November 6, 2011

Mr. Jerald G. Head
Senior Vice President, Regulatory Affairs
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P.O. Box 780, M/C A-18
Wilmington, NC 28401-0780

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RE: GE-HITACHI NUCLEAR ENERGY AMERICAS TOPICAL REPORT NEDE-33284P, SUPPLEMENT 1, "MARATHON ULTRA CONTROL ROD ASSEMBLY" (TAC NO. ME3524)

Dear Mr. Head:

By letter dated January 29, 2010 (Agencywide Documents Access and Management System Accession No. ML100331615), GE-Hitachi Nuclear Energy Americas (GEH) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review topical report (TR) NEDE-33284P, Supplement 1, "Marathon-Ultra Control Rod Assembly." Upon review of the information provided, the NRC staff has determined that additional information is needed to complete the review. On October 25, 2011, James F. Harrison, Vice President - Fuel Licensing, and I agreed that the NRC staff will receive your response to the enclosed Request for Additional Information (RAI) questions by November 15, 2011.

If you have any questions regarding the enclosed RAI questions, please contact me at 301-415-2365 or Stephen.Philpott@nrc.gov.

Sincerely,

/RA/

Stephen S. Philpott, Project Manager
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 710

Enclosures:
1. RAI questions (Non-proprietary)
2. RAI questions (Proprietary)

cc w/encl 1 only: See next page

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REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

NEDE-33284P, SUPPLEMENT 1, "MARATHON-ULTRA CONTROL ROD ASSEMBLY"

GE-HITACHI NUCLEAR ENERGY AMERICAS, LLC

PROJECT NO. 710

RAI-1: Section 3.6.3 of Topical Report (TR) NEDE-33284P, Supplement 1, describes a thermal finite element analysis.

- Explain how the heat generation rates were determined for the thermal model. The boron carbide (B_4C) material was split into a number of rings, each with a particular heat generation rate. What is the basis for the diameters of the rings and the separate heat generation zones? How do these compare to the Marathon-5S design, which has a different B_4C capsule geometry?
- Explain how the convection coefficient that defines heat transfer between the B_4C material and the capsule wall was determined. How well does this convection coefficient match experimental data? What physical conditions (such as temperature, diameter, amount of void space, etc.) affect this convection coefficient? Was the same convection value used in the Marathon-5S and Economic Simplified Boiling Water Reactor (ESBWR)? Is this convection coefficient intended to represent conduction and radiation heat transfer as well?
- Discuss the representation of the helium gap as a conductive material. With the change in gap size, is it necessary to include convection or radiation for correct heat transfer across the gap?
- Explain how the convection heat transfer coefficient between the crud layer and the coolant is calculated. This appears to be based on a Jens-Lottes correlation and modeled as a function of pressure, total heat generation, and exterior surface area. Was this same function used in the Marathon-5S and ESBWR to define the convection coefficient? How well does this function match experimental convection data under similar conditions (temperatures, geometry, flow rates, etc.)?

RAI-2: Section 3.7 of TR NEDE-33284P, Supplement 1, describes a handling load structural finite element analysis.

- Discuss the choice of analyzing the lifting load at a material temperature of 70 degrees Fahrenheit. Since yield strength and ultimate strength of the handle material decreases with temperature, is this a conservative temperature assumption?
- The 2*g* lifting loads are based on control rod weights that are less than the maximum control rod weights listed in Table 2-1 of TR NEDE-33284P, Supplement 1. Discuss the conservatism of these loads and the choice of control rod weight.

RAI-3: Tables 4-1, 4-2, and 4-3 of TR NEDE-33284P, Supplement 1 contain the depletion calculation results for the D, C, and S Lattice designs, respectively. Specifically, they list the calculated changes in hot and cold worth as a function of irradiation time with respect to an unirradiated blade. Why is there a change in hot and cold worth listed for the 0-day irradiated case? The U.S. Nuclear Regulatory Commission (NRC) staff's confirmatory calculation below depicts this change, which is potentially being propagated throughout the entire calculation. Address this apparent bias over the entire irradiation domain.

[ ]

RAI-4: In the nuclear design analysis presented in Chapter 4 of TR NEDE-33284P, Supplement 1, the depletion of the B_4C absorber material in the blades is tracked with Monte Carlo calculations. The NRC staff noted that while the depletion of the blades is tracked from time step to time step, the fuel assembly is assumed to be fresh throughout the analysis. Provide an explanation as to how this is conservative for calculating the limiting quarter-segment depletion.

RAI-5: The B-10 depletion calculations described in Section 4 of TR NEDE-33284P are performed with a constant 40 percent void fraction. What is the basis for the 40 percent void fraction assumption and is this conservative for the expected limiting conditions?

RAI-6: The Executive Summary of TR NEDE-33284P, Supplement 1, states that the Marathon-Ultra control blade design is nuclear lifetime limited. Describe how the hafnium depletion is tracked in the nuclear lifetime calculations and whether alternate absorber loading patterns (described in Section 10 of TR NEDE-33284P, Supplement 1) would invalidate this statement.

RAI-7: Section 10 of TR NEDE-33284P, Supplement 1, describes a process whereby alternate absorber loading patterns may be developed and implemented without NRC involvement or notification.

- Confirm that the alternate absorber loading patterns are limited to interchanging B_4C capsules (and optional empty capsules) with a full length hafnium rod. In other words, a partial length hafnium rod will not reside within the same absorber tube as B_4C capsules.
- Confirm that the potential impact of weight differences between alternate absorber loading patterns is being addressed in the mechanical design calculations and identify the limiting loading pattern. Discuss the maximum possible control rod weights and how they compare to the loads used in the current lifting load finite element models.
- The NRC staff is considering imposing a letter notification requirement, similar to the GESTAR-II process, on any Marathon-Ultra control blade design with an alternative absorber loading pattern. The notification would provide detailed specifications of the alternate absorber loading pattern for each lattice configuration, document the acceptance criteria used to judge its performance, and confirm compliance with these criteria. Discuss the use of a notification process for future design alterations.

RAI-8: Section 6.5 of TR NEDE-33284P, Supplement 1, describes the surveillance program to confirm in-reactor performance. The proposed surveillance requirements are based upon those established for the Marathon-5S design. The fourth and fifth bullet were designed to confirm the mechanical performance as the blade approaches the nuclear lifetime and the breakpoint (percent of design nuclear lifetime) was originally selected based on in-reactor degradation experienced with the Marathon-5S design.

- Discuss the logic used to alter the breakpoint in the fifth bullet (90 percent of design nuclear lifetime) relative to the requirement for the Marathon-5S design ([ ] of design nuclear lifetime).
- Discuss the extension of this breakpoint to 90 percent of design nuclear lifetime (in the fifth bullet) and the potential for this surveillance to merge with the end-of-life surveillance requirement (sixth bullet). In other words, will utilities elect to retire a blade once it exceeds 90 percent of design nuclear lifetime (based on concerns that the end of life would be exceeded during a subsequent operating cycle)?