Thomas D. Gatlin
Vice President, Nuclear Operations
803.345.4342

SCE&G®
A SCANA COMPANY

June 24, 2015

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

Dear Sir / Madam:

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

South Carolina Electric & Gas Company (SCE&G), acting for itself and as agent for South Carolina Public Service Authority, hereby submits the 2014 Emergency Core Cooling System (ECCS) Evaluation Model Revisions Annual Report for 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 2014 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

TS/TDG/wm
Attachments

c: K. B. Marsh
S. A. Byrne
J. B. Archie
N. S. Carns
J. H. Hamilton
J. W. Williams
W. M. Cherry
V. M. McCree
S. A. Williams
NRC Resident Inspector
K. M. Sutton
NSRC
RTS (LTD 321, RR 8375)
File (818.02-17)
PRSF (RC-15-0100)

A002
NRR

Attachment I

Changes and Enhancements

to the

ECCS Evaluation Models for 2014

GENERAL CODE MAINTENANCE

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 Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The nature of these changes leads to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

REVISED TOTAL CODE UNCERTAINTY IN BE LBLOCA MONTE CARLO SIMULATIONS

Background

As part of the WCOBRA/TRAC validation basis for use in Best-Estimate (BE) Large-Break Loss-of-Coolant Accident (LBLOCA) analysis, simulations of many separate effects tests (SETs) and integral effects tests (IETs) were performed. In the Westinghouse 1996 BE LBLOCA evaluation model (CQD evaluation model), the simulations of the test data which included core heat transfer measurements were used in the uncertainty methodology in two ways:

1. To develop heat transfer multiplier distributions which are used in the HOTSPOT code for local hot rod calculations.
2. To determine the minimum code uncertainties for blowdown and reflood that are used in the MONTECF code for the Monte Carlo uncertainty calculations.

The effects of several changes and error corrections to the WCOBRA/TRAC code were previously reported in 2013, including effects of revised heat transfer multiplier distributions. As a result of previously reported changes and error corrections made to WCOBRA/TRAC, the total code uncertainty values utilized in the MONTECF code for both blowdown and reflood were recalculated. The recalculated total code uncertainty values are lower than the previous values. Resolution of this issue 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

The total code uncertainty value is essentially a minimum limit for the superposition correction in the Monte Carlo simulations performed with the MONTECF code. As a result, a reduction in the minimum superposition correction would be expected to produce a small benefit, and will thus be conservatively assigned a 0°F estimate of effect.

FUEL ROD GAP CONDUCTANCE ERROR

Background

An error was identified in the fuel rod gap conductance model in the NOTRUMP computer code (reactor coolant system response model). The error is associated with the use of an incorrect temperature in the calculation of the cladding emissivity term. This error corresponds to a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The estimated effect was determined based on a combination of engineering judgment of the phenomena and physics of a small break LOCA and sensitivity calculations performed with the advanced plant version of NOTRUMP. It was concluded that this error has a negligible effect on small break LOCA analysis results, leading to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

RADIATION HEAT TRANSFER MODEL ERROR

Background

Two errors were discovered in the calculation of the radiation heat transfer coefficient within the fuel rod model of the NOTRUMP computer code (reactor coolant system response model). First, existing logic did not preclude non-physical negative or large (negative or positive) radiation heat transfer coefficients from being calculated. These erroneous calculations occurred when the vapor temperature exceeded the cladding surface temperature or when the predicted temperature difference was less than 1°F. Second, a temperature term incorrectly used degrees Fahrenheit instead of Rankine. These errors represent a closely related group of Non-Discretionary problems in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The estimated effect was determined based on a combination of engineering judgment of the phenomena and physics of a small break LOCA and sensitivity calculations performed with the advanced plant version of NOTRUMP. It was concluded that this error has a negligible effect on small break LOCA analysis results, leading to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

SBLOCTA PRE-DNB CLADDING SURFACE HEAT TRANSFER COEFFICIENT CALCULATION

Background

Two errors were discovered in the pre-departure from nucleate boiling (pre-DNB) cladding surface heat transfer coefficient calculation in the SBLOCTA code (cladding heat-up calculations). The first error is a result of inconsistent time units (hours vs. seconds) in the parameters used for the calculation of the Reynolds and Prandtl numbers, and the second error relates to an incorrect diameter used to develop the area term in the cladding surface heat flux calculation. Both of these issues impact the calculation of the pre-DNB convective heat transfer coefficient, representing a closely related group of Non-Discretionary Changes to the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

These errors have been corrected in the SBLOCTA code. Because this condition occurred prior to DNB, it was judged that these errors had no direct impact on the cladding heat-up related to the core uncovery period. A series of validation tests were performed and confirmed that these errors have a negligible effect on SBLOCA analysis results, leading to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

Attachment II

Peak Clad Temperature (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: 2/10/2015

Composite

Analysis Information

EM:	CQD (1996)	**Analysis Date:**	2/3/2003	**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
LICENSING BASIS				
Analysis-Of-Record PCT		**1988**	**1**	
PCT ASSESSMENTS (Delta PCT)				
A. PRIOR ECCS MODEL ASSESSMENTS				
1. Backfit Through 2001 Reporting Year		0	2	
2. Revised Blowdown Heatup Uncertainty Distribution		5	3	
3. PAD 4.0 Implementation		-118	6	
4. Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown		123	6	(a)
5. Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error		0	6	(b)
6. Revised Heat Transfer Multiplier Distributions		-35	7	
7. Changes to Grid Blockage Ratio and Porosity		24	8	
8. Error in Burst Strain Application		0	9	
B. PLANNED PLANT MODIFICATION EVALUATIONS				
1. Fan Cooler Performance Increase		2	2	
2. Upflow Conversion Evaluation		-29	4	
3. Additional Heat Sinks and Increased Spray Flow Rate		1	5	
C. 2014 ECCS MODEL ASSESSMENTS				
1. None		0		
D. OTHER				
1. None		0		
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	1961		

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, "10 CFR 50.46 Reports for the V. C. Summer (CGE) Upflow Conversion Large Break LOCA Evaluation and Assessment of Transverse Momentum Cells with a Zero Cross-flow Boundary Condition Error," January 2009.
5. CGE-10-29, "BELOCA Summary Report," November 2010.
6. LTR-LIS-12-372, "V. C. Summer, 10 CFR 50.46 Notification and Reporting for Fuel

Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.
7. LTR-LIS-13-353, "V. C. Summer 10 CFR 50.46 Report for Revised Heat Transfer Multiplier Distributions," July 2013.
8. LTR-LIS-13-476, "V. C. Summer 10 CFR 50.46 Report for Changes to Grid Blockage Ratio and Porosity," October 2013.
9. LTR-LIS-14-37, "V. C. Summer 10 CFR 50.46 Report for the HOTSPOT Burst Strain Error Correction," January 2014.

Notes:

(a) This evaluation credits peaking factor burndown; see Reference 6.
(b) This input error was originally reported in Reference 4. That evaluation is superseded by the report in Reference 6.

Westinghouse LOCA Peak Clad Temperature Summary for Best Estimate Large Break
Plant Name: V. C. Summer
Utility Name: South Carolina Electric & Gas

Revision Date: 2/10/2015

Blowdown

Analysis Information

EM:	CQD (1996)	**Analysis Date:**	2/3/2003	**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
LICENSING BASIS			
Analysis-Of-Record PCT	**1860**	**1**	
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1. Backfit Through 2001 Reporting Year	0	2	
2. Revised Blowdown Heatup Uncertainty Distribution	49	3	
3. PAD 4.0 Implementation	-83	6	
4. Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	0	6	(a)
5. Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error	0	6	(b)
6. Revised Heat Transfer Multiplier Distributions	-5	7	
7. Changes to Grid Blockage Ratio and Porosity	0	8	
8. Error in Burst Strain Application	0	9	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1. Fan Cooler Performance Increase	0	2	
2. Upflow Conversion Evaluation	-7	4	
3. Additional Heat Sinks and Increased Spray Flow Rate	0	5	
C. 2014 ECCS MODEL ASSESSMENTS			
1. None	0		
D. OTHER			
1. None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =** 1814		

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, "10 CFR 50.46 Reports for the V. C. Summer (CGE) Upflow Conversion Large Break LOCA Evaluation and Assessment of Transverse Momentum Cells with a Zero Cross-flow Boundary Condition Error," January 2009.
5. CGE-10-29, "BELOCA Summary Report," November 2010.

6. LTR-LIS-12-372, "V. C. Summer, 10 CFR 50.46 Notification and Reporting for Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.
7. LTR-LIS-13-353, "V. C. Summer 10 CFR 50.46 Report for Revised Heat Transfer Multiplier Distributions," July 2013.
8. LTR-LIS-13-476, "V. C. Summer 10 CFR 50.46 Report for Changes to Grid Blockage Ratio and Porosity," October 2013.
9. LTR-LIS-14-37, "V. C. Summer 10 CFR 50.46 Report for the HOTSPOT Burst Strain Error Correction," January 2014.

Notes:

(a) This evaluation credits peaking factor burndown, see Reference 6.
(b) This input error was originally reported in Reference 4. That evaluation is superseded by the report in Reference 6.

Westinghouse LOCA Peak Clad Temperature Summary for Best Estimate Large Break
Plant Name: V. C. Summer
Utility Name: South Carolina Electric & Gas

Revision Date: 2/10/2015 **Reflood 1**

Analysis Information

EM:	CQD (1996)	**Analysis Date:**	2/3/2003	**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
LICENSING BASIS				
Analysis-Of-Record PCT		**1808**	**1**	
PCT ASSESSMENTS (Delta PCT)				
A. PRIOR ECCS MODEL ASSESSMENTS				
1. Backfit Through 2001 Reporting Year		0	2	
2. Revised Blowdown Heatup Uncertainty Distribution		5	3	
3. PAD 4.0 Implementation		-118	6	
4. Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown		113	6	(a)
5. Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error		0	6	(b)
6. Revised Heat Transfer Multiplier Distributions		5	7	
7. Changes to Grid Blockage Ratio and Porosity		24	8	
8. Error in Burst Strain Application		20	9	
B. PLANNED PLANT MODIFICATION EVALUATIONS				
1. Fan Cooler Performance Increase		1	2	
2. Upflow Conversion Evaluation		-44	4	
3. Additional Heat Sinks and Increased Spray Flow Rate		0	5	
C. 2014 ECCS MODEL ASSESSMENTS				
1. None		0		
D. OTHER				
1. None		0		
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	1814		

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, "10 CFR 50.46 Reports for the V. C. Summer (CGE) Upflow Conversion Large Break LOCA Evaluation and Assessment of Transverse Momentum Cells with a Zero Cross-flow Boundary Condition Error," January 2009.

5. CGE-10-29, "BELOCA Summary Report," November 2010.
6. LTR-LIS-12-372, "V. C. Summer, 10 CFR 50.46 Notification and Reporting for Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.
7. LTR-LIS-13-353, "V. C. Summer 10 CFR 50.46 Report for Revised Heat Transfer Multiplier Distributions," July 2013.
8. LTR-LIS-13-476, "V. C. Summer 10 CFR 50.46 Report for Changes to Grid Blockage Ratio and Porosity," October 2013.
9. LTR-LIS-14-37, "V. C. Summer 10 CFR 50.46 Report for the HOTSPOT Burst Strain Error Correction," January 2014.

Notes:

(a) This evaluation credits peaking factor burndown, see Reference 6.
(b) This input error was originally reported in Reference 4. That evaluation is superseded by the report in Reference 6.

Westinghouse LOCA Peak Clad Temperature Summary for Best Estimate Large Break
Plant Name: V. C. Summer
Utility Name: South Carolina Electric & Gas

Revision Date: 2/10/2015 **Reflood 2**

Analysis Information

EM:	CQD (1996)	**Analysis Date:**	2/3/2003	**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
LICENSING BASIS				
Analysis-Of-Record PCT		**1988**	**1**	
PCT ASSESSMENTS (Delta PCT)				
A. PRIOR ECCS MODEL ASSESSMENTS				
1. Backfit Through 2001 Reporting Year		0	2	
2. Revised Blowdown Heatup Uncertainty Distribution		5	3	
3. PAD 4.0 Implementation		-118	6	
4. Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown		123	6	(a)
5. Transverse Momentum Cells for Zero Cross-flow Boundary Condition Error		0	6	(b)
6. Revised Heat Transfer Multiplier Distributions		-35	7	
7. Changes to Grid Blockage Ratio and Porosity		24	8	
8. Error in Burst Strain Application		0	9	
B. PLANNED PLANT MODIFICATION EVALUATIONS				
1. Fan Cooler Performance Increase		2	2	
2. Upflow Conversion Evaluation		-29	4	
3. Additional Heat Sinks and Increased Spray Flow Rate		1	5	
C. 2014 ECCS MODEL ASSESSMENTS				
1. None		0		
D. OTHER				
1. None		0		
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	1961		

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, "10 CFR 50.46 Reports for the V. C. Summer (CGE) Upflow Conversion Large Break LOCA Evaluation and Assessment of Transverse Momentum Cells with a Zero Cross-flow Boundary Condition Error," January 2009.
5. CGE-10-29, "BELOCA Summary Report," November 2010.
6. LTR-LIS-12-372, "V. C. Summer, 10 CFR 50.46 Notification and Reporting for Fuel

Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.
7. LTR-LIS-13-353, "V. C. Summer 10 CFR 50.46 Report for Revised Heat Transfer Multiplier Distributions," July 2013.
8. LTR-LIS-13-476, "V. C. Summer 10 CFR 50.46 Report for Changes to Grid Blockage Ratio and Porosity," October 2013.
9. LTR-LIS-14-37, "V. C. Summer 10 CFR 50.46 Report for the HOTSPOT Burst Strain Error Correction," January 2014.

Notes:

(a) This evaluation credits peaking factor burndown, see Reference 6.
(b) This input error was originally reported in Reference 4. That evaluation is superseded by the report in Reference 6.

Westinghouse LOCA Peak Clad Temperature Summary for Appendix K Small Break
Plant Name: V. C. Summer
Utility Name: South Carolina Electric & Gas

Revision Date: 2/4/2015

Analysis Information

EM:	NOTRUMP	**Analysis Date:**	9/12/2006	**Limiting Break Size:**	3 Inch
FQ:	2.45	**FdH:**	1.62		
Fuel:	Vantage +	**SGTP (%):**	10		
Notes:					

		Clad Temp (°F)	Ref.	Notes
LICENSING BASIS				
Analysis-Of-Record PCT		**1775**	**9**	**(a)**
PCT ASSESSMENTS (Delta PCT)				
A. PRIOR ECCS MODEL ASSESSMENTS				
1. None		0		
B. PLANNED PLANT MODIFICATION EVALUATIONS				
1. Upflow Conversion		148	10,11	
C. 2014 ECCS MODEL ASSESSMENTS				
1. None		0		
D. OTHER				
1. None		0		
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	1923		

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 Small 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)