PSE&G

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February 14, 1980

Director of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, D.C. 20555

Att: Mr. Olan D. Parr, Chief
Light Water Reactors Branch 3
Division of Project Management

Gentlemen:

DEGRADATION OF GUIDE THIMBLE TUBE WALLS
NO. 2 UNIT
SALEM NUCLEAR GENERATING STATION
DOCKET NO. 50-311

PSE&G hereby submits sixty (60) copies of its responses to your requests for additional information concerning degradation of guide thimble tube walls dated September 7, 1979 and December 18, 1979. This response to your concerns references the Westinghouse proprietary letter from Mr. R. A. Weisemann to H. R. Denton, CAW-79-40, dated November 7, 1979. This Westinghouse response demonstrated the adequacy of the guide thimble tubes based on post-radiation observations of 14 X 14 fuel assembly and conservative analytical extrapolation of this 14 X 14 data to the 17 X 17 fuel assemblies such as are installed in the Salem reactor.

Your letter of December 18, 1979 stated that the Westinghouse analysis probably accounted for all of the major variables that control the guide thimble tube wear process. Because of the complexities and uncertainties, however, the NRC believes that it is prudent to examine a typical 17 X 17 fuel assembly to verify the Westinghouse calculational model.

It is our understanding that TVA has committed to the performance of a surveillance program on their Sequoyah Nuclear Plant for examination of guide thimble tube wear and that this issue is resolved for the Salem 2 first cycle of operation until the first refueling outage, based on your letter of December 18, 1979.

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Should you have any further questions in this regard, please do not hesitate to contact us.

Very truly yours,

R. L. Mittl
General Manager -
Licensing and Environment
Engineering and Construction

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QUESTION 3.18

Please provide the basis and derivation of the guide thimble wear model described in Reference 1. In particular, explain assumption 4 and the equations provided under assumption 7. Does the model predict maximum local wear or average circumferential wear?

ANSWER

Refer to response to Question 1 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.19

Using the guide thimble wear model, Westinghouse has predicted maximum stresses and stress intensity limits for worn guide thimble walls in two fuel assembly designs, which were subjected to a 6g handling load. These calculated values are listed in Table 4.1 of Reference 1. We note that the stress intensity limits increase as a function of time for both fuel assembly designs and that the limits always remain greater than the maximum stresses, which increase as the wall is worn away. From the supporting discussion preceding Table 4.1, it is not clear if the stress intensity limits are time dependent. Such an assumption would explain the noted increase in stress limits, but does not address the decreasing material toughness, associated with irradiation hardening. If such credit is being used, it is contrary to the previous Westinghouse position in Reference 2 and item 4.0.5 of Reference 1. Please clarify whether or not Westinghouse has taken credit for irradiation strengthening. Show that the criteria adopted represents the more conservative approach.

ANSWER

Refer to response to Question 2 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.20

Guide thimble wear data, which were taken from Point Beach Units 1 and 2 spent fuel, are discussed, listed, and plotted in Section 2.3, Table 2.1, and Figure 5, respectively, of Reference 1. Please confirm that the time units in Section 2.3 and Table 2.1 are in error and make corrections as needed. Should not the units be days instead of hours?

ANSWER

Refer to response to Question 3 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.21

Submitted Westinghouse information does not explain why the guide thimble wear model, which was developed from measurements taken on two 2-loop plants with 14 x 14 fuel assemblies, is applicable to wear predictions on plants of other designs. Other NSSS-vendor-designed plants have experienced a "plant-specific" and "core-position" dependence in the observed wear. Therefore, please explain how the model accounts for wear differences and provide supporting data for all Westinghouse design variations. If the analytical treatment of design variations are justified, the supporting data can be provided in a confirmatory manner after NRC approval of the model. Please provide details of your data-gathering proposal, a schedule for its implementation, and state your commitment to carry out this confirmatory program. This data-gathering program should be completed expeditiously considering the availability of irradiated assemblies in all Westinghouse plants.

ANSWER

Refer to response to Question 4 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

PSE&G is working with Westinghouse in an owner's group effort, to develop a surveillance program for examination of guide thimble tube wear. The specifics of this surveillance program have not yet been determined, but since the wear phenomenon is a time-dependent process, PSE&G believes that details of such an inspection program need not be specified prior to the first refueling outage. It is anticipated, as a result of this owner's group effort, that sufficient surveillance data can be provided to demonstrate that there is no occurrence of hole formation in rodded guide thimble tubes. Details of such a surveillance program will be provided prior to startup following the first refueling outage.

QUESTION 3.22

In Reference 3, Westinghouse stated that the effect of hydrogren content on the mechanical properties of Zircaloy is discussed in WCAP-9179 (Reference 4). We have reviewed that topical report and found no information on this issue. Please provide your evaluation of how this consideration affects the safety analysis. Include in this evaluation a description of the propensity for hydrogen uptake of the Zircaloy as a function of the accumulative wear.

ANSWER

Refer to response to Question 5 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.23

When Eddy current testing was conducted on worn guide thimble tubes from the Point Beach Units, did the presence of zirconium hydrides affect the results? How sensitive is the interpretation of eddy current signals to hyride presence? How is this effect taken into account?

ANSWER

Refer to response to Question 6 contained in proprietary letter form R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.24

References 1, 3, and 5 do not address the consequences of hole formation in worn guide thimble tubes. Moreover, it is not clear from the submitted information if Westinghouse (1) has observed holes during inspection of the 49 guide thimble tubes that were examined in the Point Beach spent fuel, or (2) has predicted (with the guide thimble wear model) hole formation to occur during projected fuel lifetime. Please clarify. Also, if holes have been observed or are anticipated, provide a discussion on the impact of such holes on guide thimble tube integrity, control rod motion, and thermal-hydraulic performance. This discussion should also account for flow-induced vibration resulting in crack propagation and possibly fatigue fracture in locally thinned areas of the thimble wall. This discussion should address the integrity of the thimble tubes during the entire core residence time; both during periods of wear (under RCCA) and when the fuel assemblies are not under RCCAs.

ANSWER

Refer to response to Question 7 contained in proprietary letter form R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.25

During the review of WCAP-9179 (Reference 6), the staff questioned the Westinghouse value for the ultimate tensile strength of Zircaloy components. The subsequent Westinghouse response (Reference 2) stated that the ultimate tensile strength of Zircaloy was not used in the design analyses of present fuel assembly designs. However, the analysis contained in Reference 1 uses the ultimate strength as a limiting variable. Therefore, please submit for review the Westinghouse correlation for the ultimate tensile strength of Zircaloy.

ANSWER

Refer to the response to Question 8 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.26

Section 4.1 of Reference 1 states that the stress intensity factors are plotted as a function of time for 14x14 and 17x17 fuel assemblies in Figure 5. This is not true. Please provide such a figure or amend Figure 5 as necessary.

ANSWER

Refer to response to Question 9 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.27

Peritem 4, Section 4.0 of Reference 1, your analyses are based on uniform wear in all thimble tubes. Address the margin of conservatism for this assumption. Compare your results in a shift of the neutral axis. Note that such shifts will result in both direct stress and bending stresses.

ANSWER

Refer to response to Question 10 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.28

For Condition 1 and 2 load analyses of Reference 1, a skew factor is mentioned that accounts for the uneven axial load distribution. Clarify how the skew factor is related to both geometric changes (resulting from uneven wear) and assembly misalignment. How does the skew factor impact the load analyses?

ANSWER

Refer to response to Question 11 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.29

The equation for the wear volume in Reference 1 appears linear with time. However, in Figures 5 and 6, wear depth is plotted versus time, and the resulting correlation appears to be non-linear. Please provide information on how these parameters are related.

ANSWER

Refer to response to Question 12 contained in proprietary letter from R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.

QUESTION 3.30

For Condition 3 and 4 load analyses, described in Reference 1, it is stated that the stresses in a worn guide thimble tube are based on generic stress calculations. Please reference where these generic stress calculations can be found. It is also stated that the stresses in the unworn guide thimble tubes are increased to account for the reduction of the tube cross-section due to the wear scar. This would indicate credit for a load redistribution to the unworn guide thimble tubes. Is a skew factor employed in the Condition 3 and 4 load analyses? Describe the state of stress in the worn guide tubes and how the uneven wear affects the load-bearing characteristics of the worn tubes.

ANSWER

Refer to response to Question 13 contained in proprietary letter form R. A. Weisemann, Westinghouse, to H. R. Denton, NRC, CAW-79-40, dated November 7, 1979.