10CFR50.46

SCE&G
A SCANA Company

South Carolina Electric & Gas Company
P.O. Box 88
Jenkinsville, SC 29065
(803) 345-4344

Gary J. Taylor
Vice President
Nuclear Operations

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

Gentlemen:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
ECCS EVALUATION MODEL REVISIONS REPORT (ANN 2300)

Attached is the annual Emergency Core Cooling System (ECCS) Evaluation Model Revisions Report for the Virgil C. Summer Nuclear Station (VCSNS). This report is submitted pursuant to 10CFR50.46 which requires licensees to notify the NRC on at least an annual basis of errors or changes in the ECCS Evaluation Models.

Tables 2 through 5 in the attachment summarize the changes in peak clad temperature (PCT) from the previous analysis of record. None of the model changes is considered significant under 10CFR50.46. All ECCS Evaluation Model changes and errors that significantly impacted PCT were previously reported. Refer to RC-94-0017, RC-94-0251, and RC-94-0313.

I declare that the statements and matters set forth herein are true and correct to the best of my knowledge, information, and belief.

If you have any questions, please call Mr. Philip Rose at (803) 345-4052 at your convenience.

Very truly yours,

Gary J. Taylor

PAR/GJT/nkk
Attachment

c: J. L. Skolds
O. W. Dixon
R. R. Mahan (w/o att.)
R. J. White
S. D. Ebneter
S. Dembek
General Managers

NRC Resident Inspector
J. B. Knotts, Jr.
NSRC
Central File System
RTS (ANN 2300)
File (813.12-4, 818.02-17)

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CHANGES TO THE WESTINGHOUSE ECCS EVALUATION MODELS

INTRODUCTION

Provisions in 10CFR50.46 require the annual reporting of corrections to or changes in the ECCS Evaluation Model (EM) approved for use in performing safety analyses for the Loss of Cooling Accident (LOCA). This report describes corrections and revisions to the Westinghouse ECCS EM which are applicable to the V. C. Summer Nuclear Station (VCSNS). The current approved Westinghouse ECCS EMs are listed in Table 1 and consist of several computer codes with specific functions.

Westinghouse has completed the evaluation of several items related to the Westinghouse ECCS EM listed in Table 1. Each of these items is discussed in the following sections, which include a description of the item, the assessment which was performed, the resulting change to the EM, and the effect of the change on the Peak Clad Temperature (PCT).

TABLE 1
SUMMARY OF WESTINGHOUSE
ECCS EVALUATION MODELS
FOR VCSNS

NAME: 1981 MODEL WITH BASH

APPLICATION: Analysis of Large Break LOCA

CODES USED:	PURPOSE:
SATAN-VI	Blowdown hydraulic transient
BASH	Reflood hydraulic transient
LOCBART	Hot assembly thermohydraulics and fuel rod thermal transient
WREFLOOD/COCO/LOTIC	Containment pressure transient

NAME: 1985 SBLOCA MODEL

APPLICATION: Analysis of Small Break LOCA

CODES USED:	PURPOSE:
NOTRUMP	System Hydraulic transient
SBLOCTA	Fuel rod thermal transient

TABLE 2

CHANGES OR ERRORS TO THE VIRGIL C. SUMMER

NUCLEAR STATION ECCS EVALUATION MODELS

NOT PREVIOUSLY REPORTED

CODE STREAM IMPROVEMENT

Reference

Letter NTD-NRC-94-4143, "Change in Methodology for Execution of BASH Evaluation Model", N.J. Liparulo (W) to W.T. Russell (NRC), May 23,1994.

Background

Revisions were made to the procedures used to interface the various codes that comprise the entire execution stream for performing a Large Break LOCA analysis with the BASH Evaluation Model. The previous use of the coupled WREFLOOD/COCO code for calculating containment pressure response, which was then transferred as a boundary condition to the BASH code, has been replaced with direct coupling of the BASH and COCO codes such that the same code used to calculate the RCS conditions during reflood, also supplies the boundary conditions for the containment pressure calculation. In conjunction with this, the portion of the WREFLOOD code which calculated the refill phase of the transient has been reprogrammed into a separate , but identical code called REFILL, which is also coupled with COCO.

This methodology revision was made only as a process improvement for conducting analyses and involved no changes to the approved physical models or basic solution techniques governing the solutions provided by the individual computer codes. The NRC was advised of the implementation of this methodology on a forward-fit basis via the reference letter.

Affected Evaluation Models

1981 ECCS LBLOCA Evaluation Model with BASH

Estimated Effect

Due to small perturbations in the boundary conditions resulting from this revised methodology for interfacing with the codes, small differences in predicted results were observed. The effects were minor, with no observed bias. Since this methodology is a process improvement which is to be implemented on a forward-fit basis, there are no effects on existing licensee analyses, and any small effects on results will be implicitly accounted for in future analyses.

BASH: LOOP/CORE INTERFACE CORRECTIONS

Background

Corrections were made to the logic for interfacing the loop model and BART code model. One correction prevents the possibility of an occasional inconsistency in how the core timestep was limited by the loop timestep. Another corrects the fluid density used in the interface calculation when the inlet flowrate is negative.

Affected Evaluation Models

1981 ECCS LBLOCA Evaluation Model with BASH

Estimated Effect

Results from sensitivity studies for the corrections demonstrated negligible perturbations in the trends of the system parameters with a very minor net effect on peak clad temperature predictions relative to results from the previous version. Since this is a very small net effect, with no apparent bias, the net effect on existing analyses is estimated to be zero degrees for margin tracking purposes. The change has been implemented on a forward- fit basis only and will be incorporated implicitly in any future analyses.

PELLET POWER RADIAL FLUX DEPRESSION ERROR

Background

A coding error (an incorrect sign) was discovered and corrected in a subroutine that calculates radial distribution power factors in the fuel pellet for the LOCBART code.

Affected Evaluation Models

1981 ECCS Evaluation Model with BASH

Estimated Effect

Sensitivity studies found the error correction to result in less than a ± 0.1°F effect on predicted peak clad temperature. The net effect on existing analyses is therefore zero degrees for margin tracking purposes, and will be implicitly included in future recalculations.

IMPROVEMENTS TO FLOODING RATE SMOOTHING

Background

Part of the approved methodology for performing large break LOCA analyses with the BASH Evaluation Model is the requirement that the core inlet flooding rate calculated by the BASH code be linearized in a piece-wise manner to remove oscillations prior to use in the hot channel,fuel rod calculation. This operation is termed "smoothing", and guidelines are provided to the analysts describing how to linearize the curve by observing inflections in the overall flooding rate. To facilitate consistency in performing this operation, the logic has been coded into a program named SMUUTH. A new version of the SMUUTH program has been implemented which incorporates improved logic for determining the inflection points gained through experience in utilizing the program for a broad range of plant transients.

Affected Evaluation Models

1981 ECCS Evaluation Model with BASH

Estimated Effect

There are no changes to the approved evaluation model methodology from this revision. The SMUUTH program merely represents a convenient way of automating the approved methodology and does not explicitly introduce any effects on the results. This revision is being reported only as a change to the code stream used for standard analyses. There are no effects on predicted results from using the new program version.

ACCUMULATOR WATER TEMPERATURE

Background

The choice of accumulator water temperature can affect the calculated Peak Cladding Temperature (PCT) associated with large break LOCA analyses. Early Westinghouse Evaluation Models had assumed a generic value of 90°F for the accumulator water temperature based on a conservatively low value of containment air temperature at 100% power in fulfillment of the Appendix K requirements associated with the calculation of a low containment backpressure. These containment initial temperature and pressure assumptions in a plant's LBLOCA analysis have been consistently reported to the NRC in the Final Safety Analysis Report. The NRC had previously reviewed and approved this aspect of the LBLOCA Evaluation Model via plant specific Safety Evaluation Reports. Using these assumptions, and with the early Westinghouse models, 90°F was conservative with respect to the overall effect on large break LOCA PCT.

Newer evaluation models have demonstrated that a higher containment air temperature, coupled with higher accumulator water temperatures, may result in an even more conservative calculation for PCT, even if containment pressure is slightly higher than calculated with the 90°F assumption. Sensitivity studies performed with these newer evaluation models (identified below) have shown a small sensitivity to accumulator water temperature. The effect on PCT was a 1.3°F change in PCT for a 1.0°F change in accumulator water temperature when the accumulator water temperature varies over a range from 90° to 120°F. Application of this sensitivity over its applicable range results in a PCT effect which is below the 10CFR50.46 threshold for determination of a significant change (i.e, <50°F). It is therefore Westinghouse's position that immediate implementation of this new methodology is not required. As such, application of the new plant specific methodology and associated change in analysis assumptions can be forward-fit to new large break LOCA analyses.

In support of future analyses, Westinghouse has developed a set of criteria for selection of the accumulator water temperature for use in large break LOCA analyses which use either the 1981 EM with BART or the 1981 EM with BASH. SCE&G will be provided with these criteria prior to having a new large break LOCA analysis performed.

Affected Evaluation Models

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

Estimated Effect

As accumulator water temperatures are expected to vary during plant operation, the estimated effect will be assessed once detailed accumulator water temperature data is available. This data will be included in the calculation when implementation of the new methodology occurs during the next time a LBLOCA analyses is performed that uses these affected Evaluation Models. VCSNS's current analysis of record is based on an accumulator water temperature of 120°F.

PRESSURE SEARCH CONVERGENCE CRITERIA IN NOTRUMP

Background

The convergence criteria used during the pressure search in NOTRUMP have been found to not be adequately restrictive to ensure a sufficiently accurate value for Fluid Node pressure when conditions approach the boundary between subcooled and saturated in some cases. The resulting effects on predicted pressure were more pronounced at pressures below those normally seen during standard Evaluation Model calculations. The previously hardwired convergence criteria values have been made user input, appropriate values have been determined and these will be implemented in all future analyses.

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

Affected Evaluation Model

1985 SBLOCA Evaluation Model (NOTRUMP)

Estimated Effect

The nature of this error led to an estimated generic PCT effect of 0°F for existing analyses.

FRICTION VALUE INPUT CORRECTIONS

Background

The SPADES code is used to generate input decks for the small break analysis code, NOTRUMP. An error was found in the code which involved the values assigned to some of the friction factor input. The erroneous values had no impact on transient calculations and were corrected in order to maintain the consistency of the SPADES code with the relevant documentation.

The errors were considered to be Discretionary Changes as described in Section 4.1.1 of WCAP-13451 and were corrected in accordance with Section 4.1.3 of WCAP-13451.

Affected Evaluation Model

1985 SBLOCA Evaluation Model (NOTRUMP)

Estimated Effect

Representative plant calculations indicate no effect on PCT analyses.

AUTOMATIC CONTAINMENT SPRAY ACTUATION DURING SBLOCA

Background

Automatic containment spray actuation during a SBLOCA had not previously been addressed in the Westinghouse Small Break LOCA Evaluation Model. The containment pressure transient is not modeled because the small break PCT is not directly sensitive to this effect. While investigating this issue, however, Westinghouse concluded that containment spray early in the small break transient is possible for a variety of containment types. Containment spray actuation could result in draindown of the RWST prior to conclusion of the small break transient. Switching to cold leg recirculation during the transient may reduce or briefly interrupt the modeled ECCS injection flow in some plants and elevate the enthalpy of ECCS injection water. Furthermore, an alternate single failure scenario could result in earlier draindown for the RWST and subsequent switchover to cold leg recirculation.

Future small break LOCA analyses will explicitly consider these issues.

Affected Evaluation Models

1975 SBLOCA Evaluation Model (WFLASH)
1985 SBLOCA Evaluation Model (NOTRUMP)

Estimated Effects

A plant specific evaluation for VCSNS indicated no PCT effect due to SI interruption or reduction following switchover to cold leg recirculation. In addition, no PCT effect results from the potential increase in ECCS injection water enthalpy with an alternate single failure.

SAFETY INJECTION IN THE BROKEN LOOP

Reference

WCAP-10054-P, Addendum 2, "Addendum to the Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code: Safety Injection into the Broken Loop and COSI Condensation Model," August, 1994.

Background

The referenced topical report presents a change to the Westinghouse SBLOCA methodology dealing with ECCS flows in the broken loop. It also presents a revised condensation model that will be used on the safety injection jet in future analyses. This change is being implemented on a forward-fit basis prior to formal approval in accordance with Section 4.1.3 of WCAP-13451.

Affected Evaluation Model

1985 SBLOCA Evaluation Model (NOTRUMP)

Estimated Effect

This change has been shown to typically produce PCT benefits in studies presented in the reference. Since it is being implemented on a forward-fit basis, a net PCT impact of 0°F is being assessed against the existing analyses.

TABLE 3

MARGIN UTILIZATION SHEETS

Table 3

Small Break Peak Clad Temperature Margin Utilization

Revision Date: 10/12/94

Plant Name: Virgil C. Summer
Utility Name: South Carolina Electric & Gas

Eval. Model: NOTRUMP FQ = 2.45 FΔH = 1.62

Fuel: Vantage + SGTP = 10%

		Reference *	Clad Temperature		Notes
A.	ANALYSIS OF RECORD (2/94)		PCT =	1823°F	1
B.	PRIOR PERMANENT ECCS MODEL ASSESSMENTS		ΔPCT =	-16°F	
C.	10 CFR 50.59 SAFETY EVALUATIONS	Table 4	ΔPCT =	1°F	
D.	1994 10 CFR 50.46 MODEL ASSESSMENTS (Permanent Assessment of PCT Margin)				
	1. Boiling Heat Transfer Correlation Error		ΔPCT =	-6°F	
	2. Steam Line Isolation Logic Error		ΔPCT =	18°F	
	3. Axial Nodalization, RiP Model Revision, and SBLOCTA Error Corrections Analysis		ΔPCT =	96°F	
E.	OTHER MARGIN ALLOCATIONS				
	1. Burst and Blockage/Time in Life		ΔPCT =	73°F	2
	LICENSING BASIS PCT + MARGIN ALLOCATIONS		**PCT =**	**1989°F**	

* References for the Peak Clad Temperature Margin Utilization summary can be found in Table 5.

Notes:

1. AOR performed for core power = 2900 MWt and Δ75 steam generators.
2. This assessment is a function of base PCT plus permanent margin allocation and as such will increase/decrease with margin allocation changes.

TABLE 3

Large Break Peak Clad Temperature Margin Utilization

Revision Date: 10/12/94

Plant Name: Virgil C. Summer
Utility Name: South Carolina Electric & Gas

Eval. Model: BASH FQ = 2.45 FΔH = 1.62

Fuel: Vantage + SGTP = 10%

		Reference *	Clad Temperature		Notes
A.	ANALYSIS OF RECORD (8/93)	2	PCT =	2007°F	1
B.	PRIOR PERMANENT ECCS MODEL ASSESSMENTS		ΔPCT =	-6°F	
C.	10 CFR 50.59 SAFETY EVALUATIONS	Table 4	ΔPCT =	1°F	
D.	1994 10 CFR 50.46 MODEL ASSESSMENTS (Permanent Assessment of PCT Margin)				
	1. None		ΔPCT =	0°F	
E.	TEMPORARY ECCS MODEL ISSUES				
	1. None		ΔPCT =	0°F	
F.	OTHER MARGIN ALLOCATIONS				
	1. None		ΔPCT =	0°F	
	LICENSING BASIS PCT + MARGIN ALLOCATIONS		**PCT =**	**2002°F**	

* References for the Peak Clad Temperature Margin Utilization summaries can be found in Table 5

Notes:

1. AOR is for Δ75 steam generators and core power = 2775 MWt.

TABLE 4 - 10 CFR 50.59 Safety Evaluations

Revision Date: 10/12/94

Plant Name: Virgil C. Summer
Utility Name: South Carolina Electric & Gas

		Reference	Clad Temperature	Notes
I.	SMALL BREAK ECCS SAFETY EVALUATIONS			
	A. Fuel Reconstitution		ΔPCT= 1°F	1
	TOTAL 10 CFR 50.59 SMALL BREAK ASSESSMENTS		**PCT= 1°F**	

Revision Date: 08/10/94

II.	LARGE BREAK ECCS SAFETY EVALUATIONS			
	A. Fuel Reconstitution		ΔPCT= 1°F	1
	TOTAL 10 CFR 50.59 LARGE BREAK ASSESSMENTS		**PCT= 1°F**	

Notes:

1. This penalty is due to a fuel assembly reconstitution in assemblies K21 and K46 for Cycle 9. The penalty will be removed when assemblies K21 and K46 are removed from the core.

TABLE 5 - References

1. Steam Generator Replacement Technical Specification Change Request (TSP 930015) from J. L. Skolds to Document Control Desk, dated March 11, 1994.

2. 10CFR50.46 30 Day Report (ANN 2300) from J. L. Skolds to Document Control Desk , dated January 28, 1994.

3. 10CFR50.46 30 Day report (ANN 2300) from J. L. Skolds to Document Control Desk, dated September 22, 1994.

4. 10CFR50.46 30 Day Report (ANN 2300) from J. L Skolds to Document Control Desk , dated December 7, 1994.

5. 10CFR50.46 Annual report (ANN 2300) from J. L. Skolds to Document Control Desk, dated June 6, 1994.