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Document Control Desk
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 REPORT

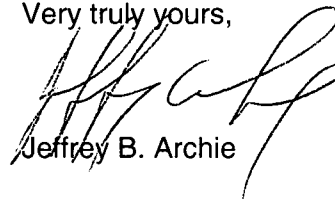
South Carolina Electric & Gas Company (SCE&G), acting for itself and as agent for South Carolina Public Service Authority hereby submits the 2007 Emergency Core Cooling System (ECCS) Evaluation Model Revisions Annual Report for the Virgil C. Summer Nuclear Station (VCSNS). This report is being submitted 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 2007 are included in Attachment I.

Peak Clad Temperature (PCT) sheets are included in Attachment II. The Non-Discretionary Changes identified in Attachment I did not result in any non-zero changes to PCT.

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

Very truly yours,



Jeffrey B. Archie

GAR/JBA/mb
Attachments

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Attachment I

Changes and Enhancements to the ECCS Evaluation Models for 2007

HOTSPOT FUEL RELOCATION (Non-Discretionary Change)

Background

In the axial node where burst is predicted to occur, a fuel relocation model in HOTSPOT is used to account for the likelihood that additional fuel pellet fragments above that elevation may settle into the burst region. It was discovered that the effect of fuel relocation on local linear heat rate was being calculated, but then cancelled out later in the coding. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

1996 and 1999 BELOCA EMs analyses were assessed on a plant-specific basis, via the HOTSPOT reanalysis of a representative WCOBRA/TRAC case using the corrected code version at the burst elevation/burst model enabled sub-case. The HOTSPOT 95% probability PCT results were used to establish the plant-specific PCT penalty.

The VCSNS PCT penalty was 0°F for Blowdown, 0°F for Reflood 1, and 0°F for Reflood 2.

STEAM GENERATOR NOZZLE VOLUME ACCOUNTING ERROR (Non-Discretionary Change)

Background

It was discovered that many plant-specific WCOBRA/TRAC calculations shared a common error of double accounting of the volume of one or both SG Plenum Nozzles. The extent of over-accounting is plant-specific but would be in the vicinity of 7-9 ft³ per nozzle. This change represents a Non- Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

RCS Loop inventory does not significantly contribute to core cooling during blowdown since most of the fluid in both the intact and broken RCS loops will exit the break without entering the core, making RCS Loop volume a tertiary player in system behavior. A small volume error of this nature is anticipated to be negligible throughout the transient, such that an estimated effect of 0°F is assigned for 10 CFR 50.46 reporting purposes for VCSNS.

**COLD LEG VOLUME DISCREPANCY
(Non-Discretionary Change)**

Background

An error was identified during the course of a Best Estimate Large Break LOCA analysis. An extra cell was modeled in one of the intact cold leg components, resulting in extra water volume being modeled in the loop piping. The error was corrected and representative WCOBRA/TRAC steady state and transient reruns were performed to quantify the effect on PCT. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

Estimated Effect

The results of the representative WCOBRA/TRAC steady state and transient runs yielded an estimated PCT impact of 0°F for both blowdown and reflood for VCSNS.

ERRORS IN REACTOR VESSEL NOZZLE DATA COLLECTIONS (Non-Discretionary Change)

Background

Some minor errors were discovered in the reactor vessel nozzle data collections that potentially affect the vessel inlet and outlet nozzle fluid volume, metal mass and surface area. The corrected values have been evaluated for impact on current licensing-basis analysis results and will be incorporated into the plant specific input databases on a forward-fit basis. These changes represent a closely-related group of Non- Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

These errors were evaluated to have a negligible impact on the Large Break LOCA analysis results for VCSNS, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

NOTRUMP-EM REFINED BREAK SPECTRUM (Non-Discretionary Change)

Background

During the course of reviewing several extended power uprate and replacement steam generator Small Break LOCA (SBLOCA) analyses, the Nuclear Regulatory Commission (NRC) questioned the break spectrum analyzed in the NOTRUMP evaluation model (EM). The NRC was concerned that the resolution of the break spectrum used in the NOTRUMP EM (1.5, 2, 3, 4, and 6 inch cases) may not be fine enough to capture the worst break with regard to limiting peak clad temperature as per 10 CFR 50.46. That is, the plant could be SBLOCA limited with regard to overall LOCA results.

In response to this, Westinghouse performed some preliminary work indicating that in some cases more limiting results could be obtained from non-integer break sizes; however, the magnitude of the impact was far less than that shown in preliminary work performed by the NRC. Based on this, Westinghouse performed evaluations to determine if all currently operating plants would maintain compliance with the 10 CFR 50.46 acceptance criteria when considering a refined SBLOCA break spectrum. It should be noted that use of a refined break spectrum is not an error, but a change, since evaluating only integer break sizes has been the standard practice since the initial licensing of NOTRUMP.

This change represents a Non-Discretionary Change 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

Consistent with the method described in Reference 1, for plants with low SBLOCA peak cladding temperatures (PCTs) (i.e., less than 1700°F) and overall SBLOCA results that are significantly non-limiting when compared with large break LOCA (LBLOCA) results, no explicit refined break spectrum calculations were performed, leading to an estimated impact of 0°F for 10 CFR 50.46 reporting purposes. For VCSNS with a high SBLOCA PCT (i.e., equal to or greater than 1700°F), explicit refined break spectrum calculations were performed, but no PCT penalty was assessed.

Reference(s)

1. LTR-NRC-06-44, "Transmittal of LTR-NRC-06-44 NP-Attachment, 'Response to NRC Request for Additional Information on the Analyzed Break Spectrum for the Small Break Loss of Coolant Accident (SBLOCA) NOTRUMP Evaluation Model (NOTRUMP EM), Revision 1,' (Non-Proprietary)," July 14, 2006.

ERRORS IN REACTOR VESSEL NOZZLE DATA COLLECTIONS (Non-Discretionary Change)

Background

Some minor errors were discovered in the reactor vessel nozzle data collections that potentially affect the vessel inlet and outlet nozzle fluid volume, metal mass and surface area. The corrected values have been evaluated for impact on current licensing-basis analysis results and will be incorporated into the plant specific input databases on a forward-fit basis. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

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

Estimated Effect

The differences in the vessel inlet and outlet nozzle fluid volume, metal mass and surface area are relatively minor and would be expected to produce a negligible effect on large break and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

PUMP WEIR RESISTANCE MODELING (Non-Discretionary Change)

Background

Review of the reactor coolant pump data collections identified instances of either including a weir resistance for a design without a weir or double-counting the weir resistance for a design with a weir. The corrected resistances have been evaluated for impact on existing analysis results and will be incorporated into the plant-specific input databases 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(s)

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

Estimated Effect

Resolving the identified discrepancies has been evaluated as having a negligible effect on existing results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

GENERAL CODE MAINTENANCE (Discretionary Change)

Background

Various changes have been made to enhance the usability of the codes and to help preclude errors in analyses. This includes items such as 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(s)

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.

HHSI THROTTLE VALVE REPLACEMENT SBLOCA ANALYSIS (Discretionary Change)

Background

VCSNS replaced twelve existing high head safety injection (HHSI) valves with FlowServe V3-B pressure-combo valves during the RF16 outage. In addition, new orifice plates were installed in the twelve (12) branch lines, upstream of the throttle valves, and in both header orifices (IFE00940 and IFE00943). The effect of this plant change resulted in an increase in the HHSI flows assumed in the SBLOCA analysis, as calculated by Fluid Systems.

In support of this, Westinghouse performed an evaluation to determine the effect of the increased HHSI flows on the SBLOCA analyses for VCSNS. The analysis was based on the current AOR break spectrum SBLOCA analysis and was mainly performed to take advantage of the increase in peak clad temperature (PCT) margin for SBLOCA. This change represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model(s)

1985 Westinghouse Appendix K Small Break LOCA Evaluation Model

Estimated Effect

A review of the VCSNS SBLOCA evaluation results for the increase in HHSI flow showed that the limiting PCT of 1775°F occurs for the 3.0-inch break at 15,000 MWD/MTU. The maximum transient oxidation of 6.92% occurs for the 2.75 inch break at 17,500 MWD/MTU. The revised SBLOCA PCT rack-up sheet that reflects the SBLOCA evaluation is provided in Attachment II.

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 /15/08

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
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	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1. Fan Cooler Performance Increase	2	2	
C. 2007 ECCS MODEL ASSESSMENTS			
1. None	0		
D. OTHER			
1. None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1995	

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.

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 /15/08

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
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	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1. Fan Cooler Performance Increase	0	2	
C. 2007 ECCS MODEL ASSESSMENTS			
1. None	0		
D. OTHER			
1. None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1909	

References:

- WCAP-16043, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Virgil C. Summer Nuclear Station," June 2003.
- CGE-03-12, "10 CFR 50.46 Annual Notification and Reporting for 2002," March 2003.
- CGE-05-20, "10 CFR 50.46 Annual Notification and Reporting for 2004," April 2005.

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 /15/08

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
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	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1. Fan Cooler Performance Increase	1	2	
C. 2007 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.

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: 1/15/08

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
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	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1. Fan Cooler Performance Increase	2	2	
C. 2007 ECCS MODEL ASSESSMENTS			
1. None	0		
D. OTHER			
1. None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1995	

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.

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: 4/29/08

Analysis Information

EM:	NOTRUMP	Analysis Date:	9/12/06	Limiting Break Size:	3 Inch
FQ:	2.4	FdH:	1.62		
Fuel:	Vantage +	SGTP (%):	10		

	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. None	0		
C. 2007 ECCS MODEL ASSESSMENTS			
1. None	0		
D. OTHER*			
1. None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1775	

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.

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)