From: Boska, John
Sent: Thursday, October 04, 2012 8:20 AM
To: Alter, Kent R
Cc: 'Shingleton, Boyd'
Subject: Oconee Units 1, 2, and 3, NRC Request for Additional Information on Analysis for Vessel Internals, ME8436, ME8437, and ME8438

Importance: High

On February 20, 2012, Duke Energy Carolinas, LLC (Duke), submitted a plant-specific analysis to demonstrate that the reactor vessel internals will meet the deformation limits at expiration of the renewed licenses for the Oconee Nuclear Station, Units 1, 2, and 3.

The Nuclear Regulatory Commission staff is reviewing the submittal and has determined that additional information is needed to complete its review. The specific questions are found below. On October 3, 2012, the Duke staff indicated that a response to the RAI would be provided within 45 days of the date of this email.

RAI 1

Section 3.2 of the report entitled “Update of Irradiation Embrittlement in BAW-10008 Part 1 Rev. 1,” (Ref. 1) provided the neutron flux and neutron fluence for the core barrel flanges. Section 3.2 of the Reference 1 describes the assumptions used in determining the fluence but does not describe the methodology used to calculate the fluence.
Describe the methodology used to determine the neutron fluence and address the consistency of the fluence methodology with the guidance of Regulatory Guide 1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence.”

RAI 2

Appendix E to BAW-10008, Part 1, Rev. 1, “Reactor Internals Stress and Deflection Due to Loss-of-Coolant Accident and Maximum Hypothetical Earthquake," (Ref. 2) evaluates the adequacy of the ductility of the Oconee Nuclear Station (ONS) Units 1, 2, and 3 reactor vessel internals (RVI) under the combined loading resulting from a loss of coolant accident (LOCA) and seismic event. Section 3.4 of Reference 1 provides a justification for the use of uniform elongation data from slow strain rate tests (SSRT) which are performed at strain rates of around 10-7/second rather than data from standard tensile tests which are performed at 10-2/second to 10-4/ second, to evaluate the ductility of the internals in the update of this analysis for 60 years. However, it is not clear how the strain rates from the different test methods relate to the strain rate that would occur in the postulated LOCA plus seismic event.
What strain rates are assumed in the loadings evaluated in BAW-10008 Part 1, Rev. 1? If the strain rates for the test data are substantially different from the strain rates for the postulated event, discuss how the test data for uniform elongation are conservative for evaluating the ductility of the RVI during the postulated event.

RAI 3

Section 3.4 of Reference 1 indicates that the majority of the uniform elongation data for solution annealed Type 304 stainless steel (Type 304SA) presented in Reference 1 is from SSRT, which are performed at strain rates of around 10E-7/second, while standard tensile tests are performed at 10E-2/second to 10E-4/ second. Section 3.4 of the report references Figure 3-11 of Reference 1 with respect to the effect of strain rate on the uniform elongation of Type 304SA. Figure 3-11 provides uniform elongation data from Type 304SA irradiated in the EBR-II test reactor as a function of strain rate for room temperature, 450°F, and 700°F. Section 3.4 of Reference 1 states that uniform elongation is seen to decrease moderately with decreasing strain rate at elevated temperatures of 450°F and 700°F [thus] the uniform elongation values from SSRT at ~10E-7/second are conservative compared to those obtained from conventional tensile tests at a strain rate typically ranging from 10E-4/second to 10E-2/second. However, the staff notes that the uniform elongation data shown in Figure 3-11 are from material irradiated to approximately 1x10E23 neutrons per square centimeter (n/cm2) (Energy > 0.1 megaelectronvolt (MeV)), which is two orders of magnitude higher than the predicted end-of-life fluence for the limiting high-strain component for the ONS, Units 1, 2, and 3 RVI. Additionally, the strain rates of the tests depicted in Figure 3-11 range from 2x10E-3/minute (3.3x10E-5/second) to 2/minute (3.3x10E-2/second), which do not overlap the strain rates of the SSRT. Provide further justification for applying the data in Figure 3-11 of Reference 1 to demonstrate that the use of SSRT data to predict the uniform elongation of Type 304SA in the ONS Units 1, 2, and 3 RVI is conservative, given the higher neutron fluence of the EBR-II materials and the different strain rate range of the testing.

References

1. Update of Irradiation Embrittlement in BAW-10008, Part 1, Rev. 1, Areva Document No. 51-9038244, Duke Energy Calculation OSC-10237, Enclosure to letter from T. Preston Gilespie to NRC dated February 20, 2012; Subject: Duke Energy Carolinas, LLC, Oconee Nuclear Station Units 1,2, and 3, Docket Numbers 50-269, 50-270, and 50-287, License Renewal Commitment to Submit a Time Limiting Aging Analysis for the Reactor Vessel Internals to the NRC For Review. (ADAMS Accession No. ML12053A332).
2. AREVA NP Inc. Document BAW-10008, Part 1, Rev.1, “Reactor Internals Stress and Deflection Due to Loss-of-Coolant Accident and Maximum Hypothetical Earthquake," June, 1970.

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