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SUBJECT: Submits response to RAI re 10CFR50.46 large break loss of coolant accident evaluation model.

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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE 10 CFR 50.46 LARGE BREAK
LOSS OF COOLANT EVALUATION MODEL

Gentlemen:

The purpose of this letter is to respond to an NRC request for additional information (RAI) regarding resinter density utilization in the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, Large Break Loss-of-Coolant Accident (LBLOCA) Evaluation Model (EM). By letter dated April 21, 1997, the NRC requested that Carolina Power & Light (CP&L) Company provide a response to their request within 21 days of receipt of their letter (i.e., May 20, 1997).

By letter dated October 11, 1996, the NRC stated that certain changes incorporated in the 1991 LBLOCA EM, described in Siemens Power Corporation (SPC) topical report XN-NF-82-20, "EXEM/PWR Large Break LOCA ECCS TOODEE2 Updates," Revision 1, Supplement 5, were unacceptable. By letters dated October 14, 1996, October 25, 1996, October 29, 1996, and January 17, 1997, CP&L submitted required notifications in accordance with 10 CFR 50.46. Additionally, by letter dated January 15, 1997, the NRC issued an RAI regarding the heat transfer coefficient correlation utilized in the LBLOCA EM, and the CP&L responded to the RAI by letter dated March 12, 1997. The CP&L response included data regarding the fuel resinter density utilized in the current evaluation of a significant error in the LBLOCA EM. Based upon information supplied in the CP&L letters dated January 17, 1997, and March 12, 1997, the NRC issued the RAI to which this letter responds.

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The CP&L response to the NRC RAI is provided in Attachment I to this letter.

If you have any questions concerning this matter, please contact me or Mr. Harold Chernoff of my staff at (803) 857-1437.

Very truly yours,

Jerry M. Wilkerson

T. M. Wilkerson
Manager - Regulatory Affairs

ALG/alg
Attachment

c: Mr. L. A. Reyes, Regional Administrator, USNRC, Region II
Ms. B. L. Mozafari, USNRC Project Manager, HBRSEP
Mr. B. B. Desai, USNRC Resident Inspector, HBRSEP

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
NRC DOCKET NO. 50-261/LICENSE NO. DPR-23
RESPONSE TO REQUEST FOR
ADDITIONAL INFORMATION REGARDING THE
10 CFR 50.46 LARGE BREAK LOSS OF COOLANT EVALUATION MODEL

By letter dated April 21, 1997, the NRC issued a request for additional information (RAI) pertaining to the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, Large Break Loss-of-Coolant Accident (LBLOCA) Evaluation Model (EM). The NRC request referenced CP&L letters dated January 17, 1997, and March 12, 1997, in which CP&L provided information regarding utilization of a measured resinter density as an input to the RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model (EM) (Reference 1).

Provided below is the question from the NRC RAI regarding resinter density followed by the CP&L response.

"Reg Guide 1.126 states that when applying the 95% UCL statistical method, the largest mean $\Delta\rho_{sntr}$ densification value (i.e. 1.11% TD, Lot 709-02 from Table 1) shall be used; as opposed to the 0.87% TD (also from Table 1) average mean $\Delta\rho_{sntr}$ densification value used by SPC. Provide a discussion on why SPC analysis (SPC Topical XN-NF-81-58(P)(A), "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model") uses the average mean $\Delta\rho_{sntr}$ densification value instead of the largest mean $\Delta\rho_{sntr}$ densification value required by the Reg Guide when applying the 95% UCL."

Response

The as-built resinter density was used in the RODEX2 fuel performance code only in the calculation of initial stored energy for the HBRSEP, Unit No. 2 LBLOCA analyses. RODEX2 was used to determine the fuel rod stored energy conditions as an input to the LB LOCA analyses. The predicted fuel temperatures from RODEX2 did not use the largest mean $\Delta\rho_{sntr}$ densification value from a subset of lot data. Conservatism was established by using a 95% upper confidence limit (UCL) for the resinter density change value for the Cycle 18 reload quantity of fuel in conjunction with the overall conservatism of the RODEX2 code. Usage of the 95% UCL differs from the guidance in Regulatory Guide 1.126 (Reference 2) Position C.3.a, "Single Pellet Effects," which allows use of a 95/95 upper tolerance limit (UTL) for the resinter density change value when the use of the value applies to single pellet effects. The 95% UCL provides 95% confidence that the mean resinter density change value of a population of measured resinter density change values from the reload quantity of fuel is bounded by the value used in the RODEX2 analysis. The 95/95 UTL allowed by Regulatory Guide 1.126 provides 95% confidence that the resinter density change value input to the RODEX2 analysis bounds 95% of the population of measured resinter density change values.

Regulatory Guide 1.126, Position C.3.b, "Multiple-Pellet Effects," allows use of the application of an upper one-sided 95% UCL on the mean resinter density change of the material population within the reload quantity that exhibits the largest mean resinter densification value. In accordance with this position of Regulatory Guide 1.126, the largest mean resinter densification value is used to determine average pellet behavior when fuel column length changes are to be considered. In the case of HBRSEP, Unit No. 2, the resinter density change value was applied only to the effect of densification on stored energy and linear heat generation rate, and therefore the resinter densification used was considered a single pellet effect in accordance with Regulatory Guide 1.126, Position C.3.a.

In LOCA analyses, single pellet densification effects are important because they can affect the stored energy in the pellet. Specifically, as the gap between the pellet and the cladding increases, the fuel will operate at higher temperatures for the same power.

Regulatory Guide 1.126 states that the "population of analytical interest" is the initial core loading or reload quantity of fuel for which the safety analysis, and hence the densification analysis, is being performed, and this population may be comprised of subsets from a number of material populations. For HBRSEP, Unit No. 2, the material population is defined as a group of pellets manufactured from a single powder source under the same range of fabrication conditions. Each lot number listed in CP&L letter dated March 12, 1997, was considered a material population, and the population of analytical interest includes the entire reload.

Regulatory Guide 1.126, Position C.3.a allows the use of the 95/95 UTL for the density change. Regulatory Guide 1.126 provides a formula for determining the 95/95 UTL resinter density change as a function of the mean resinter density change of the sample data, the standard deviation of the sample data, and a table of values to be applied to the standard deviation. This formula establishes the conservatism in determining the fuel densification change from actual data for the population of analytical interest.

In lieu of Position C.3.a of Regulatory Guide 1.126, Siemens Power Corporation proposed an alternative method for modeling single pellet effects during the NRC review of the RODEX2 topical report. In response to NRC Question 4 (Reference 1), SPC proposed an empirical formula (i.e., Equation 4.2) that was based upon previous resinter density measurements. The equation determines the upper limit of the 95% confidence interval of the mean density change (i.e., 95% UCL). The empirical equation was proposed for use when fuel resinter density measurements for the particular fuel design were not available.

The NRC Safety Evaluation Report (SER) for Reference 1, Section 5.3, "Thermal Margin," evaluated the acceptability of Equation 4.2. The SER evaluation indicated that the use of a conservative densification model (i.e., Equation 4.2) resulted in conservative fuel temperatures almost at the 95/95 tolerance level and that this is suitably conservative for LOCA applications.

Equation 4.2 did not represent the largest mean resinter densification value from a subset of lot data. Equation 4.2 represents a 95% UCL resinter density value that is based on data from fuel density measurements calculated by averaging the lot means. By using the as-built resinter density value calculated in the same manner, the consistency with the methodology described in the response to NRC Question 4 is preserved. The 95% UCL (based either on Equation 4.2 or a 95% UCL on a reload quantity of fuel), along with other models in the RODEX2 code, provides a sufficient level of conservatism in predicted fuel temperatures in LOCA applications.

Use of the 95% UCL resinter density value taken as a single parameter input to RODEX2 does not predict fuel temperatures as conservative as the use of 95/95 UTL resinter density value described in Regulatory Guide 1.126. However, the temperature models in RODEX2 as a whole overpredict the pellet temperatures for a given power. Specifically, as described in Reference 1, RODEX2 predicted temperatures that are about 7% to 8% higher than experimental data. The temperature prediction conservatively bounds the measured fuel centerline temperature data with an 89% probability at the 95% confidence level. These evaluations were based on comparisons with measured pellet temperatures using nominal conditions. Use of the inputs to RODEX2 consistent with the methodologies of Reference 1 results in a conservative prediction of initial fuel temperature for LOCA Applications.

References

1. XN-NF-81-58(P)(A), "RODEX 2 Fuel Rod Thermal-Mechanical Response Evaluation Model," Supplements 1 & 2, Revision 2, Siemens Power Corporation (NRC Safety Evaluation Report Issued November 16, 1983).

2. Regulatory Guide 1.126, "An Acceptable Model and Related Statistical Methods for the Analysis of Fuel Densification," Revision 1, U. S. Nuclear Regulatory Commission, March 1978.