

**J. Bernie Beasley, Jr., P.E.**  
Vice President

**Southern Nuclear  
Operating Company, Inc.**  
40 Inverness Center Parkway  
Post Office Box 1295  
Birmingham, Alabama 35201

Tel 205.992.7110  
Fax 205.992.0403



March 22, 2002

LCV-1602

Docket Nos.: 50-424  
50-425

U. S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D. C. 20555

Ladies and Gentlemen:

**VOGTLE ELECTRIC GENERATING PLANT**  
**10 CFR 50.46 ECCS EVALUATION MODELS 2001 ANNUAL REPORT**

Pursuant to the reporting requirements of 10 CFR 50.46 (a)(3)(ii), Southern Nuclear Operating Company (SNC) is submitting the Emergency Core Cooling System (ECCS) Evaluation Models 2001 Annual Report for Vogtle Electric Generating Plant (VEGP) Units 1 and 2. Attached is a description of the errors along with a revised assessment of the Large-Break Loss of Coolant Accident (LBLOCA) and Small-Break Loss of Coolant Accident (SBLOCA) peak clad temperature (PCT). The report is based on information provided by Westinghouse of changes and errors assessed against the VEGP ECCS Evaluation Models and has been prepared in accordance with the guidance in WCAP-13451 and additional guidance provided by Westinghouse.

In the 2000 Annual Report (LCV-1540, June 4, 2001), SNC reported a LBLOCA PCT of 2144 °F for both Unit 1 and Unit 2. The LBLOCA PCT remained unchanged during 2001. The LBLOCA PCT at the end of 2001 was 2144 °F for both Unit 1 and Unit 2.

In the 2000 Annual Report (LCV-1540, June 4, 2001), SNC reported a SBLOCA PCT of 1900 °F for Unit 1 and 1896 °F for Unit 2. The SBLOCA PCT for Unit 1 and Unit 2 remained unchanged during 2001. The SBLOCA PCT at the end of 2001 was 1900 °F for Unit 1 and 1896 °F for Unit 2.

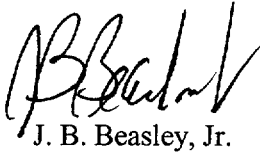
The LBLOCA and SBLOCA PCT for each unit remains in compliance with the criterion set forth in 10 CFR 50.46 (b)(1). The criterion requires that the PCT does not exceed 2200 °F.

Per 10 CFR 50.46 (a)(3)(ii), reanalysis or taking other action is not required because compliance with 10 CFR 50.46 (b)(1) has been demonstrated for both LBLOCA and SBLOCA.

A001

US. Nuclear Regulatory Commission  
LCV-1602  
Page 2

Sincerely,



J. B. Beasley, Jr.

JBB/RJF

Attachment

cc: Southern Nuclear Operating Company  
Mr. J. T. Gasser  
Mr. M. Sheibani  
SNC Document Management

U. S. Nuclear Regulatory Commission  
Mr. L. A. Reyes, Regional Administrator  
Mr. F. Rinaldi, Project Manager, NRR  
Mr. J. Zeiler, Senior Resident Inspector, Vogtle

**ATTACHMENT**  
**VOGTLE ELECTRIC GENERATING PLANT**  
**10 CFR 50.46 ECCS EVALUATION MODELS SIGNIFICANT ERROR REPORT**

**BACKGROUND**

Provisions in 10 CFR 50.46 require applicants and holders of operating licenses or construction permits to notify the Nuclear Regulatory Commission (NRC) of errors and changes in the Emergency Core Cooling System (ECCS) Evaluation Models on an annual basis when the errors and changes are not significant, and within 30 days of discovery when the errors and changes are significant. A significant error or change, as defined by 10 CFR 50.46, is one which results in a calculated fuel peak cladding temperature (PCT) different by more than 50 °F from the temperature calculated for the limiting transient using the last acceptable model, or a cumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than 50 °F.

The following presents a summary of the effects of errors and changes to the Westinghouse ECCS Evaluation Models on the Vogtle Electric Generating Plant (VEGP) Units 1 and 2 loss of coolant accident (LOCA) analyses since the 2000 Annual Report (Reference 12). This report has been prepared in accordance with the methodology presented in WCAP-13451 (Reference 3) and additional guidance provided by Westinghouse (Reference 13). The LBLOCA and SBLOCA analyses, Evaluation Model assessments, and planned plant change evaluation results reported herein will be included in a future VEGP Final Safety Analysis Report (FSAR) update.

**LARGE-BREAK LOCA**

ECCS Evaluation Model Analysis-of-Record

In the 2000 Annual Report (Reference 12), SNC reported a LBLOCA PCT of 2144 °F for both Unit 1 and Unit 2. The LBLOCA PCT remained unchanged during 2001. The LBLOCA PCT at the end of 2001 was 2144 °F for both Unit 1 and Unit 2.

The LBLOCA analysis results are based on the Westinghouse BASH large-break ECCS Evaluation Model (Reference 4), as approved by the NRC for VEGP-specific application (References 5 and 6), and the latest acceptable LOCBART model. The limiting size break analysis continues to assume the following information important to the LBLOCA analyses:

- o 17x17 VANTAGE-5 Fuel Assembly
- o Core Power = 1.02 \* 3565 MWT
- o Vessel Average Temperature = 571.9 °F
- o Steam Generator Plugging Level = 10%
- o  $F_Q = 2.50$
- o  $F_{\Delta H} = 1.65$

## Attachment

### Page 2

For VEGP Units 1 and 2, the limiting size break continues to be the double-ended guillotine rupture of the cold leg piping with a discharge coefficient of  $C_D = 0.6$ . The LBLOCA LOCBART analysis-of-record calculated PCT value is 1915 °F.

The Analysis-of-Record category continues to include an assessment of - 4 °F for the LOCBART clad creep and burst error.

The containment purge,  $T_{avg}$  uncertainty, and transition core penalty items continue to be listed separately. The items are listed separately because these items are not explicitly modeled. The PCT assessment values of the containment purge and  $T_{avg}$  penalties remain at 10 and 11 °F, respectively. The cycle-specific transition core penalty may be used in subsequent cycles, depending on core design, so it remains a line item but is reported as having a value of 0 °F.

VEGP cores contain ZIRLO clad IFBA fuel rods with a backfill pressure of 100 psig. The ZIRLO clad IFBA rods result in a penalty of 21 °F PCT as calculated by the latest acceptable LOCBART model.

The use of ZIRLO clad fuel rods results in a penalty of 5 °F PCT as calculated by the latest acceptable LOCBART model.

For Unit 1, the combined Analysis-of-Record PCT with assessments is 1958 °F.

For Unit 2, the combined Analysis-of-Record PCT with assessments is 1958 °F.

#### Prior 10CFR50.46 Large-Break ECCS Evaluation Model Assessments

As reported in the significant error report in Reference 2, four prior model assessments have been combined into a single assessment of - 6 °F. These assessments are: (1) Steam Generator Flow Area Application, (2) Structural Metal Heat Modeling, (3) LUCIFER Error Correction, and (4) Translation of Fluid Conditions from SATAN to LOCTA.

In the significant error report in Reference 10, three model assessments were reported. Their combined assessment is 206 °F. These assessments are: (1) Increased Accumulator Line Resistances, (2) LOCBART Spacer Grid Single-Phase Heat Transfer Error, and (3) LOCBART Zirc-Water Oxidation Error.

For Unit 1, the combined assessment previously reported in significant error reports is + 200 °F.

For Unit 2, the combined assessment previously reported in significant error reports is + 200 °F.

The 2000 Annual Report (Reference 12) included three changes that affect the LBLOCA analysis results. The combined PCT effects from the two evaluations for the permanent radiation shield and for the trisodium phosphate baskets result in only a 1 °F PCT assessment. The third plant modification is the addition of metal mass in containment. An allowance of 10 °F has been made for both units for future additions of metal mass.

**Attachment**  
**Page 3**

For Unit 1, the combined assessment is + 11 °F.

For Unit 2, the combined assessment is + 11 °F.

Current 10CFR50.46 BASH Large-Break ECCS Evaluation Model Assessments

Since the significant error report in Reference 10, an additional error in the LOCBART computer code resulted in a 15 °F LBLOCA PCT benefit. The model for film boiling used in LOCBART computes the cladding-to-fluid heat transfer coefficient for heat transfer across the vapor film. An error was discovered in LOCBART that resulted in an underprediction of the heat transfer coefficient. The correction of the error resulted in a PCT benefit, i.e., reduction in PCT.

Another error in the LOCBART computer code resulted in a 10 °F LBLOCA PCT benefit. The error was found in the expressions used to model radiation heat exchange between the rod, grid, and fluid during the reflood phase. It was discovered that the cladding surface emissivity values used were substantially lower than the values that would be expected to exist during the reflood phase. The correction of the error resulted in a PCT benefit, i.e., reduction in PCT.

For Unit 1, the combined current assessment is - 25 °F.

For Unit 2, the combined current assessment is - 25 °F.

Current Planned Plant Change Evaluations

There are no current planned plant changes that affect PCT for Unit 1 and Unit 2.

LBLOCA 10CFR50.46 ECCS Evaluation Model Assessment Summary

For Unit 1, the absolute sum of the LBLOCA PCT assessments since the last LBLOCA significant error report (Reference 10) is 25 °F. This is not considered to be significant per 10 CFR 50.46 (a)(3)(i).

For Unit 2, the absolute sum of the LBLOCA PCT assessments since the last LBLOCA significant error report (Reference 10) is 25 °F. This is not considered to be significant per 10 CFR 50.46 (a)(3)(i).

**Attachment**

**Page 4**

Unit 1 Licensing Basis LBLOCA PCT

Based on the above discussions concerning the VEGP-specific application of the Westinghouse BASH large-break ECCS Evaluation Model, the licensing basis LBLOCA PCT is as follows:

A.	LBLOCA BASH ECCS Model Analysis-of-Record	
	1. LOCBART Analysis Result	1915 °F
	2. LOCBART Clad Creep and Burst Error	- 4 °F
	3. Evaluation for Containment Purging	+ 10 °F
	4. Evaluation for +/- 6 °F Uncertainty Band	+ 11 °F
	5. Evaluation for Transition Cycle Penalty	+ 0 °F
	6. 100 psig Backfill Pressure IFBA with ZIRLO Clad	+ 21 °F
	7. ZIRLO Clad Fuel Rods	+ 5 °F
B.	Prior 10CFR50.46 Large-Break ECCS Model Assessments	
	Combined assessments previously reported as significant in References 2 and 10	+ 200 °F
	Combined planned plant change evaluations included in 2000 Annual Report (Reference 12)	+ 11 °F
C.	Current 10CFR50.46 BASH Large-Break ECCS Model Assessments	
	LOCBART Vapor Film Flow Regime Heat Transfer Error	- 15 °F
	LOCBART Cladding Emissivity Error	- 10 °F
D.	Current Planned Plant Change Evaluations	
	None	+ 0 °F
	Licensing Basis LBLOCA PCT	= <u>2144</u> °F

Conclusion

When the effects of assessments to the BASH ECCS Evaluation Model and planned plant change evaluations were combined with the VEGP LBLOCA analysis results, it was determined that compliance with the requirements of 10 CFR 50.46 is being maintained for Unit 1.

**Attachment**  
**Page 5**

Unit 2 Licensing Basis LBLOCA PCT

Based on the above discussions concerning the VEGP-specific application of the Westinghouse BASH large-break ECCS Evaluation Model, the licensing basis LBLOCA PCT is as follows:

A.	LBLOCA BASH ECCS Model Analysis-of-Record	
	1. LOCBART Analysis Result	1915 °F
	2. LOCBART Clad Creep and Burst Error	- 4 °F
	3. Evaluation for Containment Purging	+ 10 °F
	4. Evaluation for +/- 6 °F Uncertainty Band	+ 11 °F
	5. Evaluation for Transition Cycle Penalty	+ 0 °F
	6. 100 psig Backfill Pressure IFBA with ZIRLO Clad	+ 21 °F
	7. ZIRLO Clad Fuel Rods	+ 5 °F
B.	Prior 10CFR50.46 Large-Break ECCS Model Assessments	
	Combined assessments previously reported as significant in References 2 and 10	+ 200 °F
	Combined planned plant change evaluations included in 2000 Annual Report (Reference 12)	+ 11 °F
C.	Current 10CFR50.46 BASH Large-Break ECCS Model Assessments	
	LOCBART Vapor Film Flow Regime Heat Transfer Error	- 15 °F
	LOCBART Cladding Emissivity Error	- 10 °F
D.	Current Planned Plant Change Evaluations	
	1. None	+ 0 °F
	Licensing Basis LBLOCA PCT	= <u>2144</u> °F

Conclusion

When the effects of assessments to the BASH ECCS Evaluation Model and planned plant change evaluations were combined with the VEGP LBLOCA analysis results, it was determined that compliance with the requirements of 10 CFR 50.46 is being maintained for Unit 2.

## **SMALL-BREAK LOCA**

### ECCS Evaluation Model Analysis-of-Record

In the 2000 Annual Report (Reference 12), SNC reported a SBLOCA PCT of 1900 °F for Unit 1 and 1896 °F for Unit 2. The SBLOCA PCT for Unit 1 and Unit 2 remained unchanged during 2001. The SBLOCA PCT at the end of 2001 was 1900 °F for Unit 1 and 1896 °F for Unit 2.

The current SBLOCA analysis results are based on the earlier Westinghouse NOTRUMP small-break ECCS Evaluation Model (Reference 7), as approved by the NRC for VEGP-specific application (References 5 and 6), and the latest acceptable SBLOCTA model. The limiting size break analysis continues to assume the following information important to the SBLOCA analyses:

- o 17x17 VANTAGE-5 Fuel Assembly
- o Core Power = 1.02 \* 3565 MWT
- o Vessel Average Temperature = 571.9 °F
- o Steam Generator Plugging Level = 10%
- o  $F_Q = 2.58$
- o  $F_{\Delta H} = 1.70$

For VEGP Units 1 and 2, the limiting size small-break continues to be a three-inch equivalent diameter break in the cold leg. The SBLOCA analysis-of-record SBLOCTA calculated PCT value is 1770 °F.

The Analysis-of-Record category continues to include an assessment of +8 °F for the SBLOCA fuel rod initialization error.

The steam generator lower level tap relocation and  $T_{avg}$  uncertainty items continue to be listed separately. The items are listed separately because these items are not explicitly modeled. The PCT assessment values on these items are 15 °F and 4 °F, respectively. A PCT assessment of 30 °F is also listed separately for Burst and Blockage/Time in Life.

The use of ZIRLO clad fuel rods results in a penalty of 3 °F PCT as calculated in the latest acceptable SBLOCTA model.

For Unit 1, the combined Analysis-of-Record PCT with assessments is 1830 °F.

For Unit 2, the combined Analysis-of-Record PCT with assessments is 1830 °F.

### Prior 10CFR50.46 Small-Break ECCS Evaluation Model Assessments

Five prior model assessments have been combined into a single assessment of -17 °F (Reference 8) since the SBLOCA significant error report submitted in 1994 (Reference 9).



## Attachment

### Page 7

These assessments are: (1) Safety Injection (SI) Flow into the Broken RCS Loop/Improved Steam Condensation Model, (2) Drift Flux Flow Regime Error, (3) LUCIFER Error Corrections, (4) Boiling Heat Transfer Correlation Error, and (5) Steam Line Isolation Logic Error. This is applicable to both Unit 1 and Unit 2.

In the last significant error report for Unit 1 (Reference 1), two errors were reported: (1) NOTRUMP Specific Enthalpy Error (+ 20 °F) and (2) Burst and Blockage/Time in Life SPIKE Correlation Revision (+ 31 °F) totaling + 51 °F.

In the last significant error report for Unit 2 (Reference 11), four errors were reported: (1) NOTRUMP Specific Enthalpy Error (+ 20 °F), (2) Burst and Blockage/Time in Life SPIKE Correlation Revision (+ 29 °F), (3) NOTRUMP Mixture Level Tracking/Region Depletion Errors (+ 13 °F), and (4) Additional Burst and Blockage/Time in Life Penalty Due to the previous error (+ 11 °F) totaling + 73 °F.

For Unit 1, the combined assessment previously reported in significant error reports is + 34 °F.

For Unit 2, the combined assessment previously reported in significant error reports is + 56 °F.

The 2000 Annual Report (Reference 12) included two plant changes that affect the SBLOCA analysis results for VEGP Unit 1. These are: (1) annular pellet blankets, and (2) loose part in the RCS (fuel handling tool part). The PCT penalty on annular pellet blankets is the only one of the two that is applicable to VEGP Unit 2.

For Unit 1, the combined assessment is + 12 °F.

For Unit 2, the combined assessment is + 10 °F.

#### Current 10CFR50.46 NOTRUMP Small-Break ECCS Evaluation Model Assessments

Subsequent to the last Unit 1 SBLOCA significant error report and 1999 Annual Report (Reference 1), new errors have been identified for both Unit 1 and Unit 2. Errors were identified in how NOTRUMP deals with the stack mixture level transition across a mode boundary in a stack of fluid nodes. In addition, it was discovered that NOTRUMP was not properly updating metal node temperatures as a result of the implementation of the nodal region depletion logic which can be incurred when a fluid node empties or fills. This error results in a + 13 °F penalty. As a result of these errors, an additional Burst and Blockage/Time in Life penalty of + 11 °F is being applied to both Unit 1 and Unit 2. These errors are current assessments for Unit 1. For Unit 2, these errors were reported in the last Unit 2 significant error report (Reference 11).

For Unit 1, the combined current assessment is + 24 °F.

For Unit 2, the combined current assessment is 0 °F.

**Attachment**  
**Page 8**

Current Planned Plant Change Evaluations

There are no current planned plant changes that affect PCT for Unit 1 and Unit 2.

SBLOCA 10CFR50.46 ECCS Evaluation Model Assessment Summary

For Unit 1, the absolute sum of SBLOCA PCT assessments since the last Unit 1 SBLOCA significant error report (Reference 1) is 24 °F. This is not considered to be significant per 10 CFR 50.46 (a)(3)(i).

For Unit 2, the absolute sum of SBLOCA PCT assessments since the last Unit 2 SBLOCA significant error report (Reference 11) is 0 °F. This is not considered to be significant per 10 CFR 50.46 (a)(3)(i).

**Attachment**  
**Page 9**

Unit 1 Licensing Basis SBLOCA PCT

Based on the above discussions concerning the VEGP-specific application of the Westinghouse NOTRUMP small-break ECCS Evaluation Model, the licensing basis SBLOCA PCT is as follows:

A. SBLOCA NOTRUMP ECCS Model Analysis-of-Record	
1. SBLOCTA Analysis Result	1770 °F
2. SBLOCTA Fuel Rod Initialization Error	+ 8 °F
3. Evaluation for Steam Generator Lower Level Tap Relocation	+ 15 °F
4. Evaluation for +/- 6 °F Uncertainty Band	+ 4 °F
5. Burst and Blockage/Time in Life	+ 30 °F
6. ZIRLO Clad Fuel Rods	+ 3 °F
B. Prior 10CFR50.46 Small-Break ECCS Model Assessments	
Combined assessments previously reported as significant in References 1, 8, and 9	+ 34 °F
Combined plant change evaluations included in 2000 Annual Report (Reference 12)	+ 12 °F
C. Current 10CFR50.46 NOTRUMP Small-Break ECCS Model Assessments	
1. NOTRUMP Mixture Level Tracking/Region Depletion Errors	+ 13 °F
2. Additional Burst and Blockage/Time in Life Penalty Due to C.1	+ 11 °F
D. Current Planned Plant Change Evaluations	
1. None	+ 0 °F
Licensing Basis SBLOCA PCT	= <u>1900 °F</u>

Conclusion

When the effects of assessments to the NOTRUMP ECCS Evaluation Model and planned plant changes were combined with the VEGP SBLOCA analysis results, it was determined that compliance with the requirements of 10 CFR 50.46 is being maintained for Unit 1.

**Attachment**  
**Page 10**

Unit 2 Licensing Basis SBLOCA PCT

Based on the above discussions concerning the VEGP-specific application of the Westinghouse NOTRUMP small-break ECCS Evaluation Model, the licensing basis SBLOCA PCT is as follows:

A. SBLOCA NOTRUMP ECCS Model Analysis-of-Record

1. SBLOCA Analysis Result	1770 °F
2. SBLOCA Fuel Rod Initialization Error	+ 8 °F
3. Evaluation for Steam Generator Lower Level Tap Relocation	+ 15 °F
4. Evaluation for +/- 6 °F Uncertainty Band	+ 4 °F
5. Burst and Blockage/Time in Life	+ 30 °F
6. ZIRLO Clad Fuel Rods	+ 3 °F

B. Prior 10CFR50.46 Small-Break ECCS Model Assessments

Combined assessments previously reported as significant in References 8, 9, and 11 + 56 °F

Combined plant change evaluations included in 2000 Annual Report (Reference 12) + 10 °F

C. Current 10CFR50.46 NOTRUMP Small-Break ECCS Model Assessments

No current assessments 0 °F

D. Current Planned Plant Change Evaluations

None + 0 °F

Licensing Basis SBLOCA PCT = 1896 °F

Conclusion

When the effects of assessments to the NOTRUMP ECCS Evaluation Model and planned plant changes were combined with the VEGP SBLOCA analysis results, it was determined that compliance with the requirements of 10 CFR 50.46 is being maintained for Unit 2.

**REFERENCES**

1. LCV-1436, "Vogtle Electric Generating Plant, 10 CFR 50.46 ECCS Evaluation Models Significant Error Report and 1999 Annual Report," letter from J. B. Beasley, Jr. (SNC) to USNRC, dated April 4, 2000.
2. LCV-0998, "Vogtle Electric Generating Plant, 10 CFR 50.46 ECCS Evaluation Models 1996 Annual Report and Significant Error Report," letter from C. K. McCoy (SNC) to USNRC, dated March 31, 1997.
3. WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," dated October 1992.
4. "The 1981 Version of the Westinghouse ECCS Evaluation Model Using the BASH Code," WCAP-10266-P-A, Rev. 2, (Proprietary), March 1987.
5. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment Nos. 43 and 44 to Facility Operating License NPF-68 and Amendment Nos. 23 and 24 to Facility Operating License NPF-81, attachment to letter from Hood (USNRC) to Hairston (GPC), dated September 19, 1991.
6. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 60 to Facility Operating License NPF-68 and Amendment No. 39 to Facility Operating License NPF-81, attachment to letter from Hood (USNRC) to Hairston (GPC), dated March 22, 1993.
7. "Westinghouse Small-Break ECCS Evaluation Model Using the NOTRUMP Code," WCAP-10054-P-A (Proprietary) and WCAP-10081-A (Non-Proprietary), August 1985.
8. LCV-0579, "Vogtle Electric Generating Plant, 10 CFR 50.46 ECCS Evaluation Models 1994 Annual Report," letter from C. K. McCoy (GPC) to USNRC, dated March 17, 1995.
9. LCV-0327-B, "Vogtle Electric Generating Plant, 10 CFR 50.46 ECCS Evaluation Models Significant Change Report," letter from C. K. McCoy (GPC) to USNRC, dated December 8, 1994.
10. LCV-1388, "Vogtle Electric Generating Plant, 10 CFR 50.46 ECCS Evaluation Models Significant Error Report," letter from J. B. Beasley, Jr. (SNC) to USNRC, dated October 19, 1999.
11. LCV-1474, "Vogtle Electric Generating Plant, 10 CFR 50.46 ECCS Evaluation Models Significant Error Report," letter from J. B. Beasley, Jr. (SNC) to USNRC, dated September 8, 2000.

**Attachment**

**Page 12**

12. LCV-1540, "Vogtle Electric Generating Plant, 10 CFR 50.46 ECCS Evaluation Models 2000 Annual Report," letter from J. B. Beasley, Jr. (SNC) to USNRC, dated June 4, 2001.
13. Westinghouse letter GP-17337, "Southern Nuclear Operating Company, Inc., Vogtle Electric Generating Plant Units 1 and 2, 10CFR50.46 Annual Notification and Reporting for 2001," dated March 1, 2002.