



June 5, 2006

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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 2005 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 2005 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 2005 are also provided in Section C with discussion enclosed or cited.

VCSNS has previously submitted License Amendment Request, LAR 04-3385, in letter RC 05-0097 for the use of the Westinghouse Best Estimate Loss of Coolant Accident (BELOCA) methodology.

If you have any questions, please call Mr. Robert Sweet at (803) 345-4080.

Very truly yours,

Jeffrey B. Archie

MWD/JBA/mb
Attachments

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Document Control Desk
Attachment I
L-99-0152
RC-06-0107
Page 1 of 8

Attachment 1 – 10 CFR 50.46 Reporting Text

14 Document Control Desk
Attachment I
L-99-0152
RC-06-0107
Page 2 of 8

Appendix K Large Break - BASH Related Items

14 Document Control Desk
Attachment I
L-99-0152
RC-06-0107
Page 3 of 8

PRESSURIZER FLUID VOLUMES (Non-Discretionary Change)

Background

The Westinghouse Systems and Equipment Engineering group has recommended that the previously-transmitted pressurizer fluid volumes be replaced with nominal cold values. This change resolves a discrepancy in the prior calculations while providing a close approximation of the actual as-built values. The revised values have been evaluated for impact on current licensing-basis analyses 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 Models

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

Estimated Effect

The differences between the previously-transmitted and revised volumes are very small and would be expected to produce a negligible effect on large and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

**GENERAL CODE MAINTENANCE
(Enhancements/Forward-Fit Discretionary Change)**

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.

14 Document Control Desk
Attachment I
L-99-0152
RC-06-0107
Page 5 of 8

Appendix K Small Break - NOTRUMP Related Items

PRESSURIZER FLUID VOLUMES (Non-Discretionary Change)

Background

The Westinghouse Systems and Equipment Engineering group has recommended that the previously-transmitted pressurizer fluid volumes be replaced with nominal cold values. This change resolves a discrepancy in the prior calculations while providing a close approximation of the actual as-built values. The revised values have been evaluated for impact on current licensing-basis analyses 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 Models

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

Estimated Effect

The differences between the previously-transmitted and revised volumes are very small and would be expected to produce a negligible effect on large and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

DISCREPANCY IN NOTRUMP RWST DRAINDOWN CALCULATION (Non-Discretionary Change)

Background

For small break LOCA calculations where the break size is greater than the safety injection (SI) line diameter, and where the SI line is connected directly to the reactor coolant system (RCS), it is assumed that the broken loop safety injection flows do not inject to the RCS, but rather spill to containment. Typically, this is modeled in NOTRUMP-EM analyses by setting the flows injected to the broken loop equal to zero, which neglects the continued depletion of the refueling water storage tank (RWST) inventory. As a result, the RWST draindown time is incorrectly calculated, potentially resulting in an inaccurate modeling of enthalpy changes and/or SI interruptions that can occur at switchover to sump recirculation. Therefore, the SI spilling flows need to be explicitly modeled in order to correctly calculate the RWST draindown time.

Affected Evaluation Models

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

For Westinghouse plants using the NOTRUMP-EM, the larger small breaks are typically non-limiting and the transients are of short duration. Therefore, correct modeling of the spilling flows in the RWST draindown calculation for these breaks would be expected to produce a negligible effect on SBLOCA results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

**GENERAL CODE MAINTENANCE
(Enhancements/Forward-Fit Discretionary Change)**

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.

Document Control Desk
Attachment II
L-99-0152
RC-06-0107
Page 1 of 5

Attachment 2 – PCT Rackup Sheets

Westinghouse LOCA Peak Clad Temperature Summary for Appendix K Large Break

Plant Name: V. C. Summer
Utility Name: South Carolina Electric & Gas
Revision Date: 2/23/06

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
LICENSING BASIS			
Analysis-Of-Record PCT	2099	1	(a)
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
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	
7 . LOCBART Fluid Property Logic	10	6	
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 .None	0		
C. 2005 ECCS MODEL ASSESSMENTS			
1 .None	0		
D. OTHER			
1 .None	0		

LICENSING BASIS PCT +PCT ASSESSMENTS 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 Appendix K Small Break

Plant Name: V. C. Summer
Utility Name: South Carolina Electric & Gas
Revision Date: 2/23/06

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
LICENSING BASIS			
Analysis-Of-Record PCT	1823	1	(a)
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
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. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . Increased Accumulator Pressure and Water Volume Uncertainties	34	2	(b)
2 . Annular Blankets	10	2	
3 . Main Feedwater Temperature Increase Evaluation	0	10	
C. 2005 ECCS MODEL ASSESSMENTS			
1 .None	0		
D. OTHER			
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	

LICENSING BASIS PCT + PCT ASSESSMENTS

PCT = 2196

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 Errors)
- (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.