

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

May 6, 2016

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

Serial No. 16-174
NL&OS/DEA R0
Docket Nos. 50-338/339
License Nos. NPF-4/7

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
30-DAY 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), Virginia Electric and Power Company (Dominion) hereby submits information regarding changes to the Emergency Core Cooling System (ECCS) Evaluation Models for the Small Break Loss of Coolant Accident (SBLOCA) and the Large Break Loss of Coolant Accident (LBLOCA) analyses for North Anna Power Station (NAPS), Units 1 and 2.

Attachment 1 of this letter provides a report describing plant-specific ECCS Evaluation Model changes associated with the Westinghouse and AREVA ECCS Evaluation Models for the SBLOCA and LBLOCA analyses for NAPS Units 1 and 2.

Information regarding the effect of the plant-specific ECCS Evaluation Model changes associated with the Westinghouse ECCS Evaluation Model changes for the SBLOCA and LBLOCA analyses results reported for North Anna Units 1 and 2 is provided in Attachment 2. The peak cladding temperatures (PCT) calculated for the SBLOCA and LBLOCA analyses for NAPS Units 1 and 2 are provided in Attachment 2 and summarized below:

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: 1982°F

The PCT results for NAPS Units 1 and 2 LBLOCA and SBLOCA analyses with the Westinghouse Evaluation Models are confirmed to have margin to the 2200°F limit for PCT specified in 10 CFR 50.46(b)(1).

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For consistency with the completion of the fuel transition to Westinghouse fuel assemblies and Dominion's plans not to re-insert AREVA fuel assemblies into the NAPS cores, the PCT utilization tables for AREVA Evaluation Models have been deleted as indicated below:

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

Evaluation of 10 CFR 50.46 Reporting

Since the last 30-day report or reanalysis, the accumulation of ECCS Evaluation Model changes for the Westinghouse LBLOCA Evaluation Model for NAPS Unit 2 is significant, as defined in 10 CFR 50.46(a)(3)(i), as a result of the change in the analysis of record and other PCT impacts. Therefore, a 30-day report is required to provide this information to the NRC.

10 CFR 50.46(a)(3)(ii) requires that the 30-day report include a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with the requirements of 10 CFR 50.46. In letter dated May 16, 2012 (Reference 1), the most recent reanalysis was submitted for NAPS and a commitment was made to submit to the NRC for review and approval a LBLOCA analysis that applies NRC-approved methods that include the effects of fuel pellet thermal conductivity degradation (TCD). A commitment due date of December 15, 2016 was indicated. The commitment date of December 15, 2016 was based on the completion of two milestones that would allow a revised licensing basis LBLOCA analysis with an NRC-approved ECCS Evaluation Model (EM) that explicitly accounts for TCD. The two milestones are as follows:

- 1) NRC approval of a fuel performance analysis methodology that includes the effects of TCD. The new methodology for developing inputs to the LBLOCA EM would replace the current NAPS licensing basis methodology in WCAP-15063-P-A, Revision 1 (Reference 2), which is referenced in Sections 4.2.1.3.1 and 4.4.3.4.2 of the NAPS Updated Final Safety Analysis Report (UFSAR).
- 2) NRC approval of a LBLOCA EM that includes the effects of TCD and accommodates the ongoing 10 CFR 50.46(c) rulemaking process. The new methodology would replace the current licensing basis analysis methodology, which is a plant-specific adaptation of WCAP-16009-P-A (Reference 3) as approved by the NRC in Reference 4.

The above Westinghouse methodologies intended to replace the current NAPS licensing basis methods are currently in NRC review with expected approval in 2016. As a result of the delay in completing the methodologies, the December 15, 2016 commitment date cannot be met. This letter changes the commitment date for submittal

of the LBLOCA analysis for North Anna Units 1 and 2 from December 15, 2016 to June 30, 2019. The LBLOCA analysis commitment for North Anna Units 1 and 2 will utilize the Westinghouse FULL SPECTRUM™ LOCA (FSLOCA™) Evaluation Model with fuel rod inputs that explicitly account for fuel pellet TCD based on the Westinghouse PAD5 fuel performance code. The analysis schedule is based on the expectation that the NRC will approve the topical reports for FSLOCA™ and PAD5 in 2016.

This information satisfies the 30-day reporting requirements of 10 CFR 50.46(a)(3)(ii) for NAPS Units 1 and 2. No further action is required to demonstrate compliance with the requirements of 10 CFR 50.46.

If you have any further questions regarding this submittal, please contact Ms. Diane Aitken at (804) 273-2694.

Very truly yours,



Mark D. Sartain
Vice President – Nuclear Engineering

Commitments made in this letter:

Before June 30, 2019, Dominion will submit to the NRC for review and approval a LBLOCA analysis that applies an NRC-approved ECCS Evaluation Model that includes the effects of fuel thermal conductivity degradation.

Attachments:

- 1) Report of Changes in Westinghouse and AREVA ECCS Evaluation Models
- 2) Reporting of 10 CFR 50.46 Margin Utilization

References:

1. Letter from J. Alan Price (Dominion) to USNRC, "Virginia Electric and Power Company (Dominion), North Anna Power Station Units 1 and 2, 30-Day Report of Emergency Core Cooling System (ECCS) Model Changes Pursuant to the Requirements of 10 CFR 50.46," Dominion Serial No. 12-330, May 16, 2012.
2. WCAP-15063-P-A, Revision 1 with Errata, "Westinghouse Improved Performance Analysis and Design Model (PAD 4.0)," July 2000.

3. WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)," January 2005.
4. Letter from Dr. V. Sreenivas (USNRC) to Mr. David A. Heacock (Dominion), "North Anna Power Station, Units 1 and 2, Issuance of Amendments Regarding Addition of Analytical Methodology to Core Operating Limits Report for Best Estimate Large Break Loss-of-Coolant Accident (TAC NOS. ME4933 and ME4934)," February 29, 2012.

cc: U. S. Nuclear Regulatory Commission, Region II
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ATTACHMENT 1

REPORT OF CHANGES IN
WESTINGHOUSE AND AREVA ECCS EVALUATION MODELS

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

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

North Anna Power Station Units 1 and 2

1. North Anna Unit 2 Reactor Vessel Upflow Conversion

A reactor vessel Upflow Conversion project was completed for North Anna Unit 2 during the spring 2016 refueling outage. The purpose of this design change was to reduce the potential for future fuel failures due to baffle jet impingement. The upflow conversion at North Anna Unit 2 changed the coolant flow path in the baffle-barrel region from downflow to upflow, thereby reducing the differential pressure across the baffle joint in order to diminish the potential for baffle jetting. The Upflow Conversion project at Unit 2 is equivalent to the upflow conversion project at Unit 1 performed between Cycles 11 and 12 in early 1996.

North Anna Units 1 and 2 have separate Best-Estimate Large-Break Loss-of-Coolant Accident (BE LBLOCA) analyses of record using the ASTRUM Evaluation Model. These analyses are presented in Sections 15.4.1.1 through 15.4.1.6 of the Updated Final Safety Analysis Report (UFSAR). The primary reason for having separate BE LBLOCA analyses for each unit is the difference in the baffle/barrel configuration.

To support the North Anna Unit 2 Upflow Conversion project, Westinghouse performed an evaluation to ensure that the Unit 1 model is representative of Unit 2 subsequent to the Unit 2 Upflow Conversion. Westinghouse concluded that the results of the BE LBLOCA analysis for Unit 1 presented in UFSAR Sections 15.4.1.1 through 15.4.1.6 are applicable to Unit 2 after implementation of the Upflow Conversion, including all post-analysis PCT assessments discussed in UFSAR Section 15.4.1.6.

The North Anna Units 1 and 2 Small-Break Loss-of-Coolant Accident (SBLOCA) analysis of record used the NOTRUMP Evaluation Model. To support the North Anna Unit 2 Upflow Conversion project, Westinghouse performed an evaluation and concluded that the results of the SBLOCA analysis presented in Sections 15.3.1.1 through 15.3.1.7 of the Updated Final Safety Analysis Report (UFSAR) remain applicable to North Anna Unit 2 after the implementation of the Upflow Conversion.

- 2.** A change to the North Anna UFSAR was made to remove the AREVA Loss of Coolant Accident (LOCA) analyses for the Advanced Mark-BW fuel product. AREVA fuel assemblies are not used in current cycles and there are no plans to re-insert AREVA fuel assemblies into North Anna cores. Therefore, the AREVA LBLOCA and SBLOCA analyses are not applicable and were removed from the UFSAR. With the deletion of the AREVA LOCA analyses from the UFSAR, North Anna also will discontinue reporting PCT margin utilization for the AREVA LOCA analyses under 10 CFR 50.46.

3. For consistency with the plans not to re-insert AREVA fuel assemblies into the cores at North Anna Units 1 and 2, the PCT impact for the transition core of 0°F is removed from the Westinghouse LBLOCA rackups that are provided in Attachment 2.
4. Westinghouse has identified one change and no errors since the 2014 Annual Report submitted to the NRC in Dominion letter 15-299, dated June 30, 2015. Westinghouse provided the following for the 1985 Westinghouse SBLOCA Evaluation Model with NOTRUMP for North Anna Units 1 and 2:
 - **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.

Conclusion

The LOCA results for North Anna Units 1 and 2 are confirmed to have margin to the 2200°F limit for PCT specified in 10 CFR 50.46. Based on the evaluation of this information and the associated changes in the applicable licensing basis PCT results, no further action is required to demonstrate compliance with the requirements of 10CFR50.46(b)(1). Since the last 30-day report or reanalysis, the accumulation of ECCS Evaluation Model changes for the Westinghouse LBLOCA Evaluation Model for NAPS Unit 2 is significant, as defined in 10CFR50.46(a)(3)(i), as a result of the change in the analysis of record and other PCT impacts. Therefore, a 30-day report is required to provide this information to the NRC.

ATTACHMENT 2

REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

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

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA

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

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

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

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

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		

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

PCT ASSESSMENTS (Delta PCT)

A. Prior ECCS Model Assessments

- | | | |
|----|---|---|
| 1. | NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation | 0 |
| 2. | 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
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10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

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

Analysis Information

EM: ASTRUM (2004) **Limiting Break Size:** DEGB
Analysis Date: 8/25/2010
Vendor: Westinghouse
FQ: 2.32 **FΔH:** 1.65
Fuel: RFA-2 **SGTP (%):** 7
Notes: Core Power ≤ 100% of 2951 MWt; SG Model 54F; 17x17 RFA-2 Fuel with ZIRLO® or Optimized ZIRLO™ cladding, Non-IFBA or IFBA, IFMs

Clad Temp (°F)

LICENSING BASIS

Analysis of Record PCT 1852

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

LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1982
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