Duke Power
A Duke Energy Company

WILLIAM R MCCOLLUM, JR.
VP, Nuclear Support
Duke Energy Corporation

Duke Power
EC07H / 526 South Church Street
Charlotte, NC 28202-1802

Mailing Address:
P. O. Box 1006 - EC07H
Charlotte, NC 28201-1006

704 382 8983
704 382 6056 fax
wrmccoll@duke-energy.com

May 26, 2004

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

Subject: Duke Energy Corporation
McGuire Nuclear Station, Units 1 and 2
Docket Number 50-369 and 50-370
Catawba Nuclear Station, Units 1 and 2
Docket Number 50-413 and 50-414

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

Reference: 1) Letter, W. R. McCollum, Jr. (DPC) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," July 29, 2003.

10 CFR 50.46 (a)(3)(ii) requires the reporting of errors or changes in the Emergency Core Cooling System (ECCS) evaluation models (EM). This report covers the time period from January 1, 2003 to December 31, 2003.

On July 29, 2003, a significant input change/error was reported in the large break LOCA analysis related to the safety injection water temperature assumption (Reference 1). In addition to this error, there were two other errors during this time period that resulted in a PCT impact. Both of these errors are not classified as significant per the 10 CFR 50.46 criterion. The first error is related to an incorrect input parameter in the WCOBRA/TRAC best-estimate large break LOCA analysis which resulted in an incomplete solution matrix. The second error was to remove inconsistencies in several drift flux models as well as the nodal bubble rise/droplet fall models in the NOTRUMP small break computer code. The specifics of these errors are provided in Table 1.

During this time there were also a number of errors in the Westinghouse evaluation models for which no PCT impact was assessed or the estimated impact was determined to be 0 °F. In addition, there were two enhancements made to the small break LOCA (SBLOCA) evaluation model. These changes were not considered to have any impact on the SBLOCA calculated PCTs. The specifics of these errors and changes are provided in Table 2. Since there was no PCT impact determined for these errors or changes, they are not included in the PCT summary tables.

A001

A summary of the peak cladding temperatures for McGuire Units 1 and 2 is provided in Table 3. Tables 4 and 5 provide a summary of the peak cladding temperatures for Catawba Units 1 and 2 respectively.

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.

Very truly yours,

W. R. McCollum, Jr.

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 and 2
- Table 4 – Peak Cladding Temperature Summary – Catawba Unit 1
- Table 5 – Peak Cladding Temperature Summary – Catawba Unit 2

xc (with attachments)

L. A. Reyes, Regional Administrator
U. S. Nuclear Regulatory Commission, Region II
Sam Nunn Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, GA 30303-8931

J. J. Shea (addressee only)
NRC Senior Project Manager (MNS)
U. S. Nuclear Regulatory Commission
Mail Stop 0-8 H12
Washington, DC 20555-0001

S. E. Peters (addressee only)
NRC Project Manager (CNS)
U. S. Nuclear Regulatory Commission
Mail Stop 0-8 H12
Washington, DC 20555-0001

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

E. F. Guthrie
NRC Senior Resident Inspector
Catawba Nuclear Station

Table 1
Errors / Evaluation Model Changes with PCT Impact

Input Error Resulting in Incomplete Solution Matrix (WCOBRA/TRAC Model)

Input parameter MSIM identifies the last cell number in each simultaneous solution group for the 3-D vessel component. A survey of WCOBRA/TRAC input decks identified two plant models and one test simulation in which the MSIM input value was less than the total number of cells in the vessel. This error results in an incomplete solution matrix. An input diagnostic check has been added to prevent any future occurrences.

A plant specific calculation was performed using the McGuire/Catawba model to estimate the PCT effect of this error. It was confirmed that the fundamental LOCA transient characteristics were unchanged by the error correction. The reference double-ended guillotine break was used in the assessment which resulted in a PCT increase of 25 °F.

Bubble Rise/Drift Flux Model Inconsistencies (NOTRUMP SBLOCA Model)

NOTRUMP was updated to resolve some inconsistencies in several drift flux models as well as the nodal bubble rise/droplet fall models. A summary of the relevant changes are as follows: The bubble rise and droplet fall model calculations were made consistent with flow link calculations. Corrections were made to limits employed in the vertical counter-current flooding models. Checking logic was added to correct situations where drift-flux model inconsistencies could result (i.e. prevent liquid flow from an all vapor node and vapor flow from an all liquid node.). Also a more rigorous version of the Yeh drift flux model was implemented given that the previous model was incorrectly restricted to a 50% void fraction limit. These changes are treated together since they are closely related.

Representative plant calculation using the NOTRUMP code demonstrated that the implementation of these corrections leads to a bounding 35 °F increase in the calculated PCT for 10 CFR 50.46 reporting purposes.

Table 2
Errors / Evaluation Model Changes with no PCT Impact

Inconel 690 Material Properties Capability (WCOBRA/TRAC Model)

WCOBRA/TRAC originally had built-in properties for Inconel 600, which is a material commonly used in steam generator tubes. Several replacement steam generator designs use tubes made of Inconel 690. The capability to model Inconel 690 material properties had previously been implemented in the best-estimate version of WCOBRA/TRAC, along with a variety of other built-in property options. This code version was released for general use in 2000, but the change was not included in the 10 CFR 50.46 annual report for 2000. The capability is reported herein to correct that omission. The limiting steam generator type for the McGuire/Catawba composite analysis is the model D5 steam generators which contain Inconel 600 tubes. Therefore the limiting case for McGuire/Catawba is unaffected by this change. Representative plant calculations indicate that the change in material properties from Inconel 600 to Inconel 690 has little effect on the overall results. Thus the limiting steam generator type would remain the model D5 steam generators and the composite plant calculation is not affected. As a result, no PCT change needs to be reported for this change.

IMP Database Error (WCOBRA/TRAC and NOTRUMP SBLOCA Models)

The IMP database error relates to an incorrect treatment of the inlet and outlet plenum volumes of the McGuire Units 1 and 2 and the Catawba Unit 1 BWI replacement steam generators. The plenum volumes loaded into the IMP database were assumed to exclude the tube volume from within the tube sheet when in fact they included this tube volume. The magnitude of this volume discrepancy is approximately 60 ft^3 per steam generator. This error impacts the replacement steam generator beat-estimate large break LOCA (BE LBLOCA) and the SBLOCA calculations.

For the BE LBLOCA, the magnitude of the error is insufficient to alter the conclusion that the model D5 steam generators are limiting. As such, the composite plant model BE LBLOCA analysis is not affected by the correction of the IMP volume error. In assessing the SBLOCA analysis, the change in volume from this error relative to the overall flooded volume of the RCS was considered. The error represents about 1.8% of the RCS volume and this volume is less significant than a change of equal magnitude in the vessel. The change in RCS volume (and RCS mass) may shift the loop seal clearing to a slightly earlier time frame but this will have little impact on the actual mass remaining in the vessel. Given that the vessel volume has not changed, it is judged that the mass in the vessel at the start of the boil-off phase of the transient will remain approximately the same. As such, the impact on the final PCT should be negligible and will therefore be assigned a 0°F PCT impact for 10 CFR 50.46 reporting purposes.

Inconsistencies in Vessel Geometric Input Data (NOTRUMP SBLOCA Model)

Several inconsistencies were identified in the specifications of vessel geometric data for plant-specific input models. A combination of sensitivity calculations and engineering evaluation led to the conclusion that the identified changes have a negligible effect on small break LOCA analysis results. These changes will therefore be assigned a 0°F PCT impact for 10 CFR 50.46 reporting purposes. These changes were evaluated for impacts on current licensing-basis analyses, and will be incorporated into the corresponding input databases on a forward-fit basis.

NOTRUMP Drift Flux Model Inconsistencies (NOTRUMP SBLOCA Model)

NOTRUMP was updated to resolve some inconsistencies in the resetting of certain parameters in the drift flux models when single phase conditions are determined to exist. The previous coding had inadvertently omitted certain conditions of drift velocity and void fraction which are now included. Also, in the logic for node boundary mixture level crossing, several partial derivatives in the void fraction model were erroneously set to zero. In addition, there were several instances (stacking logic, accumulator empty logic, and pump critical flow logic) where flow linked specific volume values were always bases on saturated conditions. All of these coding errors were corrected. Given that the corrected set of logic is seldom used in standard EM calculations, the PCT impact is estimated to be 0 °F for 10 CFR 50.46 reporting purposes.

NOTRUMP Inverted T-Node Sign Convention (NOTRUMP SBLOCA Model)

This change deals with the correction of the sign convention for inverted T-nodes, which was incorrectly applied via the evaluation model input. It can potentially impact the reactor vessel lower plenum and the lower reactor coolant pump node in standard EM calculations. This error affects the mixture/vapor interfacial area within a fluid node. These conditions only exist momentarily within the pump stack node and never in the reactor vessel lower plenum. Therefore it is judged that the impact of this error correction is insignificant. Based on this judgment, coupled with plant model calculations that support this conclusion, the correction of this error will be assigned a PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

NOTRUMP Vapor Region Formation Logic (NOTRUMP SBLOCA Model)

The logic governing formation of a vapor region within a fluid node in NOTRUMP was corrected to allow superheated conditions where appropriate, instead of always being formed at saturated conditions. Typically, a vapor region is formed at saturated conditions in standard EM calculations. If a region is formed at superheated conditions, the amount of superheat is usually small and the region quickly reaches saturation conditions. As such, the nature of this change leads to an estimated PCT impact of 0 °F.

SBLOCA Burnup Study Methodology (NOTRUMP SBLOCA Model)

The guidance for performing small break LOCA burnup studies was expanded to ensure that the maximum local oxidation was captured in addition to the peak cladding temperature. This change does not affect the limiting PCT, which was adequately captured in the previous burnup study guidance. For local oxidation, a combination of SBLOCA calculations and engineering evaluation led to the conclusion that all plants analyzed by the Westinghouse Pittsburgh office remain in compliance with the 17% limit of 10 CFR 50.46.

SBLOCTA Burst Logic (NOTRUMP SBLOCA Model)

The burst logic in SBLOCTA was updated to preclude burst from occurring at more than one axial elevation on a given rod. Most SBLOCTA calculations predict burst at no more than one axial elevation per rod and are therefore unaffected by this discrepancy. The McGuire/Catawba calculations are not affected by this error. Thus, the correction of this error will be assigned a 0°F PCT impact for 10 CFR 50.46 reporting purposes.

SBLOCTA ZIRLO™ Cladding Creep Constants (NOTRUMP SBLOCA Model)

SBLOCA was updated to correct two of the constants in the high-temperature creep model for ZIRLO™ cladding, which were found to disagree with the documentation. These changes led to a small change in the creep rate over a limited range of temperatures, which is considered to have a negligible effect on the results. Correcting these constants will therefore be assigned a 0°F PCT impact for 10 CFR 50.46 reporting purposes.

SBLOCTA Oxide-to Metal Ratio (NOTRUMP SBLOCA Model)

An option has been added to SBLOCTA to allow conversion of the user-supplied zirconium oxide thickness into equivalent cladding reacted. This adjustment is made during problem initialization, and the cladding outside diameter is modified according. A sample SBLOCTA calculation showed that this change has a minimal effect on PCT and will be treated as a 0 °F for 10 CFR 50.46 reporting purposes. This change will be implemented in future calculations on a forward-fit basis.

SBLOCTA Gap Conductance Model (NOTRUMP SBLOCA Model)

The convective term in the SBLOCTA pellet-to-cladding gap conductance model was updated for consistency with the corresponding model in LOCBART. Included in this change is the implementation of a PAD version-specific value of the gap reduction factor, which is specified by the user in the SBLOCTA input file. Sample SBLOCTA calculations showed that this change has a negligible effect on PCT. Thus, the change will be assigned a 0°F PCT impact for 10 CFR 50.46 reporting purposes and be implemented on a forward-fit basis.

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

LBLOCA	Cladding Temp (°F)	Comments
Evaluation model : WCOBRA/TRAC		
Analysis of record PCT	2028	MNS/CNS Composite Model
Prior errors (ΔPCT) 1. Decay heat in Monte Carlo calculations 2. MONTECF power uncertainty correction 3. Safety Injection temperature range	 8 20 59	 Reference A Reference B Reference C
Prior evaluation model changes (ΔPCT) 1. None	 0	
Errors (ΔPCT) 1. Input error resulting in an incomplete solution matrix	 25	
Evaluation model changes (ΔPCT) 1. None	 0	
Absolute value of errors/changes for this report (ΔPCT)	25	
Net change in PCT for this report	25	
Final PCT	2140	
SBLOCA		
Evaluation model : NOTRUMP		
Analysis of record PCT	1177	Note (1)
Prior errors (ΔPCT) 1. Mixture level tracking/region depletion	 13	 Reference A
Prior evaluation model changes (ΔPCT) 1. None	 0	
Errors (ΔPCT) 1. NOTRUMP bubble rise/drift flux model corrections	 35	
Evaluation model changes (ΔPCT) 1. None	 0	
Absolute value of errors/changes for this report (ΔPCT)	35	
Net change in PCT for this report	35	
Final PCT	1225	

Reference:

A) letter, M. S. Tuckman (DPC) 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 (DPC) 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. (DPC) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", July 29, 2003

Note:

(1) The analysis of record PCT includes a 10 °F allowance for the presence of FANP fuel.

Table 4
Peak Cladding Temperature Summary – Catawba Unit 1

LBLOCA	Cladding Temp (°F)	Comments
Evaluation model : WCOBRA/TRAC		
Analysis of record PCT	2028	MNS/CNS Composite Model
Prior errors (ΔPCT) 1. Decay heat in Monte Carlo calculations 2. MONTECF power uncertainty correction 3. Safety Injection temperature range	 8 20 59	 Reference A Reference B Reference C
Prior evaluation model changes (ΔPCT) 1. None	 0	
Errors (ΔPCT) 1. Input error resulting in an incomplete solution matrix	 25	
Evaluation model changes (ΔPCT) 1. None	 0	
Absolute value of errors/changes for this report (ΔPCT)	25	
Net change in PCT for this report	25	
Final PCT	2140	
SBLOCA		
Evaluation model : NOTRUMP		
Analysis of record PCT	1177	Note (1)
Prior errors (ΔPCT) 1. Mixture level tracking/region depletion	 13	 Reference A
Prior evaluation model changes (ΔPCT) 1. None	 0	
Errors (ΔPCT) 1. NOTRUMP bubble rise/drift flux model corrections	 35	
Evaluation model changes (ΔPCT) 1. None	 0	
Absolute value of errors/changes for this report (ΔPCT)	35	
Net change in PCT for this report	35	
Final PCT	1225	

Reference:

A) letter, G. R. Peterson (DPC) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", April 11, 2001

B) letter, M. S. Tuckman (DPC) 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. (DPC) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", July 29, 2003

Note:

(1) The analysis of record PCT includes a 10 °F allowance for the presence of FANP fuel.

Table 5
Peak Cladding Temperature Summary – Catawba Unit 2

LBLOCA	Cladding Temp (°F)	Comments
Evaluation model : WCOBRA/TRAC		
Analysis of record PCT	2028	MNS/CNS Composite Model
Prior errors (ΔPCT) 1. Decay heat in Monte Carlo calculations 2. MONTECF power uncertainty correction 3. Safety Injection temperature range	 8 20 59	 Reference A Reference B Reference C
Prior evaluation model changes (ΔPCT) 1. None	 0	
Errors (ΔPCT) 1. Input error resulting in an incomplete solution matrix	 25	
Evaluation model changes (ΔPCT) 1. None	 0	
Absolute value of errors/changes for this report (ΔPCT)	25	
Net change in PCT for this report	25	
Final PCT	2140	
SBLOCA		
Evaluation model : NOTRUMP		
Analysis of record PCT	1073	Note (1)
Prior errors (ΔPCT) 1. Mixture level tracking/region depletion	 13	 Reference A
Prior evaluation model changes (ΔPCT) 1. None	 0	
Errors (ΔPCT) 1. NOTRUMP bubble rise/drift flux model corrections	 35	
Evaluation model changes (ΔPCT) 1. None	 0	
Absolute value of errors/changes for this report (ΔPCT)	35	
Net change in PCT for this report	35	
Final PCT	1121	

Reference:

A) letter, G. R. Peterson (DPC) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", April 11, 2001

B) letter, M. S. Tuckman (DPC) 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. (DPC) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model", July 29, 2003

Note:

(1) The analysis of record PCT includes a 10 °F allowance for the presence of FANP fuel.