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U.S. Nuclear Regulatory Commission
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Washington, DC 20555

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NRA/JH : R1
Docket Nos.: 50-336/423
50-338/339
50-280/281
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DPR-32/37
NPF-12

DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
DOMINION ENERGY SOUTH CAROLINA, INC.
VIRGINIA ELECTRIC AND POWER COMPANY
MILLSTONE POWER STATION UNITS 2 AND 3
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1
2022 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL
CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

In accordance with 10 CFR 50.46(a)(3)(ii), Dominion Energy Nuclear Connecticut, Inc. (DENC), Virginia Electric and Power Company (Dominion Energy Virginia) and Dominion Energy South Carolina, Inc. hereby submit the annual summary of permanent changes to the emergency core cooling system (ECCS) evaluation models (EMs) for Millstone Power Station Unit 2 (MPS2) and Unit 3 (MPS3), North Anna Power Station Unit 1 (NAPS1) and Unit 2 (NAPS2), Surry Power Station Unit 1 (SPS1) and Unit 2 (SPS2), and Virgil C. Summer Nuclear Station Unit 1 (VCSNS), respectively.

Attachment 1 of this letter provides a report describing plant-specific EM changes associated with the Westinghouse and Framatome Small Break (SB) Loss of Coolant Accident (LOCA) and Large Break LOCA (LBLOCA) ECCS EMs for MPS2, MPS3, NAPS1, NAPS2, SPS1, SPS2, and VCSNS, as applicable.

Information regarding the effect of the ECCS EM changes upon the reported SBLOCA and LBLOCA analyses of record results is provided for MPS2, MPS3, NAPS1, NAPS2, SPS1, SPS2, and VCSNS1 in Attachments 2, 3, 4 and 5, respectively. The calculated peak cladding temperatures (PCT) for the SBLOCA and LBLOCA analyses for MPS2, MPS3, NAPS1, NAPS2, SPS1, SPS2, and VCSNS are summarized below:

Millstone Unit 2	Small break - Framatome EM:	1714°F
Millstone Unit 2	Large break - Framatome EM (Zr4 fuel):	1845°F
Millstone Unit 2	Large break - Framatome EM (M5 fuel):	1615°F

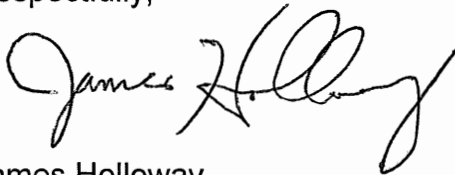
Millstone Unit 3	Small break - Westinghouse EM:	1193°F
Millstone Unit 3	Large break - Westinghouse EM:	1933°F
Millstone Unit 3	Westinghouse Full Spectrum (FS) LOCA EM	
	Region II Large break:	1712°F
North Anna Units 1 and 2	Fuel-vendor Independent (FVI)	
	Small break - Framatome EM:	1801°F
North Anna Units 1 and 2	Large break – Westinghouse EM:	1982°F
North Anna Units 1 and 2	Westinghouse FSLOCA EM	
	Region II Large break:	1893°F
Surry Units 1 and 2	FVI Small break - Framatome EM:	1694°F
Surry Units 1 and 2	Large break - Westinghouse EM:	2071°F
Surry Units 1 and 2	Westinghouse FSLOCA EM	
	Region II Large break:	1921°F
Virgil C. Summer Unit 1	Westinghouse FSLOCA EM	
	Region I Small break:	1108°F
Virgil C. Summer Unit 1	Westinghouse FSLOCA EM	
	Region II Large break:	1879°F

The LOCA results for MPS2, MPS3, NAPS1, NAPS2, SPS1, SPS2, and VCSNS are confirmed to have sufficient margin to the 2200°F limit for PCT as specified in 10 CFR 50.46. Based on the evaluation of this information and the resulting changes in the applicable licensing basis PCT results, no further action is required to demonstrate compliance with the 10 CFR 50.46 requirements.

The information contained herein satisfies the 2022 annual reporting requirements of 10 CFR 50.46(a)(3)(ii).

If you have any questions regarding this submittal, please contact Ms. Julie Hough at (804) 273-3586.

Respectfully,



James Holloway
Vice President - Nuclear Engineering and Fleet Support
Dominion Energy Nuclear Connecticut, Inc.
Dominion Energy South Carolina, Inc
Virginia Electric and Power Company

Commitments made in this letter: None

Attachments:

1. Report of Changes in Framatome and Westinghouse ECCS Evaluation Models
2. 2022 Annual Reporting of 10 CFR 50.46 Margin Utilization - Millstone Power Station Units 2 and 3
3. 2022 Annual Reporting of 10 CFR 50.46 Margin Utilization – North Anna Power Station Units 1 and 2
4. 2022 Annual Reporting of 10 CFR 50.46 Margin Utilization – Surry Power Station Units 1 and 2
5. 2022 Annual Reporting of 10 CFR 50.46 Margin Utilization – Virgil C. Summer Nuclear Station

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Attachment 1

**2022 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

**REPORT OF CHANGES IN
FRAMATOME AND WESTINGHOUSE ECCS EVALUATION MODELS**

**DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
VIRGINIA ELECTRIC AND POWER COMPANY
DOMINION ENERGY SOUTH CAROLINA, INC.
MILLSTONE POWER STATION UNITS 2 AND 3
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1**

**REPORT OF CHANGES IN
FRAMATOME AND WESTINGHOUSE ECCS EVALUATION MODELS**

Millstone Power Station Unit 2

1. Framatome identified no changes or errors applicable to the EMF-2328(P)(A), Revision 0 with Supplement 1 evaluation model (EM) for Small Break (SB) Loss of Coolant Accident (LOCA) for Millstone Power Station Unit 2 (MPS2) during 2022.
2. Framatome identified no changes or errors applicable to the SEM/PWR-98 EM for Large Break LOCA (LBLOCA) for MPS2 during 2022. This EM is only applicable to fuel with Zr-4 cladding at MPS2.
3. Framatome identified no changes or errors applicable to the realistic LBLOCA method described in EMF-2103(P)(A), Revision 3, "Realistic Large Break LOCA (RLBLOCA) Methodology for Pressurized Water Reactors" for MPS2 during 2022. This EM is only applicable to the AREVA Standard CE14 HTP fuel product with M5™¹ fuel rod cladding at MPS2.

Millstone Power Station Unit 3

1. Westinghouse identified no changes or errors applicable to the 1985 Westinghouse SBLOCA EM with NOTRUMP for Millstone Power Station Unit 3 (MPS3) during 2022.
2. Westinghouse identified the following change which is applicable to the 2004 Westinghouse Best Estimate (BE) LBLOCA EM using the Automated Statistical Treatment of Uncertainty Method (ASTRUM) for MPS3 during 2022:

• **Non-Conservation of Energy in the Generalized Energy Deposition Model**

The Generalized Energy Deposition Model (GEDM) used within WCOBRA/TRAC is described in Section 8-6-2 of WCAP-12945-P-A, "Code Qualification Document for Best-Estimate LOCA Analysis," and Section 8-6-2 of WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)." Non-conservation of the deposited energy was discovered to exist, whereby a very small fraction of the redistributed energy was not being included in the core balance rods. The energy deposited to the hot rod and hot assembly was confirmed to be conserved and correct. This item represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse

¹ M5 is a trademark or registered trademark of Framatome or its affiliates, in the USA or other countries.

Methodology for Implementation of 10 CFR 50.46 Reporting.” The error was qualitatively evaluated, and the nature of the error leads to a peak cladding temperature impact of 0°F.

3. Full Spectrum LOCA (FSLOCA^{TM2}) Region II LBLOCA – On October 5, 2021, a new analysis was approved by the NRC based upon the Westinghouse Topical Report WCAP-16996-P-A, Revision 1, “Realistic LOCA Evaluation Methodology Applied to the Full Spectrum of Break Sizes (FSLOCA).” The new LBLOCA Analysis of Record (AOR) is defined as the Region II spectrum. The analysis predicted a PCT of 1712 °F. This analysis became the AOR during 2022.

Westinghouse identified the following errors applicable to the FSLOCA EM for MPS3 in 2022.

- **Non-Conservation of Energy in the Generalized Energy Deposition Model**

The GEDM used within WCOBRA/TRAC-TF2 is described in Section 9.6.2 of WCAP-16996-P-A, Revision 1. Non-conservation of the deposited energy was discovered to exist, whereby a very small fraction of the redistributed energy was not being included in the core balance rods. The energy deposited to the hot rod and hot assembly was confirmed to be conserved and correct. This item represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was qualitatively evaluated, and the nature of the error leads to a peak cladding temperature impact of 0°F.

- **Error in Hoop Stress Used in Cladding Rupture Model**

Two different hoop stress variables are calculated in WCOBRA/TRAC-TF2. The first is calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 and was used in the cladding elastic deformation model. The second is calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1, and was used in the cladding creep deformation and cladding rupture models. For two instances within the cladding rupture logic, the hoop stress calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 was used, whereas the hoop stress calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1, should have been used. The correction of this error represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was evaluated to have a negligible impact on the calculated results for FSLOCA EM analyses, leading to a peak cladding temperature impact of 0°F.

North Anna Power Station Units 1 and 2

1. Framatome identified no changes or errors applicable to the EMF-2328(P)(A), Revision 0, PWR Small Break LOCA EM using S-RELAP5 for North Anna Power Station Unit 1 (NAPS1) and Unit 2 (NAPS2) during 2022.

² FSLOCA is a trademark or registered trademark of Westinghouse or its affiliates, in the USA or other countries.

2. Westinghouse identified the following error applicable to the 2004 Westinghouse BE LBLOCA EM using ASTRUM for NAPS1 and NAPS2 during 2022.

- **Non-Conservation of Energy in the Generalized Energy Deposition Model**

The GEDM used within WCOBRA/TRAC is described in Section 8-6-2 of WCAP-12945-P-A and Section 8.6.2 of WCAP-16009-P-A. Non-conservation of the deposited energy was discovered to exist, whereby a very small fraction of the redistributed energy was not being included in the core balance rods. The energy deposited to the hot rod and hot assembly was confirmed to be conserved and correct. This item represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was qualitatively evaluated, and the nature of the error leads to a peak cladding temperature impact of 0°F.

3. On October 29, 2020, a new LBLOCA methodology was approved by the NRC for use at NAPS1 and NAPS2 based upon the Westinghouse Topical Report WCAP-16996-P-A, Revision 1, "Realistic LOCA Evaluation Methodology Applied to the Full Spectrum of Break Sizes (FSLOCA)." The new LBLOCA AOR analysis is defined as the Region II spectrum. The Region II FSLOCA analysis predicted a PCT of 1893 °F. This analysis became the AOR during 2022.

Westinghouse identified the following changes or errors applicable to the WCAP-16996-P-A Region II EM for NAPS1 and NAPS2 during 2022.

- **Non-Conservation of Energy in the Generalized Energy Deposition Model**

The GEDM used within WCOBRA/TRAC-TF2 is described in Section 9.6.2 of WCAP-16996-P-A, Revision 1. Non-conservation of the deposited energy was discovered to exist, whereby a very small fraction of the redistributed energy was not being included in the core balance rods. The energy deposited to the hot rod and hot assembly was confirmed to be conserved and correct. This item represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was qualitatively evaluated, and the nature of the error leads to a peak cladding temperature impact of 0°F.

- **Error in Hoop Stress Used in Cladding Rupture Model**

Two different hoop stress variables are calculated in WCOBRA/TRAC-TF2. The first is calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 and was used in the cladding elastic deformation model. The second is calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1 and was used in the cladding creep deformation and cladding rupture models. For two instances within the cladding rupture logic, the hoop stress calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 was used, whereas the hoop stress calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1 should have been used. The correction of this error represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was evaluated to have a negligible impact on the calculated results for FSLOCA EM analyses, leading to a peak cladding temperature (PCT) impact of 0°F.

• **LBLOCA Evaluation of Containment Spray Flow Increase**

Dominion Energy Virginia requested that Westinghouse perform a qualitative evaluation to support a less than 2% increase in containment spray flow rate. The containment spray flow rate affects the containment backpressure calculated using the COCO code, which was used to establish the conservatively low containment backpressure assumed in the LBLOCA analysis performed using the FSLOCA EM.

This input change represents a Non-Discretionary Change in the application of the EM as described in Section 4.1.2 of WCAP-13451. A qualitative evaluation was performed, and the containment pressure boundary condition modeled in the LBLOCA analysis was determined to remain conservatively low when considering the effect of the containment spray flow increase. This change leads to a peak cladding temperature impact of 0°F.

Surry Power Station Units 1 and 2

1. Framatome identified no changes or errors applicable to the EMF-2328(P)(A), Revision 0, PWR Small Break LOCA EM using S-RELAP5 for Surry Power Station Unit 1 (SPS1) and Unit 2 (SPS2) during 2022. A 21°F PCT increase is incurred upon completion of the Surry Upflow baffle conversion. The Upflow conversion for SPS1 was completed during the fall 2022 outage. The Upflow conversion for SPS2 was completed during the spring 2023 outage and is therefore considered a planned plant modification for 10 CFR 50.46 reporting year 2022.
2. Westinghouse identified the following error applicable to the 2004 Westinghouse BE LBLOCA EM using ASTRUM for SPS1 and SPS2 during 2022.

• **Non-Conservation of Energy in the Generalized Energy Deposition Model**

The GEDM used within WCOBRA/TRAC is described in Section 8-6-2 of WCAP-12945-P-A and Section 8.6.2 of WCAP-16009-P-A. Non-conservation of the deposited energy was discovered to exist, whereby a very small fraction of the redistributed energy was not being included in the core balance rods. The energy deposited to the hot rod and hot assembly was confirmed to be conserved and correct. This item represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was qualitatively evaluated, and the nature of the error leads to a peak cladding temperature impact of 0°F.

3. On October 28, 2020, a new analysis LBLOCA methodology was approved by the NRC for use at Surry Units 1 and 2 based upon the Westinghouse Topical Report WCAP-16996-P-A, Revision 1, "Realistic LOCA Evaluation Methodology Applied to the Full Spectrum of Break Sizes (FSLOCA)." The new LBLOCA AOR analysis is defined as the Region II spectrum. The Region II FSLOCA analysis predicted a PCT of 1875 °F. This analysis became the AOR during 2022.

- **Upflow Baffle Conversion**

WCAP-18561-P was produced in support of the conversion of Surry Units 1 and 2 to an Upflow plant design. The WCAP included an assessment of the impact of the Upflow design on the Region II FSLOCA analysis once the modification is completed. The PCT impact of the conversion resulted in an increase of 46 °F over the Region II FSLOCA AOR. The Upflow conversion for SPS1 was completed during the fall 2022 outage. The Upflow conversion for SPS2 was completed during the spring 2023 outage and is therefore considered a planned plant modification for 10 CFR 50.46 reporting year 2022.

In their 2021 annual report letter to Dominion Energy Virginia, Westinghouse identified the following change which is applicable to the WCAP-16996-P-A Region II EM. The Region II FSLOCA analysis was not the AOR at any time during 2021, so the change was not specifically discussed in the 2021 annual 10 CFR 50.46 report to the NRC. It is included in this year's annual report to the NRC as a previous evaluation.

- **Advanced Debris Filter Bottom Nozzle Large Break LOCA Evaluation**

The Westinghouse 15x15 Advanced Debris Filter Bottom Nozzle (ADFBN) is designed to have the same loss coefficient as the Standardized Debris Filter Bottom Nozzle (SDFBN) design but has lowered side skirts for the purposes of improving debris mitigation performance. The effect of ADFBN implementation on the LBLOCA licensing basis analysis using the FSLOCA EM was investigated. This item represents a Change in Plant Configuration or Set Points in accordance with Section 4 of WCAP-13451, rather than an EM change.

A qualitative evaluation was performed and determined that implementation of the ADFBN design would have negligible impact on the model used to perform the LBLOCA analysis, leading to a 0°F peak cladding temperature impact.

Westinghouse identified the following changes or errors applicable to the WCAP-16996-P-A Region II EM for SPS1 and SPS2 during 2022.

- **Non-Conservation of Energy in the Generalized Energy Deposition Model**

The GEDM used within WCOBRA/TRAC-TF2 is described in Section 9.6.2 of WCAP-16996-P-A, Revision 1. Non-conservation of the deposited energy was discovered to exist, whereby a very small fraction of the redistributed energy was not being included in the core balance rods. The energy deposited to the hot rod and hot assembly was confirmed to be conserved and correct. This item represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was qualitatively evaluated, and the nature of the error leads to a peak cladding temperature impact of 0°F.

- **Error in Hoop Stress Used in Cladding Rupture Model**

Two different hoop stress variables are calculated in WCOBRA/TRAC-TF2. The first is calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 and was used in the cladding elastic deformation model. The second is calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1 and was used in the cladding creep deformation and

cladding rupture models. For two instances within the cladding rupture logic, the hoop stress calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 was used, whereas the hoop stress calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1 should have been used. The correction of this error represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was evaluated to have a negligible impact on the calculated results for FSLOCA EM analyses, leading to a peak cladding temperature impact of 0°F.

- **LBLOCA Evaluation of Containment Spray Flow Increase**

Dominion Energy Virginia requested that Westinghouse perform a qualitative evaluation to support a less than 2% increase in containment spray flow rate. The containment spray flow rate affects the containment backpressure calculated using the COCO code, which was used to establish the conservatively low containment backpressure assumed in the LBLOCA analysis performed using the FSLOCA EM.

This input change represents a Non-Discretionary Change in the application of the EM as described in Section 4.1.2 of WCAP-13451. A qualitative evaluation was performed, and the containment pressure boundary condition modeled in the LBLOCA analysis was determined to remain conservatively low when considering the effect of the containment spray flow increase. This change leads to a peak cladding temperature impact of 0°F.

- **Reduction of Total Core Peaking Factor Surveillance Uncertainty**

The Surry LBLOCA analysis using the FSLOCA EM was performed assuming a total core peaking factor (F_Q) surveillance uncertainty of 8.15%. However, the current Technical Specifications for the SPS1 and SPS2 specify a F_Q surveillance uncertainty of 8%. Therefore, a 0.15% decrease in F_Q surveillance uncertainty (from 8.15% to 8%) was qualitatively assessed for impact on the LBLOCA analysis. This item represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The evaluation determined that a reduced F_Q surveillance uncertainty from 8.15% to 8% has a negligible effect on the LBLOCA analysis results, leading to a peak cladding temperature impact of 0°F.

Virgil C. Summer

1. FSLOCA Region I Small Break: Westinghouse identified the following changes or errors applicable to the WCAP-16996-P-A Region I EM for Virgil C. Summer Nuclear Station (VCSNS) during 2022.

- **Non-Conservation of Energy in the Generalized Energy Deposition Model**

The GEDM used within WCOBRA/TRAC-TF2 is described in Section 9.6.2 of WCAP-16996-P-A, Revision 1. Non-conservation of the deposited energy was discovered to exist, whereby a very small fraction of the redistributed energy was not being included in the core balance rods. The energy deposited to the hot rod and hot assembly was confirmed to be conserved and correct. This item represents a Non-Discretionary Change

in accordance with Section 4.1.2 of WCAP-13451. The error was qualitatively evaluated, and the nature of the error leads to a peak cladding temperature impact of 0°F.

- **Error in Hoop Stress Used in Cladding Rupture Model**

Two different hoop stress variables are calculated in WCOBRA/TRAC-TF2. The first is calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 and was used in the cladding elastic deformation model. The second is calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1 and was used in the cladding creep deformation and cladding rupture models. For two instances within the cladding rupture logic, the hoop stress calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 was used, whereas the hoop stress calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1 should have been used. The correction of this error represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was evaluated to have a negligible impact on the calculated results for FSLOCA EM analyses, leading to a peak cladding temperature impact of 0°F.

2. FSLOCA Region II Large Break: Westinghouse identified the following changes or errors applicable to the WCAP-16996-P-A Region II EM for VCSNS during 2022.

- **Non-Conservation of Energy in the Generalized Energy Deposition Model**

The GEDM used within WCOBRA/TRAC-TF2 is described in Section 9.6.2 of WCAP-16996-P-A, Revision 1. Non-conservation of the deposited energy was discovered to exist, whereby a very small fraction of the redistributed energy was not being included in the core balance rods. The energy deposited to the hot rod and hot assembly was confirmed to be conserved and correct. This item represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was qualitatively evaluated, and the nature of the error leads to a peak cladding temperature impact of 0°F.

- **Error in Hoop Stress Used in Cladding Rupture Model**

Two different hoop stress variables are calculated in WCOBRA/TRAC-TF2. The first is calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 and was used in the cladding elastic deformation model. The second is calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1 and was used in the cladding creep deformation and cladding rupture models. For two instances within the cladding rupture logic, the hoop stress calculated using Equation 8-40 of WCAP-16996-P-A, Revision 1 was used, whereas the hoop stress calculated using Equation 8-51 of WCAP-16996-P-A, Revision 1 should have been used. The correction of this error represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451. The error was evaluated to have a negligible impact on the calculated results for FSLOCA EM analyses, leading to a peak cladding temperature impact of 0°F.

Conclusion

The LOCA results for MPS2, MPS3, NAPS1, NAPS2, SPS1, SPS2, and VCSNS are confirmed in the PCT rackup tables in Attachments 2 through 5 to this 10 CFR 50.46 Annual Report letter,

to have margin to the 2200°F limit for PCT specified in 10 CFR 50.46. Based on the evaluation of this information and the resulting changes in the applicable licensing basis PCT results, no further action is required to demonstrate compliance with the 10 CFR 50.46 requirements. Reporting of this information is required per 10 CFR 50.46(a)(3)(ii), which directs each licensee to report the effect upon calculated temperature of any change or error in EMs or their application on an annual basis.

This information satisfies the annual reporting requirements of 10 CFR 50.46(a)(3)(ii) for calendar year 2022.

Attachment 2

**2022 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

2022 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

**DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNITS 2 AND 3**

10 CFR 50.46 MARGIN UTILIZATION - SMALL BREAK LOCA

Plant Name: Millstone Power Station, Unit 2
Utility Name: Dominion Energy Nuclear Connecticut, Inc.

Analysis Information

EM: 2015, Supp. 1, SBLOCA, S-RELAP5 Based **Limiting Break Size:** 3.78 Inches
Analysis Date: April 2015
Vendor: AREVA
Peak Linear Power: 15.1 kW/ft
Notes: None

	<u>Clad Temp(°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1707
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. Zirc-4 Product Penalty	4
2. M5 LOCA Swelling and Rupture	0
3. S-RELAP5 Oxidation Calculations	3
B. Planned Plant Modification Evaluations	
1. None	0
C. 2022 ECCS Model Assessments	
1. None	0
D. Other	
1. None	0
LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1714	

10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Millstone Power Station, Unit 2		
Utility Name:	Dominion Energy Nuclear Connecticut, Inc.		
Analysis Information			
EM:	SEM/PWR-98	Limiting Break Size:	1.0 DECLG
Analysis Date:	November 1998		
Vendor:	AREVA		
Peak Linear Power:	15.1 kW/ft		
Notes:	None		

	Clad Temp(°F)
LICENSING BASIS	
Analysis of Record PCT	1814

PCT ASSESSMENTS (Delta PCT)

A.	Prior ECCS Model Assessments	
	1. Corrected Corrosion Enhancement Factor	-1
	2. ICECON Coding Errors	0
	3. Setting RFPAC Fuel Temperatures at Start of Reflood	-2
	4. SISPUNCH/ujun98 Code Error	0
	5. Error in Flow Blockage Model in TOODEE2	0
	6. Change in TOODEE2-Calculation of QMAX	0
	7. Change in Gadolinia Modeling	0
	8. PWR LBLOCA Split Break Modeling	0
	9. TEOBY Calculation Error	0
	10. Inappropriate Heat Transfer in TOODEE2	0
	11. End-of-Bypass Prediction by TEOBY	0
	12. R4SS Overwrite of Junction Inertia	0
	13. Incorrect Junction Inertia Multipliers	1
	14. Errors Discovered During RODEX2 V&V	0
	15. Error in Broken Loop SG Tube Exit Junction Inertia	0
	16. RFPAC Refill and Reflood Calculation Code Errors	16
	17. Incorrect Pump Junction Area Used in RELAP4	0
	18. Error in TOODEE2 Clad Thermal Expansion	-1
	19. Accumulator Line Loss Error	-1
	20. Inconsistent Loss Coefficients Used for Robinson LBLOCA	0
	21. Pump Head Adjustment for Pressure Balance Initialization	-3
	22. ICECON Code Errors	0
	23. Containment Sump Modification and Replacement PZR	2
	24. Non-Conservative RODEX Fuel Pellet Temperature	20
	25. Array Index Issues in the RELAP4 Code	0
B.	Planned Plant Modification Evaluations	
	1. None	0
C.	2022 ECCS Model Assessments	
	1. None	0
D.	Other	
	1. None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1845
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10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Millstone Power Station, Unit 2 (M5 Fuel)		
Utility Name:	Dominion Energy Nuclear Connecticut, Inc.		
<u>Analysis Information</u>			
EM:	EMF-2103	Limiting Break Size:	1.0 DEGB
Analysis Date:	January 2017		
Vendor:	AREVA		
Peak Linear Power:	15.1 kW/ft		
Notes:	None		

	<u>Clad Temp(°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1615
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. Placement of Hot Leg Piping Form Loss Coefficient	0
2. M5 LOCA Swelling and Rupture	0
3. S-RELAP5 Oxidation Calculations	0
4. Cathcart-Pawel correlation implementation	0
5. Rod pressure not reset after rupture in S-RELAP5 LOCA calculations	0
6. Radiation enclosure input error	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2022 ECCS Model Assessments	
1. None	0
D. Other	
1. None	0
<hr/> <hr/>	
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1615

10 CFR 50.46 MARGIN UTILIZATION - SMALL BREAK LOCA

Plant Name: Millstone Power Station, Unit 3
Utility Name: Dominion Energy Nuclear Connecticut, Inc.

Analysis Information

EM:	NOTRUMP	Limiting Break Size:	4 inches
Analysis Date:	02/07/07		
Vendor:	Westinghouse		
FQ:	2.6	FdH:	1.65
Fuel:	RFA-2	SGTP (%):	10
Notes:	None		

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1193

PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments

- | | | |
|-----|---|---|
| 1. | Errors in Reactor Vessel Lower Plenum Surface Area Calculations | 0 |
| 2. | Discrepancy in Metal Masses Used From Drawings | 0 |
| 3. | Urania-Gadolinia Pellet Thermal Conductivity Calculation | 0 |
| 4. | Pellet Crack and Dish Volume Calculation | 0 |
| 5. | Treatment of Vessel Average Temperature Uncertainty | 0 |
| 6. | Maximum Fuel Rod Time Step Logic | 0 |
| 7. | Radiation Heat Transfer Logic | 0 |
| 8. | NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation | 0 |
| 9. | SBLOCTA Cladding Strain Requirement for Fuel Rod Burst | 0 |
| 10. | Fuel Rod Gap Conductance Error | 0 |
| 11. | Radiation Heat Transfer Model Error | 0 |
| 12. | SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient Calculation | 0 |
| 13. | Insertion of AXIOM™ Cladding LTAs | 0 |
| 14. | Vessel Average Temperature Uncertainty | 0 |
| 15. | Error in the Upper Plenum Fluid Volume Calculation | 0 |
| 16. | UO ₂ Fuel Pellet Heat Capacity | 0 |
| 17. | Small Break LOCA PAD5 Implementation | 0 |
| 18. | Reduction in Flow Area to the Bottom of the Barrel/Baffle Region | 0 |
| 19. | Measurement Uncertainty Recapture Uprate | 0 |

B. Planned Plant Modification Evaluations

- | | | |
|----|------|---|
| 1. | None | 0 |
|----|------|---|

C. 2022 ECCS Model Assessments

- | | | |
|----|------|---|
| 1. | None | 0 |
|----|------|---|

D. Other

- | | | |
|----|------|---|
| 1. | None | 0 |
|----|------|---|

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1193
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10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Millstone Power Station, Unit 3		
Utility Name:	Dominion Energy Nuclear Connecticut, Inc.		
Analysis Information			
EM:	ASTRUM (2004)	Limiting Break Size:	Guillotine
Analysis Date:	04/17/07		
Vendor:	Westinghouse		
FQ:	2.6	FdH:	1.65
Fuel:	RFA-2	SGTP (%):	10
Notes:	None		

LICENSING BASIS	<u>Clad Temp (°F)</u>
Analysis of Record PCT	1781

PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments

1.	HOTSPOT Burst Temperature Logic Errors	0
2.	CCFL Global Volume Error	0
3.	HOTSPOT Gap Heat Transfer Logic	0
4.	Discrepancy in Metal Masses Used From Drawings	0
5.	Error in ASTRUM Processing of Average Rod Burnup and Rod Internal Pressure	0
6.	Treatment of Vessel Average Temperature Uncertainty	0
7.	PBOT and PMID Evaluation	0
8.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	222
9.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
10.	Rod Internal Pressure Calculation	0
11.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
12.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
13.	WCOBRA/TRAC Automated Restart Process Logic Error	0
14.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0
15.	Elevations for Heat Slab Temperature Initialization	0
16.	Heat Transfer Model Error Corrections	0
17.	Correction to Heat Transfer Node Initialization	0
18.	Mass Conservation Error Fix	0
19.	Correction to Split Channel Momentum Equation	0
20.	Heat Transfer Logic Correction for Rod Burst Calculation	0
21.	Changes to Vessel Superheated Steam Properties	0
22.	Update to Metal Density Reference Temperatures	0
23.	Decay Heat Model Error Corrections	0
24.	Correction to the Pipe Exit Pressure Drop Error	0
25.	WCOBRA/TRAC U19 File Dimension Error Correction	0
26.	Revised Heat Transfer Multiplier Distributions	-91
27.	HOTSPOT Burst Strain Error Correction	21
28.	Changes to Grid Blockage Ratio and Porosity	0
29.	Grid Heat Transfer Enhancement Calculation	0
30.	Burst Elevation Selection	0
31.	Errors in Decay Group Uncertainty Factors	0

32.	Errors in Support Plate, Core Barrel, and Vessel Wall Unheated Conductor	0
33.	Error in Oxidation Calculations	0
34.	Error in use of ASME Steam Tables	0
35.	Insertion of AXIOM™ Cladding LTAs	0
36.	Vessel Average Temperature Uncertainty	0
37.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
38.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
39.	Steady-State Fuel Temperature Calibration Method	0
40.	Millstone Unit 3 Cycle 20 PBOT/PMID Violations	0
41.	Vapor Temperature Resetting	0
42.	Core Barrel Heat Slab Error	0
43.	Cold Leg Volume Error	0
44.	Core Barrel Wetted Perimeter Error	0
45.	Removal of the Vessel Interfacial Heat Transfer Limit	0
46.	Cycle 21 PBOT/PMID Envelope Violations	0
47.	Measurement Uncertainty Recapture Uprate	0
B.	Planned Plant Modification Evaluations	
1.	None	0
C.	2022 ECCS Model Assessments	
1.	Non-Conservation of Energy in the Generalized Energy Deposition Model	0
D.	Other	
1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1933
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10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Millstone Power Station, Unit 3		
Utility Name:	Dominion Energy Nuclear Connecticut, Inc.		
<u>Analysis Information</u>			
EM:	FSLOCA (Region II)	Limiting Break Size:	Guillotine
Analysis Date:	October 2020		
Vendor:	Westinghouse		
FQ:	2.6	FdH:	1.65
Fuel:	RFA-2	SGTP (%):	≤10
Notes:	None		

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1712
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. None	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2022 ECCS Model Assessments	
1. Non-Conservation of Energy in the Generalized Energy Deposition Model	0
2. Error in Hoop Stress Used in Cladding Rupture Model	0
D. Other	
1. None	0
<hr/>	
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1712

ATTACHMENT 3

**2022 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

2022 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

**VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2**

10 CFR 50.46 MARGIN UTILIZATION – FRAMATOME FVI SMALL BREAK LOCA

Plant Name: North Anna Power Station, Unit 1
Utility Name: Virginia Electric and Power Company

Analysis Information

EM: W&CE SBLOCA EMF-2328	Limiting Break Size: 6.5 inches
Analysis Date: May 2018	
Vendor: Framatome	
FQ: 2.5	FΔH: 1.65
Fuel: Representative 17x17 Non-M5	SGTP (%): 7
Notes: None	

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1801
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. None	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2022 ECCS Model Assessments	
1. None	0
D. Other	
1. None	0
<hr/>	
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1801

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	North Anna Power Station, Unit 1
Utility Name:	Virginia Electric and Power Company

Analysis Information

EM:	ASTRUM (2004)	Limiting Break Size:	DEGB
Analysis Date:	8/25/2010		
Vendor:	Westinghouse		
FQ:	2.32	FΔH:	1.65
Fuel:	RFA-2	SGTP (%):	7

Notes: Core Power ≤ 100% of 2951 MWt; SG Model 54F; 17x17 RFA-2 Fuel with ZIRLO® or Optimized ZIRLO™ cladding, Non-IFBA or IFBA, IFMs

Clad Temp (°F)

LICENSING BASIS

Analysis of Record PCT	1852
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PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments

- | | | |
|-----|---|-----|
| 1. | Evaluation of Fuel Pellet Thermal Conductivity Degradation | 135 |
| 2. | HOTSPOT Burst Temperature Calculation for ZIRLO Cladding | 0 |
| 3. | Rod Internal Pressure Calculation | 0 |
| 4. | HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature | 0 |
| 5. | WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background | 0 |
| 6. | WCOBRA/TRAC Automated Restart Process Logic Error | 0 |
| 7. | Initial Fuel Pellet Average Temperature Uncertainty Calculation | 1 |
| 8. | Elevations for Heat Slab Temperature Initialization | 0 |
| 9. | Heat Transfer Model Error Corrections | 0 |
| 10. | Correction to Heat Transfer Node Initialization | 0 |
| 11. | Mass Conservation Error Fix | 0 |
| 12. | Correction to Split Channel Momentum Equation | 0 |
| 13. | Heat Transfer Logic Correction for Rod Burst Calculation | 0 |
| 14. | Changes to Vessel Superheated Steam Properties | 0 |
| 15. | Update to Metal Density Reference Temperatures | 0 |
| 16. | Decay Heat Model Error Corrections | 0 |
| 17. | Correction to the Pipe Exit Pressure Drop Error | 0 |
| 18. | WCOBRA/TRAC U19 File Dimension Error Correction | 0 |
| 19. | Revised Heat Transfer Multiplier Distributions | -27 |
| 20. | HOTSPOT Burst Strain Error Correction | 21 |
| 21. | Changes to Grid Blockage Ratio and Porosity | 0 |
| 22. | Grid Heat Transfer Enhancement Calculation | 0 |
| 23. | Vessel Section 7 Mid-Level Elevation Modeling | 0 |
| 24. | Burst Elevation Selection | 0 |
| 25. | Errors in Decay Group Uncertainty Factors | 0 |
| 26. | Error in Oxidation Calculations | 0 |
| 27. | Error in use of ASME Steam Tables | 0 |

28.	Support Column Core Barrel Unheated Conductor Errors	0
29.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
30.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
31.	Steady-State Fuel Temperature Calibration Method	0
32.	Correction to Fuel Pellet TCD Assessment	0
33.	Vapor Temperature Resetting	0
34.	Removal of the Vessel Interfacial Heat Transfer Limit	0
B.	Planned Plant Modification Evaluations	
1.	None	0
C.	2022 ECCS Model Assessments	
1.	Non-Conservation of Energy in the Generalized Energy Deposition Model	0
D.	Other	
1.	None	

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1982
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10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	North Anna Power Station, Unit 1
Utility Name:	Virginia Electric and Power Company

Analysis Information

EM:	FSLOCA (Region II)	Limiting Break Size:	DEGB
Analysis Date:	August 2019		
Vendor:	Westinghouse		
FQ:	2.5	FΔH:	1.70
Fuel:	RFA-2	SGTP (%):	≤ 2%

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1893
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. None	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2022 ECCS Model Assessments	
1. Evaluation of Containment Spray Flow Increase	0
2. Error in Hoop Stress used in Cladding Rupture Model	0
3. Non-Conservation of Energy in the Generalized Energy Deposition Model	0
D. Other	
1. None	
<hr/>	
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1893

10 CFR 50.46 MARGIN UTILIZATION – FRAMATOME FVI SMALL BREAK LOCA

Plant Name: North Anna Power Station, Unit 2
Utility Name: Virginia Electric and Power Company

Analysis Information

EM: W&CE SBLOCA EMF-2328	Limiting Break Size: 6.5 inches
Analysis Date: May 2018	
Vendor: Framatome	
FQ: 2.5	FΔH: 1.65
Fuel: Representative 17x17 Non-M5	SGTP (%): 7
Notes: None	

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1801
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. None	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2022 ECCS Model Assessments	
1. None	0
D. Other	
1. None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1801
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10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	North Anna Power Station, Unit 2
Utility Name:	Virginia Electric and Power Company

Analysis Information

EM:	ASTRUM (2004)	Limiting Break Size:	DEGB
Analysis Date:	8/25/2010		
Vendor:	Westinghouse		
FQ:	2.32	FΔH:	1.65
Fuel:	RFA-2	SGTP (%):	7

Notes: Core Power ≤ 100% of 2951 MWt; SG Model 54F; 17x17 RFA-2 Fuel with ZIRLO® or Optimized ZIRLO™ cladding, Non-IFBA or IFBA, IFMs

Clad Temp (°F)

LICENSING BASIS

Analysis of Record PCT	1852
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PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments

- | | | |
|-----|---|-----|
| 1. | Evaluation of Fuel Pellet Thermal Conductivity Degradation | 135 |
| 2. | HOTSPOT Burst Temperature Calculation for ZIRLO Cladding | 0 |
| 3. | Rod Internal Pressure Calculation | 0 |
| 4. | HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature | 0 |
| 5. | WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background | 0 |
| 6. | WCOBRA/TRAC Automated Restart Process Logic Error | 0 |
| 7. | Initial Fuel Pellet Average Temperature Uncertainty Calculation | 1 |
| 8. | Elevations for Heat Slab Temperature Initialization | 0 |
| 9. | Heat Transfer Model Error Corrections | 0 |
| 10. | Correction to Heat Transfer Node Initialization | 0 |
| 11. | Mass Conservation Error Fix | 0 |
| 12. | Correction to Split Channel Momentum Equation | 0 |
| 13. | Heat Transfer Logic Correction for Rod Burst Calculation | 0 |
| 14. | Changes to Vessel Superheated Steam Properties | 0 |
| 15. | Update to Metal Density Reference Temperatures | 0 |
| 16. | Decay Heat Model Error Corrections | 0 |
| 17. | Correction to the Pipe Exit Pressure Drop Error | 0 |
| 18. | WCOBRA/TRAC U19 File Dimension Error Correction | 0 |
| 19. | Revised Heat Transfer Multiplier Distributions | -27 |
| 20. | HOTSPOT Burst Strain Error Correction | 21 |
| 21. | Changes to Grid Blockage Ratio and Porosity | 0 |
| 22. | Grid Heat Transfer Enhancement Calculation | 0 |
| 23. | Vessel Section 7 Mid-Level Elevation Modeling | 0 |
| 24. | Burst Elevation Selection | 0 |
| 25. | Errors in Decay Group Uncertainty Factors | 0 |
| 26. | Error in Oxidation Calculations | 0 |
| 27. | Error in use of ASME Steam Tables | 0 |

28.	Support Column Core Barrel Unheated Conductor Errors	0
29.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
30.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
31.	Steady-State Fuel Temperature Calibration Method	0
32.	Correction to Fuel Pellet TCD Assessment	0
33.	Vapor Temperature Resetting	0
34.	Removal of the Vessel Interfacial Heat Transfer Limit	0
B.	Planned Plant Modification Evaluations	
1.	None	0
C.	2022 ECCS Model Assessments	
1.	Non-Conservation of Energy in the Generalized Energy Deposition Model	0
D.	Other	
1.	None	

LICENSING BASIS PCT + PCT ASSESSMENTS

PCT = 1982

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	North Anna Power Station, Unit 2
Utility Name:	Virginia Electric and Power Company

Analysis Information

EM:	FSLOCA (Region II)	Limiting Break Size:	DEGB
Analysis Date:	August 2019		
Vendor:	Westinghouse		
FQ:	2.5	FΔH:	1.70
Fuel:	RFA-2	SGTP (%):	≤ 2%

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1893
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. None	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2022 ECCS Model Assessments	
1. Evaluation of Containment Spray Flow Increase	0
2. Error in Hoop Stress used in Cladding Rupture Model	0
3. Non-Conservation of Energy in the Generalized Energy Deposition Model	0
D. Other	
1. None	
<hr/>	
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1893

ATTACHMENT 4

**2022 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

2022 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

**VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2**

10 CFR 50.46 MARGIN UTILIZATION – FRAMATOME FVI SMALL BREAK LOCA

Plant Name: Surry Power Station, Unit 1
Utility Name: Virginia Electric and Power Company

Analysis Information

EM: W&CE SBLOCA EMF-2328	Limiting Break Size: 2.6 inches
Analysis Date: July 2018	
Vendor: Framatome	
FQ: 2.5	FΔH: 1.70
Fuel: Representative 15x15 Non-M5	SGTP (%): 7
Notes: None	

LICENSING BASIS	<u>Clad Temp (°F)</u>
Analysis of Record PCT	1673

PCT ASSESSMENTS (Delta PCT)

- | | |
|--|----|
| A. Prior ECCS Model Assessments | |
| 1. SBLOCA Rod History Truncation
(FVI-SBLOCA downflow baffle) | 0 |
| 2. Upflow Baffle Modification | 21 |
| B. Planned Plant Modification Evaluations | |
| 1. None | 0 |
| C. 2022 ECCS Model Assessments | |
| 1. None | 0 |
| D. Other | |
| 1. None | 0 |

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1694
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10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	Surry Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
<u>Analysis Information</u>			
EM:	ASTRUM (2004)	Limiting Break Size:	DEG
Analysis Date:	10/6/2010		
Vendor:	Westinghouse		
FQ:	2.5	FΔH:	1.7
Fuel:	Upgrade	SGTP (%):	7
Notes:	None		

Clad Temp (°F)

LICENSING BASIS

Analysis of Record PCT

1853

PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments

1.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	183
2.	Pellet Radial Profile Option	-13
3.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
4.	Rod Internal Pressure Calculation	0
5.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
6.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
7.	WCOBRA/TRAC Automated Restart Process Logic Error	0
8.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0
9.	Elevations for Heat Slab Temperature Initialization	0
10.	Heat Transfer Model Error Corrections	0
11.	Correction to Heat Transfer Node Initialization	0
12.	Mass Conservation Error Fix	0
13.	Correction to Split Channel Momentum Equation	0
14.	Heat Transfer Logic Correction for Rod Burst Calculation	0
15.	Changes to Vessel Superheated Steam Properties	0
16.	Update to Metal Density Reference Temperatures	0
17.	Decay Heat Model Error Corrections	0
18.	Correction to the Pipe Exit Pressure Drop Error	0
19.	WCOBRA/TRAC U19 File Dimension Error Correction	0
20.	Revised Heat Transfer Multiplier Distributions	-7
21.	HOTSPOT Burst Strain Error Correction	51
22.	Changes to Grid Blockage Ratio and Porosity	0
23.	Grid Heat Transfer Enhancement Calculation	0
24.	Vessel Section 7 Mid-Level Elevation Modeling	0
25.	Burst Elevation Selection	0
26.	Errors in Decay Group Uncertainty Factors	4
27.	Evaluation of Additional Containment Metal	0
28.	Error in Oxidation Calculations	0
29.	Error in use of ASME Steam Tables	0

30.	Core Barrel Unheated Conductor Errors	0
31.	Discrepancy in Wetted Perimeter Inputs	0
32.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
33.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
34.	Steady-State Fuel Temperature Calibration Method	0
35.	Vapor Temperature Resetting	0
36.	Removal of the Vessel Interfacial Heat Transfer Limit	0
B.	Planned Plant Modification Evaluations	
1.	None	0
C.	2022 ECCS Model Assessments	
1.	Non-Conservation of Energy in the Generalized Energy Deposition Model	0
D.	Other	
1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	2071
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10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	Surry Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
<u>Analysis Information</u>			
EM:	FSLOCA (Region II)	Limiting Break Size:	DEG
Analysis Date:	August 2019		
Vendor:	Westinghouse		
FQ:	≤2.5	FΔH:	≤ 1.7
Fuel:	Upgrade	SGTP (%):	≤7
Notes:	None		

LICENSING BASIS	<u>Clad Temp (°F)</u>
Analysis of Record PCT	1875

PCT ASSESSMENTS (Delta PCT)

A.	Prior ECCS Model Assessments	
	1. Advanced Debris Filter Bottom Nozzle Large Break LOCA Evaluation	0
	2. Upflow Conversion	46
B.	Planned Plant Modification Evaluations	
	1. None	0
C.	2022 ECCS Model Assessments	
	1. Evaluation of Containment Spray Flow Increase	0
	2. Error in Hoop Stress used in Cladding Rupture Model	0
	3. Non-Conservation of Energy in the Generalized Energy Deposition Model	0
	4. Reduction of Total Core Peaking Factor Surveillance Uncertainty	0
D.	Other	
	1. None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1921
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10 CFR 50.46 MARGIN UTILIZATION – FRAMATOME FVI SMALL BREAK LOCA

Plant Name: Surry Power Station, Unit 2
Utility Name: Virginia Electric and Power Company

Analysis Information

EM: W&CE SBLOCA EMF-2328	Limiting Break Size: 2.6 inches
Analysis Date: July 2018	
Vendor: Framatome	
FQ: 2.5	FΔH: 1.70
Fuel: Representative 15x15 Non-M5	SGTP (%): 7
Notes: None	

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1673

PCT ASSESSMENTS (Delta PCT)

- | | | |
|-----------|--|----|
| A. | Prior ECCS Model Assessments | |
| | 1. SBLOCA Rod History Truncation
(FVI-SBLOCA downflow baffle) | 0 |
| B. | Planned Plant Modification Evaluations | |
| | 1. Upflow Baffle Modification | 21 |
| C. | 2022 ECCS Model Assessments | |
| | 1. None | 0 |
| D. | Other | |
| | 1. None | 0 |

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1694
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10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	Surry Power Station, Unit 2		
Utility Name:	Virginia Electric and Power Company		
<u>Analysis Information</u>			
EM:	ASTRUM (2004)	Limiting Break Size:	DEG
Analysis Date:	10/6/2010		
Vendor:	Westinghouse		
FQ:	2.5	FΔH:	1.7
Fuel:	Upgrade	SGTP (%):	7
Notes:	None		

Clad Temp (°F)

LICENSING BASIS

Analysis of Record PCT	1853
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PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments

1.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	183
2.	Pellet Radial Profile Option	-13
3.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
4.	Rod Internal Pressure Calculation	0
5.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
6.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
7.	WCOBRA/TRAC Automated Restart Process Logic Error	0
8.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0
9.	Elevations for Heat Slab Temperature Initialization	0
10.	Heat Transfer Model Error Corrections	0
11.	Correction to Heat Transfer Node Initialization	0
12.	Mass Conservation Error Fix	0
13.	Correction to Split Channel Momentum Equation	0
14.	Heat Transfer Logic Correction for Rod Burst Calculation	0
15.	Changes to Vessel Superheated Steam Properties	0
16.	Update to Metal Density Reference Temperatures	0
17.	Decay Heat Model Error Corrections	0
18.	Correction to the Pipe Exit Pressure Drop Error	0
19.	WCOBRA/TRAC U19 File Dimension Error Correction	0
20.	Revised Heat Transfer Multiplier Distributions	-7
21.	HOTSPOT Burst Strain Error Correction	51
22.	Changes to Grid Blockage Ratio and Porosity	0
23.	Grid Heat Transfer Enhancement Calculation	0
24.	Vessel Section 7 Mid-Level Elevation Modeling	0
25.	Burst Elevation Selection	0
26.	Errors in Decay Group Uncertainty Factors	4
27.	Evaluation of Additional Containment Metal	0
28.	Error in Oxidation Calculations	0
29.	Error in use of ASME Steam Tables	0
30.	Core Barrel Unheated Conductor Errors	0

31.	Discrepancy in Wetted Perimeter Inputs	0
32.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
33.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
34.	Steady-State Fuel Temperature Calibration Method	0
35.	Vapor Temperature Resetting	0
36.	Removal of the Vessel Interfacial Heat Transfer Limit	0
B.	Planned Plant Modification Evaluations	
1.	None	0
C.	2022 ECCS Model Assessments	
1.	Non-Conservation of Energy in the Generalized Energy Deposition Model	0
D.	Other	
1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	2071
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10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	Surry Power Station, Unit 2		
Utility Name:	Virginia Electric and Power Company		
<u>Analysis Information</u>			
EM:	FSLOCA (Region II)	Limiting Break Size:	DEG
Analysis Date:	August 2019		
Vendor:	Westinghouse		
FQ:	≤2.5	FΔH:	≤ 1.7
Fuel:	Upgrade	SGTP (%):	≤7
Notes:	None		

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1875
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. Advanced Debris Filter Bottom Nozzle Large Break LOCA Evaluation	0
B. Planned Plant Modification Evaluations	
1. Upflow Conversion	46
C. 2022 ECCS Model Assessments	
1. Evaluation of Containment Spray Flow Increase	0
2. Error in Hoop Stress used in Cladding Rupture Model	0
3. Non-Conservation of Energy in the Generalized Energy Deposition Model	0
4. Reduction of Total Core Peaking Factor Surveillance Uncertainty	0
D. Other	
1. None	0
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LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1921

ATTACHMENT 5

**2022 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

2022 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

**DOMINION ENERGY SOUTH CAROLINA, INC.
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1**

10 CFR 50.46 Margin Utilization – Small Break LOCA

Plant Name:	V. C. Summer
Utility Name:	Dominion Energy South Carolina

Analysis Information

EM:	FSLOCA (Region I)	Limiting Break Size:	2.6 Inch
Analysis Date:	January 2019		
Vendor:	Westinghouse		
FQ:	2.5	FdH:	1.70
Notes:	None		

Clad Temp(°F)

LICENSING BASIS

Analysis of Record PCT (Including gamma energy redistribution)	1108
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PCT ASSESSMENTS (Delta PCT)

- | | | |
|-----------|--|---|
| A. | Prior ECCS Model Assessments | |
| 1. | None | 0 |
| B. | Planned Plant Modification Evaluations | |
| 1. | None | 0 |
| C. | 2022 ECCS Model Assessments | |
| 1. | Error in Hoop Stress used in Cladding Rupture Model | 0 |
| 2. | Non-Conservation of Energy in the
Generalized Energy Deposition Model | 0 |
| D. | Other | |
| 1. | None | 0 |

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1108
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10 CFR 50.46 Margin Utilization – Large Break LOCA

Plant Name: V. C. Summer
Utility Name: Dominion Energy South Carolina

Analysis Information

EM: FSLOCA (Region II) **Limiting Break Size:** DEGB
Analysis Date: January 2019
Vendor: Westinghouse
FQ: 2.5 **FdH:** 1.70
Notes: None

Clad Temp(°F)

LICENSING BASIS

Analysis of Record PCT 1879
(Including gamma energy redistribution)

PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments

1. None 0

B. Planned Plant Modification Evaluations

1. None 0

C. 2022 ECCS Model Assessments

1. Error in Hoop Stress used in Cladding Rupture Model 0
2. Non-Conservation of Energy in the Generalized Energy Deposition Model 0

D. Other

1. None 0

LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1879
