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*A Member of the  
Constellation Energy Group*

May 26, 2000

U. S. Nuclear Regulatory Commission  
Washington, DC 20555

**ATTENTION:** Document Control Desk

**SUBJECT:** Calvert Cliffs Nuclear Power Plant  
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318  
Submittal of Emergency Core Cooling System Codes and Methods Report

As required by 10 CFR 50.46(a)(3)(ii), the Emergency Core Cooling System Codes and Methods Report is provided in Attachment (1). In addition to the final report, a summary of computer code errors resolved in calendar year 1999 that do not impact the peak cladding temperature or other Emergency Core Cooling System Acceptance Criteria is provided in Attachment (2).

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

A handwritten signature in black ink, appearing to read 'Charles H. Cruse', written in a cursive style.

CHC/DJM/dlm

Attachments (1) CENPD-279, Supplement 11, "Annual Report on ABB CENP ECCS Performance Evaluations Models," ABB C-E Nuclear Power Engineering Services, March 2000  
(2) Errors in Codes Used for PWR ECCS Performance Analysis

cc: A. W. Dromerick, NRC

**(Without Attachments)**

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ADD/

**ATTACHMENT (1)**

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**CENPD-279, Supplement 11,  
“ANNUAL REPORT ON ABB CENP ECCS PERFORMANCE  
EVALUATIONS MODELS,”  
ABB C-E Nuclear Power Engineering Services,  
March 2000**

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**Baltimore Gas and Electric Company  
Calvert Cliffs Nuclear Power Plant  
May 26, 2000**

**CENPD-279**  
**Supplement 11**

**ANNUAL REPORT ON ABB CENP ECCS  
PERFORMANCE EVALUATION MODELS**

**CEOG Task 1144**

Prepared for the  
C-E OWNERS GROUP

**March 2000**

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**ABB C-E Nuclear Power  
Engineering Services**

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## ABSTRACT

This report describes changes and errors in the ABB C-E Nuclear Power (CENP) models for PWR ECCS performance analysis in calendar year 1999 per the requirements of 10CFR50.46. For this reporting period, there were no changes or errors in the evaluation models or application of the models that affect the cladding temperature calculation.

The sum of the absolute magnitude of the peak cladding temperature (PCT) changes for the large break LOCA June 1985 EM from all reports to date continues to be less than 1°F excluding plant specific effects. The total effect relative to the 50°F definition of a significant change in PCT is the sum of <1°F and plant specific effects, if any, described in Appendices A-G. The sum of the absolute magnitude of the maximum cladding temperature changes for the small break LOCA S1M evaluation model from all reports to date is less than 3°F. The accumulated change in cladding temperature for the small break LOCA S2M evaluation model is 0°F. No change occurred in the PCT due to post-LOCA long term cooling issues.

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## 1.0 INTRODUCTION

This report addresses the NRC requirement to report changes or errors in ECCS performance evaluation models. The ECCS Acceptance Criteria, Reference 1, spell out reporting requirements and actions required when errors are corrected or changes are made in an evaluation model or in the application of a model for an operating licensee or construction permittee of a nuclear power plant.

The action requirements in 10CFR50.46(a)(3) are:

1. Each applicant for or holder of an operating license or construction permit shall estimate the effect of any change to or error in an acceptable evaluation model or in the application of such a model to determine if the change or error is significant. For this purpose, a significant change or error is one which results in a calculated peak fuel cladding temperature (PCT) different by more than 50°F from the temperature calculated for the limiting transient using the last acceptable model, or is a cumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than 50°F.
2. For each change to or error discovered in an acceptable evaluation model or in the application of such a model that affects the temperature calculation, the applicant or licensee shall report the nature of the change or error and its estimated effect on the limiting ECCS analysis to the Commission at least annually as specified in 10CFR50.4.
3. If the change or error is significant, the applicant or licensee shall provide this report within 30 days and include with the report a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with 10CFR50.46 requirements. This schedule may be developed using an integrated scheduling system previously approved for the facility by the NRC. For those facilities not using an NRC approved integrated scheduling system, a schedule will be established by the NRC staff within 60 days of receipt of the proposed schedule.
4. Any change or error correction that results in a calculated ECCS performance that does not conform to the criteria set forth in paragraph (b) of 10CFR50.46 is a reportable event as described in 10CFR50.55(e), 50.72 and 50.73. The affected applicant or licensee shall propose immediate steps to demonstrate compliance or bring plant design or operation into compliance with 10CFR50.46 requirements.

This report documents all the errors corrected in and/or changes to the presently licensed ABB CENP ECCS performance evaluation models for PWRs, made in the year covered by this report, which have not been reviewed by the NRC staff. This document is provided to satisfy the reporting requirements of the second item above. ABB CENP reports for earlier years are given in References 2-12.

## 2.0 ABB CENP ECCS EVALUATION MODELS AND CODES

Four ABB CENP evaluation models (EM) for ECCS performance analysis of PWRs are described in topical reports, are licensed by the NRC, and are covered by the provisions of 10CFR50.46. The evaluation model for large break LOCA (LBLOCA) is the June 1985 EM. There are two evaluation models for small break LOCA (SBLOCA): the original SBLOCA Evaluation Model (S1M) and the S2M SBLOCA EM accepted by the NRC in 1997. Post-LOCA long term cooling (LTC) analyses are performed with the LTC evaluation model.

ABB CENP uses several digital computer codes to do ECCS performance analyses of PWRs for the evaluation models described above that are covered by the provisions of 10CFR50.46. Those for LBLOCA calculations are CEFLASH-4A, COMPERC-II, HCROSS, PARCH, STRIKIN-II, and COMZIRC. CEFLASH-4AS is used in conjunction with COMPERC-II, STRIKIN-II, and PARCH for SBLOCA calculations. The codes for post-LOCA LTC analysis are BORON, CEPAC, NATFLOW, and CELDA.

### 3.0 EVALUATION MODEL CHANGES AND ERROR CORRECTIONS

This section discusses all error corrections and model changes to the ABB CENP ECCS performance evaluation models for PWRs which may affect the calculated PCT.

There were no changes to or errors in the ECCS evaluation models for PWRs or changes to their application for calendar year 1999 that affect the cladding temperature calculation.

#### 4.0 CONCLUSIONS

There were no changes or errors in the ABB CENP ECCS evaluation models for PWRs or their application for LBLOCA, SBLOCA, or post-LOCA long term cooling that affect the cladding temperature calculation during 1999. The sum of the absolute magnitude of the changes in PCT calculated using the ABB CENP June 1985 EM for LBLOCA, including those from previous annual reports, References 2-12, remains less than 1°F relative to the 50°F criterion for a significant change in PCT. The total LBLOCA PCT impact for a given plant is <1°F plus the plant specific effects, if any, discussed in Appendices A through G.

The sum of the absolute magnitude of the changes in maximum cladding temperature for the SBLOCA S1M evaluation model (due to the change in application of the SBLOCA S1M evaluation model described in Reference 11) is less than 3°F. The accumulated change in cladding temperature for the S2M evaluation model is 0°F. Plant specific SBLOCA considerations for each plant, if any, are discussed in Appendices A through G.

The sum of the absolute magnitude of the changes in cladding temperature for the post-LOCA long term cooling evaluation model is zero.

## 5.0 REFERENCES

1. "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors," Code of Federal Regulations, Title 10, Part 50, Section 50.46.
2. "Annual Report on C-E ECCS Codes and Methods for 10CFR50.46," CENPD-279, April, 1989.
3. "Annual Report on C-E ECCS Codes and Methods for 10CFR50.46," CENPD-279, Supplement 1, February, 1990.
4. "Annual Report on C-E ECCS Codes and Methods for 10CFR50.46," CENPD-279, Supplement 2, April, 1991.
5. "Annual Report on C-E ECCS Codes and Methods for 10CFR50.46," CENPD-279, Supplement 3, April, 1992.
6. "Annual Report on C-E ECCS Codes and Methods for 10CFR50.46," CENPD-279, Supplement 4, April, 1993.
7. "Annual Report on C-E ECCS Codes and Methods for 10CFR50.46," CENPD-279, Supplement 5, February, 1994.
8. "Annual Report on ABB C-E ECCS Performance Evaluation Models," CENPD-279, Supplement 6, February, 1995.
9. "Annual Report on ABB C-E ECCS Performance Evaluation Models," CENPD-279, Supplement 7, February, 1996.
10. "Annual Report on ABB CE ECCS Performance Evaluation Models," CENPD-279, Supplement 8, March, 1997.
11. "Annual Report on ABB CE ECCS Performance Evaluation Models," CENPD-279, Supplement 9, February, 1998.
12. "Annual Report on ABB CE ECCS Performance Evaluation Models," CENPD-279, Supplement 10, February, 1999.

APPENDIX A

ARIZONA PUBLIC SERVICE COMPANY

Plant Specific Considerations for Palo Verde Units 1, 2 and 3

This information does not apply to Baltimore Gas and Electric Company and, therefore is not part of the submittal.

APPENDIX B

BALTIMORE GAS AND ELECTRIC COMPANY

Plant Specific Considerations for Calvert Cliffs Units 1 and 2

There are no outstanding plant specific considerations for Calvert Cliffs Units 1 and 2.

APPENDIX C

SOUTHERN CALIFORNIA EDISON COMPANY

Plant Specific Considerations for SONGS Units 2 and 3

This information does not apply to Baltimore Gas and Electric Company and, therefore is not part of the submittal.

APPENDIX D

CONSUMERS ENERGY

Plant Specific Considerations for Palisades

This information does not apply to Baltimore Gas and Electric Company and, therefore is not part of the submittal.

APPENDIX E

ENTERGY OPERATIONS, INCORPORATED

Plant Specific Considerations for Arkansas Nuclear One Unit 2

This information does not apply to Baltimore Gas and Electric Company and, therefore is not part of the submittal.

Plant Specific Considerations for Waterford Unit 3

This information does not apply to Baltimore Gas and Electric Company and, therefore is not part of the submittal.

APPENDIX F

FLORIDA POWER AND LIGHT COMPANY

Plant Specific Considerations for St. Lucie Unit 2

This information does not apply to Baltimore Gas and Electric Company and, therefore is not part of the submittal.

APPENDIX G

NORTHEAST UTILITIES

Plant Specific Considerations for Millstone Unit 2.

This information does not apply to Baltimore Gas and Electric Company and, therefore is not part of the submittal.

**ATTACHMENT (2)**

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**ERRORS IN CODES USED FOR  
PWR ECCS PERFORMANCE ANALYSIS**

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**Baltimore Gas and Electric Company  
Calvert Cliffs Nuclear Power Plant  
May 26, 2000**

## Errors in Codes Used for PWR ECCS Performance Analysis

The code errors described here were resolved in calendar year 1999 per the provisions of the computer software section, QP 3.13, of the ABB CENP Quality Procedures Manual, Ref. 1. They have a lower level of severity than the items in the formal report on ECCS performance codes and methods changes and errors in that there was no impact on the peak cladding temperature (PCT); therefore, these errors are not reportable under the provisions of 10CFR50.46. This information is provided for completeness in the error reporting process.

### COMPERC-II Errors

COMPERC-II performs the refill/reflood hydraulic and reflood heat transfer coefficient calculations in the ABB CENP ECCS performance evaluation model for PWRs.

An option in COMPERC-II to model simultaneous injection of safety injection tanks (SITs) and safety injection pumps (SIPs) for analysis of non-CE PWRs does not account for spillage of SIP flow to containment. This option is not used for ECCS performance analysis of ABB CENP PWRs; hence, the error has no effect on the licensing analysis results for ECCS performance analyses.

The treatment of ECCS spillage flow for a suction leg break in the COMPERC-II code is inconsistent with the description in the topical report for the LBLOCA evaluation model (EM). Since suction leg breaks are non-limiting compared to discharge leg breaks, this inconsistency has no effect on the PCT of the limiting ECCS analysis.

### STRIKIN-II Error

STRIKIN-II performs the hot rod heatup calculation in the LBLOCA EM and is used in the SBLOCA EM for PWRs.

A STRIKIN-II option that allows the code to identify the cladding rupture node was found to malfunction. This option is not used since the current methodology is to perform a sensitivity study to determine the limiting cladding rupture node. In each case of the sensitivity study, cladding rupture is forced at a different user specified node. The PCT and oxidation results reported for the licensing analysis are taken from the case with the rupture node that produces the highest PCT. Consequently, the code error has no effect on licensing results for LBLOCA ECCS performance analyses since the option that malfunctions is not used. The error has no impact on SBLOCA analyses.

### Reference

1. "ABB Combustion Engineering Nuclear Power Quality Procedures Manual," QPM-101, Rev. 04, March 13, 2000.