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June 2, 2005

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U. S. Nuclear Regulatory Commission  
Washington, DC 20555

Dear Sir / Madam:

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

Attached is the 2004 Emergency Core Cooling System (ECCS) Evaluation Model Revisions Annual Report for the Virgil C. Summer Nuclear Station (VCSNS). This report is being submitted pursuant to 10 CFR 50.46, which requires licensees to notify the NRC on at least an annual basis of corrections to or changes in the ECCS evaluation models.

Summary sheets describing changes and enhancements to the ECCS evaluation models for 2004 are included in Attachment I.

Peak Clad Temperature (PCT) sheets are included in Attachment II. All necessary revisions for any non-zero, non-discretionary, PCT change to Section C have been included. Any plant specific errors in the application of the model for 2004 are also provided in Section C with discussion enclosed or cited.

VCSNS is currently revising its calculations for both Large and Small Break Loss of Coolant Accidents (LOCA). Submittal of these revisions are forthcoming.

If you have any questions, please call Mr. Arnie J. Cribb, Jr. at (803) 345-4346.

Very truly yours,

A handwritten signature in black ink, appearing to read 'Jeffrey B. Archie', is written over a printed name. The signature is fluid and cursive.

Jeffrey B. Archie

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AJC/JBA/mb  
Attachments

c: N. O. Lorick  
N. S. Carns  
T. G. Eppink (w/o attachments)  
R. J. White  
W. D. Travers  
R. E. Martin

Winston & Strawn  
NRC Resident Inspector  
NSRC  
RTS (L-99-0152)  
File (818.02-17, RR 8375)  
DMS (RC-05-0080)

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## **Attachment 1**

### **Changes and Enhancements to the Evaluation Models for 2004**

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**Non-Discretionary Changes with PCT Impact**  
LOCBART Fluid Property Logic

**Non-Discretionary Changes with No PCT Impact**  
Steam Generator Inlet/Outlet Plenum Flow Areas  
LBLOCA Initial Containment Relative Humidity Assumption

**Enhancements/Forward-Fit Discretionary Changes**  
General Code Maintenance (BASH/NOTRUMP)

## **LOCBART FLUID PROPERTY LOGIC**

### **Background**

Several minor discrepancies related to the LOCBART fluid property logic were discovered and corrected. For example, the routine used to calculate the enthalpy and specific volume of superheated steam was renamed to resolve a naming conflict with a library routine that uses different logic to calculate the same parameters. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

### **Affected Evaluation Models**

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

### **Estimated Effect**

Representative plant calculations using the LOCBART code generally showed either no effect or a negligible effect on results, with some tendency for a small increase in peak cladding temperature (PCT) for plants with an early-reflood or mid-reflood PCT. For these plant categories, 10 CFR 50.46 assessments were developed either to bound the representative plant calculations or on a plant-specific basis. VCSNS falls into this category and the maximum expected impact is +10°F in peak cladding temperature.

## **STEAM GENERATOR INLET/OUTLET PLENUM FLOW AREAS**

### **Background**

The basis for calculating the steam generator inlet and outlet plenum flow areas used with the SATAN-VI momentum flux model has been redefined as the average area over the plenum height. This change resolves a discrepancy in the original calculation and provides a more appropriate basis for the corresponding flow area terms. This change represents 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 BASH

### **Estimated Effect**

Calculations using the SATAN-VI code indicated that this change has a negligible effect on the blowdown thermal-hydraulic transient results that will be assigned a 0°F PCT impact for 10 CFR 50.46 reporting purposes.

## **LBLOCA INITIAL CONTAINMENT RELATIVE HUMIDITY ASSUMPTION**

### **Background**

Large break LOCA analyses have historically used maximum initial relative humidity to specify the initial containment air and steam partial pressures. This assumption is conservative for a given total initial containment pressure, but is non-conservative for a given initial containment air partial pressure. The historical assumption has been revised to reflect this distinction, and the analysis input guidelines have been updated accordingly. This change represents 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 BASH

### **Estimated Effect**

The nature of this change lead to an estimated PCT effect of 0°F for VCSNS.

## **GENERAL CODE MAINTENANCE (BASH/NOTRUMP)**

### **Background**

Various changes in code input and output format have been made to enhance usability and help preclude errors in analyses. This includes both input changes (e.g., more relevant input variables defined and more common input values used as defaults) and input diagnostics designed to preclude unreasonable values from being used, as well as various changes to code output which have no effect on calculated results. In addition, various updates were made to eliminate inactive coding, improve active coding, and enhance commenting, both for enhanced usability and to facilitate code debugging when necessary. These changes represent Discretionary Changes that will be implemented on a forward-fit basis in accordance with Section 4.1.1 of WCAP-13451.

### **Affected Evaluation Models**

1981 Westinghouse Large Break LOCA Evaluation Model with BASH  
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

### **Estimated Effect**

The nature of these changes leads to an estimated PCT impact of 0°F.



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## **Attachment 2**

### **PCT Sheets for Virgil C. Summer Nuclear Station**

**Westinghouse LOCA Peak Clad Temperature Summary for Large Break**

**Plant Name:** V. C. Summer  
**Utility Name:** South Carolina Electric & Gas  
**Revision Date:** 3 /31/05

**Analysis Information**

**EM:** BASH                      **Analysis Date:** 10/1/95                      **Limiting Break Size:** Cd = 0.4  
**FQ:** 2.4                      **FdH:** 1.62  
**Fuel:** Vantage +              **SGTP (%):** 10  
**Notes:** Analysis-Of-Record was done with FQ=2.50 and FdH = 1.70.

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	2099	1	(a)
<b>MARGIN ALLOCATIONS (Delta PCT)</b>			
<b>A. PRIOR PERMANENT ECCS MODEL ASSESSMENTS</b>			
1 . SI Error Reanalysis (Plant Specific)	-90	2	(a,b)
2 . Accumulator Line/Pressurizer Surge Line Data, LOCBART Spacer Grid Single-Phase Heat Transfer Error, LOCBART Zirc-Water Oxidation Error, and Reanalysis of Limiting AOR Case	153	2	(a,c)
3 . LOCBART Vapor Film Flow Regime Heat Transfer Error	-15	3	
4 . LOCBART Cladding Emissivity Errors	-10	4	
5 . LOCBART ZIRLO™ Cladding Specific Heat Model	40	5	
6 . PAD 4.0 Initial Pellet Temperatures	-40	5	
<b>B. PLANNED PLANT CHANGE EVALUATIONS</b>			
1 .None	0		
<b>C. 2004 PERMANENT ECCS MODEL ASSESSMENTS</b>			
1 . LOCBART Fluid Property Logic	10	6	
<b>D. TEMPORARY ECCS MODEL ISSUES</b>			
1 .None	0		
<b>E. OTHER</b>			
1 .None	0		

**LICENSING BASIS PCT +MARGIN ALLOCATIONS                      PCT = 2147**

**References:**

1. CGE-95-0009-SGUL, "Revised Large Break LOCA Results for Uprating Submittal," October 24, 1995.
2. CGE-99-044, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 BART/BASH Evaluation Model, Mid-Year Notification and Reporting for 1999," September 17, 1999.
3. CGE-00-044, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Appendix K (BART/BASH/NOTRUMP) Evaluation Model, Mid-Year Notification and Reporting for 2000", June 30, 2000.
4. CGE-00-112, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 BART/BASH Evaluation Model Mid-Year Notification and Reporting for 2000," December 2000.
5. CGE-03-12, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Annual Notification and Reporting for 2002," March 2003.
6. CGE-04-49, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 BASH Evaluation Model Interim Notification and Reporting for 2004," July 2004.

**Notes:**

- (a) Analysis was done for Delta-75 steam generators and core power at 2900 MWt.
- (b) This plant specific reanalysis addressed the correction of Safety Injection Performance Inputs. These results incorporate the SATAN/LOCTA Fluid Conditions Translation Error and the Accumulator Pressure and Water Volume Uncertainties evaluation, so these PCT penalties are no longer applicable. IFBA fuel is limiting compared to non-IFBA fuel.
- (c) This reanalysis was based on the SI Error reanalysis; modelled a reduction in FQ from 2.5 to 2.4, a reduction in FdH from 1.70 to 1.62, and a reduction in P-bar-HA from 1.514 to 1.443; and addressed the following issues: Accumulator Line/Pressurizer Surge Line Data, LOCBART Spacer Grid Single-Phase Heat Transfer Error, and LOCBART Zirc-Water Oxidation Error. IFBA fuel is limiting compared to non-IFBA fuel.

**Westinghouse LOCA Peak Clad Temperature Summary for Small Break**

**Plant Name:** V. C. Summer  
**Utility Name:** South Carolina Electric & Gas  
**Revision Date:** 3/31/05

Analysis Information

**EM:** NOTRUMP      **Analysis Date:** 2/1/94      **Limiting Break Size:** 2 inch  
**FQ:** 2.4      **FdH:** 1.62  
**Fuel:** Vantage +      **SGTP (%):** 10  
**Notes:** Limiting Break Size shifted from 2 inch to 3 inch (b,d) and FQ reduced from 2.45 to 2.40 (f)

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1823	1	(a)
<b>MARGIN ALLOCATIONS (Delta PCT)</b>			
<b>A. PRIOR PERMANENT ECCS MODEL ASSESSMENTS</b>			
1 . LUCIFER Error Corrections	-16	3	
2 . Effect of SI in Broken Loop	150	3	
3 . Effect of Improved Condensation Model	-150	3	
4 . Axial Nodalization, RIP Model Revision and SBLOCTA Error Corrections Analysis	96	4	
5 . Boiling Heat Transfer Correlation Error	-6	5	
6 . Steam Line Isolation Logic Error	18	5	
7 . NOTRUMP Specific Enthalpy Error	20	6	
8 . SALIBRARY Double Precision Error	-15	6	
9 . SBLOCTA Fuel Rod Initialization Error	10	7	
10 . NOTRUMP Mixture Level Tracking / Region Depletion Errors	13	9	
11 . NOTRUMP Bubble Rise / Drift Flux Model Inconsistency Corrections	35	12	
<b>B. PLANNED PLANT CHANGE EVALUATIONS</b>			
1 . Increased Accumulator Pressure and Water Volume Uncertainties	34	2	(b)
2 . Annular Blankets	10	2	
3 . Main Feedwater Temperature Increase Evaluation	0	10	
<b>C. 2004 PERMANENT ECCS MODEL ASSESSMENTS</b>			
1 . None			
<b>D. TEMPORARY ECCS MODEL ISSUES</b>			
1 . None	0		
<b>E. OTHER</b>			
1 . Burst and Blockage/Time in Life	245	9	(c,e)
2 . Margin Recovery (SI Performance Inputs Evaluation)	-36	8	(d)
3 . GEDM Evaluation	0	11	(f)
4 . Analysis Margin	-35	12	
<b>LICENSING BASIS PCT +MARGIN ALLOCATIONS</b>	<b>PCT = 2196</b>		

References:

- 1 . CGE-93-0054-SGUL, "SECL-93-036, Rev. 1," March 9, 1994.
- 2 . CGE-99-008, "South Carolina Electric and Gas Company, Virgil C. Summer Station, 10 CFR 50.46 Annual Notification and Reporting for 1998," March 5, 1999.
- 3 . CGE-94-205, "South Carolina Electric and Gas Company, Virgil C. Summer Station, 10 CFR 50.46 Notification and Reporting Information," February 8, 1994.
- 4 . CGE-94-228, "South Carolina Electric and Gas Company, Virgil C. Summer Station, SBLOCTA Axial Nodalization," October 27, 1994.
- 5 . CGE-95-201, "South Carolina Electric and Gas Company, Virgil C. Summer Station, 10 CFR 50.46 Notification and Reporting Information," February 3, 1995.
- 6 . CGE-96-202, "South Carolina Electric and Gas Company, Virgil C. Summer Station, 10 CFR 50.46 Annual Notification and Reporting," February 9, 1996.
- 7 . CGE-96-213, "South Carolina Electric and Gas Company, Virgil C. Summer Station, 10 CFR 50.46 Small Break LOCA Notification and Reporting," July 8, 1996.
- 8 . CGE-00-006, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Annual Notification and Reporting for 1999," February 25, 2000.
- 9 . CGE-00-044, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Appendix K (BART / BASH / NOTRUMP) Evaluation Model, Mid-Year Notification and Reporting for 2000," June 30, 2000.
- 10 . CGE-00-063, "Safety Evaluation for Increased Main Feedwater Temperature (SECL-00-118)," August 25, 2000.
- 11 . CAB-02-64/NF-CG-02-16, "Cycle 14 Reload Safety Evaluation," March 2002.
- 12 . CGE-03-80, "10 CFR 50.46 Mid-Year Notification and Reporting for 2003," January 2004.

Notes:

- (a) AOR performed for core power = 2900 MWt and Delta-75 steam generators.
- (b) The SBLOCA evaluation for increased accumulator pressure and water volume uncertainties causes the limiting break equivalent diameter to shift from 2-inch to 3-inch. The 34°F value does not include the effect on SBLOCA burst/blockage behavior.
- (c) This assessment is a function of base PCT plus margin allocation and as such will increase/decrease with margin allocation changes.
- (d) The Margin Recovery (SI Performance Evaluation) resulted in a 36 °F PCT benefit. Note that the evaluation considered the 2 inch and 3 inch break and resulted in the limiting break equivalent diameter to remain shifted from 2 inch to 3 inch
- (e) Value includes previous Burst and Blockage / Time in Life penalty SPIKE Correlation Revision penalty (1999 Annual Report), and consideration of a new penalty due to item C.1 (NOTRUMP Mixture Level Tracking / Region Depletion
- (f) The reduced AOR GEDMs have been violated during the CGE Cycle 14 Reload Process. An evaluation was performed using default GEDMs and taking credit for a lower PHA of 1.42 and FQ of 2.40. Analysis-of-record was done with FQ=2.45 and PHA=1.443. The evaluation concluded a net zero PCT effect to the Small Break LOCA Analysis.