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

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION UNIT 1  
DOCKET NO. 50/395  
OPERATING LICENSE NO. NPF-12  
ECCS EVALUATION MODEL REVISIONS REPORT

South Carolina Electric & Gas Company (SCE&G) hereby submits the 2009 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 2009 are included in Attachment I. Peak Clad Temperature (PCT) sheets are included in Attachment II.

If you have any questions, please call Bruce L. Thompson at (803) 931-5042.

Very truly yours,

Thomas D. Gatlin

GAR/TDG/wm  
Attachments

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A002  
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**Attachment I**

**Changes and Enhancements  
to the  
ECCS Evaluation Models for 2009**

**GENERAL CODE MAINTENANCE  
(Discretionary Change)**

**Background**

Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. 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 Model**

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

**Estimated Effect**

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

**DISCREPANCY IN METAL MASSES USED FROM DRAWINGS  
(Non-Discretionary Change)**

**Background**

Discrepancies were discovered in the use of lower support plate (LSP) metal masses from drawings. The updated LSP metal masses have been evaluated for impact on current licensing-basis analysis results and will be incorporated on a forward-fit basis. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

**Affected Evaluation Model**

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

**Estimated Effect**

Sensitivity studies were performed using a representative WCOBRA/TRAC model in which the correct LSP mass was used. It was determined that the effect of the error correction on the peak cladding temperature was negligible, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

## **HOTSPOT GAP HEAT TRANSFER LOGIC (Non-Discretionary Change)**

### **Background**

The HOTSPOT code has been updated to incorporate the following changes to the gap heat transfer logic: (1) change the gap temperature from the pellet average temperature to the average of the pellet outer surface and cladding inner surface temperatures; (2) correct the calculation of the pellet surface emissivity to use a temperature in °R (as specified in Equation 7-28 of Reference 1) instead of °F; and (3) revise the calculation of the gap radiation heat transfer coefficient to delete a term and temperature adder not shown in or suggested by Equation 7-28 of Reference 1. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

### **Affected Evaluation Model**

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

### **Estimated Effect**

Sample calculations showed a minimal impact on PCT, leading to an estimated effect of 0°F.

### **Reference**

1. WCAP-12945-P-A, Volume 1, Revision 2, "Code Qualification Document for Best Estimate LOCA Analysis, Volume I: Models and Correlations," March 1998.

## **HOTSPOT STATISTICAL OUTPUT LOGIC (Non-Discretionary Change)**

### **Background**

The HOTSPOT code has been updated to incorporate the following changes to the statistical output logic for calculations using the Code Qualification Document methodology: (1) revise one of the three methods for calculating the standard deviation of cladding temperature to correctly identify the bin containing the 97.5<sup>th</sup> percentile value; and (2) change the 50<sup>th</sup>, 95<sup>th</sup> and 97.5<sup>th</sup> percentile bin values from the lower end of the range to the upper end. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

### **Affected Evaluation Model**

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

### **Estimated Effect**

Sample calculations suggested a minimal impact on the 95<sup>th</sup> percentile PCT, leading to an estimated effect of 0°F.

## **LARGE BREAK LOCA EVALUATION FOR VCSNS UPFLOW CONVERSION**

### **Background**

SCE&G requested that Westinghouse perform an evaluation for VCSNS to evaluate the impact of a conversion of the barrel-baffle region to an upflow configuration. This conversion to an upflow configuration was completed during Refuel 18.

### **Affected Evaluation Model**

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

### **Evaluation and Estimated Effect**

The impact of converting the barrel-baffle region to an upflow configuration on the current licensing basis (Reference 1) Best-Estimate Large Break LOCA analysis for VCSNS was determined. The WCOBRA/TRAC reference steady state and transient decks used in the VCSNS analysis of record (Section 4.0 of Reference 1) were modified to reflect the conversion of the barrel-baffle region to an upflow configuration; the detailed thermal-hydraulic parameters associated with the modified barrel-baffle region flow were modeled, and the reference steady state and transient were executed using the same approved version of WCOBRA/TRAC. This evaluation resulted in a 7°F reduction in PCT during the Blowdown period, a 44°F reduction in PCT during the Reflood 1 period, and a 29°F reduction in PCT during the Reflood 2 period. Based on these results, it was concluded that VCSNS continues to maintain a margin of safety to the limits prescribed by 10 CFR 50.46.

### **Reference**

1. WCAP-16043, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Virgil C. Summer Nuclear Station," June 2003.

## **10 CFR 50.46 REPORT FOR THE VCSNS UPFLOW CONVERSION PROGRAM SMALL BREAK LOCA EVALUATION**

### **Background**

SCE&G requested an evaluation for VCSNS to support the conversion of the barrel-baffle region from a downflow configuration to an upflow configuration. In support of this modification, Westinghouse performed an evaluation (Reference 3) to determine the effect of converting the barrel-baffle region to an upflow configuration on the current licensing basis Small Break LOCA (SBLOCA) analysis (References 1 and 2). This conversion to an upflow configuration was completed during Refuel 18.

### **Affected Evaluation Model**

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

### **Estimated Effect**

The evaluation (Reference 3) resulted in a net increase in the SBLOCA peak cladding temperature (PCT) of +148°F. Based on these results, it is concluded that VCSNS continues to maintain margin to the limits prescribed by 10 CFR 50.46.

### **References**

1. CGE-06-62, "South Carolina Electric and Gas, V. C. Summer Nuclear Plant, Replacement of High Head Safety Injection Throttle Valves 50.59 Evaluation," October 2, 2006.
2. LTR-LIS-06-662, "Transmittal of V. C. Summer SBLOCA PCT Rackup Sheets for HHSI Throttle Valve Replacement," November 10, 2006.
3. WCAP-16980-P, Revision 1, "Reactor Internals Upflow Conversion Program Engineering Report V.C. Summer Nuclear Station Unit 1," December 2008.

**Attachment II**

**PCT Rackup Sheets**

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

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

**Revision Date:** 1/27/10

**Composite**

**Analysis Information**

**EM:** CQD (1996)      **Analysis Date:** 2/3/03      **Limiting Break Size:** Guillotine  
**FQ:** 2.5      **FdH:** 1.7  
**Fuel:** Vantage +      **SGTP (%):** 10  
**Notes:** Delta 75 Replacement Steam Generator Uprate Core Power 2900 MWt

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1988	1	
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1. Backfit Through 2001 Reporting Year	0	2	
2. Revised Blowdown Heatup Uncertainty Distribution	5	3	
3. Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error	-14	4	
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1. Fan Cooler Performance Increase	2	2	
2. Upflow Conversion Evaluation	-29	4	
<b>C. 2009 ECCS MODEL ASSESSMENTS</b>			
1. None	0		
<b>D. OTHER</b>			
1. None	0		

**LICENSING BASIS PCT + PCT ASSESSMENTS      PCT = 1952**

**References:**

1. WCAP-16043, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Virgil C. Summer Nuclear Station," June 2003.
2. CGE-03-12, "10 CFR 50.46 Annual Notification and Reporting for 2002," March 2003.
3. CGE-05-20, "10 CFR 50.46 Annual Notification and Reporting for 2004," April 2005.
4. LTR-LIS-08-578, Revision 2, "Large Break LOCA Evaluation for V. C. Summer (CGE) Upflow Conversion and Assessment of Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error," January 2009.

**Notes:**

None



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

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

**Revision Date:** 1/27/10

**Blowdown**

**Analysis Information**

**EM:** CQD (1996)      **Analysis Date:** 2/3/03      **Limiting Break Size:** Guillotine  
**FQ:** 2.5      **FdH:** 1.7  
**Fuel:** Vantage +      **SGTP (%):** 10  
**Notes:** Delta 75 Replacement Steam Generator Uprate Core Power 2900 MWt

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1860	1	
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1. Backfit Through 2001 Reporting Year	0	2	
2. Revised Blowdown Heatup Uncertainty Distribution	49	3	
3. Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error	1	4	
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1. Fan Cooler Performance Increase	0	2	
2. Upflow Conversion Evaluation	-7	4	
<b>C. 2009 ECCS MODEL ASSESSMENTS</b>			
1. None	0		
<b>D. OTHER</b>			
1. None	0		
<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>			
		<b>PCT = 1903</b>	

**References:**

1. WCAP-16043, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Virgil C. Summer Nuclear Station," June 2003.
2. CGE-03-12, "10 CFR 50.46 Annual Notification and Reporting for 2002," March 2003.
3. CGE-05-20, "10 CFR 50.46 Annual Notification and Reporting for 2004," April 2005.
4. LTR-LIS-08-578, Revision 2, "Large Break LOCA Evaluation for V. C. Summer (CGE) Upflow Conversion and Assessment of Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error," January 2009.

**Notes:**

None

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

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

**Revision Date:** 1/27/10

**Reflood 1**

**Analysis Information**

**EM:** CQD (1996)      **Analysis Date:** 2/3/03      **Limiting Break Size:** Guillotine  
**FQ:** 2.5      **FdH:** 1.7  
**Fuel:** Vantage +      **SGTP (%):** 10  
**Notes:** Delta 75 Replacement Steam Generator Uprate Core Power 2900 MWt

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1808	1	
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1. Backfit Through 2001 Reporting Year	0	2	
2. Revised Blowdown Heatup Uncertainty Distribution	5	3	
3. Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error	-9	4	
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1. Fan Cooler Performance Increase	1	2	
2. Upflow Conversion Evaluation	-44	4	
<b>C. 2009 ECCS MODEL ASSESSMENTS</b>			
1. None	0		
<b>D. OTHER</b>			
1. None	0		
<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>			
			<b>PCT = 1761</b>

**References:**

1. WCAP-16043, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Virgil C. Summer Nuclear Station," June 2003.
2. CGE-03-12, "10 CFR 50.46 Annual Notification and Reporting for 2002," March 2003.
3. CGE-05-20, "10 CFR 50.46 Annual Notification and Reporting for 2004," April 2005.
4. LTR-LIS-08-578, Revision 2, "Large Break LOCA Evaluation for V. C. Summer (CGE) Upflow Conversion and Assessment of Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error," January 2009.

**Notes:**

None

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

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

**Revision Date:** 1/27/10

**Reflood 2**

**Analysis Information**

**EM:** CQD (1996)      **Analysis Date:** 2/3/03      **Limiting Break Size:** Guillotine  
**FQ:** 2.5      **FdH:** 1.7  
**Fuel:** Vantage +      **SGTP (%):** 10  
**Notes:** Delta 75 Replacement Steam Generator Uprate Core Power 2900 MWt

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1988	1	
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1. Backfit Through 2001 Reporting Year	0	2	
2. Revised Blowdown Heatup Uncertainty Distribution	5	3	
3. Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error	-14	4	
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1. Fan Cooler Performance Increase	2	2	
2. Upflow Conversion Evaluation	-29	4	
<b>C. 2009 ECCS MODEL ASSESSMENTS</b>			
1. None	0		
<b>D. OTHER</b>			
1. None	0		

**LICENSING BASIS PCT + PCT ASSESSMENTS**      **PCT = 1952**

**References:**

1. WCAP-16043, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Virgil C. Summer Nuclear Station," June 2003.
2. CGE-03-12, "10 CFR 50.46 Annual Notification and Reporting for 2002," March 2003.
3. CGE-05-20, "10 CFR 50.46 Annual Notification and Reporting for 2004," April 2005.
4. LTR-LIS-08-578, Revision 2, "Large Break LOCA Evaluation for V. C. Summer (CGE) Upflow Conversion and Assessment of Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error," January 2009.

**Notes:**

None.

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

**Plant Name:** V. C. Summer  
**Utility Name:** South Carolina Electric & Gas  
**Revision Date:** 1/27/10

**Analysis Information**

**EM:** NOTRUMP                      **Analysis Date:** 9/12/06      **Limiting Break Size:** 3 Inch  
**FQ:** 2.45                              **FdH:** 1.62  
**Fuel:** Vantage +                      **SGTP (%):** 10  
**Notes:**

	Clad Temp (°F)	Ref.	Notes
<b>LICENSING BASIS</b>			
<b>Analysis-Of-Record PCT</b>	1775	9	(a)
<b>PCT ASSESSMENTS (Delta PCT)</b>			
<b>A. PRIOR ECCS MODEL ASSESSMENTS</b>			
1. None	0		
<b>B. PLANNED PLANT MODIFICATION EVALUATIONS</b>			
1. Upflow Conversion	148	10, 11	
<b>C. 2009 ECCS MODEL ASSESSMENTS</b>			
1. None	0		
<b>D. OTHER</b>			
1. None	0		
<b>LICENSING BASIS PCT + PCT ASSESSMENTS</b>	<b>PCT = 1923</b>		

**References:**

1. CGE-94-205, "South Carolina Electric and Gas Company, Virgil C. Summer Station, 10 CFR 50.46 Notification and Reporting Information," February 8, 1994.
2. CGE-94-228, "South Carolina Electric and Gas Company, Virgil C. Summer Station, SBLOCTA Axial Nodalization," October 27, 1994.
3. CGE-95-201, "South Carolina Electric and Gas Company, Virgil C. Summer Station, 10 CFR 50.46 Notification and Reporting Information," February 3, 1995.
4. CGE-96-202, "South Carolina Electric and Gas Company, Virgil C. Summer Station, 10 CFR 50.46 Annual Notification and Reporting," February 9, 1996.
5. 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.
6. 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.
7. CGE-03-80, "10 CFR 50.46 Mid-Year Notification and Reporting for 2003," January 2004.

8. LTR-LIS-06-344, "Transmittal of Updated V. C. Summer SBLOCA PCT Rackup Sheets," November 2006.
9. LTR-LIS-06-662, Transmittal of V. C. Summer SBLOCTA PCT Rackup Sheets for HHSI Throttle Valve Replacement," November 2006.
10. WCAP-16980-P, Revision 1, "Reactor Internals Upflow Conversion Program Engineering Report V. C. Summer Nuclear Station Unit 1," December 2008.
11. LTR-LIS-09-18, "10 CFR 50.46 Report for the V. C. Summer (CGE) Upflow Conversion Program Break LOCA Evaluation," January 2009.

**Notes:**

- (a) The Rebaseline Analysis includes the impacts of the following model assessments:
  1. LUCIFER Error Corrections (Ref. 1)
  2. Effect of SI in Broken Loop (Ref. 1)
  3. Effect of Improved Condensation Model (Ref. 1)
  4. Axial Nodalization, RIP Model Revision and SBLOCTA Error Corrections Analysis (Ref. 2)
  5. Boiling Heat Transfer Error (Ref. 3)
  6. Steam Line Isolation Logic Error (Ref. 3)
  7. NOTRUMP Specific Enthalpy Error (Ref. 4)
  8. SALIBRARY Double Precision Error (Ref. 4)
  9. SBLOCTA Fuel Rod Initialization Error (Ref. 5)
  10. NOTRUMP Mixture Level Tracking / Region Depletion Errors (Ref. 6)
  11. NOTRUMP Bubble Rise / Drift Flux Model Inconsistency Corrections (Ref. 7)
  12. Refined Break Spectrum (Ref. 8)
  13. High Head Safety Injection (HHSI) Flow Increase (Ref. 9)