 2010 (Note 13)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 6, 2011 (Note 15)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 6, 2012 (Note 17)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 5, 2013 (Note 19)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 7, 2014 (Note 21)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 7, 2015 (Note 22)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 7, 2016 (Note 23)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 7, 2017 (Note 24)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 9, 2018 (Note 25)	$\Delta PCT = 0^{\circ}F$
10 CFR 50.46 report dated April 9, 2019 (Note 26)	$\Delta PCT = 0^{\circ}F$

NET PCT

PCT = 1749.0°F

**Attachment 2
Byron Station, Units 1 and 2
10 CFR 50.46 Report**

B. CURRENT LOCA MODEL ASSESSMENTS

None	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Total PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$
Cumulative PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT

PCT = 1749.0°F

Attachment 2
Byron Station, Units 1 and 2
10 CFR 50.46 Report

PLANT NAME: Byron Station Unit 1
 ECCS EVALUATION MODEL: Large Break Loss of Coolant Accident (LBLOCA)
 REPORT REVISION DATE: 04/09/20
 CURRENT OPERATING CYCLE: 24

AOR

Evaluation Model: ASTRUM (2004)
 Calculation: Westinghouse WCAP-16841-P, November 2007
 Fuel: VANTAGE+ 17 x 17
 Limiting Fuel Type: VANTAGE+ 17 x 17
 Limiting Single Failure: Loss of one train of ECCS flow
 Limiting Break Size and Location: Guillotine break in the Cold Leg
 Reference PCT PCT = 1913.0°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

30-Day 10 CFR 50.46 report dated March 15, 2011 (Note 14)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2011 (Note 15)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2012 (Note 17)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
30-Day 10 CFR 50.46 report dated May 21, 2012 (Note 18)	$\Delta PCT = +44\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 5, 2013 (Note 19)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
30-Day 10 CFR 50.46 report dated February 27, 2014 (Note 20)	$\Delta PCT = +66\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2014 (Note 21)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2015 (Note 22)	$\Delta PCT = +2\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2016 (Note 23)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2017 (Note 24)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2018 (Note 25)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2019 (Note 26)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT

PCT = 2025.0°F

B. CURRENT LOCA MODEL ASSESSMENTS

Removal Of The Vessel Interfacial Heat Transfer Limit (Note 27)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
General Code Maintenance (Note 27)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Total PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$
Cumulative PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT

PCT = 2025.0°F

Attachment 2
Byron Station, Units 1 and 2
10 CFR 50.46 Report

PLANT NAME: Byron Station Unit 2
 ECCS EVALUATION MODEL: Small Break Loss of Coolant Accident (SBLOCA)
 REPORT REVISION DATE: 04/09/20
 CURRENT OPERATING CYCLE: 22

AOR

Evaluation Model: NOTRUMP
 Calculation: Westinghouse CN-LIS-00-208, December 2000
 Fuel: VANTAGE+ 17 x 17
 Limiting Fuel Type: VANTAGE+ 17 x 17
 Limiting Single Failure: Loss of one train of ECCS flow
 Limiting Break Size and Location: 2-inch Break in the Bottom of the Cold Leg
 Reference PCT PCT = 1627.0°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (Note 1)	Δ PCT = +3 °F
10 CFR 50.46 report dated April 18, 2002 (Note 2)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (Note 3)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (Note 4)	Δ PCT = +35 °F
10 CFR 50.46 report dated April 14, 2005 (Note 5)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 14, 2006 (Note 6)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 13, 2007 (Note 7)	Δ PCT = 0 °F
30-Day 10 CFR 50.46 report dated May 10, 2007 (Note 8)	Δ PCT = +90 °F
30-Day 10 CFR 50.46 report dated June 22, 2007 (Note 9)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 11, 2008 (Note 11)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 9, 2009 (Note 12)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 8, 2010 (Note 13)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 6, 2011 (Note 15)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 6, 2012 (Note 17)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 5, 2013 (Note 19)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 7, 2014 (Note 21)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 7, 2015 (Note 22)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 7, 2016 (Note 23)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 7, 2017 (Note 24)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 9, 2018 (Note 25)	Δ PCT = 0 °F
10 CFR 50.46 report dated April 9, 2019 (Note 26)	Δ PCT = 0 °F

NET PCT

PCT = 1755.0°F

Attachment 2
Byron Station, Units 1 and 2
10 CFR 50.46 Report

B. CURRENT LOCA MODEL ASSESSMENTS

None	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Total PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$
Cumulative PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT

PCT = 1755.0°F

Attachment 2
Byron Station, Units 1 and 2
10 CFR 50.46 Report

PLANT NAME: Byron Station Unit 2
 ECCS EVALUATION MODEL: Large Break Loss of Coolant Accident (LBLOCA)
 REPORT REVISION DATE: 04/09/20
 CURRENT OPERATING CYCLE: 22

AOR

Evaluation Model: ASTRUM (2004)
 Calculation: Westinghouse WCAP-16841-P, November 2007
 Fuel: VANTAGE+ 17 x 17
 Limiting Fuel Type: VANTAGE+ 17 x 17
 Limiting Single Failure: Loss of one train of ECCS flow
 Limiting Break Size and Location: Guillotine break in the Cold Leg
 Reference PCT PCT = 2041.0°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

30-Day 10 CFR 50.46 report dated March 15, 2011 (Note 14)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2011 (Note 15)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
30-Day 10 CFR 50.46 report dated March 19, 2012 (Note 16)	$\Delta PCT = -42\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 6, 2012 (Note 17)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 5, 2013 (Note 19)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2014 (Note 21)	$\Delta PCT = +46\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2015 (Note 22)	$\Delta PCT = +2\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2016 (Note 23)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 7, 2017 (Note 24)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2018 (Note 25)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
10 CFR 50.46 report dated April 9, 2019 (Note 26)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT PCT = 2047.0°F

B. CURRENT LOCA MODEL ASSESSMENTS

Removal Of The Vessel Interfacial Heat Transfer Limit (Note 27)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
General Code Maintenance (Note 27)	$\Delta PCT = 0\text{ }^{\circ}\text{F}$
Total PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$
Cumulative PCT change from current assessments	$\sum \Delta PCT = 0\text{ }^{\circ}\text{F}$

NET PCT PCT = 2047.0°F

Attachment 3
Braidwood and Byron Stations, Units 1 and 2
10 CFR 50.46 Report Assessment Notes

1. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated June 11, 2001 reported new small break loss of coolant accident (SBLOCA) analyses to support operations at uprated power conditions. The same report assessed the impact from annular axial blankets on SBLOCA analysis, which determined a 0°F PCT penalty for Units 1 and a 3°F PCT penalty for Units 2. Evaluations for plant conditions and SBLOCA model changes which resulted in 0°F PCT change were reported.

2. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 18, 2002 reported evaluations for SBLOCA model changes which resulted in 0°F PCT change.

3. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 14, 2003 reported evaluations for SBLOCA model changes which resulted in 0°F PCT change.

4. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 14, 2004 reported evaluations for a SBLOCA assessment related to NOTRUMP bubble rise/drift flux model inconsistency corrections, which resulted in 35°F PCT assessment.

5. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 14, 2005 reported evaluations for SBLOCA model changes which resulted in 0°F PCT change for Byron and Braidwood Unit 1 and Unit 2. The Braidwood Station, Unit 1 assembly N10S was reconstituted with two stainless steel filler rods during Braidwood Unit 1 Refueling Outage 11. This assembly is reloaded into the core and is in use during Braidwood Unit 1 Cycle 12 operation. The introduction of up to five stainless steel filler rods has been evaluated and shown to have no impact on SBLOCA analysis. The estimated PCT effect is 0°F for Braidwood Unit 1. This assembly was discharged during Reload 12.

6. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 14, 2006 reported evaluations for SBLOCA NOTRUMP General Code Maintenance which resulted in 0°F change.

7. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 13, 2007 reported evaluations for SBLOCA model changes and errors. The report documented general code maintenance for

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NOTRUMP, AXIOM lead test assembly evaluation and NOTRUMP refined break spectrum, which resulted in 0°F PCT impact.

8. Prior LOCA Model Assessment

The 30-day 10 CFR 50.46 report dated May 10, 2007 applicable to Byron Unit 2 reported an assessment of the Emergency Core Cooling System (ECCS), which evaluated changes in ECCS flow during the recirculation phase due to Generic Safety Issue (GSI) -191 related safety injection (SI) throttle valve replacements. The evaluation of recirculation phase ECCS flow changes relative to impact on the current Analysis of Record (AOR) was performed for the SBLOCA. Based on the NOTRUMP and SBLOCA calculations performed for Byron Unit 2, a conservative, bounding PCT assessment of +90°F was applied to the current Byron Unit 2 SBLOCA PCT.

9. Prior LOCA Model Assessment

The 30-day 10 CFR 50.46 report dated June 22, 2007 applicable to Byron Units 1 and 2 and Braidwood Units 1 and 2 reported an error in the HOT SPOT Code which did not impact the SBLOCA analysis. The 30-day report also reported minor errors with the reactor vessel data collections that potentially affected the vessel inlet and outlet fluid volume, metal mass and surface area. The corrected values were evaluated for impact, and a 0°F penalty was assessed for Byron Units 1 and 2, and Braidwood Units 1 and 2, SBLOCA analysis.

10. Prior LOCA Model Assessment

The 30-day 10 CFR 50.46 report dated November 19, 2007 applicable to Braidwood Unit 1 reported an assessment of the Emergency Core Cooling System (ECCS), which evaluated changes in ECCS flow during the recirculation phase due to GSI-191 related SI throttle valve replacements. The evaluation of recirculation phase ECCS flow changes relative to impact on the current Analysis of Record (AOR) was performed for the small break loss of coolant accident (SBLOCA). Based on the NOTRUMP and SBLOCA calculations performed for Braidwood Unit 1, a conservative, bounding PCT assessment of +90°F was applied to the Braidwood Unit 1 SBLOCA PCT.

11. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 11, 2008 reported evaluations for LOCA model changes and errors. Applicable to Braidwood Unit 2 and Byron Unit 1, the ECCS assessment evaluated changes in ECCS flow during the recirculation phase due to GSI-191 related safety injection (SI) throttle valve replacements. A conservative, bounding PCT assessment of +90°F was applied to the Braidwood Unit 2 and Byron Unit 1 SBLOCA PCTs. The report also documented general code maintenance for

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SBLOCA and evaluation for pump weir resistance modeling for SBLOCA analyses, which resulted in 0°F PCT impact.

12. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 9, 2009 reported evaluations for LOCA model changes and errors. The report documents general code maintenance for SBLOCA, errors in reactor vessel lower plenum surface area calculations, discrepancies in metal mass from drawings, and an evaluation of AREVA LUAs. All of which have a 0°F PCT penalty associated with them.

13. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 8, 2010 reported no evaluations for SBLOCA model changes which resulted in 0°F PCT change.

14. Prior LOCA Model Assessment

The 30-day 10 CFR 50.46 report dated March 15, 2011 reported a new large break BELOCA (ASTRUM) analysis to support operations for Byron and Braidwood Stations Units 1 and 2. The same report assessed the impact from several errors, issues, and code enhancements. Each of these errors/issues/code enhancements had a 0°F PCT impact with a net 0°F PCT impact.

15. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 6, 2011 reported no evaluations for the LBLOCA model. For the SBLOCA model, the following errors, changes, corrections or enhancements were reported. Two errors relating to urania-gadolinia pellet thermal conductivity calculation, two errors relating to pellet crack and dish volume calculation, a discrepancy involving the treatment of vessel average temperature uncertainty, and general code maintenance were reported for the SBLOCA model. All of these issues were determined to have an estimated impact of 0°F.

16. Prior LOCA Model Assessment

The 30-day 10 CFR 50.46 report dated March 19, 2012 applicable to Braidwood Unit 2 and Byron Unit 2 reported an assessment of Thermal Conductivity Degradation (TCD) with an associated peaking factor burndown and a design input change consisting of a reduction in upper bound steam generator tube plugging, a reduction in nominal upper bound nominal vessel average temperature, and an increase in the assumed containment pressure boundary condition. As a result, the estimated effect of the TCD with burndown was determined to be +148°F and the estimated effect of the design input changes was determined to be -190°F. These two assessments are coupled together via their evaluations of burnup effects which

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include thermal conductivity degradation, peaking factor burndown and design input changes. Therefore, the combined effect of these two changes results in a net change in the reported LBLOCA PCT for Braidwood Unit 2 and Byron Unit 2 of -42°F.

17. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 6, 2012 reported evaluations for LOCA model changes and errors. The report documents general code maintenance for both SBLOCA & LBLOCA, errors in Radiation Heat Transfer Logic for SBLOCA, and an error in the Maximum Fuel Rod Time Step Logic for SBLOCA. All of which have a 0°F PCT penalty associated with them.

18. Prior LOCA Model Assessment

The 30-day 10 CFR 50.46 report dated May 21, 2012 applicable to Braidwood Unit 1 and Byron Unit 1 reported an assessment of Thermal Conductivity Degradation (TCD) with an associated peaking factor burndown an analysis input change consisting of a reduction in conservatism in analyzed FQ values and an increase in the assumed containment pressure boundary condition. As a result, the estimated effect of the TCD with burndown was determined to be +110°F and the estimated effect of the analysis input changes was determined to be -66°F. These two assessments are coupled together via their evaluations of burnup effects which include thermal conductivity degradation, peaking factor burndown and analysis input changes. Therefore, the combined effect of these two changes results in a net change in the reported LBLOCA PCT for Braidwood Unit 1 and Byron Unit 1 of +44°F.

19. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 5, 2013 reported evaluations for LBLOCA model changes, and HOTSPOT and WCOBRA/TRAC code corrections. For SBLOCA, thermal conductivity degradation (TCD) was evaluated with NOTRUMP to estimate the effect on the limiting cladding temperature model. All evaluations led to PCT impact of 0°F.

20. Prior LOCA Model Assessment

The 30-day 10 CFR 50.46 report dated February 27, 2014 applicable to Braidwood Unit 1 and Byron Unit 1 reported evaluations for LBLOCA model changes and code corrections. For Braidwood Unit 2 and Byron Unit 2 a net change of 46°F PCT impact did not require inclusion in the 30-day report and is reported herein. Revised heat transfer multiplier distributions, changes to grid blockage ratio and porosity and HOTSPOT burst strain error corrections was determined to be 5°F, 24°F, and 37°F PCT impact, respectively for Braidwood Unit 1 and Byron Unit 1. Other model

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changes and code corrections sum to 0°F PCT impact. Therefore, the combined effect of the changes resulted in a net change of 66°F PCT impact for Braidwood Unit 1 and Byron Unit 1.

21. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 7, 2014 applicable to Braidwood Unit 2 and Byron Unit 2 reported evaluations for LBLOCA model changes and code corrections. For Braidwood Unit 1 and Byron Unit 1 a net change of 66°F PCT impact required a 30-day report sent on February 27, 2014 (Note 20). Revised heat transfer multiplier distributions, changes to grid blockage ratio and porosity and HOTSPOT burst strain error corrections was determined to be 7°F, 24°F, and 15°F PCT impact, respectively for Braidwood Unit 2 and Byron Unit 2. Other model changes and code corrections sum to 0°F PCT impact. Therefore, the combined effect of the changes resulted in a net change of 46°F PCT impact for Braidwood Unit 2 and Byron Unit 2 LBLOCA. SBLOCA cladding strain requirement for fuel rod burst resulted in a 0°F PCT impact to Byron and Braidwood Unit 1 and 2 SBLOCA.

22. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 7, 2015 reported General Code Maintenance and a change to Safety Injection and Core Spray flow rates for LBLOCA & SBLOCA. The report also reported an error in the decay group uncertainty factor for LBLOCA, errors in the fuel rod gap conductance, radiation heat transfer model and pre-DNB cladding surface heat transfer coefficient and an evaluation to increased Auxiliary feedwater switchover delay for SBLOCA. With the exception of 2°F PCT impact to LBLOCA due to the change to Safety Injection and Core Spray flows, all other changes reported an impact of 0°F PCT.

23. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 7, 2016 reported General Code Maintenance for the SBLOCA which led to a PCT impact of 0°F. There were no impacts to LBLOCA.

24. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 7, 2017 reported General Code Maintenance for the LBLOCA to enhance the usability of codes and to streamline future analyses which led to a PCT impact of 0°F. There were two errors assessed to the LBLOCA analysis related to the calculation of high temperature oxidation within a realistic LBLOCA calculation and to the use of the American Society of Mechanical Engineers (ASME) steam tables to calculate the steady-state upper head liquid temperature as a function of the pressure and specific enthalpy in the ASTRUM software program. Both errors each resulted in an estimated PCT impact of 0°F for

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10 CFR 50.46. Lastly there was one evaluation to the LBLOCA analysis where non-conservative methods here used in modeling the effect of containment purge on the containment pressure response. This evaluation using a more appropriate/conservative method was estimated to have an impact of 0°F for 10 CFR 50.46. There were no impacts to SBLOCA.

25. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 9, 2018 reported General Code Maintenance to enhance the usability of codes and to streamline future analyses which led to an estimated PCT impact of 0°F.

There was one error assessed to the SBLOCA analysis. An error was found in the fluid volume calculation in the upper plenum where the support column outer diameter was being used instead of the inner diameter. This error resulted in an estimated PCT impact of 0°F for 10 CFR 50.46.

There were three evaluations assessed to the LBLOCA analysis. The first evaluation involved a numerical ramp which was used to account for the disappearance of the entrained liquid phase was applied to the entrained liquid / vapor interfacial drag coefficient. The second evaluation involved the WCOBRA/TRAC routine which evaluates the mass and energy residual error of the time step solution, the transverse liquid mass flow is reset as the liquid phase disappears. The third evaluation concerned how the ASTRUM steady-state fuel pellet temperature calibration method involves solving for the hot gap width (AGFACT) to calibrate the fuel temperature for each fuel rod. All three evaluations resulted in estimated PCT impact of 0°F was assigned for 10 CFR 50.46 reporting purposes.

26. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 9, 2019 reported one error assessed applying to the SBLOCA analyses. A typographical error was discovered in the implementation of the UO₂ fuel pellet heat capacity for fuel rod heat-up calculations within the Appendix K SBLOCA evaluation models. The erroneous formulation results in an over-prediction of heat capacity that increases with fuel temperature. The corrected formulation results in a maximum decrease in heat capacity on the order of 1.2% for existing analyses of record. The small over-prediction in UO₂ fuel pellet heat capacity has been evaluated to have a negligible effect on existing SBLOCA analysis results due to the small magnitude of the change, leading to an estimated PCT impact of 0°F.

An error was assessed for the LBLOCA analysis. In the WCOBRA/TRAC and WCOBRA/TRAC-TF2 codes, when the vapor temperature is greater than the wall temperature, and several other conditions are met, the vapor temperature is reset to

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the saturation temperature for heat transfer calculations. It was discovered that this vapor temperature resetting logic results in an inconsistency between the conduction solution and the hydraulic solution, such that energy is not conserved between the two solutions. Engineering judgement supported by sensitivity calculations showed that correcting this error had minimal impact on LOCA transient calculations, leading to an estimated PCT impact of 0°F.

27. Current LOCA Model Assessment

There was General Code Maintenance of the LBLOCA analysis to enhance the usability of codes and to streamline future analyses which led to an estimated PCT impact of 0°F.

There was one error assessed applying to the LBLOCA analyses. A limit on the vessel interfacial heat transfer was implemented into the WCOBRA/TRAC code as presented in Equation 5-12 therein. The implementation of the limit was intended to prevent any extreme conditions which are detrimental to the robustness of the numerical method. During the licensing of the method, the application of the limit was found to have a small impact on predicted results as discussed in the response to RAI1-116 of WCAP-12945-P-A.

An error was found in the implementation of the vessel interfacial heat transfer limit which effectively negates the application of the limit. The error was corrected by removing the vessel interfacial heat transfer limit from the WCOBRA/TRAC code (as opposed to a direct correction of the error). Since the WCOBRA/TRAC code validation and sensitivity studies associated with the model from WCAP-12945-PA all contained the error, the removal of the limit preserves the existing validation basis and sensitivity study conclusions that were presented in the topical report. Based on the validation and RAI responses therein, it was concluded that the as-coded interfacial heat transfer models and condensation behavior was acceptable, leading to an estimated PCT impact of 0°F.