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Dominion®

June 30, 2015

10 CFR 50.46

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

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NL&OS/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
2014 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 AREVA and Westinghouse 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.

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 - AREVA Evaluation Model:	1395°F
North Anna Unit 1 - Large break - AREVA Evaluation Model:	1866°F
North Anna Unit 2 - Small break - AREVA Evaluation Model:	1338°F
North Anna Unit 2 - Large break - AREVA Evaluation Model:	1909°F

A002
NRR

North Anna Unit 1 - Small break - Westinghouse Evaluation Model:	1834.1°F
North Anna Unit 1 - Large break - Westinghouse Evaluation Model:	1982°F
North Anna Unit 2 - Small break - Westinghouse Evaluation Model:	1834.1°F
North Anna Unit 2 - Large break - Westinghouse Evaluation Model:	1994°F
Surry Units 1 and 2 - Small break - Westinghouse Evaluation Model:	2012°F
Surry Units 1 and 2 - Large break - Westinghouse Evaluation Model:	2085°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.

The information contained herein satisfies the 2014 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. 2014 Annual Reporting of 10 CFR 50.46 Margin Utilization - Millstone Power Station Units 2 and 3

3. 2014 Annual Reporting of 10 CFR 50.46 Margin Utilization – North Anna Power Station Units 1 and 2

4. 2014 Annual Reporting of 10 CFR 50.46 Margin Utilization – Surry Power Station Units 1 and 2

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ATTACHMENT 1

2014 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 the following changes or errors applicable to the S-RELAP5 based Small Break Loss of Coolant Accident (SBLOCA) Evaluation Model for Millstone Unit 2 during 2014:

   - **S-RELAP5 Vapor Absorptivity Correlation.** AREVA evaluated and observed differences between S-RELAP5 Boiling Water Reactor (BWR) LOCA results and data from the Thermal Hydraulic Test Facility (THTF).

     Upon investigation, it was found that the correlation for vapor absorptivity used in S-RELAP5 was being applied outside of its intended range of applicability (no limit on the pressure at which the correlation was applied).

     The vapor absorptivity correlation applied to the S-RELAP5 based methodologies is provided in the S-RELAP5 Models and Correlation Code Manual, Reference 1. The equation used for the absorption coefficient of vapor contains the term of the pressure which needs to be truncated in order to obtain the correct emissivity values for an optically thick steam. The applicability of the pressure limit is described in literature by S.S. Penner, Reference 2. No lower pressure limit on the vapor absorptivity correlation is required as the correlation is developed for optically thin gases, which already applies at low pressures.

     Results show that limiting the vapor absorptivity correlation to within its intended pressure range, allows S-RELAP5 to predict the wall temperatures for THTF within the uncertainty bands or above the uncertainty bands (conservative).

     A development version of S-RELAP5 was prepared containing the pressure limit for the calculation of the vapor absorptivity in order to assess the impact on the current Analysis of Record (AOR) for SBLOCA. The PCT increase was developed by comparing the AOR after correcting all previously reported errors with the new PCT results obtained with the corrected version of S-RELAP5. The limiting case and multiple break sizes around the limiting case were rerun with the developmental code version of S-RELAP5.

     The estimated impact of this change on the Millstone Unit 2 SBLOCA analysis calculated peak cladding temperature is +80°F, leading to a new calculated Peak Cladding Temperature (PCT) of 1881°F.

     References

     1. AREVA Document EMF-2100(P), Rev.16, "S-RELAP5 Models and Correlation Code Manual."

2. S. S Penner, "Quantitative Molecular Spectroscopy and Gas Emissivities" Addison Wesley Publishing Company, Inc.

For Millstone Power Station Unit 2, the above issue resulted in the accumulation of changes to the calculated PCT to exceed 50°F and was previously reported to the NRC in a letter dated May 8, 2014 (Serial No. 14-178) to meet the 30-day reporting requirements of 10 CFR 50.46(a)(3)(ii).

2. AREVA did not identify any changes or errors applicable to the SEM/PWR-98 evaluation model for Large Break LOCA (LBLOCA) for Millstone Unit 2 during 2014.

Millstone Power Station Unit 3

1. Westinghouse identified the following changes or errors to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Millstone Unit 3 during 2014:

- **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.

- **Fuel Rod Gap Conductance Error.** An error was identified in the fuel rod gap conductance model in the NOTRUMP computer code (reactor coolant system response model). The error is associated with the use of an incorrect temperature in the calculation of the cladding emissivity term. This error corresponds to a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451.

  The estimated effect was determined based on a combination of engineering judgment of the phenomena and physics of an SBLOCA and sensitivity calculations performed with the advanced plant version of NOTRUMP. It was concluded that this error has a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Radiation Heat Transfer Model Error.** Two errors were discovered in the calculation of the radiation heat transfer coefficient within the fuel rod model of the NOTRUMP computer code (reactor coolant system response model). First, existing logic did not preclude non-physical negative or large (negative or positive) radiation heat transfer coefficients from being calculated. These erroneous calculations occurred when the vapor temperature exceeded the cladding surface temperature or when the predicted temperature difference was less than 1°F. Second, a temperature term incorrectly used degrees Fahrenheit instead of Rankine. These errors represent a closely related group of Non-Discretionary problems in accordance with Section 4.1.2 of WCAP-13451.

The estimated effect was determined based on a combination of engineering judgment of the phenomena and physics of a SBLOCA and sensitivity calculations performed with the advanced plant version of NOTRUMP. It was concluded that this error has a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **SBLOCTA Pre-DNB Cladding Surface Heat Transfer Coefficient Calculation.** Two errors were discovered in the pre-departure from nucleate boiling (pre-DNB) cladding surface heat transfer coefficient calculation in the SBLOCTA code (cladding heat-up calculations). The first error is a result of inconsistent time units (hours vs. seconds) in the parameters used for the calculation of the Reynolds and Prandtl numbers, and the second error relates to an incorrect diameter used to develop the area term in the cladding surface heat flux calculation. Both of these issues impact the calculation of the pre-DNB convective heat transfer coefficient, representing a closely related group of Non-Discretionary Changes to the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

  These errors have been corrected in the SBLOCTA code. Because this condition occurred prior to DNB, it was judged that these errors had no direct impact on the cladding heat-up related to the core uncovery period. A series of validation tests were performed and confirmed that these errors 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 Best Estimate (BE) LBLOCA Evaluation Model using the Automated Statistical Treatment of Uncertainty Method (ASTRUM) for Millstone Unit 3 during 2014:

   - **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.

   - **Errors in Decay Group Uncertainty Factors.** Errors in the calculation of decay heat were discovered in the WCOBRA/TRAC code. The decay group uncertainty factors for each fissile isotope are provided in Table 8-14 of WCAP-16009-P-A. The uncertainty factors for Pu-239 were applied to U-238, and those for U-238 were applied to Pu-239. This error causes an over-prediction of the uncertainty in decay power from Pu-239 and an under-prediction of the uncertainty in decay power from U-238. Further, the decay group uncertainty factor for Decay Group 6 of U-235 was erroneously coded as 2.5% instead of 2.25%. Correction of these errors impacts the application of the sampled decay heat uncertainty, which may result in small changes to the decay heat power. These issues have been evaluated to estimate the impact on ASTRUM BE LBLOCA analysis results. The resolution of these issues represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

This issue was judged to have either no effect or a negligible effect on the LBLOCA analysis results, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

North Anna Power Station Units 1 and 2

1. AREVA identified no changes or errors in the SBLOCA evaluation models for North Anna Units 1 and 2 during 2014.

2. AREVA identified the following changes or errors applicable to the Realistic LBLOCA (RLBLOCA), RELAP5 based evaluation model for North Anna Units 1 and 2 during 2014:

   - **S-RELAP5 Vapor Absorptivity Correlation.** AREVA identified an issue with S-RELAP5 vapor absorptivity correlation. While preparing an update of the Boiling Water Reactor (BWR) LOCA Appendix K methodology using S-RELAP5, the Thermal Hydraulic Test Facility (THTF) level swell assessment for BWR was reviewed for rod wall temperatures and determined to be non-conservative relative to the data. The observation was unexpected since other assessments (including the THTF steady state and reflood tests) showed good or conservative agreement. The issue was discovered as part of a proactive response to discussions with NRC. The THTF facility, operated by Oak Ridge National Laboratory (ORNL), is a large high pressure thermal-hydraulic loop with non-nuclear (electrically heated) rods simulating a nuclear fuel bundle. The facility is designed to simulate the thermal hydraulic environments expected during SBLOCA LOCA events. Some of the phenomena simulated are applicable to the Pressurized Water Reactor (PWR) LBLOCA as well.

     Further investigation found that the correlation for vapor absorptivity used in S-RELAP5 was being applied outside of its intended range of applicability (no limit on the pressure at which the correlation was applied).

     For RLBLOCA, single phase steam only exists for a very limited time just before the beginning of reflood. During the majority of the blowdown phase and during the entire reflood phase, which are the important RLBLOCA phases, the core is in a dispersed flow regime. The S-RELAP5 methodology uses the FLECHT-SEASET reflood tests to determine the heat transfer bias and the uncertainty under these conditions. In addition, the transient progression is very quick and the system depressurizes in the first few seconds after the break opening. Due to the fast depressurization, the amount of time that the correlation for vapor absorptivity used in RLBLOCA is applied outside of the range of applicability is limited, and therefore the results predicted in the Analysis of Record (AOR) remain valid. The estimated PCT impact for North Anna Units 1 and 2 RLBLOCA is 0°F.

- **Non-Physical Axial Shapes**. AREVA identified an issue with the non-physical axial shapes generated by the modal decomposition procedure. In RLBLOCA the axial shapes for the calculations are selected from many possible shapes from a large number of PRISM depletion calculations generated by PWR Core Engineering. These shapes are dependent on the time in cycle and cover both top and bottom peaked shapes, within a range of Axial Offsets and a corresponding range of Fz values.

  A recent evaluation of the modal decomposition method led to a detailed examination of the actual axial shapes that were produced by the modal decomposition procedure, and it was observed that, in general, some of these resulting shapes were significantly different from the 24-node shape that was generated by PWR Core Engineering. These shapes exhibit a super-imposed oscillation created by the modal decomposition that leads to non-physical artificial local peaks and valleys in the shape.

  When such shapes are generated and used in the LOCA analyses, they tend to shift the PCT location toward the higher elevations. It also tends to generate higher PCT values than would normally occur. However, in certain cases the opposite occurs, i.e., a lower PCT can be calculated when power from one region of the shape that would become potentially limiting is shifted to the nodes upstream and downstream.

  The evaluation for the set of cases and axial shapes applied to North Anna Unit 1 and Unit 2 RLBLOCA AORs shows that the axial shapes mapped using modal decomposition have significant oscillations when compared to the input (pre-mapped) axial shapes. Therefore, the set of cases that showed significant oscillations were re-calculated using the linear interpolation mapping method. The new set of cases shows that, for North Anna Unit 1 and Unit 2, the modal decomposition method used in the AORs leads to conservative PCT calculations. Therefore, the estimated impact of this change on North Anna Unit 1 and Unit 2 RLBLOCA analyses calculated PCT is 0°F.

3. Westinghouse identified the following changes or errors in the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP evaluation models for North Anna Units 1 and 2 during 2014:

- **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.

- **Fuel Rod Gap Conductance Error.** An error was identified in the fuel rod gap conductance model in the NOTRUMP computer code (reactor coolant system response model). The error is associated with the use of an incorrect temperature in the calculation of the cladding emissivity term. This error corresponds to a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451.

  The estimated effect was determined based on a combination of engineering judgment of the phenomena and physics of an SBLOCA and sensitivity calculations performed with the advanced plant version of NOTRUMP. It was concluded that this error has a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Radiation Heat Transfer Model Error.** Two errors were discovered in the calculation of the radiation heat transfer coefficient within the fuel rod model of the NOTRUMP computer code (reactor coolant system response model). First, existing logic did not preclude non-physical negative or large (negative or positive) radiation heat transfer coefficients from being calculated. These erroneous calculations occurred when the vapor temperature exceeded the cladding surface temperature or when the predicted temperature difference was less than 1°F. Second, a temperature term incorrectly used degrees Fahrenheit instead of Rankine. These errors represent a closely related group of Non-Discretionary problems in accordance with Section 4.1.2 of WCAP-13451.

  The estimated effect was determined based on a combination of engineering judgment of the phenomena and physics of a SBLOCA and sensitivity calculations performed with the advanced plant version of NOTRUMP. It was concluded that this error has a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **SBLOCTA Pre-DNB Cladding Surface Heat Transfer Coefficient Calculation.** Two errors were discovered in the pre-departure from nucleate boiling (pre-DNB) cladding surface heat transfer coefficient calculation in the SBLOCTA code (cladding heat-up calculations). The first error is a result of inconsistent time units (hours vs. seconds) in the parameters used for the calculation of the Reynolds and Prandtl numbers, and the second error relates to an incorrect diameter used to develop the area term in the cladding surface heat flux calculation. Both of these issues impact the calculation of the pre-DNB convective heat transfer coefficient, representing a closely related group of Non-

Discretionary Changes to the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

These errors have been corrected in the SBLOCTA code. Because this condition occurred prior to DNB, it was judged that these errors had no direct impact on the cladding heat-up related to the core uncovery period. A series of validation tests were performed and confirmed that these errors have a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

4. Westinghouse identified the following changes or errors applicable to the 2004 Westinghouse BE LBLOCA Evaluation Model using the ASTRUM based evaluation model for North Anna Units 1 and 2 during 2014:

    - **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.

    - **Errors in Decay Group Uncertainty Factors.** Errors in the calculation of decay heat were discovered in the WCOBRA/TRAC code. The decay group uncertainty factors for each fissile isotope are provided in Table 8-14 of WCAP-16009-P-A. The uncertainty factors for Pu-239 were applied to U-238, and those for U-238 were applied to Pu-239. This error causes an over-prediction of the uncertainty in decay power from Pu-239 and an under-prediction of the uncertainty in decay power from U-238. Further, the decay group uncertainty factor for Decay Group 6 of U-235 was erroneously coded as 2.5% instead of 2.25%. Correction of these errors impacts the application of the sampled decay heat uncertainty, which may result in small changes to the decay heat power. These issues have been evaluated to estimate the impact on ASTRUM BE LBLOCA analysis results. The resolution of these issues represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

      This issue was judged to have either no effect or a negligible effect on the LBLOCA analysis results, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

Surry Power Station Units 1 and 2

1. Westinghouse identified the following changes or errors applicable to the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for Surry Units 1 and 2 during 2014:

- **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.

- **Fuel Rod Gap Conductance Error.** An error was identified in the fuel rod gap conductance model in the NOTRUMP computer code (reactor coolant system response model). The error is associated with the use of an incorrect temperature in the calculation of the cladding emissivity term. This error corresponds to a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451.

  The estimated effect was determined based on a combination of engineering judgment of the phenomena and physics of an SBLOCA and sensitivity calculations performed with the advanced plant version of NOTRUMP. It was concluded that this error has a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Radiation Heat Transfer Model Error.** Two errors were discovered in the calculation of the radiation heat transfer coefficient within the fuel rod model of the NOTRUMP computer code (reactor coolant system response model). First, existing logic did not preclude non-physical negative or large (negative or positive) radiation heat transfer coefficients from being calculated. These erroneous calculations occurred when the vapor temperature exceeded the cladding surface temperature or when the predicted temperature difference was less than 1°F. Second, a temperature term incorrectly used degrees Fahrenheit instead of Rankine. These errors represent a closely related group of Non-Discretionary problems in accordance with Section 4.1.2 of WCAP-13451.

  The estimated effect was determined based on a combination of engineering judgment of the phenomena and physics of a SBLOCA and sensitivity calculations performed with the advanced plant version of NOTRUMP. It was concluded that this error has a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **SBLOCTA Pre-DNB Cladding Surface Heat Transfer Coefficient Calculation.** Two errors were discovered in the pre-departure from nucleate boiling (pre-DNB) cladding surface heat transfer coefficient calculation in the SBLOCTA code (cladding heat-up calculations). The first error is a result of inconsistent time units (hours vs. seconds) in the parameters used for the calculation of the Reynolds and Prandtl numbers, and the second error relates to an incorrect diameter used to develop the area term in the cladding surface heat flux calculation. Both of these issues impact the calculation of the pre-DNB convective heat transfer coefficient, representing a closely related group of Non-

Discretionary Changes to the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

These errors have been corrected in the SBLOCTA code. Because this condition occurred prior to DNB, it was judged that these errors had no direct impact on the cladding heat-up related to the core uncovery period. A series of validation tests were performed and confirmed that these errors 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 Evaluation Model using the ASTRUM code for Surry Units 1 and 2 during 2014:

   - **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.

   - **Errors in Decay Group Uncertainty Factors.** Errors in the calculation of decay heat were discovered in the WCOBRA/TRAC code. The decay group uncertainty factors for each fissile isotope are provided in Table 8-14 of WCAP-16009-P-A. The uncertainty factors for Pu-239 were applied to U-238, and those for U-238 were applied to Pu-239. This error causes an over-prediction of the uncertainty in decay power from Pu-239 and an under-prediction of the uncertainty in decay power from U-238. Further, the decay group uncertainty factor for Decay Group 6 of U-235 was erroneously coded as 2.5% instead of 2.25%. Correction of these errors impacts the application of the sampled decay heat uncertainty, which may result in small changes to the decay heat power. These issues have been evaluated to estimate the impact on ASTRUM BE LBLOCA analysis results. The resolution of these issues represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

   The issues described above were evaluated to account for the correction of these errors. The plant specific sensitivity study resulted in an estimated PCT impact of +4°F for Surry Units 1 and 2.

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 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. 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) covering calendar year 2014.

ATTACHMENT 2

2014 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2014 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 ft^2
Analysis Date: January 2002
Vendor: AREVA
Peak Linear Power: 15.1 kW/ft
Notes: None

			Clad Temp (°F)
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
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2014 ECCS Model Assessments**		
	1.	S-RELAP5 Vapor Absorptivity Correlation	80
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.

Analysis Information

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

		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.	**2014 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.

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
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2014 ECCS Model Assessments**		
	1.	Fuel Rod Gap Conductance Error	0
	2.	Radiation Heat Transfer Model Error	0
	3.	SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient 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 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
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2014 ECCS Model Assessments**		
	1.	Errors in Decay Group Uncertainty Factors	0
D.	**Other**		
	1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1933

ATTACHMENT 3

2014 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2014 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 - AREVA SMALL BREAK LOCA

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

Analysis Information

EM:	AREVA SB EM	**Limiting Break Size:**	5.2 Inches (SI Line)
Analysis Date:	2004		
Vendor:	AREVA		
FQ:	2.32	**FΔH:**	1.65
Fuel:	Advanced Mark-BW	**SGTP (%):**	7
Notes:	None		

	Clad Temp (°F)
LICENSING BASIS	
Analysis of Record PCT	1404
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-8
2. RCCA Reactivity Input	-3
3. Critical Flow Transition	26
4. Revised Test Flow Curve for HHSI	-24
5. Advanced Mark BW Top Nozzle Modification	0
6. RELAP5 Kinetics and Heat Conduction Model	0
7. TACO3 – Thermal Conductivity Degradation	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2014 ECCS Model Assessments	
1. None	0
D. Other	
1. None	0
LICENSING BASIS PCT + PCT ASSESSMENTS PCT =	**1395**

10 CFR 50.46 MARGIN UTILIZATION - AREVA LARGE BREAK LOCA

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

Analysis Information

EM:	AREVA RLBLOCA EM	**Limiting Break Size:**	DEGB
Analysis Date:	2004		
Vendor:	AREVA		
FQ:	2.32	**FΔH:**	1.65
Fuel:	Advanced Mark-BW	**SGTP (%):**	12
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1853
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Forslund-Rohsenow Correlation Modeling	64
2.	RWST Temperature Assumption	8
3.	LBLOCA/Seismic SG Tube Collapse	0
4.	ICECON Code Errors	0
5.	RLBLOCA Choked Flow Disposition	-26
6.	RLBLOCA Changes in Uncertainty Parameters	10
7.	Advanced Mark-BW Top Nozzle Modification	65
8.	GSI-191 Sump Strainer	0
9.	Blowdown Quench	0
10.	Mixture Level Model Limitation in the S-RELAP5 Code	-29
11.	Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-20
12.	Cold Leg Condensation Under Predicted by S-RELAP5 Following Accumulator Injection	0
13.	Cross-Flow Junction Area in S-RELAP Model	0
14.	Radiation to Fluid Heat Transfer Model Change	-32
15.	MUR Implementation	2
16.	S-RELAP5 Kinetics and Heat Conduction Model	-29
17.	RODEX3A – Thermal Conductivity Degradation	0
18.	Steam Generator Entrainment Bias Factor (FIJ) Change	-4
19.	RLBLOCA Upper Plenum Modeling	8
20.	Sleicher-Rouse Correlation Modeling	14
21.	Liquid Fallback into Surrounding 6 Assemblies	-8
22.	Cathcart-Pawel Uncertainty Implementation in RLBLOCA Applications	0

23.	Issue with S-RELAP5 routine associated with the RODEX3a fuel rod model	-10
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2014 ECCS Model Assessments**	
1.	S-RELAP5 Vapor Absorptivity Correlation	0
2.	Non-physical axial shapes	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1866**

10 CFR 50.46 MARGIN UTILIZATION - AREVA SMALL BREAK LOCA

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

Analysis Information

EM:	AREVA SB EM	**Limiting Break Size:**	3 Inches
Analysis Date:	2004		
Vendor:	AREVA		
FQ:	2.32	**FΔH:**	1.65
Fuel:	Advanced Mark-BW	**SGTP (%):**	7
Notes:	None		

			Clad Temp (°F)
LICENSING BASIS			
	Analysis of Record PCT		1370
PCT ASSESSMENTS (Delta PCT)			
A.	**Prior ECCS Model Assessments**		
	1.	Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-8
	2.	RCCA Reactivity Input	-29
	3.	Critical Flow Transition	5
	4.	RELAP5 Kinetics and Heat Conduction Model	0
	5.	TACO3 – Thermal Conductivity Degradation	0
	6.	Advanced Mark BW Top Nozzle Modification	0
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2014 ECCS Model Assessments**		
	1.	None	0
D.	**Other**		
	1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**1338**

10 CFR 50.46 MARGIN UTILIZATION - AREVA LARGE BREAK LOCA

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

Analysis Information

EM:	AREVA RLBLOCA EM	**Limiting Break Size:**	DEGB
Analysis Date:	2004		
Vendor:	AREVA		
FQ:	2.32	**FΔH:**	1.65
Fuel:	Advanced Mark-BW	**SGTP (%):**	12
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1789
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Forslund-Rohsenow Correlation Modeling	64
2.	RWST Temperature Assumption	8
3.	LBLOCA/Seismic SG Tube Collapse	0
4.	ICECON Code Errors	0
5.	RLBLOCA Choked Flow Disposition	22
6.	RLBLOCA Changes in Uncertainty Parameters	10
7.	Advanced Mark-BW Top Nozzle Modification	65
8.	GSI-191 Sump Strainer	0
9.	Mixture Level Model Limitation in the S-RELAP5 Code	-19
10.	Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-20
11.	Cold Leg Condensation Under Predicted by S-RELAP5 Following Accumulator Injection	0
12.	Cross-Flow Junction Area in S-RELAP Model	0
13.	Radiation to Fluid Heat Transfer Model Change	-32
14.	S-RELAP5 Kinetics and Heat Conduction Model	-29
15.	RODEX3A – Thermal Conductivity Degradation	0
16.	Steam Generator Entrainment Bias Factor (FIJ) Change	-4
17.	MUR Implementation	20
18.	RLBLOCA Upper Plenum Modeling	0
19.	Sleicher-Rouse Correlation Modeling	14
20.	Liquid Fallback into Surrounding 6 Assemblies	31
21.	Cathcart-Pawel Uncertainty Implementation in RLBLOCA Applications	0
22.	Issue with S-RELAP5 routine associated with the RODEX3a fuel rod model	-10

B.	**Planned Plant Modification Evaluations**	
	1. None	0
C.	**2014 ECCS Model Assessments**	
	1. S-RELAP5 Vapor Absorptivity Correlation	0
	2. Non-physical axial shapes	0
D.	**Other**	
	1. None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1909**

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.	SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2014 ECCS Model Assessments**	
1.	Fuel Rod Gap Conductance Error	0
2.	Radiation Heat Transfer Model Error	0
3.	SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient 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
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2014 ECCS Model Assessments**		
	1.	Errors in Decay Group Uncertainty Factors	0
D.	**Other**		
	1.	Transition Core	0
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
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2014 ECCS Model Assessments**	
1.	Fuel Rod Gap Conductance Error	0
2.	Radiation Heat Transfer Model Error	0
3.	SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient 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:	8/20/2010		
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	1871
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	101
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	5
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	-4
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
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2014 ECCS Model Assessments**		
	1.	Errors in Decay Group Uncertainty Factors	0
D.	**Other**		
	1.	Transition Core	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**1994**

ATTACHMENT 4

2014 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2014 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		

Analysis Information

EM:	NOTRUMP	**Limiting Break Size:**	2.75 Inches
Analysis Date:	5/7/2009		
Vendor:	Westinghouse		
FQ:	2.5	**FΔH:**	1.7
Fuel:	Mixed: Upgrade/SIF	**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
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2014 ECCS Model Assessments**	
1.	Fuel Rod Gap Conductance Error	0
2.	Radiation Heat Transfer Model Error	0
3.	SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient 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:	Mixed: Upgrade/SIF	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1853
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Transition Core (applied to mixed SIF/Upgrade core only)	14
2.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	183
3.	Pellet Radial Profile Option	-13
4.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
5.	Rod Internal Pressure Calculation	0
6.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
7.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
8.	WCOBRA/TRAC Automated Restart Process Logic Error	0
9.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0
10.	Elevations for Heat Slab Temperature Initialization	0
11.	Heat Transfer Model Error Corrections	0
12.	Correction to Heat Transfer Node Initialization	0
13.	Mass Conservation Error Fix	0
14.	Correction to Split Channel Momentum Equation	0
15.	Heat Transfer Logic Correction for Rod Burst Calculation	0
16.	Changes to Vessel Superheated Steam Properties	0
17.	Update to Metal Density Reference Temperatures	0
18.	Decay Heat Model Error Corrections	0
19.	Correction to the Pipe Exit Pressure Drop Error	0
20.	WCOBRA/TRAC U19 File Dimension Error Correction	0
21.	Revised Heat Transfer Multiplier Distributions	-7
22.	HOTSPOT Burst Strain Error Correction	51
23.	Changes to Grid Blockage Ratio and Porosity	0
24.	Grid Heat Transfer Enhancement Calculation	0

	25.	Vessel Section 7 Mid-Level Elevation Modeling	0
	26.	Burst Elevation Selection	0
B.	**Planned Plant Modification Evaluations**		
	1.	Evaluation of Additional Containment Metal	0
C.	**2014 ECCS Model Assessments**		
	1.	Errors in Decay Group Uncertainty Factors	4
D.	**Other**		
	1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**2085**

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:	Mixed: Upgrade/SIF	**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
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2014 ECCS Model Assessments**	
1.	Fuel Rod Gap Conductance Error	0
2.	Radiation Heat Transfer Model Error	0
3.	SBLOCTA Pre-DNB Cladding Heat Transfer Coefficient 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:	Mixed: Upgrade/SIF	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1853
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Transition Core (applied to mixed SIF/Upgrade core only)	14
2.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	183
3.	Pellet Radial Profile Option	-13
4.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
5.	Rod Internal Pressure Calculation	0
6.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
7.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
8.	WCOBRA/TRAC Automated Restart Process Logic Error	0
9.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0
10.	Elevations for Heat Slab Temperature Initialization	0
11.	Heat Transfer Model Error Corrections	0
12.	Correction to Heat Transfer Node Initialization	0
13.	Mass Conservation Error Fix	0
14.	Correction to Split Channel Momentum Equation	0
15.	Heat Transfer Logic Correction for Rod Burst Calculation	0
16.	Changes to Vessel Superheated Steam Properties	0
17.	Update to Metal Density Reference Temperatures	0
18.	Decay Heat Model Error Corrections	0
19.	Correction to the Pipe Exit Pressure Drop Error	0
20.	WCOBRA/TRAC U19 File Dimension Error Correction	0
21.	Revised Heat Transfer Multiplier Distributions	-7
22.	HOTSPOT Burst Strain Error Correction	51
23.	Changes to Grid Blockage Ratio and Porosity	0
24.	Grid Heat Transfer Enhancement Calculation	0

	25.	Vessel Section 7 Mid-Level Elevation Modeling	0
	26.	Burst Elevation Selection	0
B.	**Planned Plant Modification Evaluations**		
	1.	Evaluation of Additional Containment Metal	0
C.	**2014 ECCS Model Assessments**		
	1.	Errors in Decay Group Uncertainty Factors	4
D.	**Other**		
	1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**2085**