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U. S. Nuclear Regulatory Commission
Washington, D. C. 20555-0001
Attention: Document Control Desk

Subject: Duke Energy Corporation
Oconee Nuclear Station, Units 1, 2, and 3
Docket Numbers 50-269, 50-270, and 50-287

Report Pursuant to 10CFR50.46, Errors Related to Application of the LBLOCA Evaluation Model

References: 1) Letter, M. S. Tuckman (DEC) to USNRC, "Report Pursuant to 10CFR50.46, Error in LOCA Analysis," February 4, 1999.

2) Letter, M. S. Tuckman (DEC) to USNRC, "Report Pursuant to 10CFR50.46, Error Related to Application of the LBLOCA Evaluation Model," July 8, 1999.

3) Letter, D. E. LaBarge (USNRC) to W. R. McCollum, Jr. (DEC), "Issuance of Amendments (TAC Nos. MA4451, MA4452, and MA 4453)," Safety Evaluation for Amendment No. 314, September 6, 2000.

4) Letter, W. R. McCollum, Jr. (DEC) to USNRC, "Licensee Event Report 269/2001-001, Revision 0," February 16, 2001.

5) Letter, J. J. Kelly (Framatome) to USNRC, FTI-00-2433, September 26, 2000.

10CFR50.46(a)(3)(ii) requires the reporting of changes to or errors in ECCS evaluation models (EM). This report covers the time period from January 1, 1999 to December 31, 2000.

During this time period, there were two changes/errors reported that were classified as a significant change (ΔPCT > 50 °F), where PCT is peak cladding temperature. The first change/error is related to the input for the reactor coolant pump type and associated two-phase degradation (Reference 1). In Reference 1, the PCT impact was assessed for the Mark-B10T fuel. Subsequent to this report, all new analyses were performed with the correct reactor coolant pump input

A001

and the revised two-phase degradation model assumption. Therefore, no change in the calculated peak cladding temperature (ΔPCT) is provided for these cases. The second change is related to the application of the evaluation model to show compliance with the selection of the radial and axial peaking used in the LBLOCA analysis (Reference 2).

During this same period, Oconee implemented Mark-B11 fuel at Unit 1 requiring a reanalysis of the UFSAR Chapter 15 safety analysis. Units 2 and 3 will implement Mark-B11 fuel during calendar year 2001. The Mark-B10T limits were reanalyzed at reduced kW/ft limits to provide more margin to the 2200 °F acceptance criterion. In addition, the small break analysis of record (AOR) was revised using the BWNT RELAP5 base EM (Reference 3).

Included in this report are four summary tables. Table 1 provides the changes/errors for which a PCT impact has been assessed. Table 2 presents changes/errors for which no PCT impact has been assessed. Tables 3 and 4 provide a summary of the peak cladding temperatures for Unit 1 and Units 2 & 3, respectively.

The submittal of this report was delayed while clarification of the nature of a number of changes was discussed with Framatome ANP. It was not clear if these changes should be submitted via the 10CFR50.46 process or in a separate document as an EM revision/clarification. Attachment 1 provides these items that are considered changes/clarifications of the evaluation model for which a change in PCT cannot or was not assessed.

There was one other EM change/error that was identified during this time period. On July 28, 2000 Framatome ANP initiated Preliminary Safety Concern (PSC) 2-00. It identified that the calculated consequences for a postulated core flood tank (CFT) line break could be worse if offsite power were available, with credit for the operators tripping the reactor coolant pumps at two minutes after loss of subcooling margin. For Oconee, the CFT line break at full power conditions results in an increase in the calculated PCT, however, the limiting SBLOCA PCT remains the 0.15 ft^2 break. Thus, the PCT for the limiting full power SBLOCA case is not impacted. For part power conditions (1 High Pressure Injection case), CFT line break with offsite power available and RCPs tripped at two minutes resulted in calculated PCT greater than 2200 °F. A licensee event report (Reference 4) was submitted on February 16, 2001 which included a 30 day 50.46 report. The final disposition of PSC 2-00 will be included in the 2001 annual 10CFR50.46 report.

Please address any comments or questions regarding this matter to J. S. Warren at (704) 382-4986.

Very truly yours,

M. S. Tuckman

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Attachment

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ONS Master File - ON03DM
E-NRC-LOCA (EC08H)

Table 1
Errors/Evaluation Model Changes with PCT Impact

PSC 1-99, Reactor Coolant Pump Type and Two-Phase Degradation

Preliminary Safety Concern (PSC) 1-99 deals with the Reactor Coolant Pump (RCP) type and the two-phase degradation model used in the large break LOCA evaluation model. An RCP-type sensitivity revealed that a LBLOCA analysis using the Bingham pump homologous curves (reference analysis) was less limiting than an identical analysis using the Westinghouse pump homologous curves. The impact of changing the pump type was estimated to be 60 °F. It should be noted that Oconee Units 2 & 3 have Bingham RCPs while Unit 1 has Westinghouse RCPs. This PCT impact is assigned to all units since only one LBLOCA analysis of record is currently maintained for all three units.

The other change addressed in PSC 1-99 is the choice of the two-phase degradation model. A change from a more degraded model to a less degraded model resulted in an increase in calculated PCT of about 100 °F. When the RCP-type and two-phase degradation model are taken together, the net increase in PCT is 186 °F. It should be noted that the changes in the RCP modeling resulted in the limiting axial elevation to change. The reference analysis has a limiting PCT of 2024 °F at the 9.536 ft elevation, while the revised analysis limiting PCT is 2150 °F at the 4.264 ft elevation. Therefore, the maximum change in PCT is 186 °F (evaluated at the 4.264 elevation) while the net change in PCT is 126 °F.

Since the ΔPCT for this error/change is greater than 50 °F, a 30 day notification was provided (Reference 1)

Table 2
Errors/Evaluation Model Changes with no PCT Impact

Mixed-Core Evaluation

Mixed-core sensitivities were performed for a core comprised of Mark-B11 and Mark-B10T fuel. In one case a Mark-B11 hot assembly was placed in an average core comprised on Mark-B10T fuel. In the other case a Mark-B10T hot assembly was placed in an average core comprised of Mark-B11 fuel. In both cases, the mixed-core peak end-of-blowdown temperatures were slightly lower than the corresponding non-mixed core peak end-of-blowdown temperatures. Therefore, the mixed-core impact has been assigned a 0 °F value for 10CFR50.46 reporting purposes.

LPI Valve Stroke Time

Analyses was performed to evaluate a longer LPI valve stroke time. The new valve stroke time of 36 seconds with a maximum LPI injection flow rate of 2873 gpm was considered. This analysis showed that the existing analysis using a 14-second valve stroke time and a maximum flow of 2700 gpm remains bounding. Therefore, the LPI valve stroke time has been assigned a 0 °F value for 10CFR50.46 reporting purposes.

Mark-B11 Mixing Vane Grid Specification Change

Changes to the mixing vane grid vane angle and weld nugget size were evaluated. The changes were to increase the vane angle tolerance from (29°-31° to 29°-33°) and to decrease the weld nugget average minimum leg length from 0.050 inches to 0.045 inches. The evaluation concluded that these changes would have a negligible impact on the LOCA results. Therefore, the mixing vane grid specification change has been assigned a 0 °F value for 10CFR50.46 reporting purposes.

PSC 2-00 (Core Flood Tank Line Break with Offsite Power Available

Preliminary safety concern (PSC) 2-00 was initiated by Framatome ANP on July 28, 2000. It identified that the calculated consequences for a postulated core flood tank (CFT) line break could be worse if offsite power were available, with credit for the operators tripping the reactor coolant pumps at two minutes after loss of subcooling margin. The NRC was informed of this concern on September 26, 2000 (Reference 5). The final summary report for PSC 2-00 was completed on March 30, 2001 and will be provided in the 2001 10CRF50.46 report. Therefore, no PCT impact is provided for this report.

Table 3
Peak Cladding Temperature Summary - Oconee Unit 1

LBLOCA	PCT (°F)	Comments
Evaluation model : RELAP5/MOD2-B&W		
Analysis of record PCT	2037 2050	Mark-B11 (M5), 16.8 kW/ft At 6.021 ft elevation Mark-B10T, 16.8 kW/ft At 4.264 ft elevation
Prior errors (ΔPCT) 1. None	0	
Prior evaluation model changes (ΔPCT) 1. None	0	
Errors (ΔPCT) 1. None	0	
Evaluation model changes (ΔPCT) 1. None	0	
Absolute value of errors/changes for this report (ΔPCT)	0	
Net change in PCT for this report	0	
Final PCT	2037 2050	Mark-B11 Mark-B10T
SBLOCA	**PCT (°F)**	**Comments**
Evaluation model : RELAP5/MOD2-B&W		
Analysis of record PCT	1369	Full Power 0.15 ft^2 break
Prior errors (ΔPCT) 1. None	0	
Prior evaluation model changes (ΔPCT) 1. None	0	
Errors (ΔPCT) 1. None	0	
Evaluation model changes (ΔPCT) 1. None	0	
Absolute value of errors/changes for this report (ΔPCT)	0	
Net change in PCT for this report	0	
Final PCT	1369	
Analysis of record PCT	1862	Reduced Power - 75% FP (1 HPI) 0.07 ft^2 break
Prior errors (ΔPCT) 1. None	0	
Prior evaluation model changes (ΔPCT) 1. None	0	
Errors (ΔPCT) 1. None	0	
Evaluation model changes (ΔPCT) 1. None	0	
Absolute value of errors/changes for this report (ΔPCT)	0	
Net change in PCT for this report	0	
Final PCT	1862	

Table 4
Peak Cladding Temperature Summary - Oconee Unit 2 & 3

LBLOCA	PCT (°F)	Comments
Evaluation model : RELAP5/MOD2-B&W		
Analysis of record PCT	1964 2024	Mark-B10T 17.3 kW/ft 4.264 ft elev. 17.0 kW/ft 9.536 ft elev.
Prior errors (ΔPCT) 1. None	0	
Prior evaluation model changes (ΔPCT) 1. None	0	
Errors (ΔPCT) 1. Reactor coolant pump type	60	
Evaluation model changes (ΔPCT) 1. RCP two-phase degradation model	100	
Absolute value of errors/changes for this report (ΔPCT)	186	The pump type error and two-phase degradation change taken together yields ΔPCT of 186 °F
Net change in PCT for this report	126	New limiting elevation
Final PCT	2150	17.3 kW/ft at 4.264 ft
SBLOCA	**PCT (°F)**	**Comments**
Evaluation model : RELAP5/MOD2-B&W		
Analysis of record PCT	1369	Full Power 0.15 ft^2 break
Prior errors (ΔPCT) 1. None	0	
Prior evaluation model changes (ΔPCT) 1. None	0	
Errors (ΔPCT) 1. None	0	
Evaluation model changes (ΔPCT) 1. None	0	
Absolute value of errors/changes for this report (ΔPCT)	0	
Net change in PCT for this report	0	
Final PCT	1369	
Analysis of record PCT	1862	Reduced Power - 75% FP (1 HPI) 0.07 ft^2 break
Prior errors (ΔPCT) 1. None	0	
Prior evaluation model changes (ΔPCT) 1. None	0	
Errors (ΔPCT) 1. None	0	
Evaluation model changes (ΔPCT) 1. None	0	
Absolute value of errors/changes for this report (ΔPCT)	0	
Net change in PCT for this report	0	
Final PCT	1862	

Attachment 1
Changes/Clarifications of the Evaluation Model

EOC T_{ave} Reduction Maneuver Analysis

Analyses for the end-of-cycle (EOC) Reactor Coolant System temperature (T_{ave}) reduction maneuver were completed to provide a new bounding EOC MTC value. The value of the EOC MTC was selected such that the reduced T_{ave} results are bounded by the nominal T_{ave} LBLOCA results. Since the EOC MTC value is more negative than the BOC value, it is not the value from the most limiting time in life as stated in the topical report (BAW-10192PA Rev. 0, BWNT LOCA). In the EOC analysis there are two offsetting input changes, the reduction in the RCS coolant T_{ave} and value of the MTC. As such, the change in PCT was not assessed for the change in the assumed MTC value. It should be noted that the EOC/reduced T_{ave} case does not represent the limiting case. Therefore tracking of the change in PCT for this case is not required.

Axial versus Radial Core Peaking Factors

The RELAP5/MOD2-B&W-based LOCA analyses are performed with a core axial peaking factor of 1.7, as outlined in the BWNT LOCA EM (BAW-1092PA Rev. 0). The third restriction of the SER on BWNT LOCA EM states that FTI must revalidate the acceptability of the evaluation model peaking method if: (1) significant changes are found in the core elevation at which the minimum core LOCA margin is predicted or (2) the core power distributions analyses radial and axial peaks that approach the LOCA LHR limits differ appreciably from those used to demonstrate Appendix K compliance. To address axial peaks that are appreciable different than those analyses in the EM, Framatome ANP has developed an approach to adjust the LHR limits. This approach is applied in the maneuvering analyses to axial peaks that differ appreciably from 1.7 in a manner that maintains the calculated PCT and satisfies the SER restriction. This change in the application of the evaluation model was reported in Reference 2 as a significant change. However, since a reduction in the LHR limits are used in order to maintain the calculated PCT, no ΔPCT is determined.

PSC 1-99, Reactor Coolant Pump Two-Phase Degradation

This change was described in Table 1 but is also provided in this attachment since a change in PCT was not assessed for all cases. The new analyses (Mark-B11 fuel and reduced kW/ft limits for Mark-B10T fuel) were not performed with the approved evaluation model two-phase pump degradation model. Therefore, the ΔPCT associated with the change in the RCP two-phase degradation model was not determined.

BWNT LOCA EM Limits and Restrictions (BEACH SER)

Part of the SER on revision 2 of the BEACH computer code, identified the applicable range of the initial cladding temperature (start of reflood) to be 950 °F to 1640 °F. The BEACH code is general in nature and can be used for analyses over a wide range of conditions. However, the SER limits the use of BEACH to a range over which the code performance has been assessed via existing benchmark cases. The existing benchmark cases cover an initial hot spot cladding temperature up to 1640 °F.

Framatome ANP has performed an additional benchmark to validate the BEACH code for initial cladding temperatures above 1640 °F. The benchmark case is FLECHT-SEASET Test 34420 which has an initial cladding temperature of 2045 °F and is one test in a series of experiments that has been used extensively to validate the existing BEACH analysis ranges. The test comparison provides confirmation that the general formulation of the BEACH code is appropriate for reflood heat transfer predictions above 1640 °F. The benchmark results are not provided in this report, since Framatome ANP plans to submit them to the NRC directly.

For this evaluation model change/clarification there is no change in PCT determined since the analysis of record calculations are not impacted. The only change is to extend the applicable range of the BEACH computer code.

APPENDIX A.227. NRC CORRESPONDENCE RECORD OF REVIEW

NRC CORRESPONDENCE RECORD OF REVIEW

Applicable Site(s) Oconee

Submittal Title/Subject 10CFR50.46 Report

Scheduled Submittal Date 7-12-01 Mandatory? N (Y/N)

Regulatory Compliance Submittal Lead J.S. WARREN
(Name)

Technical Lead/Contributor R.C. Harvey Division/Section NGO/SA
(Name)

Reviewer	Name	Comments? (Y/N)	Resolved? (Y/N)
Lead Technical Reviewer	M.E. Henshaw	Y	Y
Lead Technical Mgr.	G.B. Swindlehurst	Y	Y
Compliance Mgr.	A. Jones-Young	N	
Affected Group/Div Mgr.			
Safety Assurance Mgr.	James Fisicaro	N	
Independ. Tech. Reviewer			
Cross-Discipline Reviewer			
Cross-Discipline Reviewer			
Cross-Discipline Reviewer			
Commitment Coordinator			
Other Knowledgeable Person(s)			
PORC, NSRB Review per NSD 221	N/A		

CONCURRENCE ON CONTENT, INCLUDING COMMITMENTS, HAS BEEN RECEIVED BY THE LISTED REVIEWERS AND COMMENTS HAVE BEEN RESOLVED. THIS SUBMITTAL IS COMPLETE AND ACCURATE TO THE BEST OF MY KNOWLEDGE.

Submittal Technical Lead RC Harvey Date 7/12/01
(Signature)

THIS SUBMITTAL HAS BEEN PREPARED ACCORDING TO GUIDELINES IN NSD 227, APPENDIX B. THIS SUBMITTAL IS READY TO BE SENT TO THE NRC.

Regulatory Compliance (or NRIA) Lead JS Warren Date 7-12-01
(Signature)