

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

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

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License No. NPF-4

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNIT 1
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 cumulative errors in AREVA's Large Break Loss of Coolant Accident (LBLOCA) Emergency Core Cooling System (ECCS) Evaluation Model and the impact of the Measurement Uncertainty Recapture (MUR) power uprate for North Anna Power Station Unit 1 (NAPS 1) on Peak Clad Temperature (PCT). Attachment 1 provides a report describing the changes associated with the AREVA LBLOCA ECCS Evaluation Model and impact of the MUR for NAPS 1.


Information regarding the effect of the PCT changes to the reported LBLOCA licensing basis is provided for NAPS 1 in Attachment 2. To summarize the information in Attachment 2, the calculated PCT for the LBLOCA analyses is changed by an absolute value of 57°F to a new value of 1884°F for NAPS 1. This result represents a significant change in PCT, as defined in 10 CFR 50.46(a)(3)(i).

10 CFR 50.46(a)(3)(ii) requires the licensee to provide a report within 30 days, which includes a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with 10 CFR 50.46. Dominion has reviewed the information provided by AREVA and determined that the adjusted LBLOCA PCT values and the manner in which they were derived continue to conform to the requirements of 10 CFR 50.46. As such, Dominion considers the requirement for reconsideration for reanalysis specified in 10 CFR 50.46(a)(3)(ii) to be satisfied with the submission of this notification. Dominion routinely tracks adjustments to the LBLOCA calculated PCT values to ensure that reasonable margins to the acceptance value set by 10 CFR 50.46 are maintained.

This information satisfies the 30 day reporting requirements of 10 CFR 50.46(a)(3)(ii).

If you have any further questions regarding this submittal, please contact Mr. Thomas Shaub at (804) 273-2763.

Very truly yours,


J. Alan Price
Vice President – Nuclear Engineering

Commitments made in this letter: None

Attachments: (2)

- 1) Report of Changes in Areva Large Break LOCA ECCS Evaluation Model – North Anna Power Station Unit 1.
- 2) 30 Day Reporting of 10 CFR 50.46 Margin Utilization – North Anna Power Station Unit 1.

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ATTACHMENT 1

**REPORT OF CHANGES IN
AREVA LARGE BREAK LOCA ECCS EVALUATION MODEL
NORTH ANNA POWER STATION UNIT 1**

**VIRGINIA ELECTRIC AND POWER COMPANY
(DOMINION)**

**Report of Changes
AREVA LBLOCA ECCS Evaluation Model
North Anna Power Station Unit 1**

Identification of ECCS Evaluation Model Change

The current large break loss of coolant accident (LBLOCA) analyses for North Anna Power Station (NAPS) Unit 1 were performed using the AREVA Realistic (R) LBLOCA Evaluation Model (EM). Since the last 30 day report, AREVA has identified five changes impacting Peak Clad Temperature (PCT), including the NAPS Unit 1 Measurement Uncertainty Recapture (MUR) power uprate. The changes are described below and provide the results of an assessment to determine the impact on PCT.

Change: S-RELAP5 Kinetics and Heat Conduction Model changes (-29°F)

Previously, the Idaho National Laboratory (INL) announced an error in the coding of the point kinetics model. The corrections were provided by the INL and then installed into S-RELAP5. Recently, the INL announced that the previous error corrections were incorrect and that the recommended convergence criteria supplied with those corrections should be retained. This was captured in an internal AREVA corrective action system item.

The AREVA corrective action item was drafted due to the INL announcing that the heat conduction solution is incorrectly programmed. The error is associated with using the incorrect heat capacity when evaluating the right boundary mesh point. Instead of using the last (adjacent) mesh interval heat capacity, the code incorrectly uses the next to last mesh interval heat capacity. The affect of the error is maximized in cylindrical and spherical geometries with few mesh points, which can be minimized with an increased number of mesh points. The effect is further minimized by the S-RELAP5 RLBLOCA, SBLOCA and Non-LOCA methodology guidelines requiring close mesh spacing at the left and right boundaries. This error exists exclusively in the RELAP5 series of codes.

The corrections for these two errors were installed into a new code version of S-RELAP5 and 50.46 evaluations were performed. North Anna Unit 1 has a PCT impact of -29°F.

Change: Liquid and Vapor Flow Spikes in Upper Plenum and Hot Channel (+8°F)

An internal AREVA corrective action item was written to evaluate the impact of liquid and vapor flow spikes from the upper plenum (UP) into the hot channel (HC) and surrounding six assembly regions of the core and a nonphysical flow pattern in the upper plenum. Even though counter current flow (CCFL) modeling was applied at the

HC exit junction, it will not be activated due to the negative spikes in steam velocities (from upper plenum to HC).

The current RLBLOCA reactor vessel modeling was traced back to the EMF-2103 sample problem for a 3-loop Westinghouse (W) plant. This W 3-loop plant has a geometry feature in the upper plenum known as "flow mixers or standpipes". Due to this geometry feature, the upper plenum was broken into two sections, one to an open hole region and one to a flow mixer region. The modeling in the sample problem blocked the cross flow between radial junctions in the first level of upper plenum and this was carried through in plants without flow mixers as a methodology conservatism.

The UP nodalization for these plant cases was revised to make it consistent with the geometry. In addition, in all plant cases, a high reverse loss coefficient is applied to the HC and central core to UP junctions at the beginning of the core reflooding phase. Cases were rerun that had liquid down flow and potentially affect the AOR PCT limit. The corrections for this error were implemented and the PCT impact to North Anna Unit 1 is +8 °F.

Change: Steam Generator Entrainment Bias Factor (FIJ) Change (-4°F)

An internal AREVA corrective action item was written to evaluate the impact of not entraining the appropriate amount of liquid into the steam generator tubes during a LBLOCA event. The Realistic Large Break LOCA (RLBLOCA) methodology uses a bias on interphase friction at the steam generator tube sheet entrance to insure an acceptable amount of liquid is entrained into the steam generator tubes during a large break. The bias determination was performed by comparing calculated results from S-RELAP5 with measured data from the Upper Plenum Test Facility (UPTF) Tests. The UPTF test facility represents a full scale, four loop PWR complete with the necessary hardware that can be used to represent geometry specific phenomena that occurs during a large or small break LOCA. The S-RELAP5 parameter that controls entrainment is interphase friction. The range of interphase friction spans several orders of magnitude between the flow regimes occurring in the hot leg, hot leg riser, steam generator inlet plenum and steam generator tube sheet. Consequently, determining the uncertainty in interphase friction is not feasible so a conservative bias is used instead. The magnitude of the bias is determined by adjusting the S-RELAP5 RLBLOCA Multiplier "FIJ" until S-RELAP5 over-predicts the entrainment observed in UPTF Tests by an arbitrary amount. Therefore, the FIJ multiplier of 1.75 is invalid and under-predicts the measured entrainment. The re-evaluation of the S-RELAP5 entrainment yielded a value of 5.0 for the FIJ multiplier, which is appropriate with a modeling change to the steam generator riser angle, greater than 30- degrees, and with the horizontal stratification flag set to off in the hot leg.

The corrections for this error were implemented and the PCT impact to North Anna Unit 1 is assessed to be - 4°F.

Change: Impact of Measurement Uncertainty Recapture (MUR) (+2 °F)

North Anna evaluated the PCT impact of a 1.7% increase in core power for the MUR power uprate on Unit 1. For the MUR power uprate, an explicit RLBLOCA analysis was performed by AREVA by performing an analysis with 59 cases being run with increased nominal core power from 2893 MWt to 2942.2 MWt, which bounds the MUR rated thermal power of 2940 MWt.

The resulting evaluation by AREVA identified a +2°F change to the PCT for NAPS 1.

Change: Sleicher-Rouse single phase vapor heat transfer correlation (+14°F)

An internal AREVA corrective action item was written to evaluate the impact modifying the formulation of the Sleicher-Rouse single phase vapor heat transfer correlation in the S-RELAP5 code. In developing a BWR LOCA analysis methodology using S-RELAP5, AREVA noticed that the behavior of the Sleicher-Rouse single phase vapor heat transfer correlation differed from other correlations. Additionally, it was discovered that the formulation of the correlation in the S-RELAP5 code different from the formulation of the correlation used in other industry codes. AREVA prepared an S-RELAP5 code version with the alternative formulation. The alternative formulation of the Sleicher-Rouse agreed more closely with the formulation of the correlation used in the other industry codes.

The results of plant sample problems indicate that the predicted RLBLOCA PCT for North Anna Unit 1 should be increased by 14°F.

Conclusion

Dominion has performed an evaluation of PCT for comparison to 10 CFR 50.46 requirements. The Analysis of Record (AOR) PCT for NAPS 1 is 1853°F. Considering the current PCT changes as well as all previously reported changes and errors, the licensing basis LBLOCA PCT is 1884°F for NAPS 1. The LBLOCA results have sufficient margin to the 2200°F limit specified in 10 CFR 50.46(b)(1). The current PCT assessment of 57°F is greater than the 50°F limit for reporting as defined in 10 CFR 50.46(a)(3)(i); hence, the change is significant and submittal of this 30 day report to the NRC is required.

ATTACHMENT 2

30 DAY REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

NORTH ANNA POWER STATION UNIT 1

**VIRGINIA ELECTRIC AND POWER COMPANY
(DOMINION)**

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: Mixed: **SGTP (%):** 12
NAIF/Advanced Mark-BW
Notes: Only AREVA Fuel in Plant, Analysis Covers Both Types

	<u>Clad Temp (°F)</u>	<u>Notes</u>
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. Blowdown Quench	0	
8. Mixture Level Model Limitation in the S-RELAP5 Code	-29	
9. Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-20	
10. Cold Leg Condensation Under Predicted by S-RELAP5 Following Accumulator Injection	0	
11. Cross-Flow Junction Area in S-RELAP Model	0	
12. Radiation to Fluid Heat Transfer Model Change	-32	
B. Planned Plant Modification Evaluations		
1. Advanced Mark-BW Top Nozzle Modification	65	
2. GSI-191 Sump Strainer	0	
3. MUR Implementation	2	{1}
C. 2009/2010/2011 ECCS Model Assessments		
1. S-RELAP5 Kinetics and Heat Conduction Model	-29	{1}
2. RODEX3A – Thermal Conductivity Degradation	0	{1}
3. Steam Generator Entrainment Bias Factor (FIJ) Change	-4	{1}
4. RLBLOCA Upper Plenum Modeling	8	{1}
5. Sleicher-Rouse Correlation Modeling	14	{1}
D. Other		
1. None	0	

LICENSING BASIS PCT + PCT ASSESSMENTS **PCT =** **1884**

NOTES:

{1} The current accumulation of changes for these items (sum of absolute magnitudes) since the last 30-day report or reanalysis is greater than 50°F and is significant as defined in 10 CFR 50.46(a)(3)(i).