Entergy

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April 14, 2003

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

SUBJECT: Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
Docket 50-293
License No. DPR-35

Response to NRC Request for Additional Information
Appendix K Measurement Uncertainty Recovery – Power Uprate Request

REFERENCE:

1. Entergy letter to the NRC, License Amendment Appendix K Measurement Uncertainty Recovery-Power Uprate Request, dated July 5, 2002

2. Entergy letter to the NRC, Response to Request for Additional Information - License Amendment Appendix K Measurement Uncertainty Recovery-Power Uprate Request, dated March 17, 2003

LETTER NUMBER: 2.03.042

Dear Sir or Madam:

Discussions with the NRC on April 7th and 10th 2003 indicated that additional information was needed to complete their review of the reference submittal. Attached is the additional information requested.

The document identified as Attachment 2, Westinghouse Electric Company LLC calculation, "Determination of Uncertainty in Pilgrim Station's 'Core Thermal Power Evaluation' with Revised Crossflow Ultrasonic Feedwater Flow Measurement," is proprietary as noted below.

This submittal contains proprietary information owned by Westinghouse Electric Company, LLC. In conformance with the requirements of 10 CFR Section 2.790, as amended, of the Commission's regulations, we hereby request that this proprietary information be withheld from public disclosure. The attached affidavit sets forth the basis on which the information identified as proprietary and owned by Westinghouse may be withheld from public disclosure by the Commission.

APD1

This material is for your internal use and may only be used for the purpose for which it is submitted. It should not be otherwise used, disclosed, duplicated or disseminated, in whole or in part, to any other person or organization outside the NRC Office's of Nuclear Reactor Regulation without the express written approval of Westinghouse.

This response does not change the no significant hazard conclusions previously submitted in Entergy Letter 2.02.048, dated July 5, 2002.

Should you have any questions or comments concerning this submittal, please contact Bryan Ford at (508) 830-8403.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 14th day of April 2003.

Sincerely,

Robert M. Bellamy

JRH/dd

Attachments:
1. Response to NRC Request for Additional Information (4 pages)
2. Westinghouse Electric Company LLC Power **PROPRIETARY** Uncertainty Calculation (157 pages including proprietary affidavit)
3. Excerpt from Entergy's Drawing M208 showing location of Ultrasonic Flow Meters (1 page)

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ATTACHMENT 1

LETTER NUMBER 2.03.042

Response to NRC Request for Additional Information

Response to NRC Request for Additional Information

NRC Request: 1

In regard to your submittal dated March 17, 2003, the staff cannot make a licensing decision on the basis of an unsigned "draft" document having no evidence of review or of any kind of QA or document control having been applied to it. It would be acceptable for the calculation to apply assumed limiting values in those cases for which the final values cannot be established until after installation of the flowmeters, but the calculation itself must be formally issued with all appropriate reviews, signatures, etc. In such a case, it must then be shown later that the final values are enveloped by whatever was used in the calculation. Other issues related to the "draft" nature of the calculation include:

(1) Many input data (Table 6.2-1) are unsupported, and some are illegible or missing altogether. Some measurement loop uncertainties are presented as barely larger than the computer input module uncertainties alone, even though those loops contain at least two other components. There is no indication of the basis for any of the indicated parameter uncertainties, nor of what components, effects, or computational methodologies apply to them. Most of the data references are not identified. This lack of support compromises the results of the calculation, since the input data cannot be verified.

(2) Figure 6.2-1, which is described as showing the various systems involved in the calorimetric, is missing. Without this figure, the staff can only base assessment of what is provided upon general principles and not upon plant-specific details. It is possible that this figure would be helpful in resolving the issues cited elsewhere in this listing of questions in regard to Sections 6.3.1 and 6.3.2.

Response:

See Attachment 2 for a bounding calculation demonstrating that the total loop uncertainty will be 0.5% or less. This Westinghouse calculation has been accepted by PNPS and incorporated as an official design basis document.

NRC Request: 2a

Sections 6.3.1 and 6.3.2 of the calculation address the calorimetric calculation and the propagation of associated errors:

(1) The Qp formula on page 18 depends upon pump efficiency, which is usually presented as a limiting, rather than specific, value. For the purposes of an uncertainty calculation, this seems rather imprecise. Please address the impact of the potentially significant error in this term upon the accuracy of the overall thermal power uncertainty evaluation.

Response:

Equation 6.3.1 in the calculation uses a specific value for the energy added by the recirculation pumps. This specific value maximizes the contribution from the

recirculation pumps to the heat balance analysis. The uncertainty of the pump efficiency is factored in as a negative bias to the overall uncertainty calculation. This is a conservative means of treating pump efficiency uncertainty and evaluating the Core Thermal Power. In response to the second part of the question, the pump energy is small when compared to the heat input from the core.

NRC Request: 2b

(2) The section beginning "There is a somewhat subtle detail..." near the bottom of page 21 addresses an unexpected condition regarding the sensitivity of thermal power to FW flow as measured by the two venturis: If the temperatures of the two venturi flows were equal, then the partial derivative of the {core heat removed by feedwater} with respect to {the venturi flow measurements} would be zero. In other words, thermal power would be independent of feedwater flowrate. The proposed remedy, to assume that the temperatures cannot be equal, seems mathematically and physically unsound. Please verify the physical and mathematical bases for these calculations and explain, from a physical basis as well as a mathematical basis, why they are correct and reasonable. Identify and adjust all other assumptions and related aspects of the calculations as necessary.

Response:

The equation shows the weighted average of the energy in each of the venturi legs, using flow through each leg and the temperature of each leg (i.e., enthalpy). As the calculations describes it "*if the temperatures of the two flow loops are taken to be equal (i.e., in both of the venturi legs) then the enthalpies ha and hb will be equal. In this case the weighted average will be equal regardless of any difference in the flow rates through the loops*". If the temperature (and enthalpy) in both legs is the same, and we have the total FW flow, it doesn't matter what the flow distribution is, or which leg it flows through. In this case, feedwater enthalpy is independent of flow, but calculated core power is directly dependent on feedwater flow.

The description in the draft calculation supporting the basis for assuming a 5 °F difference between the A and B feedwater lines was confusing and has been revised.

Assuming that the temperatures in the two feedwater lines are not equal is a conservative assumption. This is due to the fact that the combined weighted error of both feedwater lines at equal temperature is the lowest error value; and the error increases as the temperature variation between the two lines gets larger.

The actual FW delta T reading on April 10, 2003, was ~2 °F, which is in the expected range. Using a 5 °F feedwater line delta T provides a conservative analysis. The physical basis for selecting 5 °F as conservative is based on the design of the feedwater piping. The lines are insulated and the feedwater supply to both lines is common and thoroughly mixed; the only other input source is the bypass flow and that valve is normally closed.

NRC Request: 3

Page 15 (of the Draft calculation) indicates that the UFM-based venturi correction factor (CF) is applied to the sum of the venturi flows as corrected for actual density. The W_{bp} term, however, vanishes from the equation in the transformation. Please confirm that this is an unintentional typographical error.

Response:

The bypass term does not disappear, although it is not obvious from the formula alone. The drawing excerpt from P&ID 208 sheet 1 (Attachment 3) shows the piping configuration and should clarify the discussion. The W_{bp} term (bypass flow) represents a flow not measured by the Crossflow Ultrasonic Flow Meter. W_{bp} enters the flow stream upstream of the venturis, so it is measured by them (and included in W_a plus W_b). The Crossflow flow (W_{cf}), plus the bypass flow (W_{bp}) is equal to the total flow through the venturis ($W_a + W_b$).

NRC Request: 4

Item 2 of Entergy's letter of March 17, 2003, indicates that the venturi correction factor will be re-evaluated under certain conditions that call it into question, and power will be adjusted accordingly. We expect that the correction factor would be updated continuously whenever at least one UFM is available, and that the correction factor would always be either fully reliable or not reliable at all. The conditions regarding inability to determine a "valid" correction factor and concerning some intermediate power limit reduction (to a value lower than the uprated limit but possibly higher than the pre-uprate limit) are not clear to us. Please explain.

Response:

When the AMAG system is inoperable and the installed correction factor is determined to be non-conservative, the proposed 24 hour AOT will be exited and core thermal power will be lowered to 1998 MWt expeditiously.

NRC Request: 5

The supplier information attached to the March 17, 2003, letter indicates an overall module uncertainty of 0.5%. Some of the instrument channels are claimed in Table 6.2-1 to have an uncertainty of only 0.55% despite the fact that they have at least two other components in addition to the input module. This suggests that the computer input module uncertainties are not included in the loop uncertainty evaluations. Please explain. In addition, please explain how the module uncertainty is to be limited to the manufacturer's indicated value despite an apparent lack of periodic verification of the on-board reference standards. We find the licensee's assertion that the computer input modules need not be calibrated (item 4 of licensee letter of Nov. 6, 2002, and item 4 of licensee letter of March 17, 2003) not to be supported by any of the information presented to date.

Response:

In an uncertainty analysis that includes multiple independent variables all error terms must be referenced to a common base (i.e. percent of reading). This allows combination of multiple parameter errors. An example of this methodology is presented in ANSI/ASME PTC 19.1-1985, "Measurement Uncertainty" Part 1 paragraph 5.2.

For the case in point, Pilgrim's uncertainty analysis for feedwater temperature, the manufacturer of the computer module expressed the uncertainty as ± 0.5% of scale. Pilgrim calibrated the module to a specific range and expressed the error as ± 1% of calibrated range, or 1.5 °F. When this error is converted to a common base to be combined with the other parameter errors, the error is expressed as ± 0.413% of reading. The error is still the same absolute value, 1.5 °F, just expressed with relation to a different base.

As discussed in the Analogic Manual, the A/D converter performs self-calibration checks. Please see section 3.2.9.2.12 of the Analogic Manual excerpts provided via letter dated March 17, 2003 for additional information.