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10 CFR 50.46

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**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**  
**2020 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. (DESC) hereby submit the annual summary of permanent changes to the emergency core cooling system (ECCS) evaluation models (EMs) for Millstone Power Station (MPS) Units 2 and 3, North Anna Power Station (NAPS) Units 1 and 2, Surry Power Station (SPS) Units 1 and 2, and Virgil C. Summer Nuclear Station (VCS) Unit 1, respectively.

Attachment 1 of this letter provides a report describing plant-specific evaluation model changes associated with the Westinghouse and Framatome Small Break Loss of Coolant Accident (SBLOCA) and Large Break Loss of Coolant Accident (LBLOCA) ECCS EMs for MPS 2 and 3, NAPS 1 and 2, SPS 1 and 2, and VCS 1, as applicable.

Information regarding the effect of the ECCS EM changes upon the reported SBLOCA and LBLOCA analyses of record results is provided for MPS 2 and 3, NAPS 1 and 2, SPS 1 and 2, and VCS 1 in Attachments 2, 3, 4 and 5, respectively. The calculated peak cladding temperatures (PCT) for the SBLOCA and LBLOCA analyses for MPS 2 and 3, NAPS 1 and 2, SPS 1 and 2, and VCS 1 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
North Anna Units 1 and 2	Small break - Westinghouse EM:	1834.1°F
North Anna Units 1 and 2	Large break - Westinghouse EM:	1982°F
Surry Units 1 and 2	Small break - Westinghouse EM:	2012°F
Surry Units 1 and 2	Large break - Westinghouse EM:	2071°F
Virgil C. Summer Unit 1	Small break - Westinghouse EM:	1923°F
Virgil C. Summer Unit 1	Large break - Westinghouse EM	
	Blowdown:	1814°F
	Reflood 1:	1814°F
	Reflood 2:	1961°F
	Composite:	1961°F

The LOCA results for MPS 2 and 3, NAPS 1 and 2, SPS 1 and 2, and VCS 1 are confirmed to have sufficient 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.

The information contained herein satisfies the 2020 annual reporting requirements of 10 CFR 50.46(a)(3)(ii).

If you have any questions regarding this submittal, please contact Ms. Cathie Tiernan at (804) 432-2596.

Respectfully,



Mark D. Sartain  
Vice President - Nuclear Engineering and Fleet Support  
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Dominion Energy South Carolina, Inc  
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Commitments made in this letter: None

Attachments:

Attachment 1. Report of Changes in Framatome and Westinghouse ECCS Evaluation Models

Attachment 2. 2020 Annual Reporting of 10 CFR 50.46 Margin Utilization - Millstone Power Station Units 2 and 3

Attachment 3. 2020 Annual Reporting of 10 CFR 50.46 Margin Utilization – North Anna Power Station Units 1 and 2

Attachment 4. 2020 Annual Reporting of 10 CFR 50.46 Margin Utilization – Surry Power Station Units 1 and 2

Attachment 5. 2020 Annual Reporting of 10 CFR 50.46 Margin Utilization – Virgil C. Summer Nuclear Station

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**Attachment 1**

**2020 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 for Small Break Loss of Coolant Accident (SBLOCA) for Millstone Unit 2 during 2020.
2. Framatome identified no changes or errors applicable to the SEM/PWR-98 evaluation model for Large Break LOCA (LBLOCA) for Millstone Unit 2 during 2020. This evaluation model is applicable to the Millstone Unit 2 fuel with Zr-4 cladding.
3. On January 24, 2017, a new LBLOCA analysis was approved by the NRC, Reference 8, based upon the EMF-2103(P)(A), Revision 3, "Realistic Large Break LOCA (RLBLOCA) Methodology for Pressurized Water Reactors". The new analysis is applicable to the AREVA Standard CE14 HTP fuel product with the M5™ fuel rod cladding only. The analysis predicted a PCT of 1615°F.

Framatome identified the following change and error applicable to the EMF-2103(P)(A), Revision 3 evaluation model for RLBLOCA for Millstone Unit 2 during 2020.

- **Radiation Enclosure Input Error**

An inconsistency was identified in S-RELAP5 inputs related to fuel rod radiation enclosures. The error occurs only in applications of the Framatome EMF-2103(P)(A), Revision 3, Realistic Large Break LOCA (RLBLOCA) methodology. Fuel stored energy uncertainty established for simulation of limiting fuel rods was inadvertently applied to the hot fresh and once-burned UO<sub>2</sub> rod radiation enclosures. The intent of the methodology is that the uncertainty for enclosure stored energy simulation matches that of the hot fuel assembly, which has no applied uncertainty.

Enclosures account for the effect of rod-to-rod thermal radiation. Rod-to-rod radiation comprises a fraction of the total heat transfer characteristic of fuel rods in a steam environment. The effect of the input error is small since the total heat transfer from an uncovered fuel rod is relatively small. The imposition of stored energy uncertainty can cause radiation heat transfer from a limiting rod to surrounding rods to either increase or decrease as a result of the error.

Corrections have been made to the input so that uncertainty adjustments are not made to the hot fresh and once-burned UO<sub>2</sub> rod radiation enclosures. Before and after runs of Combustion Engineering (CE) sample case sets were subsequently compared. Differences in the results are negligible. Thus, there is no effect on the Revision 3 RLBLOCA analyses of record peak clad temperature calculations. Effects of the input error on maximum local and whole core oxidation calculations are negligible as well.

### **Millstone Power Station Unit 3**

1. Westinghouse identified the following changes applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Millstone Unit 3 during 2020.

- **Small Break LOCA PAD5 Implementation**

The Westinghouse Performance Analysis and Design Model (PAD) is used to generate fuel performance input data for use in SBLOCA analyses. A new approved PAD model (PAD5, WCAP-17642-P-A, Revision 1) is now available for generation of fuel performance input data. PAD5 implementation has been evaluated through the use of qualitative examination and sensitivity calculations to have a negligible effect on the SBLOCA analysis results, leading to an estimated peak cladding temperature impact of 0°F.

2. Westinghouse identified the following change applicable to the 2004 Westinghouse Best Estimate (BE) LBLOCA Evaluation Model (EM) using the Automated Statistical Treatment of Uncertainty Method (ASTRUM) for Millstone Unit 3 during 2020:

- **Cycle 21 PBOT/PMID Envelope Violations**

The Millstone Unit 3 Cycle 21 reload core design resulted in violations of the PBOT/PMID envelope used in the LBLOCA analysis. These violations were evaluated for Millstone Unit 3 Cycle 21 operation. The peak cladding temperature impact of the PBOT/PMID violations for Millstone Unit 3 Cycle 21 was determined via a plant-specific evaluation to be 0°F.

### **North Anna Power Station Units 1 and 2**

1. Westinghouse identified no changes or errors applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for North Anna Units 1 and 2 during 2020.
2. Westinghouse identified no changes or errors applicable to the 2004 Westinghouse BE LBLOCA EM using ASTRUM for North Anna Units 1 and 2 during 2020.

### **Surry Power Station Units 1 and 2**

1. Westinghouse identified no changes or errors applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Surry Units 1 and 2 during 2020.
2. Westinghouse identified no changes or errors applicable to the 2004 Westinghouse BE LBLOCA EM using ASTRUM for Surry Units 1 and 2 during 2020.

### **Virgil C Summer**

1. Westinghouse identified the following change applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Virgil C. Summer during 2020.

- **Evaluation of an Increased Vessel Average Temperature Uncertainty**

An update to the analysis of record (AOR) for setpoint and control uncertainties resulted in an increase to the vessel average temperature (Tavg) uncertainty range for consideration in the LOCA analyses. The uncertainty range changed from +5.4°F / -6.3°F to +6.4°F / -6.3°F. The change in temperature uncertainty has been evaluated for the SBLOCA analysis basis. This change represents a Change in Plant Configuration or Setpoints, distinguished from an evaluation model change in Section 4 of WCAP-3451.

The evaluation determined that the increased Tavg uncertainty will have a negligible effect on the SBLOCA transient results, leading to an estimated peak cladding temperature impact of 0°F.

2. Westinghouse identified the following change applicable to the 1996 Westinghouse Best Estimate LBLOCA Evaluation Model for Virgil C. Summer during 2020.

- **Evaluation of an Increased Vessel Average Temperature Uncertainty**

An update to the AOR for setpoint and control uncertainties resulted in an increase to the vessel average temperature (Tavg) uncertainty range for consideration in the LOCA analyses. The uncertainty range changed from +5.4°F / -6.3°F to +6.4°F / -6.3°F. The change in temperature uncertainty has been evaluated for the best-estimate LBLOCA and FULL SPECTRUM LOCA (FSLOCA) Evaluation Model (EM) analyses. This change represents a Change in Plant Configuration or Setpoints, distinguished from an evaluation model change in Section 4 of WCAP-13451.

A qualitative evaluation based on the modeled Tavg determined that the increased uncertainty range will have a negligible effect on the analysis results for the best-estimate LBLOCA and FSLOCA EM analyses, leading to an estimated PCT impact of 0°F.

### **Conclusion**

The LOCA results for Millstone Units 2 and 3, North Anna Units 1 and 2, Surry Units 1 and 2 and Virgil C. Summer Unit 1 are confirmed in the PCT rackup tables, Attachments 2 through 5, 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 obligates each

licensee to report the effect upon calculated temperature of any change or error in evaluation models 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 2020.

**Attachment 2**

**2020 ANNUAL REPORT OF EMERGENCY CORE  
COOLING SYSTEM (ECCS) MODEL CHANGES  
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

**2020 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:** Framatome  
**Peak Linear Power:** 15.1 kW/ft  
**Notes:** None

	<b><u>Clad Temp(°F)</u></b>
<b>LICENSING BASIS</b>	
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
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**C. 2020 ECCS Model Assessments**

1. None	0
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**D. Other**

1. None	0
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<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT = 1714</b>
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**10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA**

<b>Plant Name:</b>	Millstone Power Station, Unit 2
<b>Utility Name:</b>	Dominion Energy Nuclear Connecticut, Inc.
<b><u>Analysis Information</u></b>	
<b>EM:</b>	SEM/PWR-98
<b>Analysis Date:</b>	November 1998
<b>Vendor:</b>	Framatome
<b>Peak Linear Power:</b>	15.1 kW/ft
<b>Notes:</b>	None

**Limiting Break Size: 1.0 DECLG**

**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
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**C. 2020 ECCS Model Assessments**

1.	None	0
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**D. Other**

1. None 0

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**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:	May 2016		
Vendor:	Framatome		
Peak Linear Power:	15.1 kW/ft		
Notes:	None		

		<u>Clad Temp(°F)</u>
<b>LICENSING BASIS</b>		
Analysis of Record PCT		1615
<b>PCT ASSESSMENTS (Delta PCT)</b>		
<b>A. Prior ECCS Model Assessments</b>		
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		
<b>B. Planned Plant Modification Evaluations</b>		
1. None		0
<b>C. 2020 ECCS Model Assessment</b>		
1. Radiation enclosure input error		0
<b>D. Other</b>		
1. None		0

<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT =</b>	<b>1615</b>
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# **10 CFR 50.46 MARGIN UTILIZATION - SMALL BREAK LOCA**

<b>Plant Name:</b>	Millstone Power Station, Unit 3		
<b>Utility Name:</b>	Dominion Energy Nuclear Connecticut, Inc.		
<b><u>Analysis Information</u></b>			
<b>EM:</b>	NOTRUMP	<b>Limiting Break Size:</b>	4 inches
<b>Analysis Date:</b>	02/07/07		
<b>Vendor:</b>	Westinghouse		
<b>FQ:</b>	2.6	<b>FdH:</b>	1.65
<b>Fuel:</b>	RFA-2	<b>SGTP (%):</b>	10
<b>Notes:</b>	None		

	<b>Clad Temp (°F)</b>
<b>LICENSING BASIS</b>	
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 <sub>2</sub> Fuel Pellet Heat Capacity	0

### **B. Planned Plant Modification Evaluations**

- None

### **C. 2020 ECCS Model Assessments**

- Small Break LOCA PAD5 Implementation 0

### **D. Other**

- None 0

<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT = 1193</b>
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**10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA**

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

**Clad Temp (°F)**

**LICENSING BASIS**

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
<b>B. Planned Plant Modification Evaluations</b>		
1.	None	
<b>C. 2020 ECCS Model Assessments</b>		
1.	Cycle 21 PBOT/PMID Envelope Violations	0
<b>D. Other</b>		
1.	None	0
<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>		<b>PCT = 1933</b>

**Attachment 3**

**2020 ANNUAL REPORT OF EMERGENCY CORE  
COOLING SYSTEM (ECCS) MODEL CHANGES  
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

**2020 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 - WESTINGHOUSE SMALL BREAK LOCA**

<b>Plant Name:</b>	North Anna Power Station, Unit 1		
<b>Utility Name:</b>	Virginia Electric and Power Company		
<b><u>Analysis Information</u></b>			
<b>EM:</b>	NOTRUMP	<b>Limiting Break Size:</b>	2.75 inches
<b>Analysis Date:</b>	12/20/2010		
<b>Vendor:</b>	Westinghouse		
<b>FQ:</b>	2.32	<b>FAH:</b>	1.65
<b>Fuel:</b>	RFA-2	<b>SGTP (%):</b>	7
<b>Notes:</b>	None		

	<b><u>Clad Temp (°F)</u></b>
<b>LICENSING BASIS</b>	
Analysis of Record PCT	1834.1

**PCT ASSESSMENTS (Delta PCT)**

<b>A. Prior ECCS Model Assessments</b>	
1. NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
2. SBLOCA Cladding Strain Requirement for Fuel Rod Burst	0
3. Fuel Rod Gap Conductance Error	0
4. Radiation Heat Transfer Model Error	0
5. SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0
6. Error in the Upper Plenum Fluid Volume Calculation	0
7. UO2 Fuel Pellet Heat Capacity	0
<b>B. Planned Plant Modification Evaluations</b>	
1. None	0
<b>C. 2020 ECCS Model Assessments</b>	
1. None	0
<b>D. Other</b>	
1. None	0

<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT = 1834.1</b>
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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:** ASTRUM (2004)      **Limiting Break Size:** DEGB  
**Analysis Date:** 8/25/2010  
**Vendor:** Westinghouse  
**FQ:** 2.32      **FAH:** 1.65  
**Fuel:** RFA-2      **SGTP (%):** 7

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

	<b><u>Clad Temp (°F)</u></b>
<b>LICENSING BASIS</b>	
Analysis of Record PCT	1852

**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>B.</b>	<b>Planned Plant Modification Evaluations</b>	
1.	None	0
<b>C.</b>	<b>2020 ECCS Model Assessments</b>	
1.	None	0
<b>D.</b>	<b>Other</b>	
1.	None	

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<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT =</b>	<b>1982</b>
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**10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA**

<b>Plant Name:</b>	North Anna Power Station, Unit 2		
<b>Utility Name:</b>	Virginia Electric and Power Company		
<b><u>Analysis Information</u></b>			
<b>EM:</b>	NOTRUMP	<b>Limiting Break Size:</b>	2.75 inches
<b>Analysis Date:</b>	12/20/2010		
<b>Vendor:</b>	Westinghouse		
<b>FQ:</b>	2.32	<b>FΔH:</b>	1.65
<b>Fuel:</b>	RFA-2	<b>SGTP (%):</b>	7
<b>Notes:</b>	None		

	<b><u>Clad Temp (°F)</u></b>
<b>LICENSING BASIS</b>	
Analysis of Record PCT	1834.1

**PCT ASSESSMENTS (Delta PCT)**

<b>A. Prior ECCS Model Assessments</b>	
1. NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
2. SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
3. Fuel Rod Gap Conductance Error	0
4. Radiation Heat Transfer Model Error	0
5. SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0
6. Error in the Upper Plenum Fluid Volume Calculation	0
7. UO2 Fuel Pellet Heat Capacity	0
<b>B. Planned Plant Modification Evaluations</b>	
1. None	0
<b>C. 2020 ECCS Model Assessments</b>	
1. None	0
<b>D. Other</b>	
1. None	0

<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT = 1834.1</b>
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# 10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

<b>Plant Name:</b>	North Anna Power Station, Unit 2		
<b>Utility Name:</b>	Virginia Electric and Power Company		
<b><u>Analysis Information</u></b>			
<b>EM:</b>	ASTRUM (2004)	<b>Limiting Break Size:</b>	DEGB
<b>Analysis Date:</b>	8/25/2010		
<b>Vendor:</b>	Westinghouse		
<b>FQ:</b>	2.32	<b>FΔH:</b>	1.65
<b>Fuel:</b>	RFA-2	<b>SGTP (%):</b>	7
<b>Notes:</b> Core Power ≤ 100% of 2951 MWt; SG Model 54F; 17x17 RFA-2 Fuel with ZIRLO® or Optimized ZIRLO™ cladding, Non-IFBA or IFBA, IFMs			

		<b><u>Clad Temp (°F)</u></b>
<b>LICENSING BASIS</b>		
Analysis of Record PCT		1852
<b>PCT ASSESSMENTS (Delta PCT)</b>		
<b>A. Prior ECCS Model Assessments</b>		
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
27.	Error in Oxidation Calculations	0
28.	Error in use of ASME Steam Tables	0
29.	Support Column Core Barrel Unheated Conductor Errors	0
30.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
31.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
32.	Steady-State Fuel Temperature Calibration Method	0
33.	Correction to Fuel Pellet TCD Assessment	0
34.	Vapor Temperature Resetting	0
35.	Removal of the Vessel Interfacial Heat Transfer Limit	0
<b>B.</b>	<b>Planned Plant Modification Evaluations</b>	
1.	None	0
<b>C.</b>	<b>2020 ECCS Model Assessments</b>	
1.	None	0
<b>D.</b>	<b>Other</b>	
1.	None	

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<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT =</b>	<b>1982</b>
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**Attachment 4**

**2020 ANNUAL REPORT OF EMERGENCY CORE  
COOLING SYSTEM (ECCS) MODEL CHANGES  
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

**2020 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 - WESTINGHOUSE SMALL BREAK LOCA**

<b>Plant Name:</b>	Surry Power Station, Unit 1		
<b>Utility Name:</b>	Virginia Electric and Power Company		
<b><u>Analysis Information</u></b>			
<b>EM:</b>	NOTRUMP	<b>Limiting Break Size:</b>	2.75 inches
<b>Analysis Date:</b>	5/7/2009		
<b>Vendor:</b>	Westinghouse		
<b>FQ:</b>	2.5	<b>FAH:</b>	1.7
<b>Fuel:</b>	Upgrade	<b>SGTP (%):</b>	7
<b>Notes:</b>	None		

	<b><u>Clad Temp (°F)</u></b>
<b>LICENSING BASIS</b>	
Analysis of Record PCT	2012

**PCT ASSESSMENTS (Delta PCT)**

<b>A. Prior ECCS Model Assessments</b>	
1. Urania-Gadolinia Pellet Thermal Conductivity Calculation.	0
2. Pellet Crack and Dish Volume Calculation.	0
3. Treatment of Vessel Average Temperature Uncertainty	0
4. 15X15 Upgrade Fuel	0
5. Maximum Fuel Rod Time Step Logic	0
6. Radiation Heat Transfer Logic	0
7. NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
8. SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
9. Fuel Rod Gap Conductance Error	0
10. Radiation Heat Transfer Model Error	0
11. SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0
12. Error in the Upper Plenum Fluid Volume Calculation	0
13. UO <sub>2</sub> Fuel Pellet Heat Capacity	0
<b>B. Planned Plant Modification Evaluations</b>	
1. None	0
<b>C. 2020 ECCS Model Assessments</b>	
1. None	0
<b>D. Other</b>	
1. None	0

<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT = 2012</b>
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**10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA**

<b>Plant Name:</b>	Surry Power Station, Unit 1		
<b>Utility Name:</b>	Virginia Electric and Power Company		
<b><u>Analysis Information</u></b>			
<b>EM:</b>	ASTRUM (2004)	<b>Limiting Break Size:</b>	DEG
<b>Analysis Date:</b>	10/6/2010		
<b>Vendor:</b>	Westinghouse		
<b>FQ:</b>	2.5	<b>FΔH:</b>	1.7
<b>Fuel:</b>	Upgrade	<b>SGTP (%):</b>	7
<b>Notes:</b>	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>B.</b>	<b>Planned Plant Modification Evaluations</b>	
1.	None	0
<b>C.</b>	<b>2020 ECCS Model Assessments</b>	
1.	Removal of the Vessel Interfacial Heat Transfer Limit	0
<b>D.</b>	<b>Other</b>	
1.	None	0
<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>		<b>PCT = 2071</b>



**10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA**

<b>Plant Name:</b>	Surry Power Station, Unit 2		
<b>Utility Name:</b>	Virginia Electric and Power Company		
<b><u>Analysis Information</u></b>			
<b>EM:</b>	NOTRUMP	<b>Limiting Break Size:</b>	2.75 inches
<b>Analysis Date:</b>	5/7/2009		
<b>Vendor:</b>	Westinghouse		
<b>FQ:</b>	2.5	<b>FAH:</b>	1.7
<b>Fuel:</b>	Upgrade	<b>SGTP (%):</b>	7
<b>Notes:</b>	None		

**Clad Temp (°F)**

**LICENSING BASIS**

Analysis of Record PCT

2012

**PCT ASSESSMENTS (Delta PCT)**

**A. Prior ECCS Model Assessments**

- |     |   |   |
|-----|---|---|
| 1.  | Urania-Gadolinia Pellet Thermal Conductivity Calculation.             | 0 |
| 2.  | Pellet Crack and Dish Volume Calculation.                             | 0 |
| 3.  | Treatment of Vessel Average Temperature Uncertainty                   | 0 |
| 4.  | 15X15 Upgrade Fuel  | 0 |
| 5.  | Maximum Fuel Rod Time Step Logic                                      | 0 |
| 6.  | Radiation Heat Transfer Logic   | 0 |
| 7.  | NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation | 0 |
| 8.  | SBLOCTA Cladding Strain Requirement for Fuel Rod Burst                | 0 |
| 9.  | Fuel Rod Gap Conductance Error  | 0 |
| 10. | Radiation Heat Transfer Model Error                                   | 0 |
| 11. | SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient Calculation        | 0 |
| 12. | Error in the Upper Plenum Fluid Volume Calculation                    | 0 |
| 13. | UO <sub>2</sub> Fuel Pellet Heat Capacity                             | 0 |

**B. Planned Plant Modification Evaluations**

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

**C. 2020 ECCS Model Assessments**

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

**D. Other**

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

**LICENSING BASIS PCT + PCT ASSESSMENTS**

**PCT = 2012**

**10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA**

<b>Plant Name:</b>	Surry Power Station, Unit 2		
<b>Utility Name:</b>	Virginia Electric and Power Company		
<b><u>Analysis Information</u></b>			
<b>EM:</b>	ASTRUM (2004)	<b>Limiting Break Size:</b>	DEG
<b>Analysis Date:</b>	10/6/2010		
<b>Vendor:</b>	Westinghouse		
<b>FQ:</b>	2.5	<b>FΔH:</b>	1.7
<b>Fuel:</b>	Upgrade	<b>SGTP (%):</b>	7
<b>Notes:</b>	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>B.</b>	<b>Planned Plant Modification Evaluations</b>	
1.	None	0
<b>C.</b>	<b>2020 ECCS Model Assessments</b>	
1.	None	0
<b>D.</b>	<b>Other</b>	
1.	None	0
<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>		<b>PCT = 2071</b>

**Attachment 5**

**2020 ANNUAL REPORT OF EMERGENCY CORE  
COOLING SYSTEM (ECCS) MODEL CHANGES  
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

**2020 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 – Appendix K Small Break**

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

**Analysis Information**

**EM:** NOTRUMP **Limiting Break Size:** 3 Inch  
**Analysis Date:** February 2003  
**Vendor:** Westinghouse  
**FQ:** 2.45 **FdH:** 1.62  
**Notes:** None

**Clad Temp(°F)**

**LICENSING BASIS**

Analysis of Record PCT

1775

**PCT ASSESSMENTS (Delta PCT)**

**A. Prior ECCS Model Assessments**

1.	NOTRUMP-EM Refined Break Spectrum	0
2.	Errors in Reactor Vessel Nozzle Data Collections	0
3.	Pump Weir Resistance Modeling	0
4.	Errors in Reactor Vessel Lower Plenum Surface Area Calculations	0
5.	Modeling of Annular Pellets	0
6.	Discrepancy in Metal Masses Used From Drawings	0
7.	V. C. Summer Upflow Conversion	148
8.	Treatment of Vessel Average Temperature Uncertainty	0
9.	Urania-Gadolinia Pellet Thermal Conductivity Calculation	0
10.	Pellet Crack and Dish Volume Calculation	0
11.	Radiation Heat Transfer Logic	0
12.	Maximum Fuel Rod Time Step Logic	0
13.	NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
14.	SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
15.	Fuel Rod Gap Conductance Error	0
16.	Radiation Heat Transfer Model Error	0
17.	SBLOCTA Pre-DNB Cladding Surface Heat Transfer Coefficient Calculation	0
18.	Control Rod Drop Time Technical Specification Change	0
19.	Vessel Average Temperature Uncertainty	0
20.	Error in the Upper Plenum Fluid Volume Calculation	0
21.	UO2 Fuel Pellet Heat Capacity	0

**B. Planned Plant Modification Evaluations**

1.	None	0
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**C. 2020 ECCS Model Assessments**

1. Increased Vessel Average Temperature Uncertainty 0

**D. Other**

1. None 0

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**LICENSING BASIS PCT + PCT ASSESSMENTS**

**PCT = 1923**

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**10 CFR 50.46 Margin Utilization – Best Estimate Large Break, BLOWDOWN**

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

**Analysis Information**

**EM:** CQD (1996) **Limiting Break Size:** DEGB  
**Analysis Date:** February 2003  
**Vendor:** Westinghouse  
**FQ:** 2.5 **FdH:** 1.7  
**Notes:** None

**Clad Temp(°F)**

**LICENSING BASIS**

Analysis of Record PCT

1860

**PCT ASSESSMENTS (Delta PCT)**

**A. Prior ECCS Model Assessments**

1.	Fan Cooler Performance Increase	0
2.	Improved Automation of End of Blowdown Time	0
3.	Implementation of ASTRUM Capability in HOTSPOT	0
4.	Revised Blowdown Heatup Uncertainty Distribution	49
5.	Revised Iteration Algorithm for Calculating The Average Fuel Temperature	0
6.	Improved Automation of End of Blowdown Time	0
7.	Thermodynamic Properties from Thermo	0
8.	Pressurizer Fluid Volumes	0
9.	Vessel Unheated Conductor Noding	0
10.	Containment Relative Humidity Assumption	0
11.	HOTSPOT Fuel Relocation	0
12.	Steam Generator Nozzle Volume Accounting Error	0
13.	Cold Leg Volume Discrepancy	0
14.	Errors in Reactor Vessel Nozzle Data Collection	0
15.	HOTSPOT Burst Temperature Logic Errors	0
16.	V. C. Summer Upflow Conversion	-7
17.	Zero Cross-Flow Boundary Condition Error	0
18.	Discrepancy in Metal Masses Used From Drawings	0
19.	HOTSPOT Gap Heat Transfer Logic	0
20.	HOTSPOT Statistical Output Logic	0
21.	Treatment of Vessel Average Temperature Uncertainty	0
22.	Additional Heat Sinks and Maximum Spray Flow	0
23.	Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	0
24.	PAD 4.0 Implementation	-83
25.	Zero Cross-Flow Boundary Condition Error	0
26.	HOTSPOT Burst Temperature Calculation For ZIRLO Cladding	0
27.	HOTSPOT Iteration Algorithm for Calculating The Initial Fuel Pellet Average Temperature	0

28.	WCOBRA/TRAC Automated Restart Process Logic Error	0
29.	Rod Internal Pressure Calculation	0
30.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER	0
31.	Burst Elevation Selection	0
32.	Elevation for Heat Slab Temperature Initialization	0
33.	Heat Transfer Logic for Rod Burst Calculation	0
34.	WCOBRA/TRAC U19 File Dimension Error Correction	0
35.	Heat Transfer Model Error Corrections	0
36.	Correction to Heat Transfer Node Initialization	0
37.	Mass Conservation Error Fix	0
38.	Correction to Split Channel Momentum Equation	0
39.	Changes to Vessel Superheated Steam Properties	0
40.	Update to Metal Density Reference Temperatures	0
41.	Decay Heat Model Error Correction	0
42.	Correction to the Pipe Exit Pressure Drop Error	0
43.	Vessel Section 7 Mid-Level Elevation Modeling	0
44.	Grid Heat Transfer Enhancement Calculation	0
45.	Revised Heat Transfer Multiplier Distributions	-5
46.	Changes to Grid Blockage Ratio and Porosity	0
47.	Error in Burst Strain Application	0
48.	Code Uncertainty in BE LBLOCA Monte Carlo Simulations	0
49.	Error in Oxidation Calculations	0
50.	Support Column Unheated Conductor Error	0
51.	Vessel Average Temperature Uncertainty	0
52.	Numerical Ramp Entrained Liquid/Vapor Interfacial Drag	0
53.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
54.	Vapor Temperature Resetting	0
55.	Removal of the Vessel Interfacial Heat Transfer Limit	0
<b>B.</b>	<b>Planned Plant Modification Evaluations</b>	
1.	None	0
<b>C.</b>	<b>2020 ECCS Model Assessments</b>	
1.	Increased Vessel Average Temperature Uncertainty	0
<b>D.</b>	<b>Other</b>	
1.	None	0

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<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT =</b>	<b>1814</b>
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**10 CFR 50.46 Margin Utilization – Best Estimate Large Break, REFLOOD 1**

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

**Analysis Information**

**EM:** CQD (1996) **Limiting Break Size:** DEGB  
**Analysis Date:** February 2003  
**Vendor:** Westinghouse  
**FQ:** 2.5 **FdH:** 1.7  
**Notes:** None

**Clad Temp(°F)**

**LICENSING BASIS**

Analysis of Record PCT

1808

**PCT ASSESSMENTS (Delta PCT)**

**A. Prior ECCS Model Assessments**

1.	Fan Cooler Performance Increase	1
2.	Improved Automation of End of Blowdown Time	0
3.	Implementation of ASTRUM Capability in HOTSPOT	0
4.	Revised Blowdown Heatup Uncertainty Distribution	5
5.	Revised Iteration Algorithm for Calculating The Average Fuel Temperature	0
6.	Improved Automation of End of Blowdown Time	0
7.	Thermodynamic Properties from Thermo	0
8.	Pressurizer Fluid Volumes	0
9.	Vessel Unheated Conductor Noding	0
10.	Containment Relative Humidity Assumption	0
11.	HOTSPOT Fuel Relocation	0
12.	Steam Generator Nozzle Volume Accounting Error	0
13.	Cold Leg Volume Discrepancy	0
14.	Errors in Reactor Vessel Nozzle Data Collection	0
15.	HOTSPOT Burst Temperature Logic Errors	0
16.	V. C. Summer Upflow Conversion	-44
17.	Zero Cross-Flow Boundary Condition Error	0
18.	Discrepancy in Metal Masses Used From Drawings	0
19.	HOTSPOT Gap Heat Transfer Logic	0
20.	HOTSPOT Statistical Output Logic	0
21.	Treatment of Vessel Average Temperature Uncertainty	0
22.	Additional Heat Sinks and Maximum Spray Flow	0
23.	Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	113
24.	PAD 4.0 Implementation	-118
25.	Zero Cross-Flow Boundary Condition Error	0
26.	HOTSPOT Burst Temperature Calculation For ZIRLO Cladding	0
27.	HOTSPOT Iteration Algorithm for Calculating The Initial Fuel Pellet Average Temperature	0

28.	WCOBRA/TRAC Automated Restart Process Logic Error	0
29.	Rod Internal Pressure Calculation	0
30.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER	0
31.	Burst Elevation Selection	0
32.	Elevation for Heat Slab Temperature Initialization	0
33.	Heat Transfer Logic for Rod Burst Calculation	0
34.	WCOBRA/TRAC U19 File Dimension Error Correction	0
35.	Heat Transfer Model Error Corrections	0
36.	Correction to Heat Transfer Node Initialization	0
37.	Mass Conservation Error Fix	0
38.	Correction to Split Channel Momentum Equation	0
39.	Changes to Vessel Superheated Steam Properties	0
40.	Update to Metal Density Reference Temperatures	0
41.	Decay Heat Model Error Correction	0
42.	Correction to the Pipe Exit Pressure Drop Error	0
43.	Vessel Section 7 Mid-Level Elevation Modeling	0
44.	Grid Heat Transfer Enhancement Calculation	0
45.	Revised Heat Transfer Multiplier Distributions	5
46.	Changes to Grid Blockage Ratio and Porosity	24
47.	Error in Burst Strain Application	20
48.	Code Uncertainty in BE LBLOCA Monte Carlo Simulations	0
49.	Error in Oxidation Calculations	0
50.	Support Column Unheated Conductor Error	0
51.	Vessel Average Temperature Uncertainty	0
52.	Numerical Ramp Entrained Liquid/Vapor Interfacial Drag	0
53.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
54.	Vapor Temperature Resetting	0
55.	Removal of the Vessel Interfacial Heat Transfer Limit	0
<b>B.</b>	<b>Planned Plant Modification Evaluations</b>	
1.	None	0
<b>C.</b>	<b>2020 ECCS Model Assessments</b>	
1.	Increased Vessel Average Temperature Uncertainty	0
<b>D.</b>	<b>Other</b>	
1.	None	0

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<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT =</b>	<b>1814</b>
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**10 CFR 50.46 Margin Utilization – Best Estimate Large Break, REFLOOD 2**

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

**Analysis Information**

**EM:** CQD (1996) **Limiting Break Size:** DEGB  
**Analysis Date:** February 2003  
**Vendor:** Westinghouse  
**FQ:** 2.5 **FdH:** 1.7  
**Notes:** None

**Clad Temp(°F)**

**LICENSING BASIS**

Analysis of Record PCT

1988

**PCT ASSESSMENTS (Delta PCT)**

**A. Prior ECCS Model Assessments**

1.	Fan Cooler Performance Increase	2
2.	Improved Automation of End of Blowdown Time	0
3.	Implementation of ASTRUM Capability in HOTSPOT	0
4.	Revised Blowdown Heatup Uncertainty Distribution	5
5.	Revised Iteration Algorithm for Calculating The Average Fuel Temperature	0
6.	Improved Automation of End of Blowdown Time	0
7.	Thermodynamic Properties from Thermo	0
8.	Pressurizer Fluid Volumes	0
9.	Vessel Unheated Conductor Noding	0
10.	Containment Relative Humidity Assumption	0
11.	HOTSPOT Fuel Relocation	0
12.	Steam Generator Nozzle Volume Accounting Error	0
13.	Cold Leg Volume Discrepancy	0
14.	Errors in Reactor Vessel Nozzle Data Collection	0
15.	HOTSPOT Burst Temperature Logic Errors	0
16.	V. C. Summer Upflow Conversion	-29
17.	Zero Cross-Flow Boundary Condition Error	0
18.	Discrepancy in Metal Masses Used From Drawings	0
19.	HOTSPOT Gap Heat Transfer Logic	0
20.	HOTSPOT Statistical Output Logic	0
21.	Treatment of Vessel Average Temperature Uncertainty	0
22.	Additional Heat Sinks and Maximum Spray Flow	1
23.	Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	123
24.	PAD 4.0 Implementation	-118
25.	Zero Cross-Flow Boundary Condition Error	0
26.	HOTSPOT Burst Temperature Calculation For ZIRLO Cladding	0
27.	HOTSPOT Iteration Algorithm for Calculating The Initial Fuel Pellet Average Temperature	0

28.	WCOBRA/TRAC Automated Restart Process Logic Error	0
29.	Rod Internal Pressure Calculation	0
30.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER	0
31.	Burst Elevation Selection	0
32.	Elevation for Heat Slab Temperature Initialization	0
33.	Heat Transfer Logic for Rod Burst Calculation	0
34.	WCOBRA/TRAC U19 File Dimension Error Correction	0
35.	Heat Transfer Model Error Corrections	0
36.	Correction to Heat Transfer Node Initialization	0
37.	Mass Conservation Error Fix	0
38.	Correction to Split Channel Momentum Equation	0
39.	Changes to Vessel Superheated Steam Properties	0
40.	Update to Metal Density Reference Temperatures	0
41.	Decay Heat Model Error Corrections	0
42.	Correction to the Pipe Exit Pressure Drop Error	0
43.	Vessel Section 7 Mid-Level Elevation Modeling	0
44.	Grid Heat Transfer Enhancement Calculation	0
45.	Revised Heat Transfer Multiplier Distributions	-35
46.	Changes to Grid Blockage Ratio and Porosity	24
47.	Error in Burst Strain Application	0
48.	Code Uncertainty in BE LBLOCA Monte Carlo Simulations	0
49.	Error in Oxidation Calculations	0
50.	Support Column Unheated Conductor Error	0
51.	Vessel Average Temperature Uncertainty	0
52.	Numerical Ramp Entrained Liquid/Vapor Interfacial Drag	0
53.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
54.	Vapor Temperature Resetting	0
55.	Removal of the Vessel Interfacial Heat Transfer Limit	0
<b>B.</b>	<b>Planned Plant Modification Evaluations</b>	
1.	None	0
<b>C.</b>	<b>2020 ECCS Model Assessments</b>	
1.	Increased Vessel Average Temperature Uncertainty	0
<b>D.</b>	<b>Other</b>	
1.	None	0

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<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT =</b>	<b>1961</b>
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**10 CFR 50.46 Margin Utilization – Best Estimate Large Break, COMPOSITE**

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

**Analysis Information**

**EM:** CQD (1996) **Limiting Break Size:** DEGB  
**Analysis Date:** February 2003  
**Vendor:** Westinghouse  
**FQ:** 2.5 **FdH:** 1.7  
**Notes:** None

**Clad Temp(°F)**

**LICENSING BASIS**

Analysis of Record PCT

1988

**PCT ASSESSMENTS (Delta PCT)**

**A. Prior ECCS Model Assessments**

1.	Fan Cooler Performance Increase	2
2.	Improved Automation of End of Blowdown Time	0
3.	Implementation of ASTRUM Capability in HOTSPOT	0
4.	Revised Blowdown Heatup Uncertainty Distribution	5
5.	Revised Iteration Algorithm for Calculating The Average Fuel Temperature	0
6.	Improved Automation of End of Blowdown Time	0
7.	Thermodynamic Properties from Thermo	0
8.	Pressurizer Fluid Volumes	0
9.	Vessel Unheated Conductor Noding	0
10.	Containment Relative Humidity Assumption	0
11.	HOTSPOT Fuel Relocation	0
12.	Steam Generator Nozzle Volume Accounting Error	0
13.	Cold Leg Volume Discrepancy	0
14.	Errors in Reactor Vessel Nozzle Data Collection	0
15.	HOTSPOT Burst Temperature Logic Errors	0
16.	V. C. Summer Upflow Conversion	-29
17.	Zero Cross-Flow Boundary Condition Error	0
18.	Discrepancy in Metal Masses Used From Drawings	0
19.	HOTSPOT Gap Heat Transfer Logic	0
20.	HOTSPOT Statistical Output Logic	0
21.	Treatment of Vessel Average Temperature Uncertainty	0
22.	Additional Heat Sinks and Maximum Spray Flow	1
23.	Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	123
24.	PAD 4.0 Implementation	-118
25.	Zero Cross-Flow Boundary Condition Error	0
26.	HOTSPOT Burst Temperature Calculation For ZIRLO Cladding	0
27.	HOTSPOT Iteration Algorithm for Calculating The Initial Fuel Pellet Average Temperature	0

28.	WCOBRA/TRAC Automated Restart Process Logic Error	0
29.	Rod Internal Pressure Calculation	0
30.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER	0
31.	Burst Elevation Selection	0
32.	Elevation for Heat Slab Temperature Initialization	0
33.	Heat Transfer Logic for Rod Burst Calculation	0
34.	WCOBRA/TRAC U19 File Dimension Error Correction	0
35.	Heat Transfer Model Error Corrections	0
36.	Correction to Heat Transfer Node Initialization	0
37.	Mass Conservation Error Fix	0
38.	Correction to Split Channel Momentum Equation	0
39.	Changes to Vessel Superheated Steam Properties	0
40.	Update to Metal Density Reference Temperatures	0
41.	Decay Heat Model Error Correction	0
41.	Correction to the Pipe Exit Pressure Drop Error	0
42.	Vessel Section 7 Mid-Level Elevation Modeling	0
43.	Grid Heat Transfer Enhancement Calculation	0
44.	Revised Heat Transfer Multiplier Distributions	-35
45.	Changes to Grid Blockage Ratio and Porosity	24
46.	Error in Burst Strain Application	0
47.	Code Uncertainty in BE LBLOCA Monte Carlo Simulations	0
48.	Error in Oxidation Calculations	0
49.	Support Column Unheated Conductor Error	0
50.	Vessel Average Temperature Uncertainty	0
51.	Numerical Ramp Entrained Liquid/Vapor Interfacial Drag	0
52.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
53.	Vapor Temperature Resetting	0
54.	Removal of the Vessel Interfacial Heat Transfer Limit	0
<b>B.</b>	<b>Planned Plant Modification Evaluations</b>	
1.	None	0
<b>C.</b>	<b>2020 ECCS Model Assessments</b>	
1.	Increased Vessel Average Temperature Uncertainty	0
<b>D.</b>	<b>Other</b>	
1.	None	0

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<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT =</b>	<b>1961</b>
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