VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

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United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No. 00-271
NL&OS/GDM R0
Docket Nos. 50-280/281
50-338/339
License Nos. DPR-32/37
NPF-4/7

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY AND NORTH ANNA POWER STATIONS UNITS 1 AND 2
REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) EVALUATION MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10CFR50.46

Pursuant to 10CFR50.46(a)(3)(ii), Virginia Electric and Power Company is providing information concerning changes to the ECCS Evaluation Models and their application in existing licensing analyses. Information is also provided which quantifies the effect of these changes upon reported results for North Anna and Surry Power Stations, and demonstrates continued compliance with the acceptance criteria of 10CFR50.46.

Attachment 1 contains excerpted portions of Westinghouse reports describing the changes to the Westinghouse ECCS Evaluation Models which are applicable to North Anna and Surry and have been implemented during calendar year 1999.

Information regarding the effect of the ECCS Evaluation Model changes upon the reported LOCA analysis of record (AOR) results is provided for the North Anna and Surry Power Stations in Attachments 2 and 3, respectively. To summarize the information in Attachments 2 and 3, the calculated peak cladding temperature (PCT) for the small and large break LOCA analyses for North Anna and Surry are given below. These results do not represent significant changes based on the criterion established in 10CFR50.46(a)(3)(i).

North Anna Unit 1 - Small break:	1675°F
North Anna Unit 1 - Large break:	2122°F
North Anna Unit 2 - Small break:	1676°F
North Anna Unit 2 - Large break:	2142°F
Surry Units 1 and 2 - Small break:	1717°F
Surry Units 1 and 2 - Large break:	2089°F

A001

We have evaluated these changes in the applicable licensing basis PCT results. These results demonstrate compliance with the requirements of 10CFR50.46(b). No further action is required to demonstrate compliance with 10CFR50.46 requirements.

If you have further questions or require additional information, please contact us.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering and Services

Commitments made in this letter: None.

Attachments:

1) Westinghouse Report of ECCS Evaluation Model Changes - North Anna Units 1 and 2 and Surry Units 1 and 2

2) Effect of ECCS Evaluation Model Changes - North Anna Units 1 and 2

3) Effect of ECCS Evaluation Model Changes - Surry Units 1 and 2

cc: U.S. Nuclear Regulatory Commission
Region II
Atlanta Federal Center
61 Forsyth Street, SW
Suite 23 T85
Atlanta, Georgia 30303

Mr. M. J. Morgan
NRC Senior Resident Inspector
North Anna Power Station

Mr. R. A. Musser
NRC Senior Resident Inspector
Surry Power Station

ATTACHMENT 1

WESTINGHOUSE REPORT OF
ECCS EVALUATION MODEL CHANGES

NORTH ANNA UNITS 1 AND 2
AND
SURRY UNITS 1 AND 2

SMALL BREAK LOCA BURST AND BLOCKAGE/TIME IN LIFE

Background

The SPIKE computer program and the associated methodology are used as an evaluation tool in the 10CFR50.46 plant licensing process to estimate fuel rod burst peak cladding temperature penalties for Small Break LOCA analyses. (This evaluation tool was previously discussed in Reference 1.) The SPIKE code has been revised to reflect more recent data generated using the current Small Break LOCA Evaluation Model and methodology. The revision could result in a net PCT penalty for Small Break LOCA analyses which have utilized the SPIKE code. This correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

- 1975 Westinghouse Small Break LOCA Evaluation Model with WFLASH
- 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The current Small Break LOCA Evaluation Model was employed, and a series of plant types was considered at varying beginning-of-life non-burst PCTs to develop a new database of burst "data" points. The evaluation tool was updated and validated to reflect the new database information. Small Break LOCA analyses which include burst and blockage effects based on direct burnup studies are not impacted by the revision to SPIKE. Also, burst and blockage effects do not adversely impact Small Break LOCA analyses with PCTs less than 1700°F.

The SBLOCA for North Anna included a burnup study in the analysis of record. The analysis considered cases at 150, 8000, and 20000 MWD/MTU. BOC (beginning of cycle) was still limiting for PCT. There was no burst for the BOC and 8000 MWD cases. Although burst occurred for the 20000 MWD/MTU case, the PCT was less than 1700°F. Therefore, there is no adverse impact to the small break LOCA analysis for North Anna.

The SBLOCA for Surry included a burnup study in the analysis of record. The analysis considered cases at 150, 10000, and 20000 MWD/MTU. BOC was still limiting for PCT. There was no burst for the BOC and 10000 MWD cases. Although burst occurred for the 20000 MWD/MTU case, the PCT was less than 1700°F. Therefore, there is no adverse impact to the small break LOCA analysis for Surry.

LUCIFER2 DOWNCOMER AZIMUTHAL FLOW PATH CALCULATIONS

Background

The LUCIFER2 code generates component databases that are used by the SATIMP, BASHER, and SPADES input processors to develop plant-specific input models for large and small break LOCA analyses. An error was discovered in LUCIFER2 whereby a vessel diameter below the hot/cold leg elevation was used for calculations that apply above the hot/cold leg elevation, resulting in incorrect values for various downcomer azimuthal flow path parameters. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

- 1981 Westinghouse Large Break LOCA Evaluation Model
- 1981 Westinghouse Large Break LOCA Evaluation Model with BART
- 1981 Westinghouse Large Break LOCA Evaluation Model with BASH
- 1975 Westinghouse Small Break LOCA Evaluation Model with WFLASH
- 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

For SBLOCA, this error has no impact on the calculated PCT for standard Westinghouse plant calculations, since the downcomer azimuthal flow paths defined in LUCIFER2 are not used.

For LBLOCA, this error only affects the SATAN6 code, since the downcomer azimuthal flow paths defined in LUCIFER2 are not used in BASH. Representative plant calculations using the SATAN6 code showed that this error correction has a negligible impact on end-of-blowdown results and is being reported as a 0°F PCT effect for 10CFR50.46 reporting purposes.

BASH VAPOR FILM FLOW REGIME HEAT TRANSFER ERROR

Background

As discussed in Reference 1, the Berenson model for film boiling is used in BASH to compute the cladding-to-fluid heat transfer coefficient for conduction across the vapor film in the vapor film flow regime, which occurs near the quench front and is assumed to consist of a conduction component and a radiation component. An error was discovered in BASH whereby the multiplier on this correlation was programmed incorrectly, resulting in a relatively minor underprediction of the cladding-to-fluid heat

transfer coefficient. This correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the BASH code showed that this error correction has a negligible impact on the core inlet flooding rate during reflood and is being reported as a 0°F PCT effect for 10CFR50.46 reporting purposes.

Reference

1. WCAP-9561-P-A, "BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients," M. Y. Young, et. al., March, 1984.

BASH BROKEN LOOP ACCUMULATOR EMPTY TIME LOGIC ERROR

Background

An error was discovered in the BASH code that caused almost immediate emptying of the broken loop accumulator upon entry into the reflood phase of the transient, as opposed to the more gradual emptying that would generally be expected based on the accumulator conditions at the end of refill. This correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

For typical cases where the broken loop accumulator empties prior to entry into the reflood phase of the transient, this change has no effect on results. For atypical cases where the broken loop accumulator empties during reflood, correcting this error will have a very minor effect on the containment pressure early in reflood that would be expected to result in a negligible effect on the core inlet flooding rate. As a result, for any potentially affected cases, this correction is being reported as a 0°F PCT effect for 10CFR50.46 reporting purposes.

BASH PUMPED INJECTION SPILL LOGIC ERROR

Background

An error was discovered in BASH that resulted in an underprediction of the spilling flow to containment, for dry containment plants with accumulator/SI interaction that use interactive COCO. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the BASH code showed that this error correction had a very minor effect on the containment pressure during reflood which led to a negligible effect on the core inlet flooding rate. As a result, this correction is being reported as a 0°F PCT effect for 10CFR50.46 reporting purposes.

LOCBART PELLET DIAMETER ADJUSTMENT ERROR

Background

To account for small differences between the LOCA models and the fuel rod design models (PAD), part of the initialization process for the LOCTA-IV (Reference 1) fuel rod model involves making small adjustments to the fuel pellet diameter such that the pellet average temperature at steady-state full-power operation matches the data from the PAD code. To compensate for this adjustment to the pellet diameter, a factor is applied to the core power such that the ratio of core power to UO_2 mass remains constant. During review of the LOCBART code (which is based upon the LOCTA-IV model), it was discovered that a second compensating adjustment had also been programmed in, whereby a similar factor was being applied to the pellet density to achieve the same purpose. In order to avoid double-counting for the pellet diameter adjustment effect, the code was corrected to use only the power adjustment per the original WCAP. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

- 1981 Westinghouse Large Break LOCA Evaluation Model with BART
- 1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

In general, double-counting for the pellet diameter adjustment effect resulted in too high a power-to-pellet-mass ratio, so correcting the error would be expected to result in a small decrease in PCT that will be reported as a 0°F for 10CFR50.46 reporting purposes.

Reference

1. WCAP-8301, "LOCTA-IV Program: Loss-of-coolant Transient Analysis," F. M. Bordelon, et. al., June, 1974.

SPADES TRUNCATION ERROR

Background

Various methods exist for entering input data to the SPADES code, which is used to generate the plant-specific input models for NOTRUMP. An error was discovered in SPADES whereby different methods of entering the input data could lead to minor differences in the resulting NOTRUMP input values, due to differences in the truncation methods. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The nature of this change leads to an estimated PCT impact of 0°F.

NOTRUMP ARRAY BOUNDARY ERROR

Background

An error was discovered that could potentially affect the data stored within arrays of the NOTRUMP executable. Areas of the NOTRUMP code, and the user externals, were coded such that references to data locations beyond defined array boundaries could possibly have been utilized. This could have led to inappropriate values being used instead of the intended values. To correct this problem, array range checking is not being enabled (during execution) via the use of specific compiler options. With these compiler options activated, attempts to use data outside of defined array boundaries results in code termination with the offending source code line identified to the user. To

activate these compiler options, the dimensions on several dummy argument one-dimensional arrays were changed to utilize appropriate coding conventions. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

NOTRUMP models that were considered to encompass the range of array storage requirements were chosen and executed with both the erroneous and corrected code versions. From the results, it was determined that the nature of this error leads to an estimated PCT impact of 0°F.

NOTRUMP VOLUMETRIC/MASS BASED CONSISTENCY ERROR

Background

NOTRUMP contains user input options for either mass or volumetric flow bases in the momentum conservation equations. The latter is used in NOTRUMP for the AP600 Evaluation Model (EM) due to the low pressures experienced in the AP600 SBLOCA transient. When evaluating the use of certain AP600 model features for potential use in the standard Appendix K Evaluation Model, it was discovered that undesirable numerical oscillations were occurring when flow direction changes were predicted in certain flow links, causing the code to abort. The cause of the problem was determined to be an inconsistent method of updating certain mass and volumetric rate variables during portions of the SBLOCA transient. When reviewing the details of this error, it was discovered that other code locations were also affected by this error, which meant that both the standard NOTRUMP EM and the AP600 EM were affected. To correct the problem, several subroutines were modified to correctly update volumetric and mass based flow calculations on a consistent basis. This was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

- 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP
- 1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP (AP600 Implementation)

Estimated Effect

Representative PWR plant calculations show that the nature of this error leads to an estimated PCT impact of 0°F.

ATTACHMENT 2

EFFECT OF ECCS EVALUATION MODEL CHANGES

NORTH ANNA UNITS 1 AND 2

Effect of ECCS Evaluation Model Changes - North Anna Unit 1

The information provided herein is applicable to North Anna Power Station, Unit 1. It is based upon reports from Westinghouse Electric Corporation for issues involving the ECCS Evaluation Models and plant-specific application of the models in the existing analyses. Peak cladding temperature (PCT) values and margin allocations represent issues for which permanent resolutions have been implemented. The assessments for small break and large break LOCA are presented in Sections A and B, respectively.

Section A - Small Break LOCA Margin Utilization - North Anna Unit 1

A. PCT for Analysis of Record	1704°F	(1)
B. Prior PCT Assessments Allocated to AOR	**-29°F**	
1. NOTRUMP Specific Enthalpy Error	+20°F	(2)
2. SALIBRARY Double Precision Errors	-15°F	(2)
3. Fuel Rod Initialization Error	+10°F	(3)
4. Loop Seal Elevation Error	-44°F	(3)
SBLOCA Augmented PCT for AOR	1675°F	
C. PCT Assessments for 10CFR50.46(a)(3)(i) Accumulation {1}	**0°F**	
SBLOCA Licensing Basis PCT (AOR PCT + PCT Assessments)	1675°F	

Section B - Large Break LOCA Margin Utilization - North Anna Unit 1

A. PCT for Analysis of Record	2013°F	(1)
B. Prior PCT Assessments Allocated to AOR	**109°F**	
1. LBLOCA/Seismic SG Tube Collapse	+30°F	(1)
2. BASH Accumulator Empty Flag	+10°F	(1)
3. Translation of Fluid Conditions from SATAN to LOCTA	+15°F	(4)
4. LOCBART Spacer Grid Single-Phase Heat Transfer	+15°F	(6)
5. LOCBART Zirc-Water Oxidation Error	+39°F	(6)
LBLOCA Augmented PCT for AOR	2122°F	
C. PCT Assessments for 10CFR50.46(a)(3)(i) Accumulation {1}	**0°F**	
LBLOCA Licensing Basis PCT (AOR PCT + PCT Assessments)	2122°F	

Notes { } and References ( ) are provided below.

Effect of ECCS Evaluation Model Changes - North Anna Unit 2

The information provided herein is applicable to North Anna Power Station, Unit 2. It is based upon reports from Westinghouse Electric Corporation for issues involving the ECCS Evaluation Models and plant-specific application of the models in the existing analyses. Peak cladding temperature (PCT) values and margin allocations represent issues for which permanent resolutions have been implemented. The assessments for small break and large break LOCA are presented in Sections A and B, respectively.

Section A - Small Break LOCA Margin Utilization - North Anna Unit 2

A. PCT for Analysis of Record	1704°F	(1)
B. Prior PCT Assessments Allocated to AOR	**-29°F**	
1. NOTRUMP Specific Enthalpy Error	+20°F	(2)
2. SALIBRARY Double Precision Errors	-15°F	(2)
3. Fuel Rod Initialization Error	+10°F	(3)
4. Loop Seal Elevation Error	-44°F	(3)
SBLOCA Augmented PCT for AOR	1675°F	
C. PCT Assessments for 10CFR50.46(a)(3)(i) Accumulation {1}	**1°F**	
1. Removal of Part-Length CRDMs	+1°F	(5)
SBLOCA Licensing Basis PCT (AOR PCT + PCT Assessments)	1676°F	

Section B - Large Break LOCA Margin Utilization - North Anna Unit 2

A. PCT for Analysis of Record	2013°F	(1)
B. Prior PCT Assessments Allocated to AOR	**129°F**	
1. LBLOCA/Seismic SG Tube Collapse	+30°F	(1)
2. BASH Accumulator Empty Flag	+10°F	(1)
3. Translation of Fluid Conditions from SATAN to LOCTA	+15°F	(4)
4. Removal of Part-Length CRDMs	+18°F	(5)
5. LOCBART Spacer Grid Single-Phase Heat Transfer	+15°F	(6)
6. LOCBART Zirc-Water Oxidation Error	+41°F	(6)
LBLOCA Augmented PCT for AOR	2142°F	
C. PCT Assessments for 10CFR50.46(a)(3)(i) Accumulation {1}	**0°F**	
LBLOCA Licensing Basis PCT (AOR PCT + PCT Assessments)	2142°F	

Notes { } and References ( ) are provided below.

Effect of ECCS Evaluation Model Changes - North Anna

Notes:

{1} The accumulation of changes (sum of absolute magnitudes) is less than 50°F and is not significant, as defined in 10CFR50.46(a)(3)(i).

References:

(1) Letter from J. P. O'Hanlon (VEPCO) to Document Control Desk (USNRC), "Virginia Electric and Power Company, North Anna Power Station Units 1 and 2, 30-Day Report of ECCS Evaluation Model Changes Per Requirements of 10CFR50.46," Serial No. 95-608, November 29, 1995.

(2) Letter from J. P. O'Hanlon (Va. Electric & Power Co.) to USNRC, "Virginia Electric and Power Company, North Anna and Surry Power Station Units 1 and 2, Report of ECCS Evaluation Model Changes and 30-Day Report of ECCS Evaluation Model Changes Per Requirements of 10CFR50.46," Serial No. 96-111, March 14, 1996.

(3) Letter from J. P. O'Hanlon (Va. Electric & Power Co.) to USNRC, "Virginia Electric and Power Company, North Anna Power and Surry Power Station Units 1 and 2, Report of ECCS Evaluation Model Changes and 30-Day Report of ECCS Evaluation Model Changes Per Requirements of 10CFR50.46," Serial No. 96-390, August 1, 1996.

(4) Letter from J. P. O'Hanlon (Va. Electric & Power Co.) to USNRC, "Virginia Electric and Power Company, Surry and North Anna Power Stations Units 1 and 2, Report of Emergency Core Cooling System (ECCS) Evaluation Changes Pursuant to the Requirements of 10CFR50.46," Serial No. 97-174, March 27, 1997.

(5) Letter from J. P. O'Hanlon (Va. Electric & Power Co.) to USNRC, "Virginia Electric and Power Company, Surry and North Anna Power Stations Units 1 and 2, Report of Emergency Core Cooling System (ECCS) Evaluation Changes Pursuant to the Requirements of 10CFR50.46," Serial No. 98-303, May 28, 1998.

(6) Letter from L. N. Hartz (Va. Electric & Power Co.) to USNRC, "Virginia Electric and Power Company, Surry and North Anna Power Station Units 1 and 2, 30-Day Report – Emergency Core Cooling System (ECCS) Evaluation Model Changes Pursuant to the Requirements of 10CFR50.46," Serial No. 99-558, November 18, 1999.

ATTACHMENT 3

EFFECT OF ECCS EVALUATION MODEL CHANGES

SURRY UNITS 1 AND 2

Effect of Westinghouse ECCS Evaluation Model Changes - Surry

The information provided herein is applicable to Surry Power Station, Units 1 and 2. It is based upon reports from Westinghouse Electric Corporation for issues involving the ECCS Evaluation Models and plant-specific application of the models in the existing analyses. Peak cladding temperature (PCT) values and margin allocations represent issues for which permanent resolutions have been implemented. The assessments for small break and large break LOCA are presented in Sections A and B, respectively.

Section A - Small Break LOCA Margin Utilization - Surry Units 1 and 2

A. PCT for Analysis of Record (AOR)	1717°F	(1)
B. Prior PCT Assessments Allocated to AOR	**0°F**	
SBLOCA Augmented PCT for AOR	1717°F	
C. PCT Assessments for 10CFR50.46(a)(3)(i) Accumulation {1}	**0°F**	
SBLOCA Licensing Basis PCT (AOR PCT + PCT Assessments)	1717°F	

Section B - Large Break LOCA Margin Utilization - Surry Units 1 and 2

A. PCT for Analysis of Record (AOR)	2120°F	(2)
B. Prior PCT Assessments Allocated to AOR	**-31°F**	
1. ZIRLO™ Cladding	-16°F	
2. Vessel & SG Calculation Errors in LUCIFER	-6°F	(2)
3. LBLOCA Rod Internal Pressure Issues	0°F	(2)
4. Translation of Fluid Conditions from SATAN to LOCTA	+15°F	(3)
5. LOCBART Spacer Grid Single-Phase Heat Transfer	+15°F	(4)
6. LOCBART Zirc-Water Oxidation Error	+201°F	(4)
7. Reduction in FQ	-240°F	(4)
LBLOCA Augmented PCT for AOR	2089°F	
C. PCT Assessments for 10CFR50.46(a)(3)(i) Accumulation {1}	**0°F**	
LBLOCA Licensing Basis PCT (AOR PCT + PCT Assessments)	2089°F	

Notes { } and References ( ) on the following page

Effect of Westinghouse ECCS Evaluation Model Changes - Surry

Notes:

{1} The accumulation of changes (sum of absolute magnitudes) is less than 50°F and is not significant, as defined in 10CFR50.46(a)(3)(i).

References:

(1) Letter from W. L. Stewart (Va. Electric & Power Co.) to NRC, "Surry Power Station Units 1 and 2 - Proposed Technical Specifications Changes - FΔH Increase/Statistical DNBR Methodology," Serial No. 91-374, July 8, 1991.

(2) Letter from W. L. Stewart (VEPCO) to Document Control Desk (USNRC), "Virginia Electric and Power Company, Surry Power Station Units 1 and 2, 30-Day Report of ECCS Evaluation Model Changes Per Requirements of 10CFR50.46," Serial No. 94-254, April 27, 1994.

(3) Letter from J. P. O'Hanlon (Va. Electric & Power Co.) to USNRC, "Virginia Electric and Power Company, Surry and North Anna Power Stations Units 1 and 2, Report of Emergency Core Cooling System (ECCS) Evaluation Changes Pursuant to the Requirements of 10CFR50.46," Serial No. 97-174, March 27, 1997.

(4) Letter from L. N. Hartz (Va. Electric & Power Co.) to USNRC, "Virginia Electric and Power Company, Surry and North Anna Power Station Units 1 and 2, 30-Day Report – Emergency Core Cooling System (ECCS) Evaluation Model Changes Pursuant to the Requirements of 10CFR50.46," Serial No. 99-558, November 18, 1999.