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W3F1-2009-0001

January 8, 2009

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

SUBJECT: RAI Response to Amendment Request NPF-38-276
Core Protection Calculator Power Calibration Adjustment Limit
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

REFERENCES:
1. Entergy letter dated September 17, 2008, "License Amendment Request NPF-38-276, Core Protection Calculator Power Calibration Adjustment Limit" (W3F1-2008-0050)
2. NRC Request for Additional Information Regarding "License Amendment Request NPF-38-276 to Modify Core Protection Calculator Power Calibration Adjustment Limit," dated December 2, 2008 (TAC NO. MD9657)

Dear Sir or Madam:

By letter (Reference 1), Entergy Operations, Inc. (Entergy) proposed a change to the Waterford Steam Electric Station, Unit 3 (Waterford 3) Technical Specification (TS) 3/4.3.1 to revise Note 2 of Technical Specification Table 4.3-1.

By letter (Reference 2), the NRC issued five RAI questions. Entergy's response to the RAI is included in Attachment 1.

There are no technical changes proposed. The conclusions of the original no significant hazards consideration included in Reference 1 are not affected by any information contained in this RAI response letter.

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NRR

There are no new regulatory commitments contained in this submittal. If you have any questions or require additional information, please contact Robert J. Murillo Manager, Licensing at (504) 739-6715.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 8, 2009.

Sincerely,

RBG/MEM/ssf

Attachment: 1. RAI Response to Amendment Request NPF-38-276, Core Protection Calculator Power Calibration Adjustment Limit

cc: Mr. Elmo E. Collins, Jr.
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Attachment 1

W3F1-2009-0001

RAI Response to Amendment Request
NPF-38-276, Core Protection Calculator Power Calibration Adjustment Limit

RAI 1 - *The second paragraph on Page 4 of Attachment 1 to the Entergy submittal indicates that the calibration of CPC power indications is not required at power levels of less than 15 percent rated thermal power (RTP) since inherent conservatisms in the CPC calculations at these power levels compensate for any potential de-calibration. Please discuss the "inherent conservatisms" in the CPC calculations and justify that they are adequate to compensate for potential de-calibration at the designated power levels.*

Entergy Response:

CPC calculates DNBR and LPD assuming a power level of 20 percent whenever the power level is less than or equal to 20 percent. Between 15 percent power and approximately 40 percent power, CPC power indications are calibrated to primary calorimetric which has a maximum one-sided 95/95 uncertainty of less than 3 percent power.

In addition, the CPC calculations assume a very conservative fixed axial shape at low power levels since excore detector signals are less reliable. The fixed axial shape has a large three-dimensional peaking factor, Fq, and a negative axial shape index (ASI). The fixed axial shape is described in CEN-305-P Revision 02-P on page 4-112. The decision whether to use the fixed axial shape is based on the flag "IDIR" which is described on page 4-95. IDIR is based on the sum of the raw excore detector signals with different limits for increasing power and decreasing power in order to avoid switching back and forth. When decreasing power the measured axial shape switches to the fixed axial shape at typically no lower than 15 percent power. The fixed axial shape has an axial peak, Fz, of greater than 1.90 and the unrodded Fxy is typically greater than 1.4. Therefore, the Fq = (Fz * Fxy) that is used by CPC at low powers will be greater than 2.66. The ASI of the fixed axial shape is a value of -0.15. Since a negative ASI is a top peaked neutron flux in the reactor core, the result is more limiting for DNB than a center or bottom neutron flux peaked shape. This is due to the axial power peak being in a higher temperature region of the reactor. The combination of the higher axial power peak and higher temperature results in a more limiting DNB. The CPC LPD calculation is not an issue at 15 percent power. The centerline melt limit of 21.0 kW/ft can not be reached at 15 percent power for any possible axial shape and radial peaking factor.

In addition, the fixed axial shape is normalized to an average axial power fraction of 1.56. The combination of the minimum power level of 20 percent (vs. 0 to 15 percent), the ASI of -0.15 (vs. nominal ASI of around 0.0), the axial peak of 1.9 (vs. nominal axial peak of less than 1.25) and the normalization factor of 1.56 (vs. 1.0) make the fixed axial shape significantly conservative. The minimum power level of 20 percent by itself is sufficiently conservative to compensate for decalibration. The characteristics of the fixed axial shape are extra conservatisms to avoid potential oddities of the excore detector signals at very low power levels.

Finally, although sensitivity studies for demonstrating conservatisms at less than 15 percent power were deemed unnecessary, the Power Distribution Limits Technical Specifications provide conservative controls as contained in Technical Specifications 3/4.2.2, Planar Radial Peaking Factors, and 3/4.2.3, Azimuthal Power Tilt, Limiting Condition For Operation, where Applicability begins in Mode 1 above 20 percent of Rated Thermal Power.

RAI 2 - *A phrase, "as close as practical to calorimetric power," is added to both second paragraph of Notation 2.b for power levels between 15 percent and 80 percent of the RTP and Notation 2.c for power level at or above 80 percent of the RTP. The fourth paragraph on Page 2 of Attachment 4 for INSERT B1 to TS BASES 3/4.3 clarifies that the phrase implies that the as-left difference between the affected CPC power indication and calorimetric power should be as near to 0 percent RTP as possible. However, the proposed TS also allows the affected power to be within -0.5 percent to less than 0 percent of the RTP of calorimetric power (for example, the proposed "as left" difference between the affected CPC power indication and calorimetric power is within -0.5 percent to 10 percent and -0.5 percent to +2 percent of the RTP as specified in the second paragraph of Notation 2.b and Notation 2.c, respectively). This negative range may be non-conservative as compared with the value used in the safety analysis (see RAI 5 below). Based on the above-discussed concerns for the non-conservatism of the negative range of the difference in the power indications and non-inclusion of the bases section in the TS, please provide the necessary information to justify that the lower range of -0.5 percent to less than 0 percent of the RTP discussed in this RAI is adequate. This RAI is also applied to first paragraph of Notation 2.b that allows the indication of the reactor protection system(RPS) linear power, or either CPC power indicators to be within -0.5 percent to 10 percent of the RTP of calorimetric power at power levels within 15 percent to 80 percent of the RTP.*

Entergy Response:

The CPC DNBR and LPD calculations that are used in the trip decisions include power adjustment factors (addressable constants BERR1 for DNBR and BERR3 for LPD), power bias factors (addressable constants BERR0 or BERR2 for DNBR and BERR4 for LPD), and cycle-independent power-dependent bias factors that are not addressable. The addressable constants are calculated each cycle to address such uncertainties as CPC power distribution and thermal hydraulic modeling, CHF correlation, system parameter and measurement uncertainties. Among the uncertainty terms that are included in the calculation of these addressable constants and the verification of the cycle-independent power-dependent bias factors are the power measurement uncertainty and the calibration allowance.

If the CPC power indications are higher than the calorimetric power, the CPC DNBR and LPD calculations will be conservative. Conversely, the calculation of the power adjustment factors, power bias factors and power-dependent bias factors address the case where the CPC power indications are allowed to be lower than the calorimetric power. The negative limit of each calibration requirement is covered in the analysis. The power bias factors, BERR0 and BERR2 for DNBR and BERR4 for LPD, are calculated each cycle and include an additive term to cover the maximum calibration tolerance (2.0) in the non-conservative direction at any power level.

The requirement to calibrate "as close as practical" reflects a desire to extend the time at which drift and non-linearity would cause CPC power and secondary calorimetric power to diverge sufficiently to exceed the calibration requirement, thus reducing the probability of exceeding the negative limit for any significant amount of time.

RAI 3 – *The fourth paragraph of Notation 2(b), on page 2 of Attachment 3 in INSERT A requires that the affected CPC power indication be within 8 percent to 10 percent of the RTP greater than calorimetric power. The fifth paragraph on page 3 of Attachment 1 indicates that the analysis assumes that if adjustments are required, the resulting indication will be within 8 percent to 10 percent of the RTP above calorimetric power. Discuss the referenced analysis and address the acceptance of the analysis in support of the power adjustment range within 8 percent to 10 percent of the RTP above calorimetric power.*

Entergy Response:

The requirement to calibrate such that the CPC power indication is 8 percent to 10 percent greater than calorimetric power if it is found to be more than 10 percent greater is based on a desire to minimize adjustment of CPC power indications in the non-conservative direction whenever operating below 80 percent power. If a CPC power indication is more than 10 percent greater than the calorimetric power, it is possible that the difference is caused at least in part by an error in the calorimetric power measurement. Therefore, it is important not to recalibrate the CPC power indication such that it becomes non-conservative.

Once the CPC power indications are calibrated within range of -0.5 percent to +2.0 percent RTP of the secondary calorimetric power at or above 80 percent power, the only reasonable cause for the CPC power indications becoming more than 10 percent RTP greater than the calorimetric would be the non-linearity, drift and uncertainty of the calorimetric and drift of the inputs to the CPC power indications. As discussed in response to Question 1, CPC power indications are calibrated to the primary calorimetric between 15 percent and approximately 40 percent power and secondary calorimetric above approximately 40 percent power. The uncertainty for either calorimetric in those power ranges does not exceed 3 percent RTP. Therefore, it is extremely unlikely that non-linearity, uncertainty or drift would cause the difference between the CPC power indications and the calorimetric to exceed 10 percent RTP.

By consideration of the very unlikely scenarios that would result in a CPC power indication being more than 10 percent higher than the calorimetric power measurement, it is judged that a 2 percent window within the 10 percent difference is reasonable to maintain conservatism of the CPC DNBR and LPD calculations. Another approach would be to allow the CPC power indications to remain more than 10 percent higher than the calorimetric power measurement while the cause of the difference is investigated. Per Entergy Procedure EN-LI-102, Corrective Action Process, sub-step 5.2[1](e) employees are required to initiate condition reports for adverse conditions. Per EN-LI-102, Attachment 9.2, Examples of Adverse Conditions, Item 8, deviations from Design/Licensing Basis Conditions, includes failure to comply with design or license basis commitments as described in the SAR, TS, TRM, etc.

RAI 4 – *The third and fourth paragraphs of Notation 2.b in INSERT A specify the power adjustment range for power indication that is more than 10 percent of the RTP above the calorimetric power when power levels are within 15 percent to 80 percent of the RTP. The proposed adjustment range is within 0 percent to 10*

percent of the RTP greater than calorimetric power for the RPS linear power indication, and within 8 percent to 10 percent of the RTP greater than calorimetric power for the CPC delta T (ΔT) power, or CPC neutron flux power indicator. Please provide bases to justify that the difference values of the power adjustment ranges (i.e., 0 percent - 10 percent vs. 8 percent -10 percent) are proposed for different power indicators (i.e., the RPS linear power indicator vs. CPC ΔT power, or CPC neutron flux power indicator).

Entergy Response:

The 8 percent to 10 percent power adjustment range for the CPC power indications is discussed in response to Question 3. The RPS linear power trip is not explicitly credited in any safety analysis. Therefore, as long as the linear power indication is maintained greater than or equal to the calorimetric power measurement, it will perform its function as a backup high power trip.

RAI 5 - *Notation 2.c in INSERT A specifies that for power levels at or above 80 percent of the RTP, when the indication of the RPS linear power is not within ±2 percent of the RTP of calorimetric power, then calibrate the affected indication as close as practical to calorimetric power but within -0.5 to +2 percent of the RTP of calorimetric power.*

A similar TS specified as SR 3.3.1.4 of NUREG-1432, Standard technical Specifications for Combustion Engineering Plants, requires the operator perform a CPC calibration to make the CPC ΔT power, or CPC neutron flux power calculations <u>agree with</u> (underlined for emphasis) the calorimetric power, if the absolute difference is <u>≥ [2] percent</u> (underlined for emphasis). The number in the bracket is a plant specific number and should be justified by the licensee for each specific plant. The associated BASES section clarifies that the value of 2 percent in the bracket is used because this value is assumed for power measurement uncertainty in the safety analysis.

In the Updated Final Safety Analysis Report (UFSAR) (Revision 14B) for Waterford 3, Chapter 15 indicates that a uncertainty of power measurement of 0.5 percent is assumed in determining an initial power level used for transient and accident analyses. For example: the fourth assumption on page 15.2-5 for the heatup event analysis indicates that an initial power of 3735 megawatt thermal (MWt) is based on a RTP of 3716 MWt and <u>0.5 percent</u> (underlined for emphasis) uncertainty; and assumption b.1 on page 15.6-19 indicates that the reactor power is based on post LOCA long-term operation at a core thermal power of 3735 MWt that is <u>100.5 percent</u> (underlined for emphasis) of the RTP of 3716 MWt.

Please provide information to justify that the value of ±2 percent of the RTP discussed above for Notation 2.c is adequate by addressing its consistency with the SR 3.3.1.4 of NUREG-1432 and Waterford UFSAR Chapter 15 assumed power measurement uncertainty used for safety analysis. Also, please justify that the adjusted as-left range of -0.5 to 2 percent (specifically, the negative range from -0.5 percent to less than 0 percent) of the RTP of calorimetric power is adequate by showing that the range is bounded by the value used in the safety analysis.

Entergy Response:

The CPC DNBR and LPD calculations include allowances for both the power measurement uncertainty and the negative tolerance for calibration of the CPC power indications to secondary calorimetric power measurements. These allowances are unrelated.

The power measurement uncertainty is applied via the Modified Statistical Combination of Uncertainties (MSCU) methodology described in CEN-356(V)-P-A Revision 01-P-A, Sections 2.3 and 3.3 and Tables 3-2, 3-4 and 3-7. Typically, a secondary calorimetric power measurement uncertainty (1σ) of 1 percent RTP is used in the CPC uncertainty analysis (see CEN-356(V)-P-A Revision 01-P-A Table 3-7). The secondary calorimetric power measurement uncertainty based on the ultrasonic feedwater flow input is less than 0.5 percent RTP (95/95 one-sided). This smaller uncertainty is not credited in the CPC uncertainty analysis so that the resultant addressable constants apply to the limiting power measurement technique in case the ultrasonic feedwater flow measurement equipment is out of service.

The negative limit of the calibration tolerance (2 percent at or above 80 percent power per Notation 2.c and 0.5 percent from 15 percent to 80 percent power per Notation 2.b) is addressed as described in response to Question 2. There is no need for consistency between the calibration tolerance and the power measurement uncertainty, and they are both accounted for in the CPC analysis.

The "as-left" range extends to -0.5 percent in order to provide a reasonable range for calibration precision. As discussed in response to Question 3, the requirement to calibrate "as close as practical" reflects a desire to extend the time at which drift and non-linearity would cause CPC power and secondary calorimetric power to diverge sufficiently to exceed the calibration requirement, thus reducing the probability of exceeding the negative limit for any significant amount of time.