

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

June 21, 2016

10 CFR 50.46

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No.: 16-241
NRA/GDM R0
Docket Nos.: 50-336/423
50-338/339
50-280/281
License Nos.: DPR-65/NPF-49
NPF-4/7
DPR-32/37

DOMINION NUCLEAR CONNECTICUT, 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
2015 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 Nuclear Connecticut, Inc. (DNC) and Virginia Electric and Power Company (Dominion) hereby submit the annual summary of permanent changes to the emergency core cooling system (ECCS) evaluation models for Millstone Power Station (MPS) Units 2 and 3, North Anna Power Station (NAPS) Units 1 and 2, and Surry Power Station (SPS) Units 1 and 2, respectively.

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

Information regarding the effect of the ECCS evaluation model changes upon the reported SBLOCA and LBLOCA analyses of record results is provided for MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 in Attachments 2, 3 and 4, respectively. The calculated peak cladding temperatures (PCT) for the SBLOCA and LBLOCA analyses for MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 are summarized below:

Millstone Unit 2	Small break - AREVA Evaluation Model:	1881°F
Millstone Unit 2	Large break - AREVA Evaluation Model:	1845°F
Millstone Unit 3	Small break - Westinghouse Evaluation Model:	1193°F
Millstone Unit 3	Large break - Westinghouse Evaluation Model:	1933°F
North Anna Unit 1	Small break - Westinghouse Evaluation Model:	1834.1°F
North Anna Unit 1	Large break - Westinghouse Evaluation Model:	1982°F

ADD 2
NRR

North Anna Unit 2	Small break - Westinghouse Evaluation Model:	1834.1°F
North Anna Unit 2	Large break - Westinghouse Evaluation Model:	1982°F
Surry Units 1 and 2	Small break - Westinghouse Evaluation Model:	2012°F
Surry Units 1 and 2	Large break - Westinghouse Evaluation Model:	2071°F

The LOCA results for MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 are confirmed 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.

This information satisfies the 2015 annual reporting requirements of 10 CFR 50.46(a)(3)(ii).

If you have any questions regarding this submittal, please contact Mr. Gary D. Miller at (804) 273-2771.

Respectfully,



Mark D. Sartain
Vice President – Nuclear Engineering
Dominion Nuclear Connecticut, Inc.
Virginia Electric and Power Company

Commitments made in this letter: None

Attachments: (4)

1. Report of Changes in AREVA and Westinghouse ECCS Evaluation Models
2. 2015 Annual Reporting of 10 CFR 50.46 Margin Utilization - Millstone Power Station Units 2 and 3
3. 2015 Annual Reporting of 10 CFR 50.46 Margin Utilization – North Anna Power Station Units 1 and 2
4. 2015 Annual Reporting of 10 CFR 50.46 Margin Utilization – Surry Power Station Units 1 and 2

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ATTACHMENT 1

**2015 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

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

**DOMINION NUCLEAR CONNECTICUT, 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**

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

Millstone Power Station Unit 2

1. AREVA identified no changes or errors applicable to the S-RELAP5 based Small Break LOCA (SBLOCA) Evaluation Model for Millstone Unit 2 during 2015.
2. AREVA identified no changes or errors applicable to the SEM/PWR-98 evaluation model for Large Break LOCA (LBLOCA) for Millstone Unit 2 during 2015.

Millstone Power Station Unit 3

1. Westinghouse identified the following change(s) or error(s) to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Millstone Unit 3 during 2015:
 - **General Code Maintenance.** Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. The nature of these changes leads to an estimated Peak Cladding Temperature (PCT) impact of 0°F.
2. Westinghouse identified the following change(s) or error(s) applicable to the 2004 Westinghouse Best Estimate (BE) LBLOCA Evaluation Model using the Automated Statistical Treatment of Uncertainty Method (ASTRUM) for Millstone Unit 3 during 2015:
 - **Lower Support Plate, Core Barrel, and Vessel Wall Unheated Conductor Errors.** Modeling errors were discovered in the lower support plate, core barrel, and vessel cladding unheated conductors in the BE LBLOCA analysis-of-record. The modeling errors impacted the volume and surface area of the core barrel, the surface area and thermal resistance of the lower support plate, and the thermal resistance of the thermal wall. A quantitative evaluation was completed concluding that the modeled stored energy and heat transfer rate of the vessel wall, core barrel, and lower support plate unheated conductors were adequate. This error is estimated to have a PCT impact of 0°F.

North Anna Power Station Units 1 and 2

1. For consistency with the completion of the fuel transition to Westinghouse fuel assemblies and Dominion's plans not to re-insert AREVA fuel assemblies into

the North Anna Power Station's cores, the PCT utilization tables for AREVA Evaluation Models have been deleted, as stated in the Virginia Electric and Power Company letter to the NRC dated May 6, 2016 (ADAMS Accession No. ML16134A071) and as indicated below:

North Anna Unit 1 - Small break - AREVA Evaluation Model:	deleted
North Anna Unit 1 - Large break - AREVA Evaluation Model:	deleted
North Anna Unit 2 - Small break - AREVA Evaluation Model:	deleted
North Anna Unit 2 - Large break - AREVA Evaluation Model:	deleted

2. Westinghouse identified the following changes or errors in the 1985 Westinghouse SBLOCA Evaluation Models with NOTRUMP for North Anna Units 1 and 2 during 2015:
 - **General Code Maintenance.** Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. The nature of these changes leads to an estimated PCT impact of 0°F.
3. A design change (reactor vessel upflow conversion) was completed for North Anna Unit 2 during the spring 2016 refueling outage. Westinghouse performed an evaluation in 2016 and concluded the SBLOCA analysis of record performed with the NOTRUMP Evaluation Model continues to remain applicable to North Anna Unit 2 after the implementation of the upflow conversion. Therefore, no changes were made to the SBLOCA rack-up table for North Anna Unit 2 presented in Attachment 3. This information, regarding changes to the North Anna Unit 2 Evaluation Model in 2016, was transmitted to the NRC in the Virginia Electric and Power Company letter to the NRC dated May 6, 2016 (ADAMS Accession No. ML16134A071).
4. Westinghouse identified no changes or errors applicable to the 2004 Westinghouse BE LBLOCA Evaluation Model using the ASTRUM based models for North Anna Units 1 and 2 during 2015.
5. A design change (reactor vessel upflow conversion) was completed for North Anna Unit 2 during the spring 2016 refueling outage. Westinghouse performed an evaluation in 2016 to ensure the LBLOCA model for North Unit 1, which has an upflow baffle/barrel configuration, is representative of Unit 2 subsequent to the upflow conversion. Westinghouse concluded the LBLOCA analysis results for North Anna Unit 1 are applicable to North Anna Unit 2. Therefore, the LBLOCA rack-up table for North Anna Unit 2 presented in Attachment 3 is updated to reflect this change. This information, regarding changes to the North Anna Unit 2

Evaluation Model in 2016, was transmitted to the NRC in the Virginia Electric and Power Company letter to the NRC dated May 6, 2016 (ADAMS Accession No. ML16134A071).

Surry Power Station Units 1 and 2

1. Westinghouse identified the following change(s) or error(s) applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Surry Units 1 and 2 during 2015:
 - **General Code Maintenance.** Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. The nature of these changes leads to an estimated PCT impact of 0°F.
2. Westinghouse identified no changes or errors applicable to the 2004 Westinghouse BE LBLOCA Evaluation Model using the ASTRUM for Surry Units 1 and 2 during 2015.
3. The transition core PCT impact of 14°F is removed from the Westinghouse LBLOCA rack-up tables provided in this attachment for the Surry Units 1 and 2. Surry Unit 1 transitioned to an all 15 x15 Upgrade Fuel Design starting in spring 2015, and Surry Unit 2 operated with a full core of the 15 x15 Upgrade Fuel Design throughout 2015.

Conclusion

The LOCA results for Millstone Units 2 and 3, North Anna Units 1 and 2, and Surry Units 1 and 2 are confirmed in the PCT rackup tables, Attachments 2 through 4, 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 2015.

ATTACHMENT 2

**2015 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

2015 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

**DOMINION 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 Nuclear Connecticut, Inc.

Analysis Information

EM: PWR Small Break LOCA, S-RELAP5 Based **Limiting Break Size:** 0.08 ft²
Analysis Date: January 2002
Vendor: AREVA
Peak Linear Power: 15.1 kW/ft
Notes: None

	<u>Clad Temp (°F)</u>
LICENSING BASIS	
Analysis of Record PCT	1941
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. Decay Heat Model Error	-133
2. Revised SBLOCA Guideline	0
3. Core Exit Modeling-Upper Tie Plate Flow Area	-22
4. Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-8
5. S-RELAP5 Choked Flow Error with Non-Condensables Present	0
6. Radiation to Fluid Heat Transfer Model Change	-64
7. RELAP5 Kinetics Coding Error	4
8. RELAP5 Heat Conduction Solution	0
9. RODEX2 Thermal Conductivity Degradation	0
10. Sleicher-Rouse Correlation Modeling	83
11. S-RELAP5 Vapor Absorptivity Correlation	80
B. Planned Plant Modification Evaluations	
1. None	0
C. 2015 ECCS Model Assessments	
1. None	0
D. Other	
1. None	0
LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1881	

10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Millstone Power Station, Unit 2	
Utility Name:	Dominion Nuclear Connecticut, Inc.	
<u>Analysis Information</u>		
EM:	SEM/PWR-98	Limiting Break Size: 1.0 DECLG
Analysis Date:	11/98	
Vendor:	AREVA	
Peak Linear Power:	15.1 kW/ft	
Notes:	None	

	<u>Clad Temp (°F)</u>
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. 2015 ECCS Model Assessments

1. None 0

D. Other

1. None 0

LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1845

10 CFR 50.46 MARGIN UTILIZATION - SMALL BREAK LOCA

Plant Name:	Millstone Power Station, Unit 3		
Utility Name:	Dominion Nuclear Connecticut, Inc.		
<u>Analysis Information</u>			
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. SBLOCA Cladding Strain Requirement for Fuel Rod Burst	0
10. Fuel Rod Gap Conductance Error	0
11. Radiation Heat Transfer Model Error	0
12. SBLOCA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2015 ECCS Model Assessments	
1. None	0
D. Other	
1. None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1193

10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Millstone Power Station, Unit 3		
Utility Name:	Dominion Nuclear Connecticut, Inc.		
<u>Analysis Information</u>			
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		

	<u>Clad Temp (°F)</u>
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
B.	Planned Plant Modification Evaluations	
1.	None	0
C.	2015 ECCS Model Assessments	
1.	Errors in Support Plate, Core Barrel, and Vessel Wall Unheated Conductor	0
D.	Other	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		PCT = 1933

ATTACHMENT 3

**2015 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

2015 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

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

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

PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments		
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. SBLOCA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0	
B. Planned Plant Modification Evaluations		
1. None	0	
C. 2015 ECCS Model Assessments		
1. None	0	
D. Other		
1. None	0	

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1834.1
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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

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
B.	Planned Plant Modification Evaluations	
1.	None	0
C.	2015 ECCS Model Assessments	
1.	None	
D.	Other	
1.	Transition Core	0

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

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

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

PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments		
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. SBLOCA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0	
B. Planned Plant Modification Evaluations		
1. None	0	
C. 2015 ECCS Model Assessments		
1. None	0	
D. Other		
1. None	0	

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1834.1
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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	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

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
B.	Planned Plant Modification Evaluations	
1.	None	0
C.	2015 ECCS Model Assessments	
1.	None	
D.	Other	
1.	Transition Core	0
LICENSING BASIS PCT + PCT ASSESSMENTS PCT =		1982

ATTACHMENT 4

**2015 ANNUAL REPORT OF EMERGENCY CORE
COOLING SYSTEM (ECCS) MODEL CHANGES
PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46**

2015 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

Plant Name:	Surry Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
<u>Analysis Information</u>			
EM:	NOTRUMP	Limiting Break Size:	2.75 inches
Analysis Date:	5/7/2009		
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	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.	SBLOCA Cladding Strain Requirement for Fuel Rod Burst	0
9.	Fuel Rod Gap Conductance Error	0
10.	Radiation Heat Transfer Model Error	0
11.	SBLOCA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0
B. Planned Plant Modification Evaluations		
1.	None	0
C. 2015 ECCS Model Assessments		
1.	None	0
D. Other		
1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	2012
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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

Analysis Information

EM:	ASTRUM (2004)	Limiting Break Size:	DEG
Analysis Date:	10/6/2010		
Vendor:	Westinghouse		
FQ:	2.5	FAH:	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

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| 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
B.	Planned Plant Modification Evaluations	
1.	Evaluation of Additional Containment Metal	0
C.	2015 ECCS Model Assessments	
1.	None	0
D.	Other	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS PCT =		2071

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA

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

	<u>Clad Temp (°F)</u>
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.	SBLOCA Cladding Strain Requirement for Fuel Rod Burst	0
9.	Fuel Rod Gap Conductance Error	0
10.	Radiation Heat Transfer Model Error	0
11.	SBLOCA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0
B. Planned Plant Modification Evaluations		
1.	None	0
C. 2015 ECCS Model Assessments		
1.	None	0
D. Other		
1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	2012
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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	FAH:	1.7
Fuel:	Upgrade	SGTP (%):	7
Notes:	None		

	<u>Clad Temp (°F)</u>
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
B. Planned Plant Modification Evaluations		
1.	Evaluation of Additional Containment Metal	0
C. 2015 ECCS Model Assessments		
1.	None	0
D. Other		
1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	2071
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