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February 25, 2014

10 CFR 50.46
RA-14-0003

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Catawba Nuclear Station, Units 1 and 2
Docket Numbers 50-413 and 50-414/Renewed License Numbers NPF-35 and NPF-52

McGuire Nuclear Station, Units 1 and 2
Docket Numbers 50-369 and 50-370/Renewed License Numbers NPF-9 and NPF-17

Subject: Duke Energy Carolinas, LLC (Duke Energy): Report Pursuant to 10 CFR 50.46, Changes to or Errors in an Evaluation Model

Reference:

1) Letter, D. C. Culp (Duke Energy) to USNRC, Subject: Catawba Nuclear Station Units 1 and 2, and McGuire Nuclear Station Units 1 and 2, Response to Information Request Pursuant to 10 CFR 50.54(f) Related to the Estimated Effect on Peak Cladding Temperature Resulting from Thermal Conductivity Degradation in the Westinghouse-Furnished Realistic Emergency Core Cooling System Evaluation and 30-Day Report Pursuant to 10 CFR 50.46, Changes to or Errors in an Evaluation Model," March 16, 2012. [ADAMS ML12079A180]

10 CFR 50.46 (a)(3)(ii) requires the reporting of changes to or errors in Emergency Core Cooling System (ECCS) evaluation models (EMs). On January 29, 2014, Duke Energy received a letter from Westinghouse Electric Company identifying errors in the cladding burst strain model which affects the Large Break Loss of Coolant Accident (LBLOCA) analysis of record for Catawba Nuclear Station (Catawba) Units 1 & 2 and McGuire Nuclear Station (McGuire) Units 1 & 2. Small Break LOCA analyses for Catawba Units 1 and 2 and McGuire Units 1 and 2 are not impacted by this error.

The enclosed Attachment 1 provides a description of the errors, and the associated impact to the Catawba and McGuire LBLOCA analysis of record. Based on information supplied by Westinghouse, an assessment of this error results in a peak cladding temperature (PCT) increase of 70°F for the late reflood portion of the transient (second reflood) that has the highest PCT. When the PCT penalty of 70 °F is considered, the resultant PCT is 2070 °F for Catawba Units 1 & 2, and 2086 °F for McGuire Units 1 & 2. The impacts to the LBLOCA analyses results

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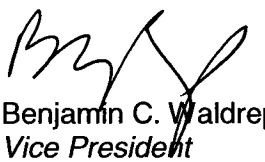
for PCT are discussed in Table 1, and are included on the PCT reporting sheets, Tables 2 through 4. Westinghouse has confirmed that all previous assessments on the PCT reporting sheets for McGuire Units 1 & 2 and Catawba Units 1 & 2 remain valid, including the measurement uncertainty recapture uprate assessment, and the evaluation of fuel pellet thermal conductivity degradation and associated peaking factor burndown.

Since the absolute value of the change in PCT is greater than 50 °F, this is considered to be a significant change, as defined by 10 CFR 50.46(a)(3)(i). The requirement in 10 CFR 50.46(a)(3)(ii) states: " ... If the change or error is significant, the applicant or licensee shall provide this report within 30 days and include with the report a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with 50.46 requirements ... ". In Reference 1, Duke Energy has previously committed to submit to the NRC for review and approval a LBLOCA analysis that applies an NRC-approved ECCS evaluation model that includes the effects of fuel pellet thermal conductivity degradation. Corrections to the errors described in this letter are planned to be included in this LBLOCA analysis to be submitted prior to December 15, 2016, as committed to in Reference 1. Therefore, the existing LBLOCA reanalysis commitment discussed in Reference 1 is sufficient to address the requirements of 10 CFR 50.46(a)(3)(ii) pertaining to the most recent ECCS evaluation model errors described herein.

There are no new regulatory commitments contained in this letter.

Please address any comments or questions regarding this matter to Thomas R. Byrne at (980) 373-3249 (Tom.Byrne@duke-energy.com).

Sincerely,



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Attachment 1
- Table 1 – Errors/Evaluation Model Changes
- Table 2 – Peak Cladding Temperature Summary – McGuire Units 1 & 2
- Table 3 – Peak Cladding Temperature Summary – Catawba Unit 1
- Table 4 – Peak Cladding Temperature Summary – Catawba Unit 2 \

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NCMPA-1
PMPA
NCEMC
NRIIA File – ELL
MNS Master File 801.01– MG02DM
CNS Master File 801.01 – CN04DM

ATTACHMENT 1

Table 1 – Errors/Evaluation Model Changes

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

Table 3 – Peak Cladding Temperature Summary – Catawba Unit 1

Table 4 – Peak Cladding Temperature Summary – Catawba Unit 2

Table 1
Errors / Evaluation Model Changes

Error in Burst Strain Application

Affected Evaluation Model(s) Applicable to Catawba/McGuire:
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

An error in the application of the burst strain was discovered in HOTSPOT. The equation for the application of the burst strain is given as Equation 7-69 in WCAP-16009-P-A and in WCAP-12945-P-A. The outer radius of the cladding after burst occurs should be calculated based on the burst strain, and the inner radius of the cladding should be calculated based on the outer radius. In HOTSPOT, the burst strain is applied to the calculation of the cladding inner radius. The cladding outer radius is then calculated based on the inner radius. As such, the burst strain is incorrectly applied to the inner radius rather than the outer radius, which impacts the resulting cladding geometry at the burst elevation after burst occurs. Correction of the erroneous calculation results in thinner cladding at the burst node and more fuel relocating into the burst node, leading to an increase in the Peak Cladding Temperature (PCT) at the burst node. This issue has been evaluated to estimate the impact on existing Best-Estimate (BE) Large-Break Loss-of-Coolant Accident (LBLOCA) analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

A representative McGuire Units 1 & 2 and Catawba Units 1 & 2 case was run using HOTSPOT versions which only differ in the burst strain application. Based on the change in the 95th percentile results, estimated PCT effects of 20°F for Reflood 1, and 70°F for Reflood 2 have been established for 10 CFR 50.46 reporting purposes for McGuire Units 1 & 2 and Catawba Units 1 & 2.

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

LBLOCA	Cladding Temp (°F)	Comments
Evaluation model : WCOBRA/TRAC, CQD 1996		
Analysis of record PCT (Reflood 2)	2028	McGuire Units 1 & 2/Catawba Units 1 & 2 Composite Model
Prior errors (ΔPCT)		
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
6. Vessel Unheated Conductor Noding	0	Reference F
7. Thermal Conductivity Degradation with Peaking Factor Burndown	15	References H, I
8. Revised Heat Transfer Multiplier Distribution	-85	Reference K
Prior evaluation model changes (ΔPCT)		
1. Revised Algorithm for Average Fuel Temperature	0	Reference F
2. PAD 3.4 to PAD 4.0	-75	References H, I
3. Peak FQ = 2.7 in bottom third of core	0	References H, I
4. MUR Uprate to 101.7% of 3411 MWt	16	References H, I
Current Errors (ΔPCT)		
1. HOTSPOT Clad Burst Strain Error	70	See Table 1
Current Evaluation model changes (ΔPCT)		
1. None		
Absolute value of errors/changes for this report (ΔPCT)	70	
Net change in PCT for this report	70	
Final PCT	2086	
SBLOCA		
Evaluation model : NOTRUMP		
Analysis of record PCT	1323	2 inch break, Reference G
Prior errors (ΔPCT)		
1. Evaluation of Fuel Pellet Thermal Conductivity Degradation	0	Reference J
Prior evaluation model changes (ΔPCT)		
1. None	0	
Current Errors (ΔPCT)		
1. None	0	
Current 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	1323	

Table 3
Peak Cladding Temperature Summary – Catawba Unit 1

LBLOCA	Cladding Temp (°F)	Comments
Evaluation model : WCOBRA/TRAC, CQD 1996		
Analysis of record PCT (Reflood 2)	2028	McGuire Units 1 & 2/Catawba Units 1 & 2 Composite Model
Prior errors (ΔPCT)		
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
6. Vessel Unheated Conductor Noding	0	Reference F
7. Thermal Conductivity Degradation with Peaking Factor Burndown	15	References H, I
8. Revised Heat Transfer Multiplier Distribution	-85	Reference K
Prior evaluation model changes (ΔPCT)		
1. Revised Algorithm for Average Fuel Temperature	0	Reference F
2. PAD 3.4 to PAD 4.0	-75	References H, I
3. Peak FQ = 2.7 in bottom third of core	0	References H, I
Current Errors (ΔPCT)		
1. HOTSPOT Clad Burst Strain Error	70	See Table 1
Current Evaluation model changes (ΔPCT)		
1. None		
Absolute value of errors/changes for this report (ΔPCT)	70	
Net change in PCT for this report	70	
Final PCT	2070	
SBLOCA		
Evaluation model : NOTRUMP		
Analysis of record PCT	1323	2 inch break, Reference G
Prior errors (ΔPCT)		
1. Evaluation of Fuel Pellet Thermal Conductivity Degradation	0	Reference J
Prior evaluation model changes (ΔPCT)		
1. None	0	
Current Errors (ΔPCT)		
1. None	0	
Current 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	1323	

Table 4
Peak Cladding Temperature Summary – Catawba Unit 2

LBLOCA	Cladding Temp (°F)	Comments
Evaluation model : WCOBRA/TRAC, CQD 1996		
Analysis of record PCT (Reflood 2)	2028	McGuire Units 1 & 2/Catawba Units 1 & 2 Composite Model
Prior errors (ΔPCT)		
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	Reference E
5. Revised Blowdown Heatup Uncertainty Distribution	0	Reference F
	15	References H, I
6. Vessel Unheated Conductor Noding		
7. Thermal Conductivity Degradation with Peaking Factor Burndown	-85	Reference K
8. Revised Heat Transfer Multiplier Distribution		
Prior evaluation model changes (ΔPCT)		
1. Revised Algorithm for Average Fuel Temperature	0	Reference F
2. PAD 3.4 to PAD 4.0	-75	References H, I
3. Peak FQ = 2.7 in bottom third of core	0	References H, I
Current Errors (ΔPCT)		
1. HOTSPOT Clad Burst Strain Error	70	See Table 1
Current Evaluation model changes (ΔPCT)		
1. None		
Absolute value of errors/changes for this report (ΔPCT)	70	
Net change in PCT for this report	70	
Final PCT	2070	
SBLOCA		
Evaluation model : NOTRUMP		
Analysis of record PCT	1243	4 inch break, Reference G
Prior errors (ΔPCT)		
1. Evaluation of Fuel Pellet Thermal Conductivity Degradation	0	Reference J
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	1243	

References:

A) Letter, G. R. Peterson (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," April 11, 2001. [ADAMS ML011070266]

B) Letter, M. S. Tuckman (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," April 3, 2002. [ADAMS ML021070672]

C) Letter, W. R. McCollum, Jr. (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," July 29, 2003. [ADAMS ML032170639]

D) Letter, W. R. McCollum, Jr. (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," May 26, 2004. [ADAMS ML041560349]

E) Letter, J. R. Morris (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," June 21, 2005. [ADAMS ML051790210]

F) Letter, T. C. Geer (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," March 13, 2007. [ADAMS ML070800546]

G) Letter, T. C. Geer (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," May 22, 2007. [ADAMS ML071500297]

H) Letter, D. C. Culp (Duke Energy) to USNRC, Subject: Catawba Nuclear Station Units 1 and 2, and McGuire Nuclear Station Units 1 and 2, Response to Information Request Pursuant to 10 CFR 50.54(f) Related to the Estimated Effect on Peak Cladding Temperature Resulting from Thermal Conductivity Degradation in the Westinghouse-Furnished Realistic Emergency Core Cooling System Evaluation and 30-Day Report Pursuant to 10 CFR 50.46, Changes to or Errors in an Evaluation Model," March 16, 2012. [ADAMS ML12079A180]

I) Letter, J. Thompson (USNRC) to K. Henderson and S. D. Capps (Duke Energy), Subject: Catawba Nuclear Station Units 1 and 2, and McGuire Nuclear Station Units 1 and 2, Closure Evaluation for Report Pursuant to Title 10 of the Code of Federal Regulations, Part 50, Section 50.46, Paragraph (a)(3)(ii) Concerning Significant Emergency Core Cooling System Evaluation Model Error Related to Nuclear Fuel Thermal Conductivity Degradation (TAC Nos. ME8447, ME8448, ME8449, and ME8450)" November 16, 2012. [ADAMS ML12314A031]

J) Letter, M. J. Annacone, (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," July 11, 2013. [ADAMS ML13199A279]

K) Letter, R. J. Duncan, (Duke Energy) to USNRC, "Report Pursuant to 10 CFR 50.46, Changes to or Errors in an ECCS Evaluation Model," August 29, 2013. [ADAMS ML13246A103].