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10 CFR 50.46

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

Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-71 and DPR-62
Docket Nos. 50-325 and 50-324

Catawba Nuclear Station, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. NPF-35 and NPF-52
Docket Nos. 50-413 and 50-414

H. B. Robinson Steam Electric Plant, Unit 2
Renewed Facility Operating License No. DPR-23
Docket No. 50-261

McGuire Nuclear Station, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. NPF-9 and NPF-17
Docket Nos. 50-369 and 50-370

Shearon Harris Nuclear Power Plant, Unit 1
Renewed Facility Operating License No. NPF-63
Docket No. 50-400

Oconee Nuclear Station, Unit Nos. 1, 2 and 3
Renewed Facility Operating License Nos. DPR-38, DPR-47 and DPR-55
Docket Nos. 50-269, 50-270 and 50-287

Subject: Annual Report of Changes Pursuant to 10 CFR 50.46

Ladies and Gentlemen:

Pursuant to 10 CFR 50.46(a)(3)(ii), Duke Energy hereby submits the enclosed annual reports of changes to or errors in Emergency Core Cooling System (ECCS) evaluation models. These reports cover the period from January 1, 2018 to December 31, 2018 for the Brunswick Steam Electric Plant, Catawba Nuclear Station, H. B. Robinson Steam Electric Plant, McGuire Nuclear Station, Shearon Harris Nuclear Power Plant and the Oconee Nuclear Station.

There are no regulatory commitments contained in this letter.

Should you have any questions concerning this letter and its enclosures, please contact Art Zaremba, Manager – Nuclear Fleet Licensing at (980) 373-2062.

Sincerely,



Steve Snider
Vice President - Nuclear Engineering

JLV

Enclosures:

1. Brunswick 10 CFR 50.46 Annual Report
2. Catawba 10 CFR 50.46 Annual Report
3. Robinson 10 CFR 50.46 Annual Report
4. McGuire 10 CFR 50.46 Annual Report
5. Shearon Harris 10 CFR 50.46 Annual Report
6. Oconee 10 CFR 50.46 Annual Report

cc: Ms. C. Haney, NRC Regional Administrator, Region II
Mr. D. J. Galvin, NRC Project Manager, BNP
Mr. G. Smith, NRC Sr. Resident Inspector, BNP
Mr. M. Mahoney, NRC Project Manager, CNS and MNS
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Mr. A. Hutto, NRC Sr. Resident Inspector, MNS
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Ms. A. Klett, NRC Senior Project Manager, ONS
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Chair – North Carolina Utilities Commission (Electronic Copy Only)
Ms. L. Garner, Manager, SC DHEC
Ms. A. Nair-Gimmi, SC DHEC
Mr. A. Wilson, Attorney General (SC)

bcc (with Enclosure):

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File: (Corporate)

Serial: RA-19-0223

Brunswick Steam Electric Plant, Units 1 and 2
Docket Nos. 50-325 and 50-324 / Renewed License Nos. DPR-71 and DPR-62

Enclosure 1

Brunswick 10 CFR 50.46 Annual Report

A10XM Summary

10 CFR 50.46 Report for Brunswick Steam Electric Plant Units 1, and 2

Plant:	Brunswick Steam Electric Plant, Units 1 and 2	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):		
Evaluation Model:	EMF-2361(P)(A), Revision 0 EXEM BWR-2000 ECCS Evaluation Model, May 2001	
Fuel:	ATRIUM 10XM (A10XM)	
A. Analysis of Record PCT	1923 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
C. Baseline PCT for assessing new changes for significance (A + B)	1923 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. Error in the Thermal Conductivity Degradation analysis for top lattices with a top peaked axial power shape. BNP's limiting lattice is a bottom lattice with a mid- peaked axial power shape – no impact. (Framatome Report FS1-0040060 Rev. 1.0).	0 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1923 °F	

ATRIUM 11 Summary

10 CFR 50.46 Report for Brunswick Steam Electric Plant Units 1, and 2

Plant:	Brunswick Steam Electric Plant, Unit 2	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):		
Evaluation Model:	EMF-2361(P)(A), Revision 0 EXEM BWR-2000 ECCS Evaluation Model, May 2001	
Fuel:	ATRIUM 11 (A11)	
A. Analysis of Record PCT	1762 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
C. Baseline PCT for assessing new changes for significance (A + B)	1762 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. Error in the Thermal Conductivity Degradation analysis for top lattices with a top peaked axial power shape. BNP's limiting lattice is a bottom lattice with a mid- peaked axial power shape – no impact. (Framatome Report FS1-0041575 Rev. 1.0).	0 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1762 °F	

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Catawba Nuclear Station, Units 1 and 2
Docket Nos. 50-413 and 50-414 / Renewed License Nos. NPF-35 and NPF-52

Enclosure 2

Catawba 10 CFR 50.46 Annual Report

Westinghouse identified and communicated in a letter that there were modeling changes and errors in the LOCA evaluation models that were assessed for impact to PCT in 2018. None of the assessments resulted in changes to PCT. The following items are included for information.

VAPOR TEMPERATURE RESETTING

Affected Evaluation Model(s):
1996 Westinghouse Best Estimate Large Break LOCA

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 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. The correction of this error represents a Non-Discretionary Change in the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

Engineering judgement supported by sensitivity calculations showed that correcting this error had minimal impact on LOCA transient calculations, leading to an estimated peak cladding temperature impact of 0 °F.

UO₂ Fuel Pellet Heat Capacity

Affected Evaluation Model: 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

A typographical error was discovered in the implementation of the UO₂ fuel pellet heat capacity as described by Equation C-4 of WCAP-8301 [1] for fuel rod heat-up calculations within the Appendix K Large Break and Small Break LOCA evaluation models. The erroneous formulation results in an overprediction of heat capacity that increases with fuel temperature. The corrected formulation results in a maximum decrease in heat capacity on the order of approximately 1.2% for existing analyses of record. This represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

The small over-prediction in UO₂ fuel pellet heat capacity has been evaluated to have a negligible effect on existing large and small break LOCA analysis results due to the small magnitude of the change, leading to an estimated PCT impact of 0 °F.

Reference

- 1) WCAP-8301, "LOCTA-IV Program: Loss-of-Coolant Transient Analysis," June 1974.

10 CFR 50.46 Report for Catawba Unit 1 – Large Break LOCA

Plant:	Catawba Nuclear Station, Unit 1	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Large Break	
Evaluation Model:	WCAP-12945-P-A, Revision 0 Code Qualification Document for Best Estimate LOCA Analysis	
Fuel:	17x17 RFA	
A. Analysis of Record PCT	2028 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +58 °F	Absolute PCT Effect 378 °F
C. Baseline PCT for assessing new changes for significance (A + B)	2086 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. Vapor Temperature Resetting	0 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	2086 °F	

10 CFR 50.46 Report for Catawba Unit 1 – Small Break LOCA

Plant:	Catawba Nuclear Station, Unit 1	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Small Break	
Evaluation Model:	WCAP-10054-P-A, Revision 0 NOTRUMP	
Fuel:	17x17 RFA	
A. Analysis of Record PCT	1323 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +0 °F	Absolute PCT Effect 0 °F
C. Baseline PCT for assessing new changes for significance (A + B)	1323 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. UO ₂ Fuel Pellet Heat Capacity	0 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1323 °F	

10 CFR 50.46 Report for Catawba Unit 2 – Large Break LOCA

Plant:	Catawba Nuclear Station, Unit 2	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Large Break	
Evaluation Model:	WCAP-12945-P-A, Revision 0 Code Qualification Document for Best Estimate LOCA Analysis	
Fuel:	17x17 RFA	
A. Analysis of Record PCT	2028 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +42 °F	Absolute PCT Effect 362 °F
C. Baseline PCT for assessing new changes for significance (A + B)	2070 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. Vapor Temperature Resetting	0 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	2070 °F	

10 CFR 50.46 Report for Catawba Unit 2 – Small Break LOCA

Plant:	Catawba Nuclear Station, Unit 2	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Small Break	
Evaluation Model:	WCAP-10054-P-A, Revision 0 NOTRUMP	
Fuel:	17x17 RFA	
A. Analysis of Record PCT	1243 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +0 °F	Absolute PCT Effect 0 °F
C. Baseline PCT for assessing new changes for significance (A + B)	1243 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. UO ₂ Fuel Pellet Heat Capacity	0 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1243 °F	

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H. B. Robinson Steam Electric Plant, Unit 2
Docket No. 50-261 / Renewed License No. DPR-23

Enclosure 3

Robinson 10 CFR 50.46 Annual Report

10 CFR 50.46 Report for H. B. Robinson Unit 2 – Large Break LOCA

Plant:	H. B. Robinson , Unit 2	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Large Break	
Evaluation Model:	EMF-2103(P)(A), Revision 0 Realistic Large Break LOCA for PWRs	
Fuel:	15x15 HTP	
A. Analysis of Record PCT	2084 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +4 °F	Absolute PCT Effect 24 °F
C. Baseline PCT for assessing new changes for significance (A + B)	2088 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. Estimated effect of including a fuel clad swelling and rupture model, inclusive of (1) M5 LOCA swelling and rupture model update and (2) error corrections to cladding oxidation calculation due to use of cold cladding dimensions.	+31 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect +31 °F	Absolute PCT Effect 31 °F
F. Licensing Basis PCT (C + E)	2119 °F	

10 CFR 50.46 Report for H. B. Robinson Unit 2 – Small Break LOCA

Plant:	H. B. Robinson , Unit 2	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Small Break	
Evaluation Model:	EMF-2328(P)(A), Revision 0 PWR Small Break LOCA Evaluation Model	
Fuel:	15x15 HTP	
A. Analysis of Record PCT	1492 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +60 °F	Absolute PCT Effect 98 °F
C. Baseline PCT for assessing new changes for significance (A + B)	1552 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. None		
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1552 °F	

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McGuire Nuclear Station, Units 1 and 2
Docket Nos. 50-369 and 50-370 / Renewed License Nos. NPF-9 and NPF-17

Enclosure 4

McGuire 10 CFR 50.46 Annual Report

Westinghouse identified and communicated in a letter that there were modeling changes and errors in the LOCA evaluation models that were assessed for impact to PCT in 2018. None of the assessments resulted in changes to PCT. The following items are included for information.

VAPOR TEMPERATURE RESETTING

Affected Evaluation Model(s):
1996 Westinghouse Best Estimate Large Break LOCA

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 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. The correction of this error represents a Non-Discretionary Change in the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

Engineering judgement supported by sensitivity calculations showed that correcting this error had minimal impact on LOCA transient calculations, leading to an estimated peak cladding temperature impact of 0 °F.

UO₂ Fuel Pellet Heat Capacity

Affected Evaluation Model: 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

A typographical error was discovered in the implementation of the UO₂ fuel pellet heat capacity as described by Equation C-4 of WCAP-8301 [1] for fuel rod heat-up calculations within the Appendix K Large Break and Small Break LOCA evaluation models. The erroneous formulation results in an overprediction of heat capacity that increases with fuel temperature. The corrected formulation results in a maximum decrease in heat capacity on the order of approximately 1.2% for existing analyses of record. This represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

The small over-prediction in UO₂ fuel pellet heat capacity has been evaluated to have a negligible effect on existing large and small break LOCA analysis results due to the small magnitude of the change, leading to an estimated PCT impact of 0 °F.

Reference

- 1) WCAP-8301, "LOCTA-IV Program: Loss-of-Coolant Transient Analysis," June 1974.

10 CFR 50.46 Report for McGuire Units 1 & 2 – Large Break LOCA

Plant:	McGuire Nuclear Station, Units 1 & 2	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Large Break	
Evaluation Model:	WCAP-12945-P-A, Revision 0 Code Qualification Document for Best Estimate LOCA Analysis	
Fuel:	17x17 RFA	
A. Analysis of Record PCT	2028 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +58 °F	Absolute PCT Effect 378 °F
C. Baseline PCT for assessing new changes for significance (A + B)	2086 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. Vapor Temperature Resetting	0 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	2086 °F	

10 CFR 50.46 Report for McGuire Units 1 & 2 – Small Break LOCA

Plant:	McGuire Nuclear Station, Units 1 & 2	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Small Break	
Evaluation Model:	WCAP-10054-P-A, Revision 0 NOTRUMP	
Fuel:	17x17 RFA	
A. Analysis of Record PCT	1323 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +0 °F	Absolute PCT Effect 0 °F
C. Baseline PCT for assessing new changes for significance (A + B)	1323 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. UO ₂ Fuel Pellet Heat Capacity	0 °F	
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1323 °F	

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Shearon Harris Nuclear Power Plant, Unit 1
Docket No. 50-400 / Renewed License No. NPF-63

Enclosure 5

Shearon Harris 10 CFR 50.46 Annual Report

10 CFR 50.46 Report for Shearon Harris Unit 1 – Large Break LOCA

Plant:	Shearon Harris, Unit 1	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Large Break	
Evaluation Model:	EMF-2103(P)(A), Revision 0 Realistic Large Break LOCA for PWRs	
Fuel:	17x17 HTP	
A. Analysis of Record PCT	1935 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +160 °F	Absolute PCT Effect 160 °F
C. Baseline PCT for assessing new changes for significance (A + B)	2095 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. None		
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	2095 °F	

10 CFR 50.46 Report for Shearon Harris Unit 1 – Small Break LOCA

Plant:	Shearon Harris, Unit 1	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Small Break	
Evaluation Model:	EMF-2328(P)(A), Revision 0 PWR Small Break LOCA Evaluation Model	
Fuel:	17x17 HTP	
A. Analysis of Record PCT	1664 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +63 °F	Absolute PCT Effect 63 °F
C. Baseline PCT for assessing new changes for significance (A + B)	1727 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. None		
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1727 °F	

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Oconee Nuclear Station, Units 1, 2 and 3
Docket Nos. 50-269, 50-270 and 50-287
Renewed License Nos. DPR-38, DPR-47 and DPR-55

Enclosure 6

Oconee 10 CFR 50.46 Annual Report

10 CFR 50.46 Report for Oconee Units 1, 2, & 3 – Large Break LOCA

Plant:	Oconee Nuclear Station, Units 1, 2, & 3	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Large Break	
Evaluation Model:	BAW-10192P-A, Revision 0, BWNT LOCA Evaluation Model for Once-Through Steam Generator Plants	
Fuel:	15x15 Mark-B-HTP	
A. Analysis of Record PCT	1852 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +2 °F	Absolute PCT Effect 858 °F
C. Baseline PCT for assessing new changes for significance (A + B)	1854 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. None		
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1854 °F	

10 CFR 50.46 Report for Oconee Units 1, 2, & 3 – Small Break LOCA

Plant:	Oconee Nuclear Station, Units 1, 2, & 3	
Reporting Period:	January 1, 2018 – December 31, 2018	
LOCA Analysis Type (if applicable):	Small Break	
Evaluation Model:	BAW-10192P-A, Revision 0, BWNT LOCA Evaluation Model for Once-Through Steam Generator Plants	
Fuel:	15x15 Mark-B-HTP	
A. Analysis of Record PCT Full Power (FP) – 100% FP	1598 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +0 °F	Absolute PCT Effect 0°F
C. Baseline PCT for assessing new changes for significance (A + B)	1598 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. None		
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1598 °F	

A. Analysis of Record PCT Reduced Power – 50% FP	1480 °F	
B. Net Cumulative 10 CFR 50.46 Changes and Error Corrections - Previously Reported	Net PCT Effect +0 °F	Absolute PCT Effect 0°F
C. Baseline PCT for assessing new changes for significance (A + B)	1480 °F	
D. Cumulative 10 CFR 50.46 Changes and Error Corrections – This Reporting Period 1. None		
E. Sum of 10 CFR 50.46 Changes and Error Corrections against Baseline PCT	Net PCT Effect 0 °F	Absolute PCT Effect 0 °F
F. Licensing Basis PCT (C + E)	1480 °F	