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Vice President, Nuclear Operations
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June 16, 2016

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 2015 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 2015 are included in Attachment I. Peak Clad Temperature (PCT) Rackup Sheets are included in Attachment II.

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

Very truly yours,

George A. Lippard

TS/GAL/wm
Attachments

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RTS (LTD 321, RR 8375)
File (818.02-17)
PRSF (RC-16-0094)

A002
NRR

Attachment I

Changes and Enhancements

to the

ECCS Evaluation Models for 2015

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

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.

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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: 2/1/2016

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. 2015 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: 2/1/2016

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. 2015 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: 2/1/2016

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. 2015 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

Reflood 2

Revision Date: 2/1/2016

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. 2015 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: 2/1/2016

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. 2015 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)