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W3F1-2006-0063

December 6, 2006

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Waterford 3
Docket No. 50-382
10 CFR 50.46 Thirty-Day Report for Changes to the Waterford 3 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) Waterford 3 License Amendment Request NPF-38-265, October 25, 2005.

(d) WCAP-16072-P-A, Rev. 0, "Implementation of Zirconium Diboride Burnable Absorber Coatings in CE Nuclear Power Fuel Assembly Designs," August 2004.

(e) Amendment 210 to Facility Operating License NPF-38, October 6, 2006.

(f) Waterford 3 License Amendment Request NPF-38-258, June 17, 2004.

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

(h) Amendment 200 to Facility Operating License NPF-38, May 9, 2005.

A001

This letter is submitted pursuant to 10 CFR 50.46(a)(3)(ii) to provide notification of significant changes to the peak cladding temperatures of the large break loss-of-coolant accident (LBLOCA) and small break loss-of-coolant accident (SBLOCA) analyses for Waterford 3. Note that the changes being reported refer to analyses that support Cycle 15 operation at Waterford 3, which will not begin until mid-December, 2006. In addition, this submittal is intended to comply with the statement given in Section 15.6.3.3.3.2 of the UFSAR for notifying the NRC of any material changes to the SBLOCA analysis.

ECCS performance for both the large break loss-of-coolant accident (LBLOCA) and the small break loss-of-coolant accident (SBLOCA) has been re-analyzed for the upcoming cycle at Waterford 3 (Cycle 15). The re-analyses used the current NRC approved versions of the Westinghouse Appendix K evaluation models for Combustion Engineering designed pressurized water reactors (PWRs) (References a and b). They are the same versions as used in the current Waterford 3 LBLOCA and SBLOCA analyses. The new analyses explicitly model the new fuel rod design being introduced in Cycle 15. The new fuel rod design implements ZIRLO™ clad Zirconium Diboride Integral Fuel Burnable Absorber (ZrB_2 IFBA) and UO_2 fuel rods. In addition, the new analyses incorporate an allowance for up to 20% Steam Generator Tube Plugging (SGTP).

Entergy Operations, Inc. requested amendments to the Waterford 3 operating license (References f and c) to add the methodology references for the implementation of ZIRLO™ cladding and ZrB_2 IFBA coatings in CE Nuclear Power fuel assembly designs (References g and d) to the list of approved core operating limits analytical methods in the Technical Specifications. The NRC approved these requests issuing Amendments 200 and 210 to Waterford's operating license (References h and 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 Waterford 3 effective with the start of Cycle 15 in mid-December, 2006.

The results of the new LBLOCA and SBLOCA analyses satisfy the ECCS acceptance criteria of 10 CFR 50.46(b). Because the sums of the absolute magnitudes of the effects on peak cladding temperature due to the changes are 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 thirty-day report. The new analyses will become the licensing basis analyses for Waterford 3 upon startup of Cycle 15, which is currently scheduled for mid-December, 2006.

There are no commitments contained in this submittal.

Should you have questions regarding this matter, please contact Greg Scott at 504-739-6703.

Sincerely,

RJM/GCS/cbh

Attachment: (1) 10 CFR 50.46 Thirty-Day Report for Changes to the Waterford 3 Emergency Core Cooling System Performance Analysis

cc: U. S. Nuclear Regulatory Commission
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ATTACHMENT 1 to

W3F1-2006-0063

10 CFR 50.46 THIRTY-DAY REPORT FOR CHANGES TO THE WATERFORD 3 EMERGENCY CORE COOLING SYSTEM PERFORMANCE ANALYSIS

INTRODUCTION

This thirty-day report is submitted 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. Analyses show that the impact of implementing Zirconium Diboride Integral Fuel Burnable Absorber (ZrB_2 IFBA) with ZIRLO™ cladding along with 20% Steam Generator Tube Plugging (SGTP) produces changes in Peak Cladding Temperature (PCT) such that the sum of the absolute magnitudes of the respective temperature changes are greater than 50°F. Therefore, the changes qualify as significant as defined in 10 CFR 50.46(a)(3)(i). No errors are reported in this thirty-day report.

ECCS performance for both the large break loss-of-coolant accident (LBLOCA) and the small break loss-of-coolant accident (SBLOCA) has been re-analyzed for Waterford 3. The re-analyses used the current NRC approved versions of the Westinghouse Appendix K evaluation models for Combustion Engineering designed pressurized water reactors (PWRs). They are the same versions as used in the current Waterford 3 LBLOCA and SBLOCA analyses. The analyses explicitly modeled the new fuel rod design that is being introduced in Waterford 3 Cycle 15. The new fuel rod design implements ZIRLO™ clad ZrB_2 IFBA and UO_2 fuel rods. In addition, the new analyses incorporate an allowance for up to 20% SGTP.

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 for the next fuel cycle of operation that use acceptable evaluation models that are applicable to Waterford 3. A summary description of the new analyses and their compliance with 10 CFR 50.46 is 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 and the models and processes for analyzing ZrB_2 IFBA fuel rods described in Reference 3. The 1999 EM, the ZIRLO™ cladding, and the ZrB_2 IFBA topical reports were generically accepted by the NRC in References 4, 5, and 6 for licensing applications for Combustion Engineering designed PWRs.

The 1999 EM and the ZIRLO™ cladding topical reports are listed in Technical Specification 6.9.1.11.1 of the Waterford 3 Technical Specifications as approved analytical methodologies that can be used to determine core operating limits in the Core Operating Limits Report. The license amendment requests to add these methodologies to the Technical Specifications were submitted to the NRC in References 9 and 10, and were accepted by the NRC in References 13 and 14. The addition of the ZrB_2 IFBA topical report to the Waterford 3 Technical Specifications was requested by Entergy Operations, Inc. in Reference 11 and approved by the NRC in Reference 15.

The analysis complies with the limitations/constraints imposed by the Safety Evaluation Reports (SERs) for the 1999 EM, the ZIRLO™ cladding, and the ZrB_2 IFBA topical reports as well as the

applicable limitations/constraints imposed by the SERs for earlier versions of the LBLOCA evaluation model.

In addition, the REX utility code, which surveys core loading patterns and provides information for selecting the limiting radiation enclosure of fuel rods as an input to the STRIKIN-II hot rod heatup computer code, has been changed. The change is a process improvement for the REX utility code and does not impact any ECCS performance analysis results. This process improvement will be described in more detail in the 10 CFR 50.46 annual report for 2006.

Fuel Design Changes

The Batch Y fuel assemblies being introduced in Cycle 15 use fuel rods with ZIRLO™ cladding and ZrB_2 IFBA coated UO_2 fuel pellets. The new LBLOCA analysis explicitly analyzed the various fuel designs present in Cycle 15, including ZIRLO™ clad ZrB_2 IFBA and UO_2 fuel rods and Zircaloy-4 clad erbia and UO_2 fuel rods, to ensure that limiting fuel rod conditions were selected for the break spectrum analysis.

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 number of assumed tubes plugged per steam generator was increased to 20%. Also, other changes relative to the Cycle 14 plant design data were identified for Cycle 15. Examples of these other changes include changes to the minimum High Pressure Safety Injection Pump (HPSIP) flow rate, containment passive heat sinks, maximum containment fan cooler performance, and the Reactor Coolant Pump (RCP) locked rotor K-factor. Entergy Operations, 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.

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.

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

Parameter	Criterion	Result
Peak Cladding Temperature	≤2200°F	2132°F
Maximum Cladding Oxidation	≤17 %	15.32 %
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 Waterford 3. 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 Cycle 15. Entergy Operations, 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 7). Additionally, the analysis used the ZIRLO™ cladding models described in Reference 2 and the models and processes for analyzing ZrB_2 IFBA fuel rods described in Reference 3. The S2M, the ZIRLO™ cladding, and the ZrB_2 IFBA topical reports were generically accepted by the NRC in References 8, 5, and 6 for licensing applications for Combustion Engineering designed PWRs.

The S2M and the ZIRLO™ cladding topical reports are listed in Technical Specification 6.9.1.11.1 of the Waterford 3 Technical Specifications as approved analytical methodologies that can be used to determine core operating limits in the Core Operating Limits Report. The license amendment requests to add these methodologies to the Technical Specifications were submitted to the NRC in References 12 and 10, and were accepted by the NRC in References 16 and 14. The addition of the ZrB_2 IFBA topical report to the Waterford 3 Technical Specifications was requested by Entergy Operations, Inc. in Reference 11 and approved by the NRC in Reference 15.

The analysis complies with the limitations/constraints imposed by the SERs for the S2M, the ZIRLO™ cladding, and the ZrB_2 IFBA topical reports as well as the applicable limitations/constraints imposed by the SERs for earlier versions of the SBLOCA evaluation model.

Fuel Design Changes

The new SBLOCA analysis used limiting initial fuel rod conditions that bound the various fuel and cladding types present in Cycle 15, including ZIRLO™ clad ZrB_2 IFBA and UO_2 fuel rods and Zircaloy-4 clad erbia and UO_2 fuel rods.

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. There was an increase to 20% SGTP per steam generator. Also, other changes in Cycle 14 plant design data were identified for Cycle 15. These include changes to the minimum HPSIP flow rate and the axial power shape.

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.

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

Parameter	Criterion	Result
Peak Cladding Temperature	≤2200°F	1972°F
Maximum Cladding Oxidation	≤17 %	12.8 %
Maximum Core-Wide Oxidation	≤1 %	<0.99 %
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 Waterford 3. 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 Cycle 15. Entergy Operations, 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.

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 satisfy the ECCS acceptance criteria [10 CFR 50.46(b)].
- This thirty-day report provides NRC with notification of the change in PCT due to 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) effective with Cycle 15, which starts mid-December, 2006. 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 Waterford 3.

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. WCAP-16072-P-A, Rev. 0, "Implementation of Zirconium Diboride Burnable Absorber Coatings in CE Nuclear Power Fuel Assembly Designs," August 2004.
4. 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)."
5. 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)."
6. Letter from Mr. H. N. Berkow (NRC) to Mr. J. A. Gresham (Westinghouse), dated May 6, 2004, "Final Safety Evaluation for Topical Report WCAP-16072-P, Revision 00, 'Implementation of Zirconium Diboride Burnable Absorber Coatings in CE Nuclear Power Fuel Assembly Designs,' (TAC No. MB8721)."
7. CENPD-137, Supplement 2-P-A, "Calculative Methods for the ABB CE Small Break LOCA Evaluation Model," April 1998.

8. 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)."

9. Waterford 3 License Amendment Request NPF-38-249, November 13, 2003 (implement Extended Power Uprate including use of the 1999 Evaluation Model).

10. Waterford 3 License Amendment Request NPF-38-258, June 17, 2004 (implementation of ZIRLO™ cladding).

11. Waterford 3 License Amendment Request NPF-38-265, October 25, 2005 (implementation of ZrB_2 IFBA).

12. Waterford 3 License Amendment Request NPF-38-208, July 29, 1998 (implementation of the S2M Model).

13. Amendment 199 to Facility Operating License NPF-38, April 15, 2005 (implementation of the 1999 Evaluation Model).

14. Amendment 200 to Facility Operating License NPF-38, May 9, 2005 (implementation of ZIRLO™ cladding).

15. Amendment 210 to Facility Operating License NPF-38, October 6, 2006 (implementation of ZrB_2 IFBA).

16. Amendment 158 to Facility Operating License NPF-38, March 7, 2000 (implementation of the S2M Evaluation Model).

Table 1

Comparison of Important Parameters Used in the Current and New Waterford 3 LBLOCA ECCS Performance Analysis

Parameter	Current Analysis	New Analysis
LBLOCA Evaluation Model	1999 EM	1999 EM
Core Power Level, MWt (including power measurement uncertainty)	3735	3735
Peak Linear Heat Generation Rate, kW/ft	12.9	12.9
Hot Rod Pin-to-Box Factor	1.035	1.03
RCS Flow Rate, lbm/hr	$148x10^6$	$148x10^6$
RCS Pressure, psia	2250	2250
Cold Leg Temperature, °F	533.0	533.0
Hot Leg Temperature, °F	598.7	598.7
Steam Generator Tube Plugging, plugged tubes/SG	1000	1870
Fuel Pin Integral Burnable Absorber Design	Erbia	ZrB_2 and Erbia
Fuel Bundle Design	Standard CE 16 x 16 Fuel	Standard CE 16 x 16 Fuel
Fuel Cladding	Zircaloy-4	ZIRLO™ and Zircaloy-4

Table 2

Comparison of Important Results of the Current and New Waterford 3 LBLOCA ECCS Performance Analysis

Parameter	Current Analysis	New Analysis
Limiting Break Size	0.8 DEG/PD[(a)]	0.6 DEG/PD
Peak Cladding Temperature, °F	2153	2132
Time of Peak Cladding Temperature, seconds	240	237
Maximum Cladding Oxidation, %	8.49	15.32
Maximum Core-Wide Cladding Oxidation, %	<0.99	<0.99
Time of Cladding Rupture, seconds	45.90	46.32

(a) DEG/PD = Double-Ended Guillotine Break in Pump Discharge Leg

Table 3

Comparison of Important Parameters Used in the Current and New Waterford 3 SBLOCA ECCS Performance Analysis

Parameter	Current Analysis	New Analysis
SBLOCA Evaluation Model	S2M	S2M
Core Power Level, MWt (including power measurement uncertainty)	3735	3735
Peak Linear Heat Generation Rate, kW/ft	13.2	13.2
RCS Flow Rate, lbm/hr	$148x10^6$	$148x10^6$
RCS Pressure, psia	2250	2250
Cold Leg Temperature, °F	552.0	552.0
Hot Leg Temperature, °F	615.5	615.5
Steam Generator Tube Plugging, plugged tubes/SG	1000	1870
Fuel Pin Integral Burnable Absorber Design	Erbia	ZrB_2 and Erbia
Fuel Bundle Design	Standard CE 16 x 16 Fuel	Standard CE 16 x 16 Fuel
Fuel Cladding	Zircaloy-4	ZIRLO™ and Zircaloy-4

Table 4

Comparison of Important Results of the Current and New Waterford 3 SBLOCA ECCS Performance Analysis

Parameter	Current Analysis	New Analysis
Limiting Break Size[(a)]	0.055 ft^2/PD[(b)]	0.055 ft^2/PD
Peak Cladding Temperature, °F	2018	1972
Time of Peak Cladding Temperature, seconds	1706	1619
Maximum Cladding Oxidation, %	13.1	12.8
Maximum Core-Wide Cladding Oxidation, %	<0.99	<0.99
Time of Cladding Rupture, seconds	1703	1616

(a) Break that resulted in the highest peak cladding temperature.
(b) PD = Pump Discharge Leg