VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

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United States Nuclear Regulatory Commission
Attention: Document Control Desk
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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
REPORT OF ECCS EVALUATION MODEL CHANGES
AND 30-DAY REPORT PER REQUIREMENTS OF 10CFR50.46
SURRY POWER STATION UNITS 1 AND 2

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 Surry Power Station and demonstrates continued compliance with the acceptance criteria of 10CFR50.46.

Attachment 1 contains excerpted portions of the Westinghouse report describing the changes to the Westinghouse ECCS Evaluation Models which are applicable to Surry and have been implemented during calendar year 1992. In addition to these generic changes, there were plant-specific changes associated with application of the evaluation models for the Surry units. Attachment 2 provides a report describing these plant-specific evaluation model changes. As indicated in the Attachment 2, these changes have been concluded to be significant, based upon the criterion established in 10CFR50.46(a)(3)(i).

Attachment 3 provides information regarding the effect of the ECCS Evaluation Model changes upon the reported LOCA results for the Surry Power Station analysis of record. To summarize the information in Attachment 3, the calculated PCT for the small and large break LOCA analyses for Surry are given below. As defined in 10CFR50.46(a)(3)(i), the change in large break LOCA PCT is a significant change, requiring a 30-day report to the NRC.

Surry Units 1 and 2 - Small break: 1852°F
Surry Units 1 and 2 - Large break: 2094°F

220015

A001
11

Since none of the calculated temperatures exceed 2200°F, no further action is required. If you have questions or require additional information, please contact us.

Very truly yours,

J. P. O'Hanlon

for W. L. Stewart
Senior Vice President - Nuclear

Attachments:
1. Westinghouse Report of LOCA Evaluation Model Changes for 1992 - Surry Units 1 and 2
2. Report of Changes in Application of Evaluation Model - Surry Units 1 and 2
3. Effect of Evaluation Model Changes - Surry Units 1 and 2

cc: U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, N. W.
Suite 2900
Atlanta, Georgia 30323

Mr. M. W. Branch
NRC Senior Resident Inspector
Surry Power Station

ATTACHMENT 1

WESTINGHOUSE REPORT OF LOCA EVALUATION MODEL CHANGES FOR 1992

SURRY UNITS 1 AND 2

LOCA Evaluation Model Changes for 1992

Bessel Function Error

Background

An error was discovered in SUBROUTINE BESSJ0 which led to calculation of incorrect values for the zeroth order Bessel function of the first kind. This calculation is used in the algorithm designed to limit heat transfer out of a quenching fuel rod to the theoretical conduction limit. This error existed only in one cycle of the NOTRUMP computer code (Cycle 23) and therefore only affects analyses performed with that version. Cycle 23 of NOTRUMP was in use from February of 1991 until the error was corrected in February of 1992. This error correction returned the NOTRUMP code to consistency with the applicable section of WCAP-10079-P-A and therefore is not a change to the Evaluation Model.

This was determined to be a Non-discretionary Change in accordance with Section 4.1.2 of WCAP-13451 and was corrected in accordance with Section 4.1.3 of WCAP-13451.

Affected Evaluation Models

1985 Small Break LOCA Evaluation Model

Estimated Effect

Plant specific PCT effects were determined by reanalysis of the limiting break size transient with the corrected NOTRUMP version. These effects are included on the attached Margin Utilization Sheet.

Auxiliary Feedwater Flow Table Error

Background

The Steam Generator Auxiliary Feedwater (AFW) flowrate is governed by the timing variable TIMESG(I). A minor logic error associated with this variable was discovered which led to a step change in the AFW flowrate once the transient time passed the value of TIMESG(7). Typically, this value is set equal to 11000 seconds and so this error would only affect very long transient calculations. In addition, the nature of the error is to allow the AFW flowrate to immediately revert to the full value of the Main Feedwater flowrate. This enormous step change has led to code aborts in the cases where it has occurred.

This logic was corrected as a Discretionary Change as described in Section 4.1.1 of WCAP-13451. This determination is based on the fact that SBLOCA transients are generally terminated before the logic error can have an effect coupled with the codes lack of capability to handle the step change if it does occur. Therefore, it was reasoned that the logic could not affect LOCA results.

Affected Evaluation Models

1985 Small Break LOCA Evaluation Model

Estimated Effect

This error correction has no effect on any current or prior applications of the Evaluation Model.

Steam Generator Secondary Side Modelling Enhancements

Background

A set of related changes which make steam generator secondary side modelling more convenient for the user were implemented into NOTRUMP. This model improvement involved several facets of feedwater flow modelling. First, the common donor boundary node for the standard Evaluation Model nodalization has been separated into two identical boundary nodes. These donor nodes are used to set the feedwater enthalpy. The common donor node configuration did not allow for loop specific enthalpy changeover times in cases where asymmetric AFW flowrates or purge volumes were being modeled for plant specific sensitivities.

The second improvement is the additional capability to initiate main feedwater isolation on either loss of offsite power coincident with reactor trip (low pressurizer pressure) or alternatively on safety injection signal (low-low pressurizer pressure). The previous model allowed this function only on loss of offsite power coincident with reactor trip. The auxiliary feedwater pumps are still assumed to start after a loss of offsite power with an appropriate delay time to model diesel generator start-up and buss loading times.

The final improvement is in the area of modelling the purging of high enthalpy main feedwater after auxiliary feedwater is calculated to start. This was previously modelled through an approximate time delay necessary to purge the lines of the high enthalpy main feedwater before credit could be taken for the much lower enthalpy auxiliary feedwater reaching the steam generator secondary. This time delay was a function of the plant specific purge volume and the auxiliary feedwater flowrate. The new modelling allows the user to input the purge volume directly. This then is used together with the code calculated integrated feedwater flow to determine the appropriate time at which the feedwater enthalpy can be assumed to change.

These improvements are considered to be a Discretionary Change as described in Section 4.1.1 of WCAP-13451. Since they involve only enhancements to the capabilities and useability of the Evaluation Model, and not changes to results calculated consistently with the previous model, these changes were implemented without prior review as discussed in Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1985 Small Break LOCA Evaluation Model

Estimated Effects

Because these enhancements only allow greater ease in modelling plant specific steam generator secondary side behavior over the previous model, it is estimated that no effect will be seen in Evaluation Model calculations.

Basis Change for Hot Assembly Rod Gap Pressure

Background

In the past, the effective hot assembly average rod power assumed to calculate the gap pressure in the hot assembly average rod was based on the total power in the hot assembly spread over all available bundle positions. That is, the power was averaged over both active rods as well as thimble tubes, which generate no power. This led to an artificially low rod internal pressure in the hot assembly average rod due to the artificially low power. In the future, the hot assembly average rod power based only on active fuel rods in the assembly will be used to calculate the rod internal pressure. The power modeled in the hot assembly rod for the purposes of channel fluid heating is still the appropriate power averaged over both fuel rods and unpowered thimble tubes.

For calculations in which rod burst is not predicted to occur, this change in basis will have a negligible effect. For calculations in which rod burst has been predicted, this change in basis will have the effect of increasing the tendency towards the limiting condition of coincident hot rod and hot assembly average rod burst. This instance would lead to a change in PCT of less than 50°F.

This change in basis is being implemented as a result of information gathered during the course of an ongoing potential issue investigation as one of a closely related group of changes as described in Section 4.1.2 of WCAP-13451. The evaluation tool described in the following Section dealing with Limiting Time in Life in SBLOCA was made to conservatively bound the effect of this change and has been applied to all affected plants to establish a Reasonable Assurance of Safe Operation as described in Section 4.2.3 of WCAP-13451. Therefore, this Non-discretionary Change has been implemented (per Section 4.1 of WCAP-13451) as an Acceptable Change as described in Section 4.1.3 of WCAP-13451. In addition, the ongoing evaluation of the issue is being performed in accordance with Section 4.2 of WCAP-13451 and so the effect of this change on the PCT is considered to be temporary pending final resolution of the issue.

Affected Evaluation Models

1975 SBLOCA Evaluation Model
1985 SBLOCA Evaluation Model

Estimated Effect

Since the effect of this basis change is captured by the methodology used to assess the effect of the Limiting Time in Life basis change which follows, this change has no effect on previous analyses pending final resolution of the issue.

Limiting Time in Life in SBLOCA

Background

It has historically been assumed that the limiting time in life for SBLOCA has coincided with the time of maximum fuel densification and, therefore, maximum fuel temperatures. It has recently been concluded that for some calculations performed under this assumption, a more limiting PCT will occur at some later time in life. This effect occurs only in cases where no rod burst has been predicted and the calculated PCT is greater than 1700°F.

This penalty arises due to both coolant channel flow blockage effects and from the heat deposited in the clad from the Zirc-water reaction which occurs on the clean interior surface of a newly burst rod. This rod burst later in life occurs due to the increase in rod internal pressure caused by the build up of fission gases in the fuel rod. While an evaluation tool has been developed to conservatively assess the impact of this issue, future analyses will include a plant specific limiting time in life determination.

This change in basis is being implemented as a result of information gathered during the course of an ongoing potential issue investigation as one of a closely related group of changes as described in Section 4.1.2 of WCAP-13451. The evaluation tool described above was developed to conservatively bound the effect of this change and has been applied to all affected plants to establish a Reasonable Assurance of Safe Operation as described in Section 4.2.3 of WCAP-13451. Therefore, this Non-discretionary Change has been implemented (per Section 4.1 of WCAP-13451) as an Acceptable Change as described in Section 4.1.3 of WCAP-13451. In addition, the ongoing evaluation of the issue is being performed in accordance with Section 4.2 of WCAP-13451 and so the effect of this change on the PCT is considered to be temporary pending final resolution of the issue.

Affected Evaluation Models

1975 SBLOCA Evaluation Model
1985 SBLOCA Evaluation Model

Estimated Effect

Since the effect of this basis change is captured by the evaluation tool used to establish a RASO for an ongoing potential issue investigation, this change has no effect on previous analyses pending final resolution of the issue.

Structural Metal Heat Modeling

Background

A discrepancy was discovered during review of the finite element heat conduction model used in the WREFLOOD-INTERIM code to calculate heat transfer from structural metal in the vessel during the reflood phase. It was noted that the material properties available in the code corresponded to those of stainless steel. While this is correct for the internal structures, it is inappropriate for the vessel wall which consists of carbon steel with a thin stainless internal clad. This was defined as a non-discretionary change per Section 4.1.2 of WCAP-13451, since there was thought to be potential for increased PCT with a more sophisticated composite model. The model was revised by replacing it with a more flexible one that allows detailed specification of structures.

Affected Evaluation Models

1981 ECCS Evaluation Model with BART
1981 ECCS Evaluation Model with BASH

Affected Codes

WREFLOOD-INTERIM

Estimated Effects

The estimated effect of this correction is a 25°F PCT benefit.

Spacer Grid Heat Transfer Error in BART

Background

During investigations into anomolous wetting and dryout behavior demonstrated by the BART grid model a programming logic error was discovered in the grid heat transfer model. The error caused the solution to be performed twice for each timestep. The error was traced back to the original coding used in all of the BART and LOCBART codes. This was defined as a non-discretionary change per Section 4.1.2 of WCAP-13451. The error was corrected, and a complete reverification of the grid model was conducted and transmitted to the NRC (WCAP-10484, Addendum 1).

Affected Evaluation Models

1981 ECCS Evaluation Model with BART
1981 ECCS Evaluation Model with BASH

Affected Codes

BART
LOCBART

Estimated Effects

Calculations performed with the affected code have consistently demonstrated significantly better grid wetting and lower clad temperatures. A conservative estimate of zero degrees PCT penalty has been assigned for this issue.

POWER SHAPE SENSITIVITY MODEL (PSSM)

Background

Historically, chopped cosine power shapes have been assumed to produce limiting results in Westinghouse large break LOCA analyses. However, with the advent of more advanced models (BART and BASH) it was discovered that under certain circumstances, top skewed power shapes could potentially be more limiting. The PSSM was developed to allow the assessment of shape specific Peak Cladding Temperature (PCT) trends in large break LOCA. As described in WCAP-12909-P and further clarified in ET-NRC-91-3633 (currently under NRC review), the methodology was developed from a large database of large break LOCA analysis results which used a wide variety of full power power shapes in typical twelve foot core for Westinghouse supplied fuel.

This methodology change is considered to be a Non-discretionary Change as described in Section 4.1.2 of WCAP-13451 and has been implemented prior to final NRC review in accordance with Section 4.1.3 of WCAP-13451.

Affected Evaluation Models

1981 ECCS Evaluation Model with BART
1981 ECCS Evaluation Model with BASH

Estimated Effect

The implementation of this methodology reasonably assures that cycle specific power distributions will not lead to results more limiting than those of the analysis of record. Therefore, there is no PCT effect for this methodology.

15x15 Optimized Fuel Assembly (OFA) Core Pressure Drop Increase

Background

Hydraulic tests performed on the 15x15 Optimized Fuel Assembly (OFA) indicated that the design values for the grid loss coefficients were previously underestimated. This results in the core pressure drop in safety analysis being underestimated by approximately 10%. The effects of this on LOCA analysis has been calculated on a plant specific basis.

This was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451 and was corrected in accordance with Section 4.1.3 of WCAP-13451. As such, affected plants have been notified previously of the impact of this error in NSAL-92-002.

Affected Evaluation Models

All Large Break and Small Break LOCA Evaluation Models used on the affected plants.

Estimated Effect

Plant specific PCT effects are included on the attached Margin Summary Sheet.

ATTACHMENT 2

REPORT OF CHANGES IN APPLICATION OF ECCS EVALUATION MODELS

SURRY UNITS 1 AND 2

LBLOCA Axial Power Distribution Penalty Elimination

Evaluation of Low Head Safety Injection Measured Flow

1.0 Background

This report provides a summary of changes in LOCA analysis results from those last reported for Surry Units 1 and 2 (1). These changes are described in Section 2.0 below. It has been concluded that these changes are significant, as defined in 10CFR50.46(a)(3)(i).

2.0 Evaluation Model Changes

2.1 LBLOCA Axial Power Distribution Penalty Elimination (Surry Units 1 and 2)

The prior report (1) included a 100°F penalty which was allocated to conservatively account for the effects of skewed core axial power distributions upon results of the large break LOCA analysis of record. Since this penalty was introduced, Westinghouse has documented a revision to the large break LOCA evaluation model which accounts for the effects of axial power distributions without need for this penalty (2). Calculations have been performed to implement this methodology, referred to as the Power Shape Sensitivity Model (PSSM), on the operating Surry cycles. These calculations have confirmed that operation within the existing Technical Specification power distribution limitations is conservatively bounded by the reported results of the existing analysis of record, without additional penalties. The PSSM methodology will be employed to assess the effects of axial power distribution upon large break LOCA analyses for future Surry reload cores.

2.2 Evaluation of Low Head SI Measured Flow (Surry Units 1 and 2)

In March 1992, flow measurements taken on the Unit 1 low head safety injection (LHSI) pumps indicated that flow during a large break LOCA accident may be less than the 3320 gpm (at 0 psig, full RWST) assumed in the existing analysis of record. Measurement data were evaluated and corrected for comparison to design conditions assumed in the safety analyses, resulting in a bounding LHSI flow shortfall of 150 gpm (including measurement uncertainties). The impact of this flow reduction upon the existing analysis of record (3) was quantified by employing a conservative estimate of the clad heatup rate associated with the limiting case large break analysis result. A PCT penalty of 23°F was assessed and reported in Reference (1). This penalty is still applicable to Surry Unit 1. For convenience of reporting, the revised penalty defined in this section will be applied to Surry Units 1 and 2.

A similar test and data evaluation has been performed during the current Surry Unit 2 Cycle 11-12 refueling outage. The Unit 2 test data indicate an additional flow shortfall of 200 gpm beyond the value previously evaluated for Unit 1. This results in a total bounding flow shortfall of 350 gpm (including uncertainties) versus the 3320 gpm (at 0 psig, full RWST) assumed in the analysis of record (AOR). The effect of this reduction in LHSI flow upon the reported results of the AOR has been quantified and allocated as a permanent PCT penalty. The methodology employed in this calculation is summarized below.

The Reference (3) analysis exhibits the PCT very early in the core reflooding transient at the elevation of the hot rod burst. At this stage of the transient, the pumped safety injection flow represents a small fraction of the total flow (from the accumulators plus the pumps) injected prior to the time of PCT. This transient behavior allows the effects of the total LHSI flow shortfall to be quantified using a relative (with respect to the AOR) evaluation of integrated flow, combined with a conservative clad heatup rate. The steps performed in this evaluation are listed below.

1. Calculate integrated SI flow shortfall to time of PCT as reported in AOR.
2. Calculate time interval required to recover the integrated shortfall, at reduced LHSI flowrate, assuming time of PCT does not change.
3. Revise calculated integrated flow shortfall from Item 1 by assuming time of PCT increases by the delay calculated in Item 2.
4. Calculate revised total time delay to recover the adjusted shortfall from Item 3 at reduced LHSI flowrate.
5. Determine conservative clad heatup rate from results of AOR.
6. Calculate PCT penalty as clad heatup rate times flow delay time.

The calculation resulted in a total penalty of 69°F which is allocated as a permanent PCT penalty in Attachment 3. As mentioned above, this penalty is allocated to both Surry units for 10CFR50.46 reporting convenience. The previous penalty of 23°F reported in Reference (1) remains valid for Surry Unit 1 and is included in the total penalty of 69°F.

3.0 References

(1) Letter from W. L. Stewart (Va. Electric & Power Co.) to NRC, "Surry Power Station Units 1 and 2, North Anna Power Station Units 1 and 2 - Report of ECCS Evaluation Model Changes Pursuant to Requirements of 10CFR50.46," Serial No. 92-560, August 31, 1992.

(2) "Westinghouse ECCS Evaluation Model: Revised Large Break LOCA Power Distribution Methodology," WCAP-12909-P, June 1991.

(3) Letter from W. L. Stewart (Va. Electric & Power Co.) to NRC, "Surry Power Station Units 1 and 2 - Proposed Technical Specifications Change - Surry Improved Fuel Assembly, " Serial No. 87-188, May 26, 1987.

ATTACHMENT 3

EFFECT OF WESTINGHOUSE ECCS EVALUATION MODEL MODIFICATIONS

SURRY UNITS 1 AND 2

Effect of Westinghouse ECCS Evaluation Model Modifications - Surry Units 1 and 2

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. Section A presents the detailed assessment for small break LOCA. The large break LOCA details are given in Section B.

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

A.	PCT for Analysis of Record (AOR)	1852°F (1)
B.	Prior Evaluation Model PCT Assessments	
	1. 1990 - Total Permanent Assessment {1} (2)	0°F
	2. 1991 - Total Permanent Assessment {2} (2)	0°F
	3. 1992 - Total Permanent Assessment {2} (3)	0°F
C.	Current Evaluation Model PCT Assessments	
	1. NOTRUMP Bessel Function Error {2}	0°F
SBLOCA Licensing Basis PCT (AOR PCT + PCT Assessments)		1852°F

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

A.	PCT for Analysis of Record (AOR)	1969°F (4)
B.	Prior Evaluation Model PCT Assessments	
	1. 1990 - Total Permanent Assessment {1} (2)	0°F
	2. 1991 - Total Permanent Assessment (2)	+ 155°F
	3. 1992 - Total Permanent Assessment {5} (3)	+ 26°F
C.	Current Evaluation Model PCT Assessments	
	1. LBLOCA Power Distribution Penalty Removal {3}	- 100°F
	2. Evaluation of LHSI Flow Measurement {6}	+ 69°F
	3. Structural Metal Heat Modeling {4}	- 25°F
	4. Spacer Grid Heat Transfer Error in BART {4}	0°F
LBLOCA Licensing Basis PCT (AOR PCT + PCT Assessments)		2094°F

Notes { } and References ( ) on the following page.

Effect of Errors/Changes in Application of ECCS Evaluation Models - Surry Units 1 and 2

Notes:

{1} No issues which were applicable to the evaluation model used in the AOR were permanently resolved for this reporting period.

{2} The AOR was performed with an evaluation model version that included corrections and/or input changes to address the applicable issues.

{3} The previous PCT assessment reported for this issue in Reference (3) has been removed by applying the Westinghouse PSSM methodology documented in Reference (5).

{4} Refer to the Westinghouse Report of LOCA Evaluation Model Changes for 1992 provided in Attachment 1.

{5} This value does not include any of the previous PCT penalty allocated for the Surry Unit 1 low head safety injection flow shortfall. The current penalty item C.2 represents a bounding PCT effect for this issue.

{6} The calculation addressing LHSI flow shortfall resulted in a total penalty of 69°F which is allocated as a permanent PCT penalty to both Surry units for 10CFR50.46 reporting convenience. The previous penalty of 23°F reported in Reference (1) remains valid for Surry Unit 1 and is included in the total penalty of 69°F.

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 (Va. Electric & Power Co.) to NRC, "Surry Power Station Units 1 and 2, North Anna Power Station Units 1 and 2- Report of ECCS Evaluation Model Changes Per Requirements of 10CFR50.46," Serial No. 91-428, August 23, 1991.

(3) Letter from W. L. Stewart (Va. Electric & Power Co.) to NRC, "Surry Power Station Units 1 and 2, North Anna Power Station Units 1 and 2- Report of ECCS Evaluation Model Changes Pursuant to Requirements of 10CFR50.46," Serial No. 92-560, August 31, 1992.

(4) Letter from W. L. Stewart (Va. Electric & Power Co.) to NRC, "Surry Power Station Units 1 and 2 - Proposed Technical Specifications Change - Surry Improved Fuel Assembly, " Serial No. 87-188, May 26, 1987.

(5) "Westinghouse ECCS Evaluation Model: Revised Large Break LOCA Power Distribution Methodology," WCAP-12909-P, June 1991.