

December 15, 2005

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

**Subject: Docket Nos. 50-361 and 50-362
2004 Emergency Core Cooling System Annual 10 CFR 50.46 Report
San Onofre Nuclear Generating Station, Units 2 and 3**

- References:
1. Letter from A. E. Scherer (SCE) to Document Control Desk (NRC), dated December 23, 2004, Subject: Docket Nos. 50-361 and 50-362, 2003 Emergency Core Cooling System Annual 10 CFR 50.46 Report, San Onofre Nuclear Generating Station, Units 2 and 3
 2. CENPD-279, Supplement 16, "Annual Report on Combustion Engineering ECCS Performance Evaluation Models for PWRs," March 2005
 3. Letter from A. E. Scherer (SCE) to Document Control Desk (NRC), dated April 13, 2004, Subject: Docket Nos. 50-361, "Report of Change in Peak Cladding Temperature, San Onofre Nuclear Generating Station," Unit 2

Gentlemen:

This letter transmits as Enclosures 1 and 2 the San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 annual report for the 2004 calendar year required by paragraph (a)(3)(ii) of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors." This regulation requires Southern California Edison (SCE) to annually report to the NRC for SONGS Units 2 and 3 the nature of each change to or error discovered in the Emergency Core Cooling System (ECCS) evaluation model or in the application of this model that affects the temperature calculation and estimated effects of any such changes, errors, or applications on the limiting ECCS analysis. Any significant change or error is required to be reported to the NRC within 30 days.

The previous Emergency Core Cooling System Annual 10 CFR 50.46 Report was submitted to the NRC in Reference 1.

A001

Reference 2 (included as Enclosure 1) describes the codes and methodology used by Westinghouse Electric Company for the SONGS Units 2 and 3 ECCS analysis for this reporting period. Reference 2, Appendix C summarizes the plant specific evaluation for SONGS Units 2 and 3. Appendices A, B, D, E, F, and G of Reference 2 apply to plants other than SONGS, and therefore, are not included.

SCE made no changes to the Loss of Coolant Accident (LOCA) evaluation models.

Enclosure 2 provides a summary of the effect on Peak Cladding Temperature (PCT) of the errors or changes to the ECCS evaluation model reported under 10 CFR 50.46 for this reporting period. While not limiting with regard to PCT, detailed information for the Small Break LOCA is also included in Enclosure 2 (in accordance with Supplement 1 to Information Notice 97-15).

Reference 3 provided notification to the NRC of a change to the Large Break LOCA PCT for Unit 2. This change resulted from an increased number of steam generator tubes assumed to be plugged and a change to the maximum allowed Linear Heat Rate (LHR). These changes are input changes, rather than changes to the evaluation model. The effects of these changes are described in Table 1 of Enclosure 2 of this letter.

Operating Cycle Information

Unit 2 and Unit 3 operation for the current reporting period is outlined below.

| Unit | Year | Cycle 12 | Cycle 13 |
|------|------|---|---|
| 2 | 2004 | January 1, 2004 to February 9, 2004 | April 6, 2004 through December 31, 2004 |
| 3 | 2004 | January 1, 2004 to September 27, 2004 | December 28, 2004 through December 31, 2004 |

SONGS Units 2 and 3 Large Break LOCA Evaluation Model - 2004 Reporting Period

The Large Break LOCA analysis uses the evaluation model approved on June 1985. The limiting Large Break LOCA PCT did not exceed the 10 CFR 50.46(b)(1) acceptance criterion of 2,200 °F. This is documented in Table 1 (Enclosure 2).

The cumulative (sum of the absolute magnitudes of PCT changes) Large Break LOCA 10CFR 50.46 model changes and model errors, since the approval of the "June 1985 Evaluation Model," remains less than 1 °F. This is documented in Table 2 (Enclosure 2).

SONGS Units 2 and 3 Small Break LOCA Evaluation Model - 2004 Reporting Period

The Small Break LOCA analysis uses the Supplement 2 Model (S2M) Small Break LOCA evaluation model approved on February 22, 2000. The limiting Small Break LOCA PCT did not exceed the 10CFR50.46(b)(1) acceptance criterion of 2,200 °F, and remained bounded by the Large Break LOCA PCT. This is documented in Table 3 (Enclosure 2).

The cumulative (sum of the absolute magnitudes of PCT changes) Small Break LOCA 10CFR50.46 model changes and model errors, since the approval of the "S2M Evaluation Model," is 19 °F. This is documented in Table 4 (Enclosure 2).

An authorization for the NRC to reproduce the copyrighted Reference 2 is provided in Enclosure 1 in the "Copyright Notice" Section.

If you have any questions or need additional information on this subject, please contact Mr. J. L. Rainsberry at 949/368-7420.

Sincerely,



cc: B. S. Mallett, Regional Administrator, NRC Region IV
N. Kalyanam, NRC Project Manager, San Onofre Units 2 and 3
C. C. Osterholtz, NRC Senior Resident Inspector, San Onofre Units 2 and 3

Enclosure 1

(14 pages including this page)

Westinghouse Non-Proprietary Class 3

CENPD-279, Supplement 16

March 2005

Annual Report on
Combustion Engineering ECCS
Performance Evaluation Models
for PWRs



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ABSTRACT

This report describes changes and errors in the ECCS performance evaluation models (EM) for PWRs developed by Combustion Engineering in calendar year (CY) 2004 per the requirements of 10CFR50.46. For this reporting period, there was one change in the implementation of the 1999 EM for LBLOCA that affects the cladding temperature calculation. There were no other 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 generic 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 generic impact on the peak cladding temperature for the large break LOCA 1999 EM is less than 1.2°F for plants analyzed with the Automated/Integrated Code System (AICS) and less than 3°F for plants analyzed with the Advanced AICS. The generic sum of the absolute magnitude of the peak cladding temperature changes for the small break LOCA SIM evaluation model from all reports to date is less than 3°F. There is no generic accumulated change in peak cladding temperature for the small break LOCA S2M evaluation model. No change occurred in the PCT due to post-LOCA long term cooling issues. The total effect relative to the 50°F definition of a significant change in PCT for each evaluation model is the sum of the generic effects for that model and plant specific effects, if any, described in Appendices A-F.

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APPENDICES (Plant Specific Considerations)

- A. ARIZONA PUBLIC SERVICE COMPANY (PVNGS Units 1-3)
- B. CALVERT CLIFFS NUCLEAR POWER PLANT INCORPORATED
(Calvert Cliffs Units 1 & 2)
- C. SOUTHERN CALIFORNIA EDISON COMPANY (SONGS Units 2 & 3)
- D. DOMINION RESOURCES (Millstone Unit 2)
- E. ENTERGY OPERATIONS, INCORPORATED
 - 1. Arkansas Nuclear One Unit 2
 - 2. Waterford Unit 3
- F. FLORIDA POWER AND LIGHT COMPANY (St. Lucie Unit 2)

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 ECCS performance evaluation models for PWRs developed by Combustion Engineering, 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. Reports for earlier years are given in References 2-17.

2.0 COMBUSTION ENGINEERING ECCS EVALUATION MODELS AND CODES

Five evaluation models (EM) for ECCS performance analysis of PWRs developed by Combustion Engineering are described in topical reports, are licensed by the NRC, and are covered by the provisions of 10CFR50.46. The evaluation models for large break LOCA (LBLOCA) are the June 1985 EM and the 1999 EM. There are two evaluation models for small break LOCA (SBLOCA): the SBLOCA Evaluation Model (S1M) and the S2M SBLOCA EM. Post-LOCA long term cooling (LTC) analyses use the LTC evaluation model.

Several digital computer codes are used 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 analyses 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 ECCS performance evaluation models for PWRs described in Section 2.0 that may affect the calculated PCT.

3.1 Zirconium Diboride Integral Fuel Burnable Absorber

Use of zirconium diboride integral fuel burnable absorbers (ZrB₂ IFBA) in CE designed PWRs was accepted by the NRC in Calendar Year (CY) 2004, Reference 19. The PCT impact is handled on a plant specific basis as discussed in Section 3.4.

3.2 Automation of LOCA Analysis Methods

The current (1999) EM for LBLOCA is described in the NRC accepted topical report, Reference 20. The methodology is implemented by the Automated / Integrated Code System (AICS) described in Reference 20 which automates data flow between the separate computer codes. A new version of the AICS called the Advanced Automated / Integrated Code System (AAICS) has been implemented to further automate data flow, reduce manual input preparation, ensure consistency of input between the codes, facilitate parametric studies and support new options. There are no changes to the EM or any of its components including those controlled by Appendix K in 10CFR50. The maximum effects on the relevant LOCA acceptance criteria are:

| Acceptance Criterion | Units | Maximum Difference |
|----------------------------------|-------------|--------------------|
| Peak Cladding Temperature (PCT) | °F | 1.4 |
| Maximum Cladding Oxidation (MCO) | % oxidation | 0.023 |
| Core Wide Oxidation (CWO) | % oxidation | 0.015 |

These changes are due to small differences in the precision of input manually prepared by the analyst and that calculated by the computer codes.

The current SBLOCA EM is the S2M described in the NRC accepted topical report, Reference 21. Some of the principles used to automate data flow between codes and facilitate parametric studies for the AAICS have been implemented in the procedures used to perform SBLOCA analyses. There are no changes to the EM or any of its components including those controlled by Appendix K in 10CFR50. The change in the implementation of the S2M SBLOCA EM has no effect on the analysis results.

3.3 Change in Computing Platform and Version of HP-UX Operating System

The version of the operating system (OS) used for the computers that perform LOCA calculations changed from HP-UX 11.00 to HP-UX 11.11. Also, a new hardware platform, the HP C8000, was introduced in 2004. A system state equivalency test demonstrates that these changes have no effect on any analysis results.

3.4 Rod Internal Pressure Effect on SBLOCA Cladding Temperature and Oxidation

Up to now, SBLOCA analyses have been performed at the burnup with the highest initial stored energy in the fuel rod per the SBLOCA EM described in Reference 22. However, a hot rod heatup calculation performed at the burnup with the maximum initial stored energy in the fuel may not be limiting for a ZrB_2 IFBA rod design because of its internal pressure behavior during a hot rod heatup calculation. A parametric study on rod internal pressure (RIP) is now used to evaluate this effect for all CE fuel assembly designs as discussed in Section 4.2.3.2 of the NRC accepted topical report for fuel with ZrB_2 IFBA rods, Reference 19. An additional RIP parametric study is performed to determine the effect on MCO. Future SBLOCA analyses for CE fuel assembly designs with ZrB_2 IFBA rods will include the results of RIP parametric studies for PCT and MCO. Because the change in PCT may be significant, e.g., greater than 50°F, the implications for 10CFR50.46 reporting requirements will be addressed in plant specific submittals, such as 30 day letters, describing introduction of fuel assemblies with ZrB_2 IFBA rods.

4.0 CONCLUSIONS

There were no changes to or errors in the ECCS evaluation models for PWRs or their application for LBLOCA, SBLOCA, or post-LOCA long term cooling that affect the calculated cladding temperature during CY 2004 except as noted below. Implementation of the AAICS for the 1999 EM had a maximum PCT impact of 1.4°F.

The sum of the absolute magnitude of the changes in PCT calculated using the June 1985 EM for LBLOCA, including those from previous annual reports, References 2-17, remains less than 1°F. The maximum impact on PCT calculated with the 1999 EM is less than 3°F (1.2°F from Reference 16 plus 1.4°F for the AAICS). Plant specific LBLOCA considerations for each plant including application of the AAICS are discussed in Appendices A through F.

Previous plant specific PCT effects for both the S1M and S2M SBLOCA evaluation models are discussed in Appendices A through F of Reference 15. In addition, there is a generic effect on maximum cladding temperature for the SBLOCA S1M (due to the change in application of the SBLOCA S1M described in Reference 11) that is less than 3°F. There is no previous generic accumulated change in cladding temperature for the S2M. The overall plant specific PCT effects for SBLOCA are summarized in Appendices A through F.

There is no PCT effect for the post-LOCA long term cooling evaluation model.

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, February, 1997.
11. "Annual Report on ABB CE ECCS Performance Evaluation Models," CENPD-279, Supplement 9, March, 1998.
12. "Annual Report on ABB CE ECCS Performance Evaluation Models," CENPD-279, Supplement 10, February, 1999.
13. "Annual Report on ABB CE ECCS Performance Evaluation Models," CENPD-279, Supplement 11, March, 2000.
14. "Annual Report on Combustion Engineering ECCS Performance Evaluation Models for PWRs," CENPD-279, Supplement 12, April, 2001.
15. "Annual Report on Combustion Engineering ECCS Performance Evaluation Models for PWRs," CENPD-279, Supplement 13, Rev. 1, April, 2002.
16. "Annual Report on Combustion Engineering ECCS Performance Evaluation Models for PWRs," CENPD-279, Supplement 14, Rev. 1, April, 2003.
17. "Annual Report on Combustion Engineering ECCS Performance Evaluation Models for PWRs," CENPD-279, Supplement 15, March 2004.

18. "Post-LOCA Long Term Cooling Evaluation Model," CENPD-254-NP-A, June 1980.
19. "Implementation of Zirconium Diboride Absorber Coatings in CE Nuclear Power Fuel Assembly Designs," WCAP-16072-NP-A, August 2004.
20. "Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model," CENPD-132, Supplement 4-NP-A, March 2001.
21. "Calculative Methods for the ABB CE Small Break LOCA Evaluation Model," CENPD-137, Supplement 2-A (non-proprietary), April 1998.
22. "Calculative Methods for the C-E Small Break LOCA Evaluation Model," CENPD-137, Rev. 1 (non-proprietary), August 1974.

APPENDIX C

SOUTHERN CALIFORNIA EDISON COMPANY

Plant Specific Considerations for SONGS Units 2 and 3

The Cycle 13 analysis for SONGS Unit 3 concluded that the Unit 2 Cycle 13 analysis is applicable. There were no other analyses in Calendar Year (CY) 2004; therefore, the discussion from the CY 2003 report, Reference 17, applies.

Enclosure 2

(5 pages including this page)

2004 REPORTING PERIOD

LOSS OF COOLANT ACCIDENT (LOCA) MARGIN SUMMARY SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 AND 3

Large Break LOCA

Table 1 provides a time line of the items, which could affect the Large Break LOCA peak cladding temperature (PCT) for this reporting period. The 10 CFR 50.46 PCT limit of 2,200°F was not exceeded.

Table 1

Limiting Large Break LOCA PCT

| | Unit 2 | Unit 3 |
|---|--|----------|
| Limiting Large Break LOCA PCT | | |
| End of 2003 | 2,135 °F | 2,129 °F |
| Changes in PCT <i>during 2004</i> due to: | | |
| a) Model changes or Model errors | | |
| • Cycle 12 | 0 °F | 0 °F |
| • Cycle 13 | 0 °F | 0 °F |
| b) Cycle Dependent Input Changes | | |
| • Cycle 12 | 0 °F | 0 °F |
| • Cycle 13 | +65 °F (Note 1,3) -30 °F (Note 2,3) | +7 °F |
| Limiting Large Break LOCA PCT | | |
| End of 2004 | 2,170 °F | 2,136 °F |

Note 1: Due to an increase in the number of assumed plugged Steam Generator tubes from 1,000 to 1,380 per Steam Generator.

Note 2: Due to a reduction in the Peak Linear Heat Generation Rate from 12.8 to 12.7 Kw/ft.

Note 3: NRC was notified of these changes per SCE's submittal dated April 13, 2004.

The cumulative 10CFR50.46 model changes and model errors for the "Large Break LOCA June 1985 Evaluation Model" are shown in Table 2.

Table 2

**Cumulative Large Break LOCA 10 CFR 50.46
Model Changes and Model Errors
 $\sum |\Delta \text{ PCT} |^*$**

| | Unit 2 | Unit 3 |
|---|----------------------------|----------------------------|
| Cumulative Large Break LOCA 10 CFR 50.46 Model Changes and Model Errors <i>Prior to 2004</i> | < 1 °F | < 1 °F |
| Changes in Large Break LOCA PCT due to Model Changes and Model Errors <i>Discovered in 2004</i> <ul style="list-style-type: none"> • Cycle 12 • Cycle 13 | 0 °F 0 °F | 0 °F 0 °F |
| Cumulative Large Break LOCA 10 CFR 50.46 Model Changes and Model Errors <i>End of 2004</i> | < 1 °F | < 1 °F |

* Sum of the absolute magnitude of the 10 CFR 50.46 model changes and model errors.

Small Break LOCA

Table 3 provides a time line of the items, which could affect the Small Break LOCA peak cladding temperature (PCT) for this reporting period. The Small Break LOCA 10 CFR 50.46 PCT limit of 2200°F was not exceeded, and remained bounded by the Large Break LOCA.

**Table 3
Limiting Small Break LOCA PCT**

| | Unit 2 | Unit 3 |
|---|---------------|---------------|
| Limiting Small Break LOCA PCT <i>End of 2003</i> | 1,903 °F | 1,903 °F |
| Changes in PCT <i>during 2004</i> due to: | | |
| a) Model changes or Model errors | | |
| Cycle 12 | 0 °F | 0 °F |
| Cycle 13 | 0 °F | 0 °F |
| b) Cycle Dependent Input Changes | | |
| Cycle 12 | 0 °F | 0 °F |
| Cycle 13 | 0 °F | 0 °F |
| Limiting Small Break LOCA PCT <i>End of 2004</i> | 1,903 °F | 1,903 °F |

The cumulative 10CFR50.46 model changes and model errors for the "Small Break LOCA S2M Evaluation Model" are shown in Table 4.

Table 4

**Cumulative Small Break LOCA 10 CFR 50.46
Model Changes and Model Errors
 $\sum |\Delta \text{ PCT} | *$**

| | Unit 2 | Unit 3 |
|--|---------------|---------------|
| Cumulative Small Break LOCA 10 CFR 50.46 Model Changes and Model Errors | | |
| <i>Prior to 2004</i> | 19 °F | 19 °F |
| Changes in Small Break LOCA PCT due to Model Changes and Model Errors | | |
| <i>Discovered in 2004</i> | | |
| • Cycle 12 | 0 °F | 0 °F |
| • Cycle 13 | 0 °F | 0 °F |
| Cumulative Small Break LOCA 10 CFR 50.46 Model Changes and Model Errors | | |
| <i>End of 2004</i> | 19 °F | 19 °F |

* Sum of the absolute magnitude of the 10 CFR 50.46 model changes and model errors.