



THOMAS C. GEER
Vice President
Nuclear Engineering

Duke Energy Corporation
526 South Church St.
Charlotte, NC 28202

Mailing Address:
EC08H / PO Box 1006
Charlotte, NC 28201-1006

704 382 4712
704 382 7852 fax

tcgeer@duke-energy.com

March 13, 2007

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555-001
Attention: Document Control Desk

Subject: Duke Power Company LLC d/b/a Duke Energy Carolinas, LLC (Duke)
McGuire Nuclear Station, Units 1 and 2
Docket Numbers 50-369 and 50-370
Catawba Nuclear Station, Units 1 and 2
Docket Numbers 50-413 and 50-414

Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS
Evaluation Model

10 CFR 50.46 (a)(3)(ii) requires the reporting of errors or changes in the Emergency Core Cooling System (ECCS) evaluation models. This report covers the time period from January 1, 2005 to December 31, 2005.

During this time period, there was one error and one evaluation model change identified by Westinghouse, both of which resulted in a small reduction in peak cladding temperature (PCT). These corrections are described in Table 1 and are not classified as significant per the 10 CFR 50.46 criteria. A zero degree impact is conservatively assigned in the PCT summary tables for 10 CFR 50.46 reporting purposes, and these changes are described only to demonstrate they do not meet the 50 degree criterion for specifying a re-analysis schedule. These corrections will be included the next time Duke has new LOCA analyses performed.

In addition, one enhancement and two non-discretionary changes were made to the large break LOCA (LBLOCA) evaluation model, and three non-discretionary changes were made to the small break LOCA (SBLOCA) evaluation model. These changes were not considered to have an impact on the calculated PCTs. The specific details of these changes are provided in Table 2. Since there was no PCT impact estimated for these changes, they are not included in the PCT summary tables.

Except for the MOX lead assemblies in Catawba Unit 1, all McGuire and Catawba units are presently loaded with a core comprised entirely of Westinghouse fuel (i.e., no AREVA fuel). However, McGuire Unit 2 and Catawba Unit 1 operated in early 2005 with some AREVA fuel present in the core. Therefore, the mixed core penalty is applied to the SBLOCA PCT results for these units.

A summary of the PCT for McGuire Units 1 and 2 and Catawba Unit 1 is provided in Table 3. Table 4 provides a summary of the PCT for Catawba Unit 2.

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This report is being submitted beyond the annual reporting requirement of 10 CFR 50.46. A licensee corrective action problem report (PIP G-07-0150) was issued to address the administrative failure to satisfy this requirement. This occurrence is currently being evaluated to identify appropriate corrective actions.

There are no regulatory commitments associated with this letter.

Please address any comments or questions regarding this matter to L. B. Jones at (704) 382-4753.

Sincerely,



Thomas C. Geer
Vice President, Nuclear Engineering

Attachments

- Table 1 – Errors/Evaluation Model Changes with PCT Impact
- Table 2 – Errors/Evaluation Model Changes with no PCT Impact
- Table 3 – Peak Cladding Temperature Summary – McGuire Units 1 & 2 and Catawba Unit 1
- Table 4 – Peak Cladding Temperature Summary – Catawba Unit 2

xc: (with attachments)

W. D. Travers, Region II Administrator
U.S. Nuclear Regulatory Commission
Sam Nunn Atlanta Federal Center, 23 T85
61 Forsyth St., SW
Atlanta, GA 30303-8931

J. F. Stang, Senior Project Manager (CNS & MNS)
U. S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop 0-8 G9A
Rockville, MD 20852-2738

J. B. Brady, NRC Senior Resident Inspector
McGuire Nuclear Station

A. T. Sabisch, NRC Senior Resident Inspector
Catawba Nuclear Station

ATTACHMENTS

Table 1 – Errors/Evaluation Model Changes with PCT Impact

Table 2 – Errors/Evaluation Model Changes with no PCT Impact

Table 3 – Peak Cladding Temperature Summary – McGuire Units 1 & 2 and Catawba Unit 1

Table 4 – Peak Cladding Temperature Summary – Catawba Unit 2

Table 1
Errors / Evaluation Model Changes with PCT Impact

Discretionary Changes:

Revised Algorithm for Calculating the Average Fuel Temperature (WCOBRA/TRAC Model)

The iteration scheme used to calculate an average fuel temperature in the HOTSPOT code converges slowly under certain conditions, thereby exceeding the maximum iteration count in such instances. This results in an average fuel temperature calculation that is inconsistent with the WCOBRA/TRAC temperature for calculating stored energy in the fuel. A revised iteration scheme, based on the combination of a secant method and a parabolic interpolation with a bracketing scheme, was implemented to resolve the non-convergence issue. Since the prior inconsistencies always resulted in the HOTSPOT code calculating a higher average fuel temperature, a small PCT benefit is estimated. Therefore, a zero degree impact is conservatively assigned for 10 CFR 50.46 reporting purposes.

Non-Discretionary Changes:

Vessel Unheated Conductor Noding (WCOBRA/TRAC Model)

Some unheated conductors used node sizes that are inconsistent with analysis input guidelines. Evaluations were completed to estimate the effect of these differences, which resulted in a small reduction in PCT. Therefore, a zero degree impact is conservatively assigned for 10 CFR 50.46 reporting purposes.

Table 2

Errors / Evaluation Model Changes with no PCT Impact

Discretionary Changes:

Improved Automation of End of Blowdown Time (WCOBRA/TRAC Model)

An automated end of blowdown selection logic was added to large break LOCA analysis method as described in the 2004 McGuire/Catawba 50.46 report. As described in the 2004 report, the end of blowdown selection was revised to be based on the time at which the system pressure stops decreasing. The definition for the end of blowdown has now been further improved by replacing the system pressure stops decreasing criterion with a selection based on the time when the liquid level in the lower plenum reaches a minimum and begins to increase again. Blowdown cooling heat transfer multipliers are applied during the time period following turnaround of the blowdown heatup through the end of blowdown. These heat transfer multipliers are considered in the uncertainty methodology as a function of the time period in the transient. All prior analyses used the correct end of blowdown time and are therefore not affected by this change. Therefore, the estimated PCT impact of this change is zero.

Non-Discretionary Changes:

Pressurizer Fluid Volumes (WCOBRA/TRAC Model and NOTRUMP Model)

Previously transmitted pressurizer fluid volumes were replaced with nominal cold values to resolve a discrepancy in prior calculations while providing a close approximation of the actual as-built values. The differences between the previously transmitted and revised values are very small and would be expected to produce a negligible effect on analysis results. Therefore, the estimated PCT impact of this change is zero.

Containment Relative Humidity Assumption (WCOBRA/TRAC Model)

Historically, maximum initial relative humidity has been used to specify the initial containment air and steam partial pressures. This is conservative for a given total initial containment pressure, but non-conservative for a given initial containment air partial pressure. The historical assumption has been revised accordingly, and an evaluation concluded that no PCT assessments are required. Therefore, the estimated PCT impact of this change is zero.

Lower Guide Tube Assembly Weight (NOTRUMP Model)

A small over-estimation of the upper plenum metal mass resulted from an error in the lower guide tube assembly weight. The corrected values have been evaluated and the differences in the upper plenum metal mass are very small. This would be expected to produce a negligible effect on the PCT results. Therefore, the estimated PCT impact of this change is zero.

Table 2 (continued)
Errors / Evaluation Model Changes with no PCT Impact

Non-Discretionary Changes (continued):

Discrepancy in RWST Draindown Calculation (NOTRUMP Model)

The RWST draindown time was incorrectly calculated due to the practice of setting flows injected to the broken loop equal to zero (since it is spilling to containment) for break sizes greater than the SI injection line diameter. Although this modeling is correct from an injection perspective, the RWST draindown time is incorrectly calculated for these larger small break sizes, potentially resulting in an inaccurate modeling of enthalpy changes and/or SI interruptions that can occur at switchover to sump recirculation. Since the larger small breaks are typically non-limiting and short in transient duration, correct modeling of the spilling flows in the RWST draindown calculation for these break sizes would be expected to produce a negligible effect on the PCT results. Therefore, the estimated PCT impact of this change is zero.

Table 3
Peak Cladding Temperature Summary – McGuire Units 1 & 2 and Catawba Unit 1

LBLOCA	Cladding Temp (°F)	Comments
Evaluation model : <u>WCOBRA/TRAC</u>		
Analysis of record PCT	2028	MNS/CNS Composite Model
Prior errors (Δ PCT)		
1. Decay heat in Monte Carlo calculations	8	Reference A
2. MONTECF power uncertainty correction	20	Reference B
3. Safety Injection temperature range	59	Reference C
4. Input error resulting in an incomplete solution matrix	25	Reference D
5. Revised Blowdown Heatup Uncertainty Distribution	5	Reference E
Prior evaluation model changes (Δ PCT)		
1. None	0	
Errors (Δ PCT)		Very Small PCT Benefit
1. Vessel Unheated Conductor Noding	< 0	
Evaluation model changes (Δ PCT)		Very Small PCT Benefit
1. Revised Algorithm for Average Fuel Temperature	< 0	
Absolute value of errors/changes for this report (Δ PCT)	> 0	Very Small
Net change in PCT for this report	0	Conservative
Final PCT	2145	
SBLOCA		
Evaluation model : <u>NOTRUMP</u>	M1 / M2 / C1	
Analysis of record PCT	1167 / 1177 / 1177	Note (1)
Prior errors (Δ PCT)		
1. Mixture level tracking/region depletion	13	Reference A
2. NOTRUMP bubble rise/drift flux model corrections	35	Reference D
Prior evaluation model changes (Δ PCT)		
1. None	0	
Errors (Δ PCT)		
1. None	0	
Evaluation model changes (Δ PCT)		
1. None	0	
Absolute value of errors/changes for this report (Δ PCT)	0	
Net change in PCT for this report	0	
Final PCT	1215 / 1225 / 1225	

Reference:

- A) letter, M. S. Tuckman (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", May 3, 2001
- B) letter, M. S. Tuckman (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", April 3, 2002
- C) letter, W. R. McCollum, Jr. (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", July 29, 2003
- D) letter, W. R. McCollum, Jr. (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", May 26, 2004
- E) letter, J. R. Morris (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", June 21, 2005

Note:

- (1) The analysis of record PCT includes an additional 10°F allowance for the presence of AREVA fuel in McGuire Unit 2 and Catawba Unit 1 in early 2005. McGuire Unit 1 operated with no AREVA fuel in 2005.

**Table 4
Peak Cladding Temperature Summary – Catawba Unit 2**

LBLOCA	Cladding Temp (°F)	Comments
Evaluation model : <u>WCOBRA/TRAC</u>		
Analysis of record PCT	2028	MNS/CNS Composite Model
Prior errors (Δ PCT)		
1. Decay heat in Monte Carlo calculations	8	Reference A
2. MONTECF power uncertainty correction	20	Reference B
3. Safety Injection temperature range	59	Reference C
4. Input error resulting in an incomplete solution matrix	25	Reference D
5. Revised Blowdown Heatup Uncertainty Distribution	5	Reference E
Prior evaluation model changes (Δ PCT)		
1. None	0	
Errors (Δ PCT)		
1. Vessel Unheated Conductor Noding	< 0	Very Small PCT Benefit
Evaluation model changes (Δ PCT)		
1. Revised Algorithm for Average Fuel Temperature	< 0	Very Small PCT Benefit
Absolute value of errors/changes for this report (Δ PCT)	> 0	Very Small
Net change in PCT for this report	0	Conservative
Final PCT	2145	
SBLOCA		
Evaluation model : <u>NOTRUMP</u>		
Analysis of record PCT	1063	Note (1)
Prior errors (Δ PCT)		
1. Mixture level tracking/region depletion	13	Reference A
2. NOTRUMP bubble rise/drift flux model corrections	35	Reference D
Prior evaluation model changes (Δ PCT)		
1. None	0	
Errors (Δ PCT)		
1. None	0	
Evaluation model changes (Δ PCT)		
1. None	0	
Absolute value of errors/changes for this report (Δ PCT)	0	
Net change in PCT for this report	0	
Final PCT	1111	

Reference:

- A) letter, M. S. Tuckman (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", May 3, 2001
- B) letter, M. S. Tuckman (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", April 3, 2002
- C) letter, W. R. McCollum, Jr. (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", July 29, 2003
- D) letter, W. R. McCollum, Jr. (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", May 26, 2004
- E) letter, J. R. Morris (Duke) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", June 21, 2005

Note:

- 1) The analysis of record PCT no longer includes a 10 °F allowance for the presence of AREVA fuel. Catawba Unit 2 operated with no AREVA fuel in 2005.