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10 CFR 50.46

RS-06-054

April 14, 2006

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

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

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

Subject: Annual Report of the Emergency Core Cooling System Evaluation Model Changes and Errors Required by 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors"

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, is submitting the annual report of the Emergency Core Cooling System Evaluation Model changes and errors for Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2. This annual report is required to be submitted to the NRC by April 14, 2006.

Attachment 1, "Peak Cladding Temperature Rack-Up Sheets," provides updated information regarding the peak cladding temperature for the limiting small break and large break loss-of-coolant accident analyses evaluations for the Byron and Braidwood Stations. Attachment 2, "Assessment Notes," contains a detailed description for each change or error reported.

Please contact J. L. Schrage at (630) 657-2821 should you have any questions concerning this report.

Respectfully,

Joseph A. Bauer

Joseph A. Bauer
Manager, Licensing

Attachment 1: Peak Cladding Temperature Rack-Up Sheets
Attachment 2: Assessment Notes

Attachment 1

BRAIDWOOD STATION
UNITS 1 AND 2

Docket Nos. 50-456 and 50-457
License Nos. NPF-72 and NPF-77

and

BYRON STATION
UNITS 1 AND 2

Docket Nos. 50-454 and 50-455
License Nos. NPF-37 and NPF-66

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

Peak Cladding Temperature Rack-Up Sheets

Attachment 1
Peak Cladding Temperature Rack-up Sheets

PLANT NAME: Braidwood Station Unit 1
ECCS EVALUATION MODEL: Small Break Loss of Coolant Accident (SBLOCA)
REPORT REVISION DATE: 02/23/06
CURRENT OPERATING CYCLE: 13*

*** Cycle 13 will start May 2006**

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
Heat Flux Hot Channel Factor (FQ) = 2.60
Nuclear Enthalpy Rise Hot Channel Factor (FNΔH) = 1.70
Steam Generator Tube Plugging (SGTP) = 5%
Limiting Break Size: 2" Low Tavg

Notes: Zr-4/ZIRLO Clad Fuel

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 (see note 1)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 18, 2002 (see note 2)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (see note 3)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (see note 4)	ΔPCT = 35 °F
10 CFR 50.46 report dated April 14, 2005 (see note 5)	ΔPCT = 0 °F

NET PCT PCT = 1659.0 °F

B. CURRENT LOCA MODEL ASSESSMENTS

General Code Maintenance (see note 7)	ΔPCT = 0 °F

NET PCT PCT = 1659.0 °F

NOTE: The referenced notes refer to Assessment Notes in Attachment 2.

Attachment 1
Peak Cladding Temperature Rack-up Sheets

PLANT NAME: Braidwood Station Unit 1
ECCS EVALUATION MODEL: Large Break Loss of Coolant Accident (LBLOCA)
REPORT REVISION DATE: 02/23/06
CURRENT OPERATING CYCLE: 13*

*** Cycle 13 will start May 2006**

AOR

Evaluation Model: CQD (1996)
Calculation: Westinghouse CN-LIS-00-7, September 2000
Fuel: VANTAGE+ 17 x 17
Limiting Fuel Type: VANTAGE+ 17 x 17
Limiting Single Failure: Loss of one train of ECCS flow
Heat Flux Hot Channel Factor (FQ) = 2.60
Nuclear Enthalpy Rise Hot Channel Factor (FNΔH) = 1.70
Steam Generator Tube Plugging (SGTP) = 5%
Limiting Break Size: Guillotine

Notes: Zr-4/ZIRLO Clad Fuel

Reference PCT PCT = 2044.0 °F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (see note 1)	ΔPCT = 12 °F
10 CFR 50.46 report dated April 18, 2002 (see note 2)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (see note 3)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (see note 4)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2005 (see note 5)	ΔPCT = 5 °F

NET PCT PCT = 2061.0 °F

B. CURRENT LOCA MODEL ASSESSMENTS

Axial Power Shape Distribution Violation (see note 6)	ΔPCT = 80 °F
Revised Iteration Algorithm (see note 8)	ΔPCT = 0 °F
Pellet Radial Profile Option (see note 9)	ΔPCT = 0 °F
Improved Automation of End of Blowdown Time (see note 10)	ΔPCT = 0 °F
General Code Maintenance (see note 11)	ΔPCT = 0 °F
Thermodynamic Properties from THERMO (see note 12)	ΔPCT = 0 °F
Vessel Unheated Conductor Noding (see note 13)	ΔPCT = 0 °F
Containment Relative Humidity Assumption (see note 14)	ΔPCT = 0 °F

NET PCT PCT = 2141.0 °F

NOTE: The referenced notes refer to Assessment Notes in Attachment 2.

Attachment 1
Peak Cladding Temperature Rack-up Sheets

PLANT NAME: Braidwood Station Unit 2
ECCS EVALUATION MODEL: SBLOCA
REPORT REVISION DATE: 02/23/06
CURRENT OPERATING CYCLE: 12

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
Heat Flux Hot Channel Factor (FQ) = 2.60
Nuclear Enthalpy Rise Hot Channel Factor (FNΔH) = 1.70
Steam Generator Tube Plugging (SGTP) = 10%
Limiting Break: 2" Low Tavg

Notes: Zr-4/ZIRLO Clad Fuel

Reference PCT PCT = 1627.0 °F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (see note 1)	ΔPCT = 3 °F
10 CFR 50.46 report dated April 18, 2002 (see note 2)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (see note 3)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (see note 4)	ΔPCT = 35 °F
10 CFR 50.46 report dated April 14, 2005 (see note 5)	ΔPCT = 0 °F

NET PCT PCT = 1665.0 °F

B. CURRENT LOCA MODEL ASSESSMENTS

General Code Maintenance (see note 7)	ΔPCT = 0 °F

NET PCT PCT = 1665.0 °F

NOTE: The referenced notes refer to Assessment Notes in Attachment 2.

Attachment 1
Peak Cladding Temperature Rack-up Sheets

PLANT NAME: Braidwood Station Unit 2
ECCS EVALUATION MODEL: LBLOCA
REPORT REVISION DATE: 02/23/06
CURRENT OPERATING CYCLE: 12

AOR

Evaluation Model: CQD (1996)
Calculation: Westinghouse CN-LIS-00-7, September 2000
Fuel: VANTAGE+ 17 x 17
Limiting Fuel Type: VANTAGE+ 17 x 17
Limiting Single Failure: Loss of one train of ECCS flow
Heat Flux Hot Channel Factor (FQ) = 2.60
Nuclear Enthalpy Rise Hot Channel Factor (FNΔH) = 1.70
Steam Generator Tube Plugging (SGTP) = 10%
Limiting Break Size: Guillotine

Notes: Zr-4/ZIRLO Clad Fuel

Reference PCT PCT = 2088.0 °F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (see note 1)	ΔPCT = 12 °F
10 CFR 50.46 report dated April 18, 2002 (see note 2)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (see note 3)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (see note 4)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2005 (see note 5)	ΔPCT = 5 °F
Axial Power Shape Distribution Violation (see note 6)	ΔPCT = 8 °F

NET PCT PCT = 2113.0 °F

B. CURRENT LOCA MODEL ASSESSMENTS

Revised Iteration Algorithm (see note 8)	ΔPCT = 0 °F
Pellet Radial Profile Option (see note 9)	ΔPCT = 0 °F
Improved Automation of End of Blowdown Time (see note 10)	ΔPCT = 0 °F
General Code Maintenance (see note 11)	ΔPCT = 0 °F
Thermodynamic Properties from THERMO (see note 12)	ΔPCT = 0 °F
Vessel Unheated Conductor Noding (see note 13)	ΔPCT = 0 °F
Containment Relative Humidity Assumption (see note 14)	ΔPCT = 0 °F

NET PCT PCT = 2113.0 °F

NOTE: The referenced notes refer to Assessment Notes in Attachment 2.

Attachment 1
Peak Cladding Temperature Rack-up Sheets

PLANT NAME: Byron Station Unit 1
ECCS EVALUATION MODEL: SBLOCA
REPORT REVISION DATE: 02/23/06
CURRENT OPERATING CYCLE: 14

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
Heat Flux Hot Channel Factor (FQ) = 2.60
Nuclear Enthalpy Rise Hot Channel Factor (FNΔH) = 1.70
Steam Generator Tube Plugging (SGTP) = 5%
Limiting Break: 2" Low Tavg

Notes: Zr-4/ZIRLO Clad Fuel

Reference 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 (see note 1)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 18, 2002 (see note 2)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (see note 3)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (see note 4)	ΔPCT = 35 °F
10 CFR 50.46 report dated April 14, 2005 (see note 5)	ΔPCT = 0 °F

NET PCT PCT = 1659.0 °F

B. CURRENT LOCA MODEL ASSESSMENTS

General Code Maintenance (see note 7)	ΔPCT = 0 °F

NET PCT PCT =1659.0 °F

NOTE: The referenced notes refer to Assessment Notes in Attachment 2.

Attachment 1
Peak Cladding Temperature Rack-up Sheets

PLANT NAME: Byron Station Unit 1
ECCS EVALUATION MODEL: LBLOCA
REPORT REVISION DATE: 02/23/06
CURRENT OPERATING CYCLE: 14

AOR

Evaluation Model: CQD (1996)
Calculation: Westinghouse CN-LIS-00-7, September 2000
Fuel: VANTAGE+ 17 x 17
Limiting Fuel Type: VANTAGE+ 17 x 17
Limiting Single Failure: Loss of one train of ECCS flow
Steam Generator Tube Plugging (SGTP) = 5%
Heat Flux Hot Channel Factor (FQ) = 2.60
Nuclear Enthalpy Rise Hot Channel Factor (FNΔH) = 1.70
Limiting Break Size: Guillotine

Notes: Zr-4/ZIRLO Clad Fuel

Reference PCT PCT = 2044.0°F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (see note 1)	ΔPCT = 12 °F
10 CFR 50.46 report dated April 18, 2002 (see note 2)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (see note 3)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (see note 4)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2005 (see note 5)	ΔPCT = 5 °F
Axial Power Shape Distribution Violation (see note 6)	ΔPCT = 80 °F

NET PCT PCT = 2141.0 °F

B. CURRENT LOCA MODEL ASSESSMENTS

Revised Iteration Algorithm (see note 8)	ΔPCT = 0 °F
Pellet Radial Profile Option (see note 9)	ΔPCT = 0 °F
Improved Automation of End of Blowdown Time (see note 10)	ΔPCT = 0 °F
General Code Maintenance (see note 11)	ΔPCT = 0 °F
Thermodynamic Properties from THERMO (see note 12)	ΔPCT = 0 °F
Vessel Unheated Conductor Noding (see note 13)	ΔPCT = 0 °F
Containment Relative Humidity Assumption (see note 14)	ΔPCT = 0 °F

NET PCT PCT = 2141.0 °F

NOTE: The referenced notes refer to Assessment Notes in Attachment 2.

Attachment 1
Peak Cladding Temperature Rack-up Sheets

PLANT NAME: Byron Station Unit 2
ECCS EVALUATION MODEL: SBLOCA
REPORT REVISION DATE: 02/23/06
CURRENT OPERATING CYCLE: 13

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
Heat Flux Hot Channel Factor (FQ) = 2.60
Nuclear Enthalpy Rise Hot Channel Factor (FNΔH) = 1.70
Steam Generator Tube Plugging (SGTP) = 10%
Limiting Break: 2" Low Tavg

Notes: Zr-4/ZIRLO Clad Fuel

Reference PCT PCT = 1627.0 °F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (see note 1)	ΔPCT = 3 °F
10 CFR 50.46 report dated April 18, 2002 (see note 2)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (see note 3)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (see note 4)	ΔPCT = 35 °F
10 CFR 50.46 report dated April 14, 2005 (see note 5)	ΔPCT = 0 °F

NET PCT PCT = 1665.0 °F

B. CURRENT LOCA MODEL ASSESSMENTS

General Code Maintenance (see note 7)	ΔPCT = 0 °F

NET PCT PCT = 1665.0 °F

NOTE: The referenced notes refer to Assessment Notes in Attachment 2.

Attachment 1
Peak Cladding Temperature Rack-up Sheets

PLANT NAME: Byron Station Unit 2
ECCS EVALUATION MODEL: LBLOCA
REPORT REVISION DATE: 02/23/06
CURRENT OPERATING CYCLE: 13

AOR

Evaluation Model: CQD (1996)
Calculation: Westinghouse CN-LIS-00-7, September 2000
Fuel: VANTAGE+ 17 x 17
Limiting Fuel Type: VANTAGE+ 17 x 17
Limiting Single Failure: Loss of one train of ECCS flow
Heat Flux Hot Channel Factor (FQ) = 2.60
Nuclear Enthalpy Rise Hot Channel Factor (FNΔH) = 1.70
Steam Generator Tube Plugging (SGTP) = 10%
Limiting Break Size: Guillotine

Notes: Zr-4/ZIRLO Clad Fuel

Reference PCT PCT = 2088.0 °F

MARGIN ALLOCATION

A. PRIOR LOCA MODEL ASSESSMENTS

10 CFR 50.46 report dated June 11, 2001 (see note 1)	ΔPCT = 12 °F
10 CFR 50.46 report dated April 18, 2002 (see note 2)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2003 (see note 3)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2004 (see note 4)	ΔPCT = 0 °F
10 CFR 50.46 report dated April 14, 2005 (see note 5)	ΔPCT = 5 °F

NET PCT PCT = 2105.0 °F

B. CURRENT LOCA MODEL ASSESSMENTS

Axial Power Shape Distribution Violation (see note 6)	ΔPCT = 8 °F
Revised Iteration Algorithm (see note 8)	ΔPCT = 0 °F
Pellet Radial Profile Option (see note 9)	ΔPCT = 0 °F
Improved Automation of End of Blowdown Time (see note 10)	ΔPCT = 0 °F
General Code Maintenance (see note 11)	ΔPCT = 0 °F
Thermodynamic Properties from THERMO (see note 12)	ΔPCT = 0 °F
Vessel Unheated Conductor Noding (see note 13)	ΔPCT = 0 °F
Containment Relative Humidity Assumption (see note 14)	ΔPCT = 0 °F

NET PCT PCT = 2113.0 °F

NOTE: The referenced notes refer to Assessment Notes in Attachment 2.

Attachment 2

BRAIDWOOD STATION
UNITS 1 AND 2

Docket Nos. 50-456 and 50-457
License Nos. NPF-72 and NPF-77

and

BYRON STATION
UNITS 1 AND 2

Docket Nos. 50-454 and 50-455
License Nos. NPF-37 and NPF-66

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

Assessment Notes

Attachment 2
Assessment Notes

1. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated June 11, 2001 reported new large break loss of coolant accident (LBLOCA) and small break loss of coolant accident (SBLOCA) analyses to support operations at uprated power conditions. The same report assessed the impact from decay heat uncertainty error in Monte Carlo calculations on LBLOCA analysis and the impact from annular axial blankets on SBLOCA analysis. Evaluations for plant conditions and LBLOCA and SBLOCA model changes which resulted in 0 °F peak cladding temperature (PCT) change were reported. Cycle specific evaluations related to axial power shape distribution envelope violation was reported for the applicable operating cycles.

2. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 18, 2002 reported evaluations for LBLOCA and SBLOCA model changes which resulted in 0 °F PCT change. Cycle specific evaluations related to axial power shape distribution envelope violation was reported for the applicable operating cycles.

3. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 14, 2003 reported evaluations for LBLOCA and SBLOCA model changes which resulted in 0 °F PCT change. Cycle specific evaluations related to axial power shape distribution envelope violation was reported for the applicable operating cycles.

4. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 14, 2004 reported evaluations for LBLOCA model changes which resulted in 0 °F PCT change. A SBLOCA assessment related to NOTRUMP bubble rise/drift flux model inconsistency corrections, which resulted in 35 °F PCT assessment, was reported. Cycle specific evaluations related to axial power shape distribution envelope violation were reported for the applicable operating cycles.

5. Prior LOCA Model Assessment

The 10 CFR 50.46 report dated April 14, 2005 reported evaluations for LBLOCA model changes, which resulted in a 5 °F PCT change due to the Revised Blowdown Heatup Uncertainty Calculation. Assembly N10S was reconstituted with two stainless steel filler rods during Braidwood Station 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 LBLOCA and SBLOCA analyses. The estimated PCT effect is 0 °F. This assembly will be discharged during Reload 12 and will not be resident in the core for Braidwood Station Unit 1 Cycle 13. Cycle specific evaluations related to axial power shape distribution envelope violation were reported for the applicable operating cycles.

6. Axial power Shape Distribution Envelope Violation (PMID, PBOT)

The LBLOCA analysis is performed based on assuming an axial power shape distribution envelope (PMID, PBOT), where PMID is the power in the middle one-third of the core; and PBOT is the power in the lower one-third of the core. The envelope is pertinent to the BELOCA analysis and is presented as Figure 11-1 of WCAP-15585, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Byron /Braidwood Units 1 and 2 Nuclear

Plant," November 2000. For every reload cycle Westinghouse verifies that the envelope remains limiting. If there is a violation, then a PCT penalty is calculated.

For Braidwood Station Unit 1 Cycle 13 there was a violation and a PCT penalty of 80 °F was calculated.

For Braidwood Station Unit 2 Cycle 12 there was a violation and a PCT penalty of 8 °F was calculated. This penalty has been reported in 10 CFR 50.46 report dated April 14, 2005.

For Byron Station Unit 1 Cycle 14 there was a violation and a PCT penalty of 80 °F was calculated. This penalty has been reported in 10 CFR 50.46 report dated April 14, 2005.

For Byron Station Unit 2 Cycle 13 there was a violation and a PCT penalty of 8 °F was calculated.

For Braidwood Station Unit 2 Cycle 12 and Byron Station Unit 1 Cycle 14, Westinghouse found two types of violations. For the violations outside of the sampling range shown in Figure 11-1 of WCAP-15585 but inside the response surface shown in Figure 9.2-1 of WCAP-15585, a PCT penalty of 8 °F and 80 °F was calculated for Braidwood Station Unit 2 Cycle 12 and Byron Station Unit 1 Cycle 14 respectively. This is the same type of violation as the cycles discussed above.

The second type of violation is for power shapes slightly outside the response surface shown in Figure 9.2-1 of WCAP-15585. These violations were determined to be non-limiting power shapes and were evaluated by extrapolating the power distribution response surface in order to predict PCT. In all cases, the predicted PCT was non-limiting as compared to the LBLOCA PCT reported in the Attachment 1 LBLOCA PCT sheet. The Westinghouse reload methodology approved by the NRC, (i.e., WCAP-9272-P-A, "Westinghouse Reload Safety Evaluation Methodology, March 1978"), allows evaluation of key parameters slightly out of bounds using conservative quantitative evaluation. The extrapolation methodology used in this evaluation is consistent with the methodology for extrapolating FQ and $F\Delta H$ described in WCAP-12945-P-A.

7. General Code Maintenance (NOTRUMP)

Various changes in code input and output format have been made to enhance usability and help preclude errors in analyses. This includes both input changes (e.g., more relevant input variables defined and more common input values used as defaults) and input diagnostics designed to preclude unreasonable values from being used, as well as various changes to code output which have no effect on calculated results. In addition, various updates were made to eliminate inactive coding, improve active coding, and enhance commenting, both for enhanced usability and to facilitate code debugging when necessary. These changes represent Discretionary Changes that will be implemented on a forward-fit basis, in accordance with Section 4.1.1 of WCAP-13451. The nature of these changes leads to an estimated PCT impact of 0 °F.

8. Revised Iteration Algorithm for Calculating the Average Fuel Temperature

Under certain conditions, the iteration scheme to calculate an average fuel temperature in HOTSPOT converged slowly, exceeding the maximum iteration count. This led to an average fuel temperature calculation that was inconsistent with the WCOBRA/TRAC temperature for calculating the stored energy in the fuel. A revised iteration scheme, based on a combination of a secant method and a parabolic interpolation with a bracketing scheme, was implemented to resolve the non-convergence issue. This change is considered to be a

Discretionary change in accordance with Section 4.1.1 of WCAP-13451. The prior inconsistencies between the WCOBRA/TRAC temperature and the HOTSPOT average fuel temperature always resulted in a higher HOTSPOT average fuel temperature. Therefore, a 0 °F impact is conservatively assigned for 10 CFR 50.46 reporting purposes.

9. Pellet Radial Profile

The radial power profile of fuel pellets was previously assumed to be uniform when setting up the conduction network over the fuel pellet in HOTSPOT. However, the accuracy of this approximation decreases for highly burned fuel since the radial power profile tends to increase from the center towards the outside of the fuel pellet at higher burnups. As such, an option was added in HOTSPOT to use a non-uniform radial power profile consistent with the WCOBRA/TRAC code. These changes were considered to be Discretionary Changes in accordance with Section 4.1.1 of WCAP-13451. This change is for forward-fit purposes only, and has no effect on existing analyses.

10. Improved Automation of End of Blowdown Time

Heat transfer multipliers are considered in the uncertainty methodology as a function of the time period in the transient. The blowdown cooling heat transfer multipliers are applied during the time period following turnaround of the blowdown heatup through the end of blowdown. For simplicity, the end of blowdown was originally defined as the time when the system pressure dropped below 40 psia. This definition was then later improved by defining end of blowdown based on the time at which the system pressure stops decreasing. This definition has been further revised in order to improve the automated selection of the end of blowdown time. The revised definition for the end of blowdown was improved by replacing system pressure stops decreasing criterion with a selection based on the time when the collapsed liquid level in the lower plenum reaches a minimum and begins to increase again. These changes were considered to be Discretionary Changes in accordance with Section 4.1.1 of WCAP-13451. The correct end of blowdown time was selected in all prior analyses. Therefore, the estimated effect is zero degrees.

11. General Code Maintenance

A number of coding changes were made as part of normal code maintenance. Examples include more descriptive file naming, improved automation in the ASTRUM codes, and improved input diagnostics in the WCOBRA/TRAC code. All of these changes are considered to be Discretionary Changes in accordance with Section 4.1.1 of WCAP-13451. None of these changes affect the results of design basis analyses. Therefore, the estimated effect is zero degrees.

12. Thermodynamic Properties from THERMO

Subroutine THERMO supplies the thermodynamic properties for the WCOBRA/TRAC one-dimensional components. It is stated in Section 10 of WCAP-12945-P-A and WCAP-16009-P-A that THERMO supplies the thermodynamic properties valid for temperatures within the following range:

$280\ K \leq T_t \leq 697\ K$

However, the thermodynamic properties supplied by THERMO are actually valid for temperatures within the following range:

$277\ K \leq T_\ell \leq 647\ K$

This is not a change in the methodology, but rather, a correction of the documentation. This change is considered to be Discretionary Change in accordance with Section 4.1.1 of WCAP-13451. This change does not affect the results of design basis analyses. Therefore, the estimated effect is zero degrees.

13. Vessel Unheated Conductor Noding

A discrepancy was identified in a 1996 Westinghouse Best Estimate Large Break LOCA (BE LBLOCA) Evaluation Model analysis whereby some unheated conductors used node sizes that are inconsistent with the analysis input guidelines. Inspection of selected other analyses using this Evaluation Model identified similar occurrences, and evaluations were completed to estimate the effect of these differences on typical large break LOCA analysis results. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451. Representative plant calculations using the 1996 Westinghouse BE LBLOCA Evaluation Model indicated that correcting the unheated conductor node sizes resulted in a small reduction in PCT that will conservatively be assigned a 0 °F effect for 10 CFR 50.46 reporting purposes.

14. Containment Relative Humidity Assumption

Large Break LOCA analyses have historically used maximum initial relative humidity to specify the initial containment air and steam partial pressures. This assumption is conservative for a given total initial containment pressure, but is non-conservative for a given initial containment air partial pressure. The historical assumption has been revised accordingly. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. An evaluation for the plants within Westinghouse Pittsburgh large break LOCA analysis cognizance concluded that no PCT assessments are required, leading to an estimated PCT effect of 0 °F.