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May 9, 2002

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
10 CFR 50.46 30-Day Report for Changes to the Calvert Cliffs Nuclear Power Plant Emergency Core Cooling System Performance Analysis

REFERENCES:

(a) CENPD-132, Supplement 4-P-A, "Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model," March 2001

(b) CENPD-137, Supplement 2-P-A, "Calculative Methods for the ABB CE Small Break LOCA Evaluation Model," April 1998

(c) Letter from Mr. C. H. Cruse (CCNPP) to NRC Document Control Desk, dated July 27, 2001, "License Amendment Request: Incorporate Methodology References for the Implementation of ZIRLO™ Clad Fuel Rods into the Technical Specifications"

(d) CENPD-404-P-A, Revision 0, "Implementation of ZIRLO™ Cladding Material in CE Nuclear Power Fuel Assembly Designs," November 2001

(e) Letter from Ms. D. Skay (NRC) to Mr. C. H. Cruse (CCNPP), dated April 8, 2002, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 Amendment Re: Implementation of ZIRLO Clad Fuel Rods (TAC Nos. MB2540 and MB2541)"

This letter is submitted pursuant to 10 CFR 50.46(a)(3)(ii) to provide notification of a significant change to the peak cladding temperature of the large break loss-of-coolant accident (LBLOCA) and small break loss-of-coolant accident (SBLOCA) analyses for Calvert Cliffs Nuclear Power Plant (CCNPP).

The analyses for the LBLOCA and SBLOCA Emergency Core Cooling System performance has been re-analyzed for the upcoming Unit 1 cycle (Cycle 16). The re-analyses were performed using the newest Nuclear Regulatory Commission (NRC)-accepted versions of the Westinghouse evaluation models for Combustion Engineering designed pressurized water reactors (References a and b). In addition, the new analyses explicitly model the replacement steam generators, which were installed prior to the startup of

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Cycle 16, and the new fuel design being introduced in Cycle 16. The new fuel design implements ZIRLO™ cladding and mixing vane grids.

Calvert Cliffs Nuclear Power Plant requested an amendment to the CCNPP Unit 1 and Unit 2 operating license (Reference c) to add the methodology references for the new LBLOCA and SBLOCA evaluation models and for ZIRLO™ cladding (Reference d) to the list of approved core operating limits analytical methods in the Technical Specifications. The NRC approved this request on April 8, 2002 (Reference e).

The results of the new analyses and their compliance with 10 CFR 50.46 are summarized in Attachment (1). As described in the attachment, the new LBLOCA and SBLOCA analyses constitute new licensing basis analyses (analyses-of-record) for Unit 1. A description of the analyses will be incorporated into a future revision of the CCNPP Updated Final Safety Analysis Report.

The results of the new LBLOCA and SBLOCA analyses conform to the Emergency Core Cooling System acceptance criteria of 10 CFR 50.46(b). Because the sum of the absolute magnitudes of the effects on peak cladding temperature due to the changes is greater than 50°F, the changes qualify as being significant as defined in 10 CFR 50.46(a)(3)(i). Consequently, the changes are being reported in this 30-day report. The new analyses will become the licensing basis analyses for Unit 1 upon startup of Cycle 16, which is currently scheduled for late May 2002. The new analyses will become the licensing basis analysis for Unit 2 upon startup of Cycle 15, which is currently scheduled for early May 2003.

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

Very truly yours,

CHC/DJM/bjd

Attachment: (1) 10 CFR 50.46 Thirty-Day Report for Changes to the Calvert Cliffs Nuclear Power Plant ECCS Performance Analysis

cc: R. S. Fleishman, Esquire
J. E. Silberg, Esquire
Director, Project Directorate I-1, NRC
D. M. Skay, NRC
H. J. Miller, NRC
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ATTACHMENT (1)

10 CFR 50.46 THIRTY-DAY REPORT FOR CHANGES TO THE CALVERT CLIFFS NUCLEAR POWER PLANT EMERGENCY CORE COOLING SYSTEM PERFORMANCE ANALYSIS

ATTACHMENT (1)

10 CFR 50.46 THIRTY-DAY REPORT FOR CHANGES TO THE CALVERT CLIFFS NUCLEAR POWER PLANT EMERGENCY CORE COOLING SYSTEM PERFORMANCE ANALYSIS

INTRODUCTION

This 30-day report is provided for Calvert Cliffs Nuclear Power Plant (CCNPP) in accordance with the requirements of 10 CFR 50.46(a)(3)(ii) for reporting (1) changes in an acceptable evaluation model or the application of such a model and (2) the estimated effect of the changes on the limiting Emergency Core Cooling System (ECCS) analysis. Because the effect on the peak cladding temperature (PCT) of the changes described herein is greater than 50°F, the changes qualify as significant as defined in 10 CFR 50.46(a)(3)(i) and, consequently, are provided in this 30-day report. No errors are reported in this 30-day report.

Emergency Core Cooling System performance for both the large break loss-of-coolant accident (LBLOCA) and the small break loss-of-coolant accident (SBLOCA) have been re-analyzed for CCNPP Unit 1. The analyses were performed with the newest Nuclear Regulatory Commission (NRC)-accepted versions of the Westinghouse Appendix K evaluation models for Combustion Engineering designed pressurized water reactors (PWRs). In addition, the analyses explicitly modeled the replacement steam generators, which were installed prior to the startup of Cycle 16, and the new fuel design that is being introduced in Cycle 16. The new fuel design implements ZIRLO™ cladding and mixing vane grids.

The new LBLOCA and SBLOCA analyses are not assessments (i.e., they do not provide an estimate of the effect of the changes on the limiting ECCS analysis). Rather, they are complete re-analyses that use acceptable evaluation models that are applicable to CCNPP Unit 1. A summary description of the new analyses and their compliance with 10 CFR 50.46 are provided below.

LBLOCA ECCS PERFORMANCE ANALYSIS

LBLOCA Evaluation Model

The new LBLOCA ECCS performance analysis was performed with the 1999 Evaluation Model (EM) version of the Westinghouse LBLOCA evaluation model for Combustion Engineering designed PWRs (Reference 1). Additionally, the analysis used the ZIRLO™ cladding models described in Reference 2. The 1999 EM and the ZIRLO™ cladding topical reports were generically accepted by the NRC in References 3 and 4 for licensing applications for Combustion Engineering designed PWRs.

The 1999 EM and the ZIRLO™ cladding topical reports are listed in Technical Specification 5.6.5.b of the CCNPP Technical Specifications as approved analytical methodologies that can be used to determine core operating limits in the Core Operating Limits Report. The license amendment request to add these methodologies to the Technical Specifications was submitted to the NRC in Reference 5 and was accepted by the NRC in Reference 6.

The analysis complies with the limitations/constraints imposed by the Safety Evaluation Reports (SERs) for the 1999 EM and the ZIRLO™ cladding topical reports as well as the applicable limitations/ constraints imposed by the SERs for earlier versions of the LBLOCA evaluation model.

The current CCNPP Unit 1 LBLOCA analysis uses the 1985 EM version of the Westinghouse LBLOCA evaluation model for Combustion Engineering designed PWRs (Reference 7).

Replacement Steam Generators

Prior to the startup of Cycle 16, the CCNPP Unit 1 Original Steam Generators (OSGs) were replaced with Replacement Steam Generators (RSGs) that were manufactured by Babcock & Wilcox Canada. The

RSGs were designed to closely resemble the OSGs and were installed under the provisions of 10 CFR 50.59.

The new LBLOCA analysis explicitly models the RSGs. The analysis accounts for up to 10% tube plugging in each steam generator. In contrast, the current analysis, which models the OSGs, accounts for up to 2500 plugged tubes (approximately 30% tube plugging) per steam generator.

The new LBLOCA analysis also models the increase in minimum Reactor Coolant System (RCS) flow rate that resulted from the installation of the RSGs. Specifically, the analysis uses a minimum RCS flow rate of 370,000 gpm in contrast to 340,000 gpm used in the current analysis.

Fuel Design Changes

The Batch V fuel assemblies being introduced in Cycle 16 use mixing vane grids (Turbo fuel assembly) and ZIRLO™ cladding. The new LBLOCA analysis explicitly analyzed the various fuel designs present in Cycle 16 in order to ensure that limiting fuel rod conditions were selected for the break spectrum analysis. The hot rod heatup portion of the break spectrum analysis, which is performed with the STRIKIN-II computer code, analyzed a ZIRLO™ clad erbia rod in a Turbo fuel assembly. It used reflood heat transfer coefficients that were conservatively biased in order to bound the results of the more limiting fuel types present in Cycle 16, that will not be present in future cycles, and to bound the impact on PCT due to the mixed core effect of co-resident Turbo and non-Turbo fuel assemblies in Cycle 16.

Other Plant Parameter Changes

In addition to the changes described above, the new LBLOCA analysis introduced several other changes to plant parameters used in the analysis. The most notable change was an increase in the Peak Linear Heat Generation Rate (PLHGR) from 13.9 kW/ft to 14.3 kW/ft. The PLHGR was reduced from 14.3 kW/ft to 13.9 kW/ft during Cycle 15 in order to avoid the adverse impact on PCT that resulted from inconsistencies in the timing of cladding rupture calculated by CEFLASH-4A and STRIKIN-II at the higher PLHGR. The improvement made to the CEFLASH-4A fuel rod internal pressure model in the 1999 EM eliminated the inconsistency in the new LBLOCA analysis.

The new LBLOCA analysis also incorporated new bounding values for several physics parameters in order to bound larger cycle-to-cycle variations in the values of the parameters.

Results and Conclusion of the New LBLOCA Analysis

Table 1 compares important inputs used in the current and the new LBLOCA analyses. Table 2 compares important results from the two analyses. A more detailed description of the new analysis, including tables and figures that present the results of the break spectrum analysis, will be incorporated into a future revision of the CCNPP Updated Final Safety Analysis Report.

As summarized below, the results of the new LBLOCA analysis conforms to the acceptance criteria of 10 CFR 50.46(b).

Parameter	Criterion	Result
Peak Cladding Temperature	≤2200°F	2026°F
Maximum Cladding Oxidation	≤17 %	8.58 %
Maximum Core-Wide Oxidation	≤1 %	<0.99 %
Coolable Geometry	Yes	Yes

The new LBLOCA analysis uses the 1999 EM, which is accepted by the NRC for licensing applications for Combustion Engineering designed PWRs such as CCNPP. The analysis complies with the limitations/constraints imposed by all applicable SERs. The analysis uses values for plant design data that are either applicable to or bound the configuration of Unit 1 Cycle 16. Calvert Cliffs Nuclear Power Plant, Inc. and Westinghouse have ongoing processes that ensure that the as-operated plant values for PCT-sensitive parameters remain bounded by the values used in the analysis.

SBLOCA ECCS PERFORMANCE ANALYSIS

SBLOCA Evaluation Model

The new SBLOCA ECCS performance analysis was performed with the S2M (Supplement 2 to CENPD-137 Evaluation Model) version of the Westinghouse SBLOCA evaluation model for Combustion Engineering designed PWRs (Reference 8). Additionally, the analysis used the ZIRLO™ cladding models described in Reference 2. The S2M and the ZIRLO™ cladding topical reports were generically accepted by the NRC in References 4 and 9 for licensing applications for Combustion Engineering designed PWRs.

The S2M and the ZIRLO™ cladding topical reports are listed in Technical Specification 5.6.5.b of the CCNPP Technical Specifications as approved analytical methodologies that can be used to determine core operating limits in the Core Operating Limits Report. The license amendment request to add these methodologies to the Technical Specifications was submitted to the NRC in Reference 5 and was accepted by the NRC in Reference 6.

The analysis complies with the limitations/constraints imposed by the SERs for the S2M and the ZIRLO™ cladding topical reports as well as the applicable limitations/constraints imposed by the SERs for earlier versions of the SBLOCA evaluation model.

The current CCNPP Unit 1 SBLOCA analysis uses the S1M (Supplement 1 to CENPD-137 Evaluation Model) version of the Westinghouse LBLOCA evaluation model for Combustion Engineering designed PWRs (Reference 10).

Replacement Steam Generators

Like the new LBLOCA analysis, the new SBLOCA analysis explicitly models the RSGs with up to 10% tube plugging per steam generator and the increased value of 370,000 gpm for the minimum RCS flow rate. The current SBLOCA analysis models the OSGs with up to 2,500 plugged tubes (approximately 30% tube plugging) per steam generator.

Fuel Design Changes

The new SBLOCA analysis used limiting initial fuel rod conditions that bound the various fuel and cladding types present in Cycle 16, including UO_2 and erbia fuel rods and Zircaloy-4 and ZIRLO™ cladding.

Other Plant Parameter Changes

In addition to the changes described above, the new SBLOCA analysis introduced several other changes to plant parameters used in the analysis. The changes include the following:

- Reduction in the high pressure safety injection pump flow
- Elimination of credit for charging pump flow
- Increase of 10 psi in the opening pressure of the first bank of the main steam safety valves
- Change in the PLHGR to 14.3 kW/ft

Results and Conclusion of the New SBLOCA Analysis

Tables 3 and 4 compare important inputs and results from the new SBLOCA analysis to those of the current SBLOCA analysis. A more detailed description of the new analysis, including tables and figures that present the results of the break spectrum analysis, will be incorporated into a future revision of the CCNPP Updated Final Safety Analysis Report.

As summarized below, the results of the new SBLOCA analysis conform to the acceptance criteria of 10 CFR 50.46(b).

Parameter	Criterion	Result
Peak Cladding Temperature	≤2200°F	1955°F
Maximum Cladding Oxidation	≤17 %	9.03 %
Maximum Core-Wide Oxidation	≤1 %	<0.81 %
Coolable Geometry	Yes	Yes

The new SBLOCA analysis uses the S2M, which is accepted by the NRC for licensing applications for Combustion Engineering designed PWRs such as CCNPP. The analysis complies with the limitations/constraints imposed by all applicable SERs. The analysis uses values for plant design data that are either applicable to or bound the configuration of Unit 1 Cycle 16. Calvert Cliffs Nuclear Power Plant, Inc. and Westinghouse have ongoing processes that ensure that the as-operated plant values for PCT-sensitive parameters remain bounded by the values used in the analysis.

Applicability of the New Analyses to Unit 2

The new LBLOCA and SBLOCA analyses were performed to be applicable to both Unit 1 and Unit 2 after the RSGs are installed. The RSGs are scheduled to be installed in Unit 2 in the spring of 2003 during the refueling outage prior to startup of Cycle 15. As part of the Unit 2 Cycle 15 reload analysis activities, CCNPP and Westinghouse will confirm the applicability of the new analyses to Unit 2 Cycle 15, by ensuring that the Cycle 15 values for PCT-sensitive parameters are bounded by the values used in the new analyses. When it is confirmed that the new analyses are applicable to Unit 2, CCNPP will incorporate the change into the Updated Final Safety Analysis Report. A separate 30-day report to the NRC detailing these same changes to the Unit 2 ECCS performance analysis will not be submitted unless there are changes to Unit 2 analysis that cause it to differ from the analysis methods and results described in this letter.

Summary

The new LBLOCA and SBLOCA analyses comply with 10 CFR 50.46 as follows:

- The analyses were performed with acceptable evaluation models and included sensitivity studies that assured the limiting LBLOCA and SBLOCA were analyzed [10 CFR 50.46(a)(1)(i)].
- The results of the new LBLOCA and SBLOCA analyses conform to the ECCS acceptance criteria [10 CFR 50.46(b)].
- This 30-day report provides NRC with notification of the change in the application of the evaluation models and their effect on the limiting ECCS analyses [10 CFR 50.46(a)(3)(ii)].

The new LBLOCA and SBLOCA analyses constitute new licensing basis analyses (analyses-of-record). They will be used as the reference analyses to evaluate the impact on PCT of future changes to or errors in the 1999 EM and the S2M, and their application to CCNPP.

References

1. CENPD-132, Supplement 4-P-A, "Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model," March 2001
2. CENPD-404-P-A, Revision 0, "Implementation of ZIRLO™ Cladding Material in CE Nuclear Power Fuel Assembly Designs," November 2001
3. Letter from Mr. S. A. Richards (NRC) to Mr. P. W. Richardson (Westinghouse), dated December 15, 2000, "Safety Evaluation of Topical Report CENPD-132, Supplement 4, Revision 1, 'Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model' (TAC No. MA5660)"
4. Letter from Mr. S. A. Richards (NRC) to Mr. P. W. Richardson (Westinghouse), dated September 12, 2001, "Safety Evaluation of Topical Report CENPD-404-P, Revision 0, 'Implementation of ZIRLO Material Cladding in CE Nuclear Power Fuel Assembly Designs' (TAC No. MB1035)"
5. Letter from Mr. C. H. Cruse (CCNPP) to NRC Document Control Desk, dated July 27, 2001, "License Amendment Request: Incorporate Methodology References for the Implementation of ZIRLO Clad Fuel Rods into the Technical Specifications"
6. Letter from Ms. D. Skay (NRC) to Mr. C. H. Cruse (CCNPP), dated April 8, 2002, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 Amendment Re: Implementation of ZIRLO Clad Fuel Rods (TAC Nos. MB2540 and MB2541)"
7. CENPD-132, Supplement 3-P-A, "Calculative Methods for the C-E Large Break LOCA Evaluation Model for the Analysis of C-E and W Designed NSSS," June 1985
8. CENPD-137, Supplement 2-P-A, "Calculative Methods for the ABB CE Small Break LOCA Evaluation Model," April 1998
9. Letter from Mr. T. H. Essig (NRC) to Mr. I. C. Rickard (ABB Combustion Engineering), dated December 16, 1997, "Acceptance for Referencing of the Topical Report CENPD-137(P), Supplement 2, 'Calculative Methods for the C-E Small Break LOCA Evaluation Model' (TAC No. M95687)"

10. CENPD-137, Supplement 1-P, "Calculative Methods for the C-E Small Break LOCA Evaluation Model," January 1977

Table 1

Comparison of Important Parameters Used in the Current and New CCNPP Unit 1 LBLOCA ECCS Performance Analysis

Parameter	**Current Analysis**	**New Analysis**
LBLOCA Evaluation Model	1985 EM	1999 EM
Core Power Level, MWt (including power measurement uncertainty)	2754	2754
Peak Linear Heat Generation Rate, kW/ft	13.9	14.3
Hot Rod Pin-to-Box Factor	1.03	1.025
RCS Flow Rate, gpm	340,000	370,000
RCS Pressure, psia	2250	2250
Cold Leg Temperature	546	546
Hot Leg Temperature	601	597
Steam Generators	OSGs	RSGs
Steam Generator Tube Plugging, plugged tubes/SG	2500	847

Table 2

Comparison of Important Results of the Current and New CCNPP Unit 1 LBLOCA ECCS Performance Analysis

Parameter	**Current Analysis**	**New Analysis**
Limiting Break Size	0.6 DEG/PD[a]	0.6 DEG/PD
Peak Cladding Temperature, °F	2078	2026
Time of Peak Cladding Temperature, seconds	285	269
Maximum Cladding Oxidation, %	6.71	8.58
Maximum Core-Wide Cladding Oxidation, %	<0.51	<0.99
Time of Cladding Rupture	27.0	26.1

[a] DEG/PD = Double-Ended Guillotine Break in Pump Discharge Leg

Table 3

Comparison of Important Parameters Used in the Current and New CCNPP Unit 1 SBLOCA ECCS Performance Analysis

Parameter	Current Analysis	New Analysis
SBLOCA Evaluation Model	S1M	S2M
Core Power Level, MWt (including power measurement uncertainty)	2754	2754
Peak Linear Heat Generation Rate, kW/ft	14.5	14.3
RCS Flow Rate, gpm	340,000	370,000
RCS Pressure, psia	2250	2250
Cold Leg Temperature	546	550
Hot Leg Temperature	601	601
Steam Generators	OSGs	RSGs
Steam Generator Tube Plugging, plugged tubes/SG	2500	847

Table 4

Comparison of Important Results of the Current and New CCNPP Unit 1 SBLOCA ECCS Performance Analysis

Parameter	Current Analysis	New Analysis
Limiting Break Size[a]	0.1 ft^2/PD[b]	0.08 ft^2/PD
Peak Cladding Temperature, °F	1985	1955
Time of Peak Cladding Temperature, seconds	1403	1293
Maximum Cladding Oxidation, %	5.42	9.03[c]
Maximum Core-Wide Cladding Oxidation, %	<0.80	<0.81
Time of Cladding Rupture	1027	1125

(a) Break that resulted in the highest peak cladding temperature.
(b) PD = Pump Discharge Leg
(c) The 0.06 ft^2/PD break produced the maximum cladding oxidation.