Duke Energy®

10 CFR 50.46(a)(3)(ii)

David C. Culp
Acting Vice President
Nuclear Engineering

Duke Energy Corporation
526 South Church Street
Charlotte, NC 28202

Mailing Address:
EC08H / P. O. Box 1006
Charlotte, NC 28201-1006

704 382 8833

704 382 7852 fax

David.Culp@duke-energy.com

May 29, 2012

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

Subject: Duke Energy Carolinas, LLC (Duke Energy)
Catawba Nuclear Station, Units 1 and 2, Docket Nos. 50-413, 50-414
McGuire Nuclear Station, Units 1 and 2, Docket Nos. 50-369, 50-370
Response to Request for Additional Information – 10 CFR 50.46 30-Day Report Regarding Thermal Conductivity Degradation in the Westinghouse-Furnished Realistic Emergency Core Cooling System Evaluation

References:

1. Letter, D. C. Culp (Duke) to USNRC, "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.
2. Letter, J. Thompson (NRC) to J. R. Morris and Regis T. Repko (Duke Energy), "Catawba Nuclear Station, Units 1 and 2, McGuire Nuclear Station, Units 1 and 2 – Request for Additional Information - 50.46, 30-Day Report Regarding Thermal Conductivity Degradation in the Westinghouse-Furnished Realistic Emergency Core Cooling System Evaluation (TAC NOs. ME8447, ME8448, ME8449, and ME8450)," April 23, 2012.
3. Letter, J. Thompson (NRC) to J. R. Morris and Regis T. Repko (Duke Energy), "Catawba Nuclear Station, Units 1 and 2, McGuire Nuclear Station, Units 1 and 2 – Further Request for Additional Information - 50.46, 30-Day Report Regarding Thermal Conductivity Degradation in the Westinghouse-Furnished Realistic Emergency Core Cooling System Evaluation (TAC NOs. ME8447, ME8448, ME8449, and ME8450)," April 27, 2012.

On March 16, 2012 (Reference 1), Duke Energy responded to 10 CFR 50.54(f) letters issued by the NRC regarding the impact on peak cladding temperature (PCT) from thermal conductivity degradation (TCD). This information is specific to the application of the Westinghouse Electric Company, LLC (Westinghouse) realistic emergency core cooling system evaluation model, as applied to the Catawba and McGuire Nuclear Stations.

On April 23, 2012 and April 27, 2012 (References 2, 3), the NRC transmitted Requests for Additional Information (RAIs) associated with Duke Energy's response in Reference 1. The purpose of this letter is to formally respond to these RAIs (Enclosures 1 - 4).

Enclosure 3 to this letter contains sensitive information.
Withhold From Public Disclosure Under 10CFR 2.390
Upon removal of Enclosure 3 this letter is uncontrolled

A002
NRR

The enclosures include, in part, the following Items:

1. 1 copy of DPC-12-54 P-Attachment, "Catawba Unit 1 & 2 and McGuire Unit 1 & 2 – Response to NRC Formal Request for Additional Information (RAI) from the Reactor Systems Branch Related to the 10 CFR 50.46, 30-Day Report" (Proprietary) (Enclosure 3)

2. 1 copy of DPC-12-54 NP-Attachment, "Catawba Unit 1 & 2 and McGuire Unit 1 & 2 Response to NRC Formal Request for Additional Information (RAI) from the Reactor Systems Branch Related to the 10 CFR 50.46, 30-Day Report" (Non-Proprietary) (Enclosure 4)

3. Westinghouse Application for Withholding Proprietary Information from Public Disclosure CAW-12-3479, accompanying Affidavit, Proprietary Information Notice, and Copyright Notice (Enclosure 5).

As Item 1 above contains information proprietary to Westinghouse Electric Company LLC, it is supported by an affidavit signed by Westinghouse (Item 3, above), the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.390 of the Commission's regulations.

Accordingly, it is respectfully requested that the information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations. Duke is treating the Westinghouse information provided in Enclosure 3 as proprietary and not for public disclosure.

Correspondence with respect to the copyright or proprietary aspects of the items listed above or the supporting Westinghouse affidavit should reference CAW-12-3479 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

There are no regulatory commitments contained in this letter.

Please address any comments or questions regarding this matter to Paul Guill at 704 382-4753 (paul.guill@duke-energy.com).

Sincerely,

David C. Culp
Acting Vice President, Nuclear Engineering

Enclosure 1: Westinghouse Letter DPC-12-53; Responses to Questions 1a, 1c, and 1d provided by NRC Letter dated April 23, 2012 (Westinghouse Non-Proprietary Information)

Enclosure 2: Responses to Question 2 provided by NRC Letter dated April 23, 2012 (Duke Energy Non-Proprietary Information)

Enclosure 3: Westinghouse Letter DPC-12-54-P, Responses to Questions 1b, 1e, 1f, provided by NRC Letter dated April 23, 2012 and Supplemental RAI provided by NRC Letter dated April 27, 2012 (Westinghouse Proprietary Information)

Enclosure 4: Westinghouse Letter DPC-12-54-NP, Responses to Questions 1b, 1e, 1f, provided by NRC Letter dated April 23, 2012 and Supplemental RAI provided by NRC Letter dated April 27, 2012 (Westinghouse Non-Proprietary Information)

Enclosure 5: Westinghouse Authorization Letter CAW-12-3479 with Westinghouse Affidavit, Proprietary Information Notice, and Copyright Notice

xc:

V. M. McCree, Region II Administrator
U.S. Nuclear Regulatory Commission
Marquis One Tower
245 Peachtree Center Avenue NE,
Suite 1200
Atlanta, Georgia 30303-1257

E. J. Leeds
Director, Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop 13-H16M
Rockville, MD 20852-2738

J. H. Thompson, Project Manager
U. S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop 0-8 G9A
Rockville, MD 20852-2738

J. Zeiler
NRC Senior Resident Inspector
McGuire Nuclear Station

G. A. Hutto, III
NRC Senior Resident Inspector
Catawba Nuclear Station

**Response to NRC Requests for Additional Information (Questions 1a, 1c, and 1d)
(Westinghouse Non-Proprietary)**

Westinghouse Letter DPC-12-53 NP, May 16, 2012

26 total pages to follow for Enclosure 1

Catawba Unit 1 & 2 and McGuire Unit 1 & 2 – Response to NRC Formal Request for Additional Information (RAI) from the Reactor Systems Branch Related to the 10 CFR 50.46, 30-Day Report

May 2012

Westinghouse Electric Company LLC
1000 Westinghouse Drive
Cranberry Township, PA 16066

NRC RAI 1a

The final paragraph on Page 2 of 9 refers to small differences in fuel characteristics that were claimed to be compared. The paragraph also discusses confirmatory evaluations concluding that other operating characteristics were acceptable. Provide the results of this comparison for Catawba Nuclear Station, Units 1 and 2 and McGuire Nuclear Station, Units 1 and 2, including the relevant conclusions and the technical basis supporting those conclusions. For any conclusion that differences in void volume are offset by other conservatisms, list those conservatisms and provide a quantitative estimate of each conservatism, as well as a brief description of the rigor associated with that estimate.

Response

No comparisons were made for Catawba Units 1 and 2 and McGuire Units 1 and 2 Duke Nuclear Stations. A fuel temperature and rod internal pressure analysis using Duke specific fuel rod dimensions, plant operating parameters, and powers was documented.

NRC RAI 1c

Please explain any error corrections, code improvements, and miscellaneous code cleanup between the WCOBRA/TRAC and HOTSPOT code versions used in the TCD evaluations and those used in the plant's AOR.

Response

The error corrections, code improvements, and miscellaneous code cleanup between the WCOBRA/TRAC and HOTSPOT code versions used in the analysis-of-record versus the evaluation of fuel pellet thermal conductivity degradation (TCD) are described in the 10 CFR 50.46 reporting pages enclosed with this response.

NRC RAI 1d

What is the thermal conductivity model impact of code version changes in HOTSPOT?

Response

The addition of a fuel conductivity model appropriate for the TCD evaluations was incorporated into WCOBRA/TRAC and HOTSPOT as discussed in LTR-NRC-12-27 (Reference 1). The error corrections and code improvements referenced in the prior paragraph do not impact the thermal conductivity model. It is more appropriate to estimate the effect of TCD using code versions with these changes because the impact of TCD on the PCT may be affected by the corrections in the updated code versions (for example the fuel relocation model correction in HOTSPOT).

References:

1) LTR-NRC-12-27, "Westinghouse Input Supporting Licensee Response to NRC 10 CFR 50.54(f) Letter Regarding Nuclear Fuel Thermal Conductivity Degradation (Proprietary/Non-Proprietary)," March 7, 2012.

Enclosure for NRC RAI Response 1c:

10 CFR 50.46 Reporting Pages for WCOBRA/TRAC and HOTSPOT

TUBE HEATED CONDUCTOR ERROR

Background:

WCOBRA/TRAC allows metal structures to be modeled as either a "Heated Conductor" in which axial conduction is calculated, or as an "Unheated Conductor" in which axial conduction is assumed to be relatively unimportant. The geometry of either Conductor can be a "WALL", a "TUBE", or a "ROD". In PWR models, Heated Conductors with a ROD geometry are used for fuel rods only. Other metal structures are modeled using Unheated Conductor types. It has been discovered that no heat is transferred to the inside Channel of a Heated Conductor if it is modeled with a TUBE geometry.

This was determined to be a Non-discretionary change as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

Estimated Effect

No SECY UPI or Best Estimate WCOBRA/TRAC calculation models heated conductors as TUBE geometry. This error does not occur for Unheated Conductors using the "TUBE" geometry type. Therefore, no estimated PCT effect is required to be assessed.

Attachment 1
Our ref: LTR-NRC-02-10
March 13, 2002

Oxidation Thickness Index Error For Best Estimate WCOBRA/TRAC

Background
A coding error has been identified in the initial outside oxidation thickness array used for fuel rods. The error was an incorrect index for storage of the oxide thickness for each fuel rod. Coding used the rod number index instead of the rod type index. This issue was determined to be a Non-Discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect
The error was found to have no effect for standard BELOCA analyses that follow the published guidance material for input of this variable. The error also did not affect any test simulations performed to support the licensing of the BE Evaluation Model. Thus, there was found to be no instance of use of erroneous oxidation thickness and there is no PCT impact for this error. The error will be corrected during the next revision of the Best Estimate WCOBRA/TRAC code.

Attachment 1
Our ref: LTR-NRC-02-10
March 13, 2002

Neutronics Calculation Moderator Density Weighting Factor Error

Background
An error was discovered in WCOBRA/TRAC whereby power used in normalization of moderator density weighting factors was double-accounted for channels with multiple simulated rods. The error biases the average moderator density to be slightly higher, resulting in slightly higher power generation in the hot rod. The error is qualitatively conservative, however, quantitatively insignificant. This issue was determined to be a Non-Discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect
At the beginning of the transient calculation, the difference in weighted density is less than 1% for all plant types. This difference is similar to the density difference between (2250 psia, 586°F) and (2250 psia, 588.8°F) thermodynamic state points. The difference in average moderator density affects the reactivity. The difference in reactivity at the beginning of the transient is negligible. As the transient progresses, with voiding of the core, the strong negative reactivity dominates. Therefore, it was estimated that the error has 0°F PCT impact on plant calculations. The error will be corrected during the next revision of the Best Estimate WCOBRA/TRAC code.

1-D MINIMUM FILM BOILING TEMPERATURE MODEL SELECTION ERROR

Background

Section 6-3-6 of WCAP-12945-P-A indicates that the minimum film boiling temperature calculation for 1-D components is calculated as the maximum of the homogeneous nucleation temperature and that predicted by the Iloeje correlation. The comparison of these two correlations is made if a flag (ITMIN) is set greater than zero. Otherwise, the homogeneous nucleation temperature is used. It was found that ITMIN was not initialized, resulting in the Iloeje correlation not being considered. This error has the potential to affect the heat transfer calculations in the steam generator tubes of the STGEN component. The coding was corrected to be consistent with the description in Section 6-3-6. This coding change was determined to be a Non-Discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

The homogeneous nucleation temperature exceeds the minimum film boiling temperature predicted by the Iloeje correlation for pressures less than about 100 psia. Therefore, this error could only potentially have an effect until the system pressure drops below about 100 psia, which typically occurs within 20-30 seconds. Examination of a typical PWR transient indicated that the transition boiling regime occurs in the steam generator tubes for only a few seconds during blowdown. Given the short period of time in the transition boiling regime, and relatively small difference between the homogeneous nucleation temperature and the Iloeje correlation results during this time period, it is concluded that the effect of the error is small enough to be considered negligible. Therefore, the estimated effect of this error correction is 0°F.

1-D CONDENSATION RAMP ERROR

Background

Section 5-3-5 of WCAP-12945-P-A indicates that condensation in specified one-dimensional components is suppressed if the pressure drops significantly below the containment pressure, using Equation 5-95a. This ramp was erroneously applied to the interfacial heat transfer for superheated liquid, affecting the evaporation process as well as the condensation due to subcooled liquid. The coding has been corrected so that it is applied to condensation conditions only. This coding change was determined to be a Non-Discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

Superheated liquid is not expected to be present in the affected components for any significant portion of a large break LOCA. A sensitivity study was performed using a PWR model in which the condensation ramp was applied. It was confirmed that the effect of the error correction on the peak cladding temperature was negligible. Therefore, the estimated effect of this error correction is 0°F.

CLADDING AXIAL THERMAL EXPANSION ERROR

Background

The cladding axial thermal expansion enters into the calculation of the fuel rod internal pressure, via the time-dependent gas plenum volume (Equation 7-46 of WCAP-12945-P-A). Equation 7-39 shows how the cladding axial thermal expansion over the length of the rod is calculated. Table 7-1 shows that the cladding axial thermal expansion is based on a linear interpolation scheme over a temperature range of 1073-1273°K. The CALL statement for the interpolation subroutine had a typographical error in one of the arguments, such that the axial thermal expansion was evaluated incorrectly. The error was corrected. This coding change was determined to be a Non-Discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

Rod internal pressures vary on the order of several hundred psi prior to burst, primarily as a result of changes in the temperatures of the various gas volumes (plenum, pellet-clad gap, effective porosity, etc.). Correction of the cladding axial thermal expansion error affects the rod internal pressure transient by only a few psi. This change is considered negligible, and the estimated effect on plant calculations is 0°F.

ERROR IN TIME AFTER SHUTDOWN FOR NEUTRON CAPTURE TERM

Background

Equation 8-45 of WCAP-12945-P-A shows the neutron capture correction factor specified by the ANSI/ANS 5.1-1979 standard. The time after shutdown term, t, was incorrectly programmed to use the total calculation time, including the steady state calculation. The coding has been corrected so that it is defined as the time after initiation of the break. This coding change was determined to be a Non-Discretionary change in accordance with Section 4.1.2 of WCAP-13451. (Note that for the SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model, this change affects only the superbounded analysis. The Appendix K analysis is unaffected.)

Affected Evaluation Models

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

The neutron capture correction factor is a multiplier slightly larger than unity, which increases with time after shutdown. The error resulted in a longer time after shutdown, which is slightly conservative. The effect of the error correction was estimated by evaluating Equation 8-45 of WCAP-12945-P-A, using typical analysis values. The results indicated that the G multiplier is reduced by about 0.4% with the correction, which would cause the total decay heat energy to be reduced by about 0.4%. This change is considered negligible, and the estimated effect on plant calculations is 0°F.

USER CONVENIENCES IN HOTSPOT

Background

The HOTSPOT code is used to quantify the propagation of local model uncertainties in the Westinghouse best estimate LOCA methodologies. HOTSPOT was updated as part of normal process improvement initiatives. The coding changes included increased array size to support longer transients, running the burst case automatically at the exact burst location, and consolidation of the advanced plant and gap re-opening versions with the production version. These changes were determined to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

Test cases with longer transient run times supported the conclusion that the prior version was adequate. Therefore, there is no PCT impact for this change.

The automation of the burst node calculation is a process improvement that reduces analyst resource requirements. There is no PCT impact for this change, as the capability previously existed for the analyst to specify the exact burst location in a separate run.

Consolidation of the advanced plant and gap re-opening versions with the production version eliminates the need to maintain single application code versions. There is no PCT effect on design basis analyses.

Based on the above, no licensees are affected by these changes, and 50.46 reporting is not required.

POTENTIAL DIVIDE BY ZERO ERROR DURING PUMP ROTATION REVERSAL

Background

While modeling a pump suction leg break, it was discovered that a divide by zero can occur if the pump speed goes to zero during the reversal. Logic was added to branch to the reverse flow coding if the speed is zero. Cold leg breaks, in which the flow is always forward, are considered in design basis analyses. Therefore, this coding change was determined to be a Discretionary change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

Design basis analyses are performed for the most limiting break location, which is in the cold leg, between the pump and the vessel inlet nozzle. The rotation of the pump is in forward direction for cold leg breaks, such that the rotation is not reversed. Therefore, this error has no effect on PWR large break LOCA design basis analyses, and 50.46 reporting is not required.

APPLICATION OF DECAY HEAT UNCERTAINTY TO PROMPT FISSION ENERGY ERROR

Background

WCOBRA/TRAC contains an option to apply a built-in decay heat uncertainty based on the ANSI/ANS 5.1-1979 Standard. Use of this option resulted in the application of the uncertainty to the prompt fission energy in addition to the decay heat energy.

For the SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model, the 1979 decay heat model is used only in the so-called superbounded analysis, which serves as a validation of the analysis with Appendix K required features. The Appendix K analysis determines the licensing basis PCT. The current coding will be retained as an accepted conservatism in the superbounded calculations, and not considered an error.

The built-in decay heat uncertainty option is not used in the current Westinghouse Best Estimate Large Break LOCA Evaluation Models (1996 and 1999 versions). However, it will be used in a future methodology improvement. Therefore, this coding change was determined to be a Discretionary change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

As noted above, the built-in decay heat uncertainty option is not used in the affected evaluation models. Therefore, this error has no effect on PWR large break LOCA design basis analyses, and 50.46 reporting is not required.

BYPASS OF ORIFICE ENTRAINMENT MODEL IN DOWNFLOW WITH CHANNEL SPLITTING

Background

Entrainment during downward flow is calculated as described in Section 4-6-4 of WCAP-12945-P-A. An orifice entrainment model is used if the void fraction is greater than 0.8, and if there is an area expansion of greater than five percent in the downflow direction. There was a coding error that would result in the orifice entrainment model being bypassed if there was channel splitting (one channel above two or more channels below). This error was corrected.

A review of the nodalization used in PWR analyses and test simulations indicated that only the G-2 test predictions were potentially affected by this error. The G-2 test predictions were not used to establish any of the uncertainty distributions used in the methodology. Therefore, this coding change was determined to be a Discretionary change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

As discussed above, the nodalization used in PWR analyses and the test simulations used to establish code and model uncertainties precluded this error from occurring. Therefore, this error has no effect on PWR large break LOCA design basis analyses, and 50.46 reporting is not required.

INPUT ERROR RESULTING IN INCOMPLETE SOLUTION MATRIX

Background

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 model in which the MSIM input value was less than the total number of cells in the vessel. This resulted in an incomplete solution matrix. An input diagnostic check has been added to prevent future occurrences. This input correction was determined to be a Non-Discretionary change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

Estimated Effect

Plant specific calculations were performed to estimate the PCT effect of this error for the two analyses affected. It was confirmed that the fundamental LOCA transient characteristics (e.g., blowdown cooling and reflood turnaround timing and behaviors) were unchanged by the error correction. The reference double-ended guillotine break was used to develop the PCT assessments for each plant.

The test simulation model affected by this error was also corrected, and the transient calculation repeated. It was found that the error correction had no significant effect on the calculation results, and the prior validation conclusions remain valid.

IMPLEMENTATION OF AUTOMATED STEADY STATE AND RESTART

Background

Westinghouse has submitted a revised treatment of uncertainties for its Large Break LOCA evaluation models, for NRC review and approval. The Automated Statistical Treatment of Uncertainties Methodology is described in WCAP-16009-P. As part of the implementation of the revised methodology, enhancements were introduced that help to automate convergence of the steady state solution to the desired set of conditions, as well as automating the restart process for beginning the LOCA transient. These changes were determined to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

These changes are for forward-fit automation purposes only, and have no effect on existing analyses.

GENERAL CODE MAINTENANCE (BEST ESTIMATE)

Background

A number of coding changes were made as part of normal code maintenance. These include improvements in user flexibility for non-standard (non-design basis) analyses, and enhancements in the information available via output edits or for plotting purposes. All of these changes are considered to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

None of these changes affect the results of design basis analyses. Therefore, the estimated effect is zero.

Attachment 1 – Standard Text
Our ref: LTR-NRC-05-20
April 11, 2005

REVISED BLOWDOWN HEATUP UNCERTAINTY DISTRIBUTION

Background

Correction of modeling inconsistencies and input errors in the LOFT input decks have resulted in a change in the predicted peak cladding temperature transients. Revised analyses of the LOFT and ORNL tests were performed using the current version of WCOBRA/TRAC. As a result of this re-analysis, revised blowdown heatup heat transfer coefficients were developed and the revised cumulative distribution function (CDF) was programmed into a new version of HOTSPOT. The revised CDF was previously reported to the NRC in LTR-NRC-04-11. The overall code uncertainty for blowdown was also recalculated and programmed into a new version of MONTECF. The overall code uncertainty for reflood was not affected. These corrections were determined to be Non-Discretionary changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

An estimate of the PCT effect of the revised blowdown heatup CDF was performed for the 1996 and 1999 Evaluation Models by calculating the impact on the reference transient for representative 2-, 3- and 4-loop plants. The estimates bound all of the 95th percentile HOTSPOT results. Estimates of the effect of the revised overall code uncertainty for blowdown were made on a plant-specific basis by repeating the MONTECF analysis, for those plants that track the blowdown period.

The revised blowdown heatup heat transfer multipliers have been and will be used for all analyses based on the 2004 ASTRUM Evaluation Model. Therefore, no PCT assessments are necessary for those plants.

Attachment 1 – Standard Text
Our ref: LTR-NRC-05-20
April 11, 2005

IMPLEMENTATION OF ASTRUM CAPABILITY IN HOTSPOT

Background

The HOTSPOT code was modified to be compatible with the Automated Statistical Treatment of Uncertainty Methodology (ASTRUM, described in WCAP-16009-P-A). An option is used to trigger the ASTRUM HOTSPOT technique (single iteration mode) or the Monte Carlo mode used in the previous Best Estimate Large Break LOCA evaluation models. These changes were considered to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

None of these changes affect the results of design basis analyses performed with these evaluation models. Therefore, the estimated effect is zero.

Attachment 1 – Standard Text
Our ref: LTR-NRC-05-20
April 11, 2005

GENERAL CODE MAINTENANCE (WC/T)

Background
A number of coding changes were made as part of normal code maintenance. Examples include correction of debug plots not used in design analyses, and improved consistency between the HOTSPOT nominal PCT (not used in the uncertainty analysis) and WCOBRA/TRAC PCT. All of these changes are considered to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
None of these changes affect the results of design basis analyses. Therefore, the estimated effect is zero.

REVISED ITERATION ALGORITHM FOR CALCULATING THE AVERAGE FUEL TEMPERATURE
(Discretionary Change)

Background
Under certain conditions, the iteration scheme to calculate an average fuel temperature in HOTSPOT converged slowly, exceeding the maximum iteration count. This led to an average fuel temperature calculation that was inconsistent with the WCOBRA/TRAC temperature for calculating the stored energy in the fuel. A revised iteration scheme, based on a combination of a secant method and a parabolic interpolation with a bracketing scheme, was implemented to resolve the non-convergence issue. This change is considered to be a Discretionary change in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
The prior inconsistencies between the WCOBRA/TRAC temperature and the HOTSPOT average fuel temperature always resulted in a higher HOTSPOT average fuel temperature. Therefore, a 0°F impact is conservatively assigned for 10 CFR 50.46 reporting purposes.

PELLET RADIAL PROFILE OPTION
(Discretionary Change)

Background
The radial power profile of fuel pellets was previously assumed to be uniform when setting up the conduction network over the fuel pellet in HOTSPOT. However, the accuracy of this approximation decreases for highly burned fuel since the radial power profile tends to increase from the center towards the outside of the fuel pellet at higher burnups. As such, an option was added in HOTSPOT to use a non-uniform radial power profile consistent with the WCOBRA/TRAC code. These changes were considered to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
This change is for forward-fit purposes only, and has no effect on existing analyses.

GENERAL CODE MAINTENANCE
(Discretionary Change)

Background
A number of coding changes were made as part of normal code maintenance. Examples include more descriptive file naming, improved automation in the ASTRUM codes, and improved input diagnostics in the WCOBRA/TRAC code. All of these changes are considered to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
None of these changes affect the results of design basis analyses. Therefore, the estimated effect is zero degrees.

GENERAL CODE MAINTENANCE
(Discretionary Change)

Background
A number of coding changes were made as part of normal code maintenance. Examples include additional information in code outputs, improved automation in the ASTRUM codes, increased WCOBRA/TRAC code dimensions, and general code cleanup. All of these changes are considered to be discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model(s)
1996 Westinghouse best estimate large break LOCA evaluation model
1999 Westinghouse best estimate large break LOCA evaluation model, application to PWRs with upper plenum injection
2004 Westinghouse realistic large break LOCA evaluation model using ASTRUM

Estimated Effect
The nature of these changes leads to an estimated PCT impact of 0°F.

HOTSPOT FUEL RELOCATION
(Non-Discretionary Change)

Background
In the axial node where burst is predicted to occur, a fuel relocation model in HOTSPOT is used to account for the likelihood that additional fuel pellet fragments above that elevation may settle into the burst region. It was discovered that the effect of fuel relocation on local linear heat rate was being calculated, but then cancelled out later in the coding. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect
1996 and 1999 BELOCA EMs analyses were assessed on a plant-specific basis, via the HOTSPOT reanalysis of a representative WCOBRA/TRAC case using the corrected code version at the burst elevation/burst model enabled sub-case. The HOTSPOT 95% probability PCT results were used to establish the plant-specific PCT penalty.

2004 ASTRUM EM analyses were assessed on a plant-specific basis, via the reanalysis of all of the burst cases from the original HOTSPOT calculations using the corrected HOTSPOT code version.

Response to NRC Requests for Additional Information (Question 2)
(Duke Energy Non-Proprietary)

5 pages total pages for Enclosure 2

NRC RAI Question 2

2. Please explain how the changed design values will be verified during operation of the plant, i.e. TS limits, Surveillances, etc. Also, explain what compensatory actions will be taken if a value is found to be outside of the limits assumed in the analysis.

Duke Energy Response to NRC RAI Question 2

The following Best-Estimate Large Break LOCA (BE-LBLOCA) limits were modified for McGuire Units 1 and 2, and Catawba Units 1 and 2 to offset the effects of fuel pellet thermal conductivity degradation (TCD).

- Maximum Enthalpy Rise Peaking Factor, $F\Delta H$
- Maximum Relative power in Hot Assembly, PBAR
- Maximum Steady State Depletion Factor, F_Q-SS
- Maximum Total Peaking Factor, F_Q-Transient

The revised limits are shown in Table 1 from Reference 1.

Table 1
BE-LBLOCA
Revised Peaking Factor Limits to Offset the Effects of TCD

Burnup (GWD/MTU)	$F\Delta H$ Limit	PBAR Limit	Steady State F_Q Limit	Transient + F_Q Limit	Transient ** F_Q Limit
0	1.67	1.6058	2.10	2.50	2.70
35	1.67	1.6058	2.10	2.50	2.70
55	1.5865	1.5255	1.89	2.25	2.43
62	1.503	1.4452	1.68	2.00	2.16

\+ Applicable to upper 2/3 of the core
** Applicable to the bottom 1/3 of the core

Verification of BE-LBLOCA limits specified in Table 1 is performed as part of the normal reload design process for each reload core. Steady state F_Q limits are verified by comparing predicted steady-state peaking factors from full power conditions against the steady-state burnup dependent F_Q peaking factor limits shown in Table 1. Transient F_Q, $F\Delta H$ and PBAR limits are verified by comparing power distributions produced during normal operation and from operational transients against the applicable limits specified in Table 1. Transient power distributions are generated based on the methodology described in Reference 2. Predicted power distributions used in reload analyses are based on core

models developed using the NRC-approved CASMO-4/SIMULATE-3 methodology described in Reference 3.

Results from cycle-specific analyses show the revised BE-LBLOCA limits that account for TCD do not change the limiting peaking margins or the core locations of the limiting peaking margins. Core locations with minimum peaking margin occur in fuel with burnups less than 30 GWD/MTU, which is well before the effect of TCD becomes important. This important conclusion demonstrates that the decrease in fuel reactivity with increasing burnup is significant enough to limit the power producing capability of high burnup fuel to a level that more than offsets the effect of the peaking factor burn down needed to account for the effects of TCD shown in Table 1. Figures 1 and 2 show F_Q transient peaking factors as function of burnup calculated for a typical core design. These factors represent the calculated maximum F_Q that can occur during normal operation and from operational transients as constrained by axial flux difference and rod insertion limits specified in the Core Operating Limits Report. Because McGuire and Catawba have an axial dependent F_Q limit, 2.5 for the upper two-thirds of the core and 2.7 for the lower one-third of the core, the F_Q transient peaking is shown in two plots (Figures 1 and 2). The peaking factor results presented in Figures 1 and 2 illustrate the significant burn down of the F_Q peaking factor at burnups greater than 30 GWD/MTU and the increase in margin relative to the limit at these higher burnups. FΔH and PBAR follow the same general trend as the F_Q trend shown in Figures 1 and 2.

Figure 3 shows best estimate steady state F_Q peaking factors at full power conditions compared against the revised transient F_Q limits. The best estimate steady state results represent the most likely condition for core peaking and illustrate the most likely margin to transient F_Q limit. The difference in margin between the best estimate steady state and transient plots is significant, and is a combination of the effects of adverse xenon distribution, control rod insertion and application of calculational uncertainty factors.

Power distribution surveillances are performed to verify the total peaking factor F_Q. Technical Specification 3.2.1 contains limits on F_Q (see Table 1 above for the limits) to preclude exceeding the initial linear power generation rate assumed in the LOCA accident analysis. The F_Q limit is verified through periodic measurements performed during the cycle consistent with Surveillance Requirements 3.2.1.1 and 3.2.1.2. The measured F_Q, $F_Q^M(X,Y,Z)$, is compared against two limits – a steady state limit, and a transient operational limit. Compensatory actions for the measured $F_Q^M(X,Y,Z)$ exceeding either the steady state or transient operational limits is defined in McGuire and Catawba Technical Specifications and includes actions to reduce reactor power level, axial flux difference (AFD) limits and reactor protection system (RPS) setpoints depending upon the type (either steady state or transient) and magnitude of the violation.

Power distribution Technical Specification surveillances are not performed against the BE-LBLOCA F_Q-SS, FΔH and PBAR input assumptions. These limits are analytically verified for each reload core design as previously described. If the analytical verification produces unacceptable results, then the core is either re-designed or the BE-LBLOCA analysis is re-analyzed with revised input peaking factor assumptions. The acceptability of analysis results is based on confirming that the reactor core is operating as designed.

Reactivity and power distribution measurements are performed periodically during the cycle as required by Technical Specifications 3.1.2 (Core Reactivity), 3.2.1 (Heat Flux Hot Channel Factor ($F_Q(X,Y,Z)$)) and 3.2.2 (Nuclear Enthalpy Rise Hot Channel Factor ($F_{\Delta H}(X,Y)$)) to verify that core reactivity and peaking factors are within their respective design limits. Measured power distributions and core reactivity are also compared against predicted power distributions and core reactivity. These comparisons when

coupled with startup physics testing results following refueling are used to verify the core design model and to demonstrate the core is operating as designed. This confirmation provides confidence in the predictive capability of the core design model used to verify BE-LBLOCA accident analysis input assumptions and its ability to predict core performance. If the core is determined to not be operating as designed, an evaluation would be performed to assess analysis margins, understand the reasons for the deviation and make appropriate adjustments on a case-by-case basis to plant operations or setpoints to ensure operation within BE-LBLOLCA analysis limits.

In summary, transient F_Q, $F\Delta H$ and PBAR, and steady state F_Q limits are confirmed analytically for each reload core as part of the reload design process. If peaking factor assumptions to the BE-LBLOCA analysis are exceeded, then either the reload core is redesigned, or the BE-LBLOCA analysis is revised with new peaking factor assumptions. Analyses have demonstrated that the reduction in the transient F_Q, $F\Delta H$ and PBAR, and steady state F_Q limits to account for the effects of TCD occur at burnups where fuel is non-limiting due to the natural decrease in reactivity with increasing burnup and the corresponding decrease in power capability. With the exception of the transient F_Q limit, the acceptability of the peaking factors assumptions used in the BE-LBLOCA analysis are confirmed by verifying the core is operating as designed. This is accomplished through a startup physics test program following refueling and through periodic power distribution and reactivity measurements performed throughout the cycle. Calculation results have shown significant peaking factor margin at burnups greater than 28 GWD/MTU demonstrating that fuel at burnups where TCD becomes important is non-limiting. As a result, it is not necessary to modify the Technical Specification SR 3.2.1.2 to account for the burn down in the F_Q limit. Figure 3 shows best estimate F_Q peaking factors relative to the transient F_Q limits and the significant amount of margin to the BE-LBLOCA F_Q input assumption for the most likely condition of operation. In addition to the analytical confirmation of the transient F_Q limit, power distribution surveillances are performed as required by Technical Specification 3.2.1 to limit the peak linear power density, F_Q, to less than the values assumed in the BE-LBLOCA analysis. If an F_Q limit is exceeded, compensatory actions include reductions in reactor power level, AFD limits and RPS setpoints, depending upon the type and magnitude of the F_Q violation. These surveillances also provide confirmation that the core is operating as designed.

Figure 1

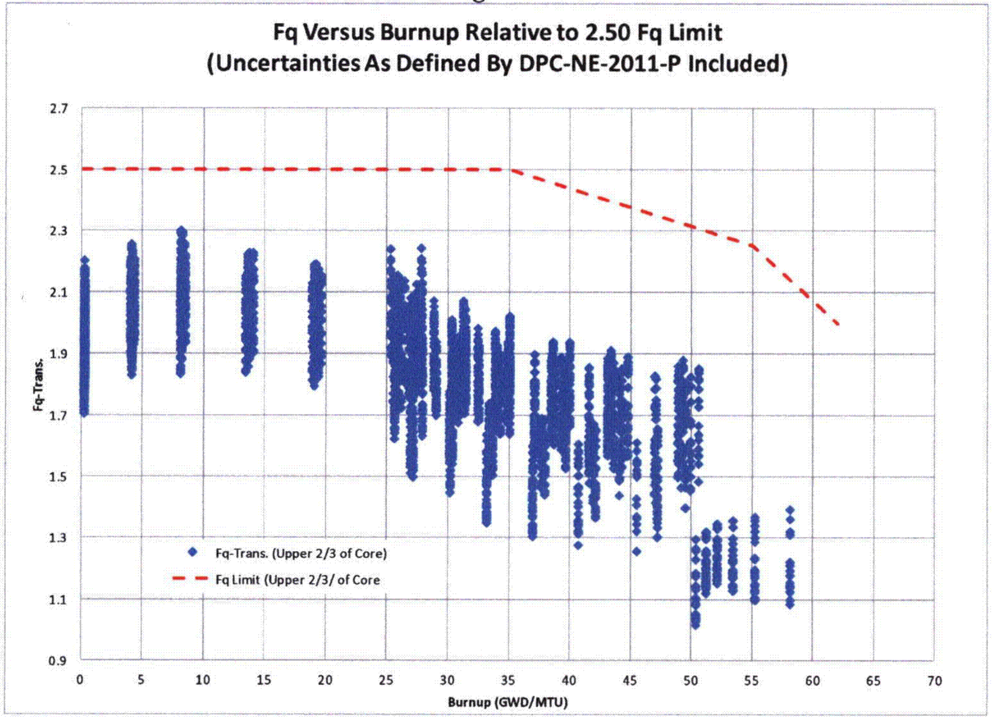


Figure 2

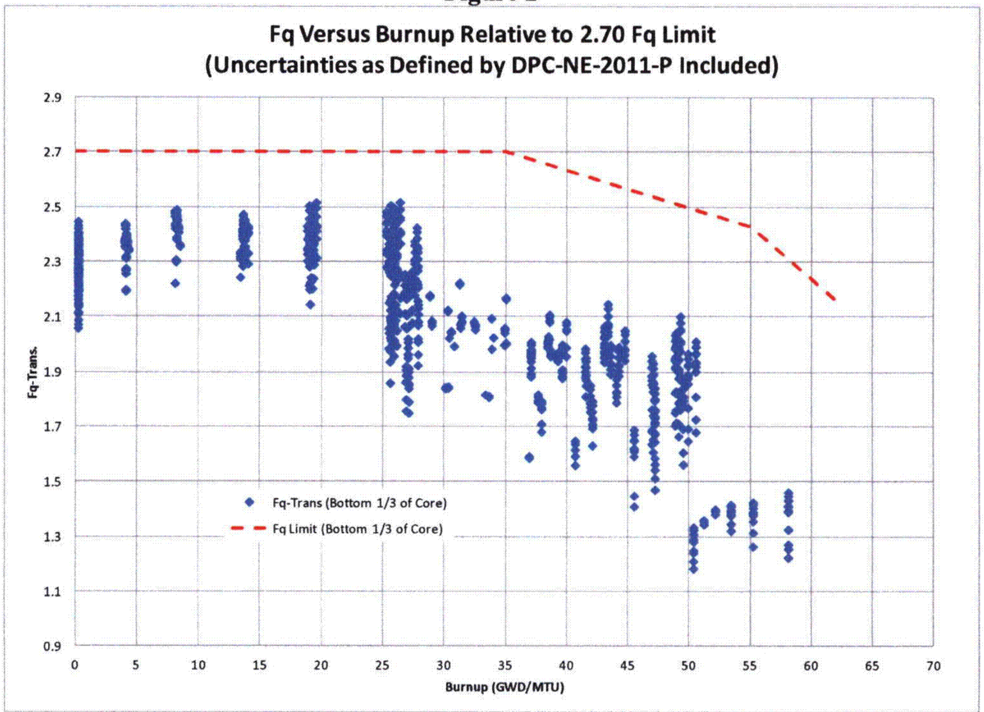
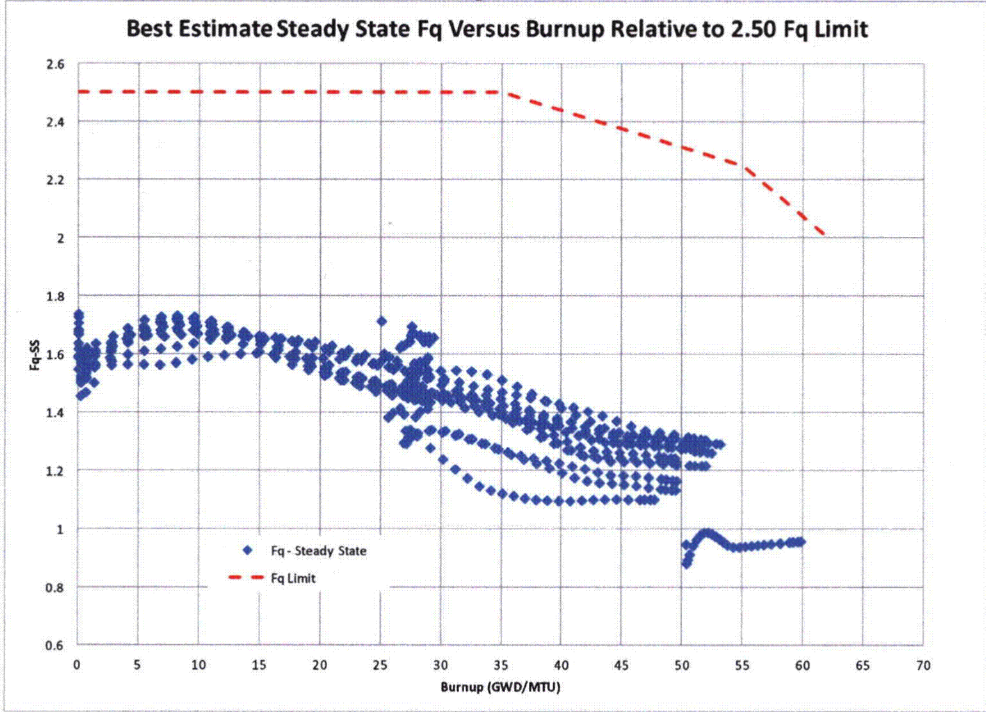


Figure 3



References for Enclosure 2

1. Letter, D. C. Culp (Duke) to USNRC, "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.

2. Duke Energy Methodology Report DPC-NE-2011-P, Rev. 1a, "Nuclear Design Methodology Report for Core Operating Limits Of Westinghouse Reactors", June 2009.

3. Duke Energy Methodology Report DPC-NE-1005-PA, Rev. 1, "Nuclear Design Methodology Using CASMO-4/SIMULATE-3 MOX", November 2008.

Response to NRC Requests for Additional Information (Questions 1b, 1e, 1f, and Supplemental RAI)

(Westinghouse Non-Proprietary)

Westinghouse Letter DPC-12-54-NP, May 17, 2012

16 total pages to follow for Enclosure 4

Catawba Unit 1 & 2 and McGuire Unit 1 & 2 – Response to NRC Formal Request for Additional Information (RAI) from the Reactor Systems Branch Related to the 10 CFR 50.46, 30-Day Report

May 2012

NRC RAI 1b

Please provide the values for the coefficients A1 and A2 used in the PAD 4.0 + TCD UO2 thermal conductivity equation.

Response

a,c

The functional form used to model TCD [ ] is as follows:

a,c

[ ]

NRC RAI 1e

Explain the differences between the HOTSPOT and PAD thermal conductivity models and the impact of those differences. Provide graphs or other quantified descriptions that aid in explanation.

Response

For the fuel thermal conductivity degradation (TCD) evaluation, PAD 4.0 TCD was used to generate the initial maximum fuel average temperature input into WCOBRA/TRAC and HOTSPOT. The PAD 4.0 TCD fuel thermal conductivity equation, for fuel at a nominal density of 95% theoretical density is given in LTR-NRC-12-11 (Reference 1) with the coefficients provided in response to part b) of this request for additional information (RAI) and repeated below.

[

]a,c

For the TCD evaluation, WCOBRA/TRAC and HOTSPOT used a fuel thermal conductivity model based on [FRAPCON 3.3 but with the degradation model from the TRANSURANUS code.]a,c For fuel at a nominal density of 95% theoretical density, the model in WCOBRA/TRAC and HOTSPOT is given in LTR-NRC-12-27 (Reference 2) and repeated below.

[

]a,c

It is observed that the functional form and units between the two models are different. For ease of comparison, the degradation terms [*f(Bu)* in both equations] are compared in Figure 1 at burnups of 20, 40 and 65 GWD/MTU. As seen from Figure 1, [

]a,c

Figures 2 through 5 compare the overall fuel thermal conductivity models at burnups of 0, 20, 40 and 65 GWD/MTU, respectively. Also included in the figures is a comparison with the FRAPCON 3.4 thermal conductivity model (Reference 3). As seen from the figures, [

]a,c

[

]a,c

Figure 1: Fuel Thermal Conductivity Degradation Model Comparison

[

]a,c

Figure 2: Fuel Thermal Conductivity Model Comparisons – 0 GWD/MTU

[

]a,c

Figure 3: Fuel Thermal Conductivity Model Comparison – 20 GWD/MTU

[

]a,c

Figure 4: Fuel Thermal Conductivity Model Comparison – 40 GWD/MTU

[

]a,c

Figure 5: Fuel Thermal Conductivity Model Comparison – 65 GWD/MTU

[

]a,c

NRC RAI 1f

Please provide additional detail concerning the steady-state ASTRUM / CQD [Code Qualification Document] initialization process. In particular, please explain what fuel characteristics are adjusted within the applicable models to obtain convergence among HOTSPOT, WCOBRA/TRAC and PAD 4.0+TCD.

Response

The following twelve parameters in WCOBRA/TRAC are used to determine steady-state convergence, as discussed in Section 20-5 of WCAP-12945-P-A (Reference 4) and Section 12-4-1 of WCAP-16009-P-A (Reference 5).

[

]a,c

[

]a,c

Table 1: Initial Gap Thickness and Average Fuel Temperature Comparison for Sample 17x17 Plant

[

]a,c

Table 2: Initial Gap Thickness and Average Fuel Temperature Comparison for Sample 15x15 Plant

[

]a,c

Table 3: HOTSPOT and WCOBRA/TRAC Steady-State Gap Heat Transfer Coefficient and Average Fuel Temperature Comparison for Sample 17x17 Plant

[

]a,c

Table 4: HOTSPOT and WCOBRA/TRAC Steady-State Gap Heat Transfer Coefficient and Average Fuel Temperature Comparison for Sample 15x15 Plant

[

]a,c

[

]a,c **Figure 6: WCOBRA/TRAC and HOTSPOT Cladding Temperature Comparison for 17x17 Plant**

[

]a,c **Figure 7: WCOBRA/TRAC and HOTSPOT Cladding Temperature Comparison for 15x15 Plant**

NRC Supplemental RAI

After review by the NRC staff, it was determined that another request for additional information (RAI) was needed regarding the compensatory measures that the licensees implemented to offset the effects of the TCD error. Specifically, the NRC staff has a concern that the actions taken by the licensee may constitute a methodology change and an evaluation in accordance with 10 CFR 50.59, which would direct them to submit a license amendment request to include these compensatory measures in their updated final safety analysis report (UFSAR). Further, the licensee committed to submit a revised evaluation by 2016 and the NRC staff wants to verify that the licensee is taking the appropriate actions to maintain the validity of the compensatory measures during this timeframe (per Nuclear Energy Institute guidance, directing 10 CFR 50.59 evaluations for temporary alterations that are in effect longer than 90 days at power). The NRC staff's RAI is as follows:

In its letter dated March 16, 2012, the licensee it appears to have revised inputs to a method of evaluation as described in the UFSAR used in establishing the design bases or in the safety analyses. The licensee should respond as to whether the methodology permits the licensee to establish how to select the value of an input parameter to yield adequately conservative results and whether the revised value is more conservative than that required by the selection method. Further, address whether any of the changes (e.g., to the uranium dioxide thermal conductivity equation) constitute a change in the calculational framework used for evaluating behavior or response of a system, structure or component.

Response

Westinghouse currently employs three best estimate Evaluation Model (EM) methodologies for analysis of the large break loss-of-coolant accidents (LBLOCA) in pressurized water reactors (PWRs):

- 1996 Westinghouse Best Estimate LBLOCA Evaluation Model (Code Qualification Document (CQD) EM, Reference 4)
- 1999 Westinghouse Best Estimate LBLOCA Evaluation Model, Application to PWRs (Pressurized Water Reactors) with Upper Plenum Injection (CQD-UPI EM, Reference 6)
- 2004 Westinghouse Realistic LBLOCA Evaluation Model using ASTRUM (Automated Statistical Treatment of Uncertainty Method) (ASTRUM EM, Reference 5)

In application of a Westinghouse best estimate large break LOCA methodology to a plant analysis, Westinghouse works with the licensee to establish several parameter values input to the specific analysis per the Nuclear Regulatory Commission (NRC) – approved evaluation model requirements (including applicability restrictions specified by the NRC in their Safety Evaluation Reports(SERs)). The licensee is permitted to establish the values of these parameters on the basis of plant-specific considerations; as such they are input to the methodology and not part of the methodology, as defined in NEI 96-07 Revision 1 (Reference 8) Section 3.8. The input parameter values may be selected conservatively in order to support current plant operation, as well as accommodate expected future changes or otherwise at the discretion of the licensee. Table 5 summarizes the selected design input changes evaluated in conjunction with the execution of the thermal conductivity degradation (TCD) evaluation(s) performed as described in the Reference 9 submittal, and relevant governing topical report references identifying how these values are to be selected.

In the evaluations of design input changes performed as described in the Reference 9 submittal, the changes to design input values were made to more closely represent current plant operation. Selection of the revised input parameter values was made in accordance with the approved EM. Therefore, the design input changes reflect reduction in the conservatism of these values and are considered an input parameter change and not a change to

the methodology, consistent with Reference 8 Section 3.8. Westinghouse and its licensees utilize processes which ensure that the LBLOCA analysis input values conservatively bound the as-operated plant values for these parameters.

Fuel pellet TCD and peaking factor burndown were not explicitly considered in the as-approved Westinghouse best estimate LBLOCA EMs. In order to evaluate the PCT effect of TCD and peaking factor burndown as described in the Reference 9 submittal, evaluation techniques were used that are outside of the as-approved EMs. This was necessary to explicitly consider the fuel performance effects of TCD, and to adequately evaluate the burnup-dependent aspects of the fuel performance changes considering TCD. Specifically, the following aspects of the TCD evaluation(s) were outside of the as-approved best estimate LBLOCA EM:

[

]a,c

10 CFR 50.46 establishes criteria for reporting and for action regarding changes or errors involving methods for loss of coolant analyses. For the evaluation and reporting of PCT impact, the changes to the LBLOCA EM to explicitly consider the fuel performance effects of TCD and to adequately evaluate the burnup-dependent aspects of the fuel performance are governed by 10 CFR 50.46. Consistent with 10 CFR 50.59(c)(4) and Reference 8 Section 4.1.1, the provisions of 10 CFR 50.59 do not apply for the LBLOCA EM changes for evaluations and reporting of PCT impact because the 10 CFR 50.46 regulation establishes more specific criteria for reporting and for action for changes involving methods for loss of coolant accidents.

In summary, in the evaluations of TCD and design input changes as described in the Reference 9 submittal, two types of changes were made:

- Design input values were changed to more closely represent plant operation, or analysis input changes were made to reduce conservatism in as-analyzed values. The licensee is permitted to establish the value of these parameters on the basis of plant-specific considerations; as such these are changes to the input of the methodology and are not part of the methodology. Therefore, the design input changes reflect reduction in the conservatism of these values and are considered an input parameter change and not a change to the methodology.

- Techniques to appropriately account for the burnup-dependent effects of TCD were used in the evaluation(s) which are outside of the as-approved EMs. These changes to the calculational framework (as defined in 10 CFR 50.46(c)(2)) were required to assess the TCD phenomena which are not explicitly accounted for in the as-approved EMs. The provisions of 10 CFR 50.59 do not apply for the LBLOCA EM changes for evaluations and reporting of PCT impact because the 10 CFR 50.46 regulation establishes more specific criteria for reporting and for action for changes involving methods for loss of coolant accidents.

Table 5. Applicable Evaluation Model Reference(s) for Selection of the Design Input Parameters Modified in TCD Evaluation for Catawba Units 1&2 and McGuire Units 1&2

Design Input Change	Relevant Sections of CQD Topical Report (Reference 4)
Implementation of PAD 4.0 (from PAD 3.4)	Use of PAD 3.4 licensed per Reference 4 Section 20-5. Per Reference 7, use of PAD 4.0 was subsequently implemented as a forward-fit, discretionary change.

References

1. LTR-NRC-12-11, "Westinghouse Thermal Conductivity Model for Turkey Point Unit 3&4 Extended Power Uprate (EPU) License Amendment Request (LAR) (Proprietary)," February 2, 2012.

2. LTR-NRC-12-27, "Westinghouse Input Supporting Licensee Response to NRC 10 CFR 50.54(f) Letter Regarding Nuclear Fuel Thermal Conductivity Degradation (Proprietary/Non-Proprietary)," March 7, 2012.

3. NUREG/CR-7022, Vol. 1 / PNNL-19418, Vol.1, "FRAPCON-3.4: A Computer Code for the Calculation of Steady-State Thermal-Mechanical Behavior of Oxide Fuel Rods for High Burnup," March 2011.

4. WCAP-12945-P-A, Volume 1 (Revision 2) and Volumes 2 – 5 (Revision 1), "Code Qualification Document for Best Estimate LOCA Analysis," March 1998. (Proprietary)

5. WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment Of Uncertainty Method (ASTRUM)," January 2005. (Proprietary)

6. WCAP-14449-P-A, Revision 1 (Proprietary), Dederer, S. I., *Application of Best Estimate Large Break LOCA Methodology to Westinghouse PWRs with Upper Plenum Injection*, October 1999.

7. LTR-NRC-01-6, Letter from H. A. Sepp (Westinghouse) to J. S. Wermiel (NRC), *U.S. Nuclear Regulatory Commission 10 CFR 50.46 Annual Notification and Reporting for 2000*, March 13, 2001.

8. NEI 96-07 Revision 1, *Guidelines for 10 CFR 50.59 Implementation*, November 2000.

9. Letter from D. C. Culp (Duke Energy), "Catawba Units 1&2, McGuire Units 1&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. NRC ADAMS Accession Number ML12079A180.

U.S. Nuclear Regulatory Commission
May 29, 2012

Enclosure 5

Westinghouse Authorization Letter CAW-12-3479 with Accompanying Affidavit. Proprietary Information Notice, and Copyright Notice

7 total pages to follow for Enclosure 5

Westinghouse

Westinghouse Electric Company
Nuclear Services
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066
USA

U.S. Nuclear Regulatory Commission
Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Direct tel: (412) 374-4643
Direct fax: (724) 720-0754
e-mail: greshaja@westinghouse.com
Proj letter: DPC-12-54

CAW-12-3479

May 17, 2012

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: DPC-12-54 P-Attachment, "Catawba Unit 1 & 2 and McGuire Unit 1 & 2 – Response to NRC Formal Request for Additional Information (RAI) from the Reactor Systems Branch Related to the 10 CFR 50.46, 30-Day Report" (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-12-3479 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by Duke Energy.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference CAW-12-3479 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

J. A. Gresham

J. A. Gresham, Manager
Regulatory Compliance

Enclosures

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared J. A. Gresham, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

J A Gresham

J. A. Gresham, Manager
Regulatory Compliance

Sworn to and subscribed before me
this 17th day of May 2012

Cynthia Olesky

Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Cynthia Olesky, Notary Public
Manor Boro, Westmoreland County
My Commission Expires July 16, 2014
Member, Pennsylvania Association of Notaries

(1) I am Manager, Regulatory Compliance, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in DPC-12-54 P-Attachment, "Catawba Unit 1 & 2 and McGuire Unit 1 & 2 – Response to NRC Formal Request for Additional Information (RAI) from the Reactor Systems Branch Related to the 10 CFR 50.46, 30-Day Report" (Proprietary) for submittal to the Commission, being transmitted by Duke Energy letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with fuel thermal conductivity degradation, and may be used only for that purpose.

This information is part of that which will enable Westinghouse to:

(a) Assist customers in providing responses to RAIs dealing with the 10 CFR 50.46, 30-day report.

Further this information has substantial commercial value as follows:

(a) Provide licensing support with respect to thermal conductivity degradation.

(b) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar fuel design and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for plant-specific review of thermal conductivity degradation impacts.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

COPYRIGHT NOTICE