April 11, 2003

Mr. Thomas Coutu
Site Vice President
Kewaunee Nuclear Power Plant
Nuclear Management Company, LLC
N490 State Highway 42
Kewaunee, WI 54216

SUBJECT: KEWAUNEE NUCLEAR POWER PLANT - REQUEST FOR ADDITIONAL INFORMATION REGARDING PROPOSED MEASUREMENT UNCERTAINTY RECAPTURE POWER UPRATE (TAC NO. MB7225)

Dear Mr. Coutu:

By application dated January 13, 2003, as supplemented February 27, 2003, the Nuclear Management Company, LLC (NMC), requested an amendment to the Operating License and Technical Specifications for the Kewaunee Nuclear Power Plant. The proposed amendment requests approval of a measurement uncertainty recapture power uprate, which would allow an increase in power level from 1650 megawatts thermal (MWt) to 1673 MWt (1.4 percent) based on installation of a Crossflow ultrasonic flow measurement system.

The Nuclear Regulatory Commission (NRC) staff has reviewed the submittals and finds that additional information is needed, as identified in the enclosed request for additional information (RAI).

Draft RAIs were e-mailed to Mr. G. Riste and Ms. L. Gunderson (NMC) on March 6, 13, 17, 26, 27, and 31 2003, and April 4, 2003. Conference calls were held on March 28, April 1, and April 2, 2003, between members of NMC's staff (G. Riste, L. Gunderson, et al.) and members of the NRC staff (R. Hernandez, L. Raghavan, G. Georgiev, T. Chan, J. Wu, C. Graham, I. Ahmed, M. Waterman, S. Peters, and myself) to discuss the RAI. A mutually agreeable response date of May 7, 2003, was established during the conference calls.

Please contact me at (301) 415-1446 if future circumstances should require a change in the response date.

Sincerely,

/RA/

John G. Lamb, Project Manager, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure: RAI

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION

MEASUREMENT UNCERTAINTY RECAPTURE POWER UPRATE

KEWAUNEE NUCLEAR POWER PLANT

DOCKET 50-305

By application dated January 13, 2003 (hereinafter referred to as “the application”), as supplemented February 27, 2003, the Nuclear Management Company, LLC (the licensee), requested an amendment to the Operating License and Technical Specifications for the Kewaunee Nuclear Power Plant. The proposed amendment requests approval of a measurement uncertainty recapture power uprate, which would allow an increase in power level from 1650 megawatts thermal (MWt) to 1673 MWt (1.4 percent) based on installation of a Crossflow ultrasonic flow measurement system. The Nuclear Regulatory Commission (NRC) staff has reviewed the licensee’s submittals and finds that the following additional information is needed:

MECHANICAL AND CIVIL ENGINEERING

1. On page 35 of Attachment 2 to the application, the licensee states that thermal, pressure, and flow rate "change factors" were developed during the evaluation of Nuclear Steam Supply System (NSSS) piping, other than the reactor coolant loop (RCL) and pressurizer surge line piping (e.g., chemical and volume control, residual heat removal (RHR), safety injection, internal containment spray, and component cooling water systems). The licensee also indicated that if the change factors were less than or equal to a five-percent increase, the increase was considered to be acceptable. If the change factors were greater than five percent, more detailed evaluations were performed. It is not clear how the five-percent criterion was determined as a cutoff percentage increase for evaluation of power uprate effects on piping.

   Provide a summary describing how the calculations of the change factors are done with respect to the increase in temperature, pressure, flow rate, and thermal/pressure transients for the proposed power uprate. Also, provide a summary of the quantitative evaluation to confirm there are more than five-percent safety margins for systems that were evaluated using the change factors.

2. Section 5.5 of Attachment 3 to the application, the licensee indicated that RCL piping analyses were performed for an uprated power level of 1772 megawatts thermal (MWt) in compliance with United States of America Standard (USAS) B31.1, “Power Piping Code,” 1967 edition, which is the code of record for RCL piping, and does not require a fatigue analysis. The acceptance criteria for the pressurizer surge line is based on the American Society of Mechanical Engineers’ *Boiling and Pressure Vessel Code* (ASME Code), Section III, Subsection NB, 1986 edition, which is the code of record Kewaunee. The calculated stresses of RCL piping for the proposed power uprate condition are provided in Table 5.5.1-2 of Appendix 3 to the application.

ENCLOSURE

Provide the calculated maximum stresses and fatigue cumulative usage factors (CUFs) in compliance with the code of record for the pressurizer surge line piping for the proposed power uprate condition.

3. In Table 5.8-1 of Attachment 4 to the application, the licensee compares the design parameter change in temperature, Delta T_{cold} (or Delta T_{hot}), between the pressurizer temperature and the cold leg (or hot leg) temperature. The higher the Delta T_{cold} is, the higher the thermal stress will be in the spray nozzle and the pressurizer upper shell. In Table 5.8-3 of Attachment 4 to the application, the licensee compares the original and revised stress intensity (SI) ranges for the proposed power uprate. The original design-basis SI range was calculated based on design-basis condition with a Delta T_{cold} of 125 °F in comparison to 132 °F for the proposed power uprate condition and 160 °F for the replacement steam generator condition.

   Provide a summary of the evaluation, including stresses and CUFs, for the spray nozzle and the upper shell, which are exposed to higher Delta T_{cold} than they were originally designed for while operating at the proposed power uprate condition and in the replacement steam generator condition. Also, clarify how Delta T_{cold} is considered as 132 °F for the proposed power uprate condition and 160 °F for the replacement steam generator condition, while both the pressurizer temperature and the cold leg temperature are the same for both cases.

4. In Section 5.8.1.6 of Attachment 4 to the application, the licensee provides an evaluation based on the ASME Code, 1965 edition with addenda through summer 1966. In Section 5.8.1.5, the licensee states that an elastic-plastic analysis was performed in accordance with Section NB-3228.3 of the ASME Code.

   Identify the code of record and code edition used in the power uprate analysis.

5. On page 36 of Attachment 2 to the January 13, 2003, application, the licensee states that assessment of the balance-of-plant (BOP) piping and supports (including main steam, condensate and feedwater, auxiliary feedwater, and steam generator blowdown systems piping) were performed for a power uprate at 1772 MWt (which is about 7.4 percent above the current rated power of 1650 MWt). The licensee concluded that the piping and pipe supports remain in compliance with the USAS B31.1.

   - Provide a summary of the evaluation for the BOP piping and supports (including calculation of the "change factor"), the calculated maximum stresses, and CUFs at critical locations evaluated for each system’s piping for the proposed power uprate conditions, the allowable ASME Code limits, and the ASME Code and its edition used in the evaluation. If different from the code of record, provide a justification.

   - Describe how the change factors were calculated and how the factors were used to predict the stress values. Also, discuss how the stress, based on the change factors, is to be combined with those stresses due to fluid transient events for which separate analyses were performed.

- Provide more details of the technical basis regarding the statement that "the current piping analysis is considered to have enough conservatism to cover a change of five percent or less." Identify each conservatism in the current analysis to demonstrate they can accommodate a five-percent increase in the change factors.

ELECTRICAL AND INSTRUMENTATION CONTROLS

General question

1. Explain how the plant process computer (PPC) reactor thermal output (RTO) calculation is used in the operation of the plant.

Questions pertaining to Attachment 2 of the application

1. Section I.1.C (page 2) states, in part, "...the RTO computer program will be modified to receive the Crossflow UFMD [ultrasonic flow meter device] generated individual venturi flow and ..."

   Explain the phrase "UFMD generated individual venturi flow." Also, discuss the RTO computer program change, in detail, to include changes in the calculation algorithm and communication interface (e.g, will the change or interface add additional uncertainties? Why or why not?).

2. Section I.1.C (page 2) states, in part, "...installation of [Crossflow] ...meets the requirements of CENP-397-P-A (reference I.1, section 1.4.2)." There do not appear to be requirements in this section. What requirements is the attachment referring to?

3. The licensee proposes the use of ultrasonic temperature measurements. As stated in Section I.1, these are "...not described in CENP-397-P-A ["Improved Flow Measurement Accuracy Using Crossflow Ultrasonic Flow Measurement Technology]." Figure 3 of Attachment 7 indicates use of the UTM [ultrasonic temperature measurement] for density correction and enthalpy of the feedwater. Furthermore, Table I.1 (page 9) suggests an additional 0.2% reactor thermal power to be gained by using the UTMs.

   Provide information on the use of the UTMs in sufficient detail for the NRC staff to evaluate its use. The following are some items to include:

   - The type of sensor and the theory of operation
   - Is it an analog or digital sensor?
     - A diagram of the sensor (preferably from the vendor drawings)
       - Make, model number, etc.
       - How the sensitivity and uncertainty values were determined (i.e., where do the numbers come from)
       - How the UTM interfaces with the PPC and have those interfaces been considered in the uncertainty determination
       - How the UTMs will be calibrated and what is the suggested calibration periodicity

4. CENPD-397-P-A identifies and details several diagnostic features associated with the ultrasonic flow meter (UFM) providing the operators with information regarding its availability. Section I.H (page 8) states, in part, "If the UTMs...become unavailable." However, there is no discussion of the UTM in CENPD-397-P.

   What indications will be available to plant operations staff letting them know that the UTM or UTMs are unavailable? Provide a detailed enough response to allow the NRC staff to understand how long the plant would be operating at the additional margin afforded by use of the UTMs before their failure is discovered by plant operations staff.

5. Section 8.1.3 of CENPD-397-P-A discusses the transducer installation.

   Discuss any expected differences in the mounted-to-a-support-frame (M/TSF) area temperature from the time it is measured at installation to the time Kewaunee will be operating.

6. Discuss, in further detail than provided on page 3 (D.1), the maintenance items the licensee foresees for the UFMD. For example, in CENPD-397-P-A, Appendix B, “Response to NRC Request for Additional Information Supporting Topical Report CENPD-397-P Review Activities,” the RAI-13 response discusses an "internal time delay check [which] is confirmed monthly in the field...."

   The licensee’s response can be in the form of a tabularized or bulleted list which can provide the NRC staff with assurance that preventative maintenance has been appropriately identified.

7. In Section F.v (page 7), the licensee addressed Regulatory Information Summary (RIS) 2002-03, “Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications,” Section F.v for the UFMDs only.

   Address Item I.1.F.v receiving and addressing manufacturer deficiency reports for the remaining "instruments that affect the power calorimetric."

<u>Questions pertaining to Attachment 7 of the application (WCAP-15591, Revision 1, “Westinghouse Revised Thermal Design Procedure Instrument Uncertainty Methodology - Kewaunee Nuclear Plant (Power Uprate to 1757 MWt - NSSS Power with Feedwater Venturis, or 1780 MWt - NSSS Power with Ultrasonic Flow Measurements, and 54F Replacement Steam Generators”)</u>

1. Explain the correlation between calorimetric sensitivities and associated measurement uncertainties given in Tables 10 - 15 and provide the methodology used to determine the individual sensitivities and uncertainties for values given in these tables.(e.g., where do the values come from?)

   - On page 3, which provides equations 1, 2, and 3, why are the variables of allowance for conversion accuracy of an analog-to-digital signal for PPC use not present?

- Table 1 (page 8) provides control and indication uncertainties. The NRC staff calculated a value of 5.25 percent for channel statistical allowance (without BIAS value) and thus calculated a different value for pressurizer pressure electronics uncertainty. Provide an explanation of the difference.

- Table 3a (page 19) provides flow uncertainties. Why are values not present for (1) the reference signal uncertainty for a closed-loop automatic control system, (2) measurement and test equipment used to calibrate the controller rack module(s) that perform the comparison between the controlled parameter and the reference signal, and (3) allowance of the controller rack module(s) that perform the comparison and calculates the difference between the controlled parameter and the reference signal?

- On page 19, the NRC staff calculates a different value than 3.6 in the table. The 3.6-percent channel statistical allowance multiplied by the span of 800 does not equal 14.2. It appears that the number 3.6 is divided by the square root of 4, and multiplied by the span, but that value is equal to 14.4. Provide an explanation of the difference.

- What equation is being used on page 33 and why are some uncertainty values being subtracted?

- Page 40 presents uncertainties of steam generator blowdown. Why are some values not present for the turbine flow meters (e.g., sensor pressure effects and primary element accuracy)?

2. Have uncertainties associated with the UFM and UTM communication protocol to the PPC been considered? If yes, are they included in the calculation? If yes, identify which part.

3. Provide a diagram similar to figures 2 and 3, but in more detail to identify calculations performed in the PPC or elsewhere, inputs to the PPC, and the communications links that exist. Also, provide the communications protocols for all inputs (e.g., analog-4-20 ma, EIA-232, 422). An engineering-grade drawing is preferable.

4. How will the PPC implement the different suite of inputs (UFM/UTM, UFM/resistence temperature device (RTD), venturi/RTD) consistent with the operational conditions of the UFMs, UTMs and RTDs? Provide enough detail to aid the NRC staff in understanding how the operational modes are selected.

5. A number of calculations are present which support reactor coolant system (RCS) flow measurement.

   Describe how use of these calculations will support the 1.4-percent power uprate (i.e., identify which calculations, pages, and tables (of Attachment 7) are being used to support the 1.4-percent power uprate).

6. Provide the in-situ calibration procedure in sufficient detail for the NRC staff to understand the plant specific configuration and process. The following are some items/considerations to include:

- A piping and instrumentation diagram showing the location of proposed UFM and UTM sensors and stand-alone UFM with detail to include the feedwater bypass and flow paths (an engineering drawing (with ISA type symbols) may be the best way to accomplish this). This drawing can then be used in the discussion.
- A discussion of the calibration procedure to be performed and which UFMs need to be calibrated using the stand-alone UFM. Are there one or two calibration UFMs?
- A discussion how often the UFMs are to be calibrated.
- A determination to verify fully developed flow in the stand-alone UFM and UFMs that do not require stand-alone calibration.
- A discussion of how the existing feedwater venturis will be calibrated to allow the operation of the reactor at power given in Table I.1.

7. For installation of the calibration UFM, how will fully developed flow be assured in the feedwater bypass line given the use of a flow straightener, venturi nozzle, and diffuser?

8. In CENPD-397-P-A, Appendix B, "Response to NRC Request for Additional Information Supporting Topical Report CENPD-397-P Review Activities," the RAI-9 response discusses the effect of corrosion products on UFM measurement. The ABB Combustion Engineering Nuclear Power response provides recommendations to address pipe-wall monitoring.

   Discuss the evaluation performed or planned to address this RAI response and CENPD-397-P-A, Section 5.4, Inside Pipe Diameter.

9. How are the velocity profile curves for each loop determined at Kewaunee?

10. Since the Crossflow is a clamp on flow meter, describe the interactions (environmental, physical, fluid communication) that will affect existing feedwater instrumentation due to the installation of the Crossflow system and any interactions that existing flow instrumentation will have on the Crossflow system.

11. In Table 10 (page 40) for UTM feedwater temperature, why is there no uncertainty for allowance for conversion accuracy of an analog-to-digital signal for PPC use? Is this already considered in the uncertainty provided to the licensee?

MATERIALS AND CHEMICAL ENGINEERING

Tube Repair Limits (Regulatory Guide 1.121 Analysis)

1. In Section 5.7.10 of Attachment 3 to the application, the licensee indicates that an analysis is being performed to define the structural limits for an assumed uniform thinning mode of degradation in both the axial and circumferential directions. Calculations have also been performed to establish the structural limit for tube straight leg (free span) flaws over an unlimited axial extent and for degradation over limited axial extent at the tube support plate and antivibration bar intersections. As part of Kewaunee License Amendment No. 158, dated May 25, 2001, related to replacement steam generators, the licensee indicated that WCAP-15325, "Regulatory Guide 1.121 Analysis for the Kewaunee Steam Generators," showed that the existing through-wall repair limits remained conservative for the replacement steam generator tubes.

Confirm that this analysis bounds the proposed power uprate operating conditions such that the through-wall defect repair limits remain appropriate for the proposed power uprate operation.

2. In many sections of the application, it states that the conditions are bounded by the analysis developed for the Steam Generator Replacement Project.

   Provide a copy of the Steam Generator Replacement Project analysis and 10 CFR 50.59 safety evaluation for the applicable sections that are referenced in the MUR power uprate submittal.

PLANT SYSTEMS

1. On page 4.2-6 of Attachment 3 to the application, the licensee states the following: "The Westinghouse original sizing criterion recommended that the steam dump system be capable of discharging 85 percent of the rated steam flow at full-load steam pressure to permit the NSSS [Nuclear Steam Supply System] to withstand an external load reduction of up to 100 percent of plant rated electrical load without a reactor trip....For the power uprate, the large load rejection (LLR) capability was demonstrated to be 50 percent of plant-rated power without a reactor trip." The Kewaunee Updated Safety Analysis Report (USAR), page 10.1-1, states the following: "The Reactor Coolant System can accept a complete loss of external load from full power without reactor trip. The steam dump and turbine electro-hydraulic control systems make it possible to accept a full load rejection to auxiliary load using atmospheric and condenser dump without reactor or turbine trip."

   Justify the difference between the original design and the USAR "to withstand an external load reduction of up to 100 percent of plant rated electrical load without a reactor trip" and the power uprate "50 percent of plant-rated power without a reactor trip." Explain the Kewaunee licensing basis.

2. Page 4.2-10 of Attachment 3 to the application states the following: "...the minimum usable inventory should be increased from 39,000 gallons to 41,500 gallons to meet the loss-of-AC [alternating current]-power licensing basis for the range of NSSS operating conditions upon approval of the 7.4% power uprate. The current capacity of the 39,000 gallons is acceptable for the 1.4% MUR power uprate."

   Explain and justify the conclusion that 39,000 gallons are acceptable for the proposed 1.4-percent MUR power uprate.

REACTOR SYSTEMS

1. Equation 5 (page 13) of Attachment 7 (WCAP-15591) to the application contains a term for reactor coolant pump heat addition (Q_P) and a term for primary system net heat losses (Q_L). These terms are introduced into the overall heat balance without consideration of their actual effect on the hot-to-cold leg enthalpy change, $h_H - h_C$. Since only the portions of these terms that affect heat addition or loss from the cold leg RTD location to the hot leg RTD location affect the temperature readings, and hence affect $h_H - h_C$, this equation is either an approximation that the licensee did not justify or an error.

Address the impact of this equation and any corrective actions that the licensee will take.

2. For the SI and RHR system analyses, the licensee states that the systems were evaluated for an uprated power of 1772 MWt.

   Were these analyses previously approved by the NRC or were they conducted using methods or processes that were previously approved by the NRC? In addition, for the SI system, provide a discussion identifying and evaluating the effects of the higher power level on the system.

3. In Section 4.1.4.3.1 of Attachment 3 to the application, the licensee justifies increased plant cooldown times based on plant economics. This practice is unacceptable.

   Provide an alternate justification for the increased RHR cooldown times.

4. In Section 5.1.2.2 of Attachment 3 to the application, the licensee states that the calculated fluence projections used in the Power Uprate Program evaluation comply with Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence."

   Describe how the fluence calculations comply with RG 1.190.

5. On page 60 of Attachment 2 to the application, the licensee states that the protection system settings will be rescaled for the proposed power level of 1673 MWt.

   Provide a discussion on the changes and a justification for the changes.