Dominion Energy Services, Inc.
5000 Dominion Boulevard, Glen Allen, VA 23060
DominionEnergy.com

Dominion Energy®

June 28, 2018

10 CFR 50.46

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

Serial No.: 18-252
NRA/GDM R1
Docket Nos.: 50-336/423
50-338/339
50-280/281
License Nos.: DPR-65/NPF-49
NPF-4/7
DPR-32/37

DOMINION ENERGY 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
2017 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) and Virginia Electric and Power Company (Dominion Energy Virginia) 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, 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 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, and SPS 1 and 2, 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, 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 - 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

A002
NRR

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

The LOCA results for MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 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 10 CFR 50.46 requirements.

This information contained herein satisfies the 2017 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 and Fleet Support
Dominion Energy Nuclear Connecticut, Inc.
Virginia Electric and Power Company

Commitments made in this letter: None

Attachments: (4)

1. Report of Changes in Framatome and Westinghouse ECCS Evaluation Models
2. 2017 Annual Reporting of 10 CFR 50.46 Margin Utilization - Millstone Power Station Units 2 and 3
3. 2017 Annual Reporting of 10 CFR 50.46 Margin Utilization – North Anna Power Station Units 1 and 2
4. 2017 Annual Reporting of 10 CFR 50.46 Margin Utilization – Surry Power Station Units 1 and 2

cc: U. S. Nuclear Regulatory Commission, Region I
Regional Administrator
2100 Renaissance Blvd., Suite 100
King of Prussia, PA 19406-2713

U. S. Nuclear Regulatory Commission, Region II
Regional Administrator
Marquis One Tower
245 Peachtree Center Ave., NE Suite 1200
Atlanta, Georgia 30303-1257

NRC Senior Resident Inspector
Millstone Power Station

NRC Senior Resident Inspector
North Anna Power Station

NRC Senior Resident Inspector
Surry Power Station

Mr. J. R. Hall
NRC Senior Project Manager - North Anna
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop O8 B-1A
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. R. Guzman
NRC Senior Project Manager - Millstone Units 2 and 3
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop O8 C-2
11555 Rockville Pike
Rockville, MD 20852-2738

Ms. K. R. Cotton Gross
NRC Project Manager - Surry
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop O8 G-9A
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. Marcus Harris
Old Dominion Electric Cooperative
Innsbrook Corporate Center, Suite 300
4201 Dominion Blvd.
Glen Allen, Virginia 23060

Attachment 1

2017 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
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 FRAMATOME AND WESTINGHOUSE ECCS EVALUATION MODELS

Millstone Power Station Unit 2

1. Framatome identified the following changes or errors applicable to the EMF-2328(P)(A) Revision 0 with Supplement 1 evaluation model for Small Break LOCA (SBLOCA) for Millstone Unit 2 during 2017.

   - **M5® LOCA Swelling and Rupture.** The M5® swelling and rupture model (SRM) is used in several of the AREVA LOCA methodologies. The SRM was approved by the NRC in the early 2000s as part of the M5® Licensing Topical Report, BAW-10227, Rev. 1 (P)(A). Additional M5® cladding rupture test data has been obtained since the model's approval. Upon review of the data and the SRM's use in LOCA analysis, it was determined that certain of aspects of the model would be impacted. Following the same approach as the original model, an updated M5® SRM was developed to take into account the updated test database. The model changes do not change the predicted occurrence or conditions at the time of rupture, but would impact the post-rupture cladding characteristics for certain rupture temperatures.

     The analysis of record (AOR) was screened relative to the predicted rupture temperature. As the AOR had rupture temperatures less than the range of the model changes, the post-rupture conditions and, therefore, transient results do not change. Therefore, the Millstone Unit 2 M5® SBLOCA analysis peak clad temperature (PCT) estimated impact is 0°F.

   - **S-RELAP5 Oxidation Calculations.** An error was identified in the S-RELAP5 calculations of oxidation due to high temperature metal-water reaction. In a LOCA event, the cladding can swell (and potentially rupture) due to the difference in pressure between the fuel and the system which causes the clad to thin. The clad radius increases, while the thickness decreases. It was discovered that the S-RELAP5 oxidation calculations used cold cladding dimensions and therefore, did not fully account for the swelling phenomena. The error can lead to an under-prediction of the oxidation and heat from the metal-water reaction.

     Only licensing bases supported by S-RELAP5 analyses which model clad swelling are impacted. The licensing basis analyses, inclusive of previous ΔPCT estimates, were evaluated and a ΔPCT estimate has been determined. The Millstone Unit 2 SBLOCA analysis of record, which models the CE14 HTP fuel product with M5® clad, has a ΔPCT estimate of +3°F. The same ΔPCT estimate of +3°F applies to the Millstone Unit 2 fuel with Zr-4 cladding. No adjustment is needed to the previous ΔPCT applied as a Zr-4 product penalty.

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 2017. 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 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 Framatome Standard CE14 HTP fuel product with the M5® fuel rod cladding. The analysis predicted a PCT of 1615°F.

   Framatome identified the following changes or errors applicable to the EMF-2103(P)(A), Revision 3, evaluation model for RLBLOCA for Millstone Unit 2 during 2017.

   - **Placement of Hot Leg Piping Form Loss Coefficient.** An inconsistency was identified related to the placement of the form loss coefficient in the hot leg in the plant models. Page A-32 of EMF-2103(P)(A)-003 provides guidance on the location of the form loss coefficients for the hot leg piping model. The model that was built for the RLBLOCA analysis for the Millstone Unit 2 M5® Upgrade has the form loss coefficient placed in the incorrect location in the hot leg piping model.

     The investigation of this issue was conducted by re-calculating the transient responses for various cases from the AOR, including blowdown cases and the late reflood cases. For the Millstone Unit 2 RLBLOCA analysis, a PCT of 1615°F was calculated, leading to an estimated PCT impact of 0°F.

   - **M5® LOCA Swelling and Rupture.** The M5® SRM is used in several of the Framatome LOCA methodologies. The SRM was approved by the NRC in the early 2000s as part of the M5® Licensing Topical Report, BAW-10227, Rev. 1 (P)(A). Additional M5® cladding rupture test data has been obtained since the model's approval. Upon review of the data and the SRM's use in LOCA analysis, it was determined that certain of aspects of the model would be impacted. Following the same approach as the original model, an updated M5® SRM was developed to take into account the updated test database. The model changes do not change the predicted occurrence or conditions at the time of rupture, but would impact the post-rupture cladding characteristics for certain rupture temperatures.

     The AOR was screened relative to the predicted rupture temperature. As the AOR had rupture temperatures less than the range of the model changes, the post-rupture conditions and, therefore, transient results do not change. Therefore, the Millstone Unit 2 RLBLOCA analysis estimated PCT impact is 0°F.

- **S-RELAP5 Oxidation Calculations.** An error was identified in the S-RELAP5 calculations of oxidation due to high temperature metal-water reaction. In a LOCA event, the cladding can swell (and potentially rupture) due to the difference in pressure between the fuel and the system which causes the clad to thin. The clad radius increases, while the thickness decreases. It was discovered that the S-RELAP5 oxidation calculations used cold cladding dimensions and therefore, did not fully account for the swelling phenomena. The error can lead to an under-prediction of the oxidation and heat from the metal-water reaction.

  Only licensing bases supported by S-RELAP5 analyses which model clad swelling are impacted. The licensing basis analyses, inclusive of previous ΔPCT estimates, were evaluated and a ΔPCT estimate has been determined. The Millstone Unit 2 M5® RLBLOCA analysis ΔPCT estimate is 0°F.

Millstone Power Station Unit 3

1. Westinghouse identified the following changes and errors applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Millstone Unit 3 during 2017.

   - **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.

   - **Vessel Average Temperature Uncertainty.** A hysteresis issue was identified for plants with Weed Resistance Temperature Detectors (RTDs) supplied to Westinghouse, which resulted in an additional uncertainty of +0.1°F bias (indicated higher than actual) that applies to the Reactor Coolant System (RCS) average temperature accident analysis initial condition uncertainty. This discrepancy has been evaluated for impact on existing SBLOCA analysis results. This issue was evaluated as having a negligible impact on existing SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

   - **Error in the Upper Plenum Fluid Volume Calculation.** An error was found in the fluid volume calculation in the upper plenum where the support column outer diameter was being used instead of the inner diameter. The correction of this error lead to a reduction in the upper plenum fluid volume used in the Appendix K SBLOCA analyses. The corrected values represent a less than 1% change in the total RCS fluid volume and will be incorporated on a forward-fit basis, based on the evaluated impact on the current licensing basis analysis results. The differences in the upper plenum fluid volume are relatively minor and have been

evaluated to have a negligible effect on the SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

2. Westinghouse identified the following changes and errors 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 2017.

   - **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.

   - **Vessel Average Temperature Uncertainty.** A hysteresis issue was identified for plants with Weed Resistance Temperature Detectors (RTDs) supplied to Westinghouse, which resulted in an additional uncertainty of +0.1°F bias (indicated higher than actual) that applies to the Reactor Coolant System (RCS) average temperature accident analysis initial condition uncertainty. This discrepancy has been evaluated for impact on existing LBLOCA analysis results. This issue was evaluated as having a negligible impact on existing LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

   - **Steady-State Fuel Temperature Calibration Method.** In the ASTRUM BE LBLOCA EM, the steady-state fuel pellet temperature calibration method involves solving for the hot gap width (AGFACT) to calibrate the fuel temperature for each fuel rod. In some infrequent situations, small non-conservatisms can occur in the calibration process such that the resulting fuel pellet temperature will be slightly lower than intended and outside the acceptable range defined by Table 12-6 of WCAP-16009-P/NP-A [1]. A review of licensing basis analyses concluded that the potential non-conservatisms in the fuel pellet temperature calibration did not occur for the limiting analysis cases. Therefore, an estimated PCT impact of 0°F is assigned for 10 CFR 50.46 reporting purposes.

   - **Inappropriate Resetting of Transverse Liquid Mass Flow.** In the WCOBRA/TRAC routine which evaluates the mass and energy residual error of the time step solution, the transverse liquid mass flow is reset as the liquid phase disappears. The routine is updated to remove the resetting of the transverse liquid mass flow since the routine is to only evaluate the residual error based on the time step solution values. Based on the code validation results and limited applicability of the logic removed, correcting the error is estimated to have a 0°F impact on PCT.

- **Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient.** A numerical ramp which was used to account for the disappearance of the entrained liquid phase was applied to the entrained liquid / vapor interfacial drag coefficient. The numerical ramp was applied such that the interfacial drag coefficient used in the solution of the entrained liquid and vapor momentum equations was not consistent. WCOBRA/TRAC was updated to apply the numerical ramp prior to usage of the interfacial drag coefficient in the momentum equations, such that a consistent interfacial drag coefficient was used in the entrained liquid and vapor momentum equations. Based on the code validation results, the impact of correcting the error is estimated to have a 0°F impact on PCT.

North Anna Power Station Units 1 and 2

1. Westinghouse identified the following changes and errors applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for North Anna Units 1 and 2 during 2017.

   - **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.

   - **Error in the Upper Plenum Fluid Volume Calculation.** An error was found in the fluid volume calculation in the upper plenum where the support column outer diameter was being used instead of the inner diameter. The correction of this error lead to a reduction in the upper plenum fluid volume used in the Appendix K SBLOCA analyses. The corrected values represent a less than 1% change in the total RCS fluid volume and will be incorporated on a forward-fit basis, based on the evaluated impact on the current licensing basis analysis results. The differences in the upper plenum fluid volume are relatively minor and have been evaluated to have a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

2. Westinghouse identified the following changes and errors applicable to the 2004 Westinghouse BE LBLOCA EM using ASTRUM for North Anna Units 1 and 2 during 2017.

   - **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.

- **Steady-State Fuel Temperature Calibration Method.** In the ASTRUM BE LBLOCA EM, the steady-state fuel pellet temperature calibration method involves solving for the hot gap width (AGFACT) to calibrate the fuel temperature for each fuel rod. In some infrequent situations, small non-conservatisms can occur in the calibration process such that the resulting fuel pellet temperature will be slightly lower than intended and outside the acceptable range defined by Table 12-6 of WCAP-16009-P/NP-A [1]. A review of licensing basis analyses concluded that the potential non-conservatisms in the fuel pellet temperature calibration did not occur for the limiting analysis cases. Therefore, an estimated PCT impact of 0°F is assigned for 10 CFR 50.46 reporting purposes.

- **Inappropriate Resetting of Transverse Liquid Mass Flow.** In the WCOBRA/TRAC routine which evaluates the mass and energy residual error of the time step solution, the transverse liquid mass flow is reset as the liquid phase disappears. The routine is updated to remove the resetting of the transverse liquid mass flow since the routine is to only evaluate the residual error based on the time step solution values. Based on the code validation results and limited applicability of the logic removed, correcting the error is estimated to have a 0°F impact on PCT.

- **Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient.** A numerical ramp which was used to account for the disappearance of the entrained liquid phase was applied to the entrained liquid / vapor interfacial drag coefficient. The numerical ramp was applied such that the interfacial drag coefficient used in the solution of the entrained liquid and vapor momentum equations was not consistent. WCOBRA/TRAC was updated to apply the numerical ramp prior to usage of the interfacial drag coefficient in the momentum equations, such that a consistent interfacial drag coefficient was used in the entrained liquid and vapor momentum equations. Based on the code validation results, the impact of correcting the error is estimated to have a 0°F impact on PCT.

- **Correction to Fuel Pellet TCD Assessment.** Westinghouse informed North Anna that the output case rank quoted in Table 30-1 from Section 30.3 of WCAP-16996 to select the ranked output of cases for the 95/95 estimates for the joint population of PCT, Maximum Local Oxidation (MLO), and Core Wide Oxidation (CWO) results was incorrect. Table 30-1 identifies required sample sizes for k-th Maximum as Estimate of 95/95. Table 30-1 was used in the 2012 assessment of fuel pellet thermal conductivity degradation (TCD) for the ASTRUM Evaluation Model. (Refer to the North Anna 30-day report provided in letter Serial No. 12-330 dated May 16, 2012 [ADAMS Accession No. ML12143A149].) The error in application did not affect the estimated effect on

PCT of 135°F that is currently applicable to Units 1 and 2. Correcting the error resulted in an increase to the transient maximum local oxidation (MLO) and core wide oxidation (CWO). The total oxidation continues to meet the 17% total oxidation criterion in 10 CFR 50.46(b)(2) with a total evaluated MLO of 16.39%. The CWO limit of 1% is met. As noted above, correction to the fuel pellet TCD assessment is estimated to have a 0°F impact on PCT.

Westinghouse had a meeting with the NRC on February 27, 2017 to discuss this issue in WCAP-16996. A Dominion Energy Virginia specific teleconference to review the North Anna ASTRUM impact was held with the NRC on March 20, 2017.

Surry Power Station Units 1 and 2

1. Westinghouse identified the following changes and errors applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Surry Units 1 and 2 during 2017.

   - **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.

   - **Error in the Upper Plenum Fluid Volume Calculation.** An error was found in the fluid volume calculation in the upper plenum where the support column outer diameter was being used instead of the inner diameter. The correction of this error lead to a reduction in the upper plenum fluid volume used in the Appendix K SBLOCA analyses. The corrected values represent a less than 1% change in the total RCS fluid volume and will be incorporated on a forward-fit basis, based on the evaluated impact on the current licensing basis analysis results. The differences in the upper plenum fluid volume are relatively minor and have been evaluated to have a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

2. Westinghouse identified the following changes or errors applicable to the 2004 Westinghouse BE LBLOCA EM using ASTRUM for Surry Units 1 and 2 during 2017.

   - **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.

- **Steady-State Fuel Temperature Calibration Method.** In the ASTRUM BE LBLOCA EM, the steady-state fuel pellet temperature calibration method involves solving for the hot gap width (AGFACT) to calibrate the fuel temperature for each fuel rod. In some infrequent situations, small non-conservatisms can occur in the calibration process such that the resulting fuel pellet temperature will be slightly lower than intended and outside the acceptable range defined by Table 12-6 of WCAP-16009-P/NP-A [1]. A review of licensing basis analyses concluded that the potential non-conservatisms in the fuel pellet temperature calibration did not occur for the limiting analysis cases. Therefore, an estimated PCT impact of 0°F is assigned for 10 CFR 50.46 reporting purposes.

- **Inappropriate Resetting of Transverse Liquid Mass Flow.** In the WCOBRA/TRAC routine which evaluates the mass and energy residual error of the time step solution, the transverse liquid mass flow is reset as the liquid phase disappears. The routine is updated to remove the resetting of the transverse liquid mass flow since the routine is to only evaluate the residual error based on the time step solution values. Based on the code validation results and limited applicability of the logic removed, correcting the error is estimated to have a 0°F impact on PCT.

- **Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient.** A numerical ramp which was used to account for the disappearance of the entrained liquid phase was applied to the entrained liquid / vapor interfacial drag coefficient. The numerical ramp was applied such that the interfacial drag coefficient used in the solution of the entrained liquid and vapor momentum equations was not consistent. WCOBRA/TRAC was updated to apply the numerical ramp prior to usage of the interfacial drag coefficient in the momentum equations, such that a consistent interfacial drag coefficient was used in the entrained liquid and vapor momentum equations. Based on the code validation results, the impact of correcting the error is estimated to have a 0°F impact on PCT.

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 rack-up tables, Attachments 2 through 4, respectively, 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 2017.

Attachment 2

2017 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2017 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

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1707
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Zirc-4 Product Penalty	4
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2017 ECCS Model Assessments**	
1.	M5 LOCA Swelling and Rupture	0
2.	S-RELAP5 Oxidation Calculations	3
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: Framatome
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.	**2017 ECCS Model Assessments**	
1. None		0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1845**

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.

Analysis Information

EM:	EMF-2103	**Limiting Break Size:** 1.0 DEGB
Analysis Date:	January 2017	
Vendor:	Framatome	
Peak Linear Power:	15.1 kW/ft	
Notes:	None	

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1615
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	None	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2017 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
D.	**Other**	
1.	None	0
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		

	Clad Temp (°F)
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
B. Planned Plant Modification Evaluations	
1. None	0
C. 2017 ECCS Model Assessments	
1. Vessel Average Temperature Uncertainty	0
2. Error in the Upper Plenum Fluid Volume Calculation	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 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		

		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
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2017 ECCS Model Assessments**		
	1.	Vessel Average Temperature Uncertainty	0
	2.	Steady-State Fuel Temperature Calibration Method	0
	3.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
	4.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
D.	**Other**		
	1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**1933**

Attachment 3

2017 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2017 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

VIRGINIA ELECTRIC AND POWER COMPANY
(DOMINION ENERGY VIRGINIA)
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

Analysis Information

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		

	Clad Temp (°F)
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. SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient Calculation	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2017 ECCS Model Assessments	
1. Error in the Upper Plenum Fluid Volume Calculation	0
D. Other	
1. None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT = 1834.1**

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
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 Errors0	0
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2017 ECCS Model Assessments**		
	1.	Steady-State Fuel Temperature Calibration Method	0
	2.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
	3.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
	4.	Correction to Fuel Pellet TCD Assessment	0
D.	**Other**		
	1.	None	

LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1982**

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

Analysis Information

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		

	Clad Temp (°F)
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. 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
B. Planned Plant Modification Evaluations	
1. None	0
C. 2017 ECCS Model Assessments	
1. Error in the Upper Plenum Fluid Volume Calculation	0
D. Other	
1. None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT = 1834.1**

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
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
27.	Error in Oxidation Calculations	0
28.	Error in use of ASME Steam Tables	0
29.	Support Column Core Barrel Unheated Conductor Errors	0

B. Planned Plant Modification Evaluations

1.	None	0

C. 2017 ECCS Model Assessments

1.	Steady-State Fuel Temperature Calibration Method	0
2.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
3.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
4.	Correction to Fuel Pellet TCD Assessment	0

D. Other

1.	None	

LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1982**

ATTACHMENT 4

2017 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2017 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

VIRGINIA ELECTRIC AND POWER COMPANY
(DOMINION ENERGY VIRGINIA)
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

Analysis Information

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		

		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
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2017 ECCS Model Assessments**	
1.	Error in the Upper Plenum Fluid Volume Calculation	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**2012**

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	**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

B. Planned Plant Modification Evaluations

1.	None	0

C. 2017 ECCS Model Assessments

1.	Steady-State Fuel Temperature Calibration Method	0
2.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
3.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	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		
Analysis Information			
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		

		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
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2017 ECCS Model Assessments**	
1.	Error in the Upper Plenum Fluid Volume Calculation	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**2012**

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	Surry Power Station, Unit 2		
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	**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
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2017 ECCS Model Assessments**		
	1.	Steady-State Fuel Temperature Calibration Method	0
	2.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
	3.	Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient	0
D.	**Other**		
	1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**2071**