REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR

WCAP-15942-P-A, SUPPLEMENT 1,

REVISION 0, "MATERIAL CHANGES FOR SVEA-96 OPTIMA2 FUEL ASSEMBLIES"

WESTINGHOUSE ELECTRIC COMPANY (WESTINGHOUSE)

PROJECT NO. 700

The U.S. Nuclear Regulatory Commission (NRC) staff requests responses to the following questions in order to continue its review of WCAP-15942-P-A, Supplement 1, Revision 0, "Material Changes for SVEA-96 Optima2 Fuel Assemblies."

1. Based on the data provided for Zr-2 beta quench and **[ ]** there does not appear to be a large advantage in performance of the former over the latter. What is the reason for the introduction of **[ ]** and why would one be preferred over the other?

2. Sections 1.1 and 5.2.2 suggest that **[ ]** only intended use for boiling water reactor (BWR) assembly components is for the outer channel and the **[ ]** Please confirm that these are the only applications of **[ ]** for BWR assemblies.

3. The amount of performance data for **[ ]** is **[ ]** Please provide additional data collected for **[ ]** since the issuance of this topical and describe the plant application including operation in relation to the data, e.g., cladding temperatures, fluences, burnup, etc.

4. The data from lead test assemblies (LTAs) have been taken from **[ ]** plants. Have these plants and subsequent plants with LTAs been more limiting in terms of channel corrosion, growth, and/or bow than other plants? Please discuss the performance of channels in these plants as compared to those in limiting plants.

5. The following are related to growth of **[ ]**

   a. Do the analytical models for channel growth account for individual effects due to hydriding, irradiation, and creep or is there one growth model that incorporates all of these effects implicitly? If the latter is true then a change in channel corrosion/hydriding or stress will change channel growth without changes in channel material. Therefore, a change to water chemistry or assembly design could change channel growth from previous experience. How does Westinghouse intend to control these potential effects on growth that are independent of the channel material? If the growth is dependent on individual model effects please provide an example analysis of how these individual model effects are included in a total growth.

b. The axial growth of **[ ]** for Zr-2 RXA material. This could affect the clearance between the sub-bundle and the frame (channel) of the handle assembly. Please discuss the impact of **[ ]** channel growth on this clearance.

6. Please confirm that the channel creep data in Figure 4.2-5 is only from Zr-2 channels and no **[ ]** channel creep data are presented. Section 4.2.1 page 4-4 suggests that **[ ]** and Zr-2 (RXA) will have **[ ]** irradiated creep rate; please provide justification to substantiate this claim. Please provide data on the irradiated creep rate of **[ ]** compared to that for Zr-2 (RXA) along with a discussion of the impact of differences in channel creep rate on in-reactor performance.

7. An example of geometric compatibility with other fuel types at **[ ]** is provided on pages 4-5 and 4-6. This example assumes **[ ]** However, it appears that the limiting condition for compatibility will be **[ ]** Is this interpretation correct? If so, please discuss the impact of **[ ]** on compatibility between the **[ ]** of the two different assemblies.

8. The following are related to channel bow.

a. How is **[ ]** bow and **[ ]** determined? Provide an example with data for both asymmetric and symmetric lattices. Why is the use of **[ ]** bow along with **[ ]** conservative for evaluating control blade insertion?

b. An example analysis example is provided on page 4-10 that assumes **[**the increase in standard deviation is linear with burnup above 25 GWd/MTU for an asymmetric lattice.**]** However, examination of the data in Figure 4.2-6 **[ ]** suggests that the increase in bow **[ ]** Please provide a discussion on why **[ ]** should not be assumed and the potential impact **[ ]** would have on control blade interference.

9. The following are related to hydrides in **[ ]**

a. Section 4.2.9 assumes **[ ]** for hydrogen pickup for evaluating channel performance, however, recent high burnup data from Zr-2 BWR fuel rods suggest that the hydrogen pickup increases exponentially above a local burnup of 45 GWd/MTU (see paper by K. Geelhood and C. Beyer entitled “Hydrogen Pickup Models for Zircaloy-2, Zircaloy-4, M5 and ZIRLO™,” 2011 Water Reactor Fuel Performance Meeting, Chengdu, China September 11-14, 2011; also see paper by E. V. Mader, et al. entitled “EPRI BWR Channel Distortion Program” at the same meeting). Please provide a discussion on significant difference of these two hydrogen pickup models for **[ ]** and Zr-2 (RXA).

b. Page 4-18 provides a limit on hydrides in **[ ]** There is some evidence that Zr-2 RXA is embrittled at hydrogen levels below those proposed as limits for **[ ]** Please provide ductility data (based on uniform elongation and yield strength) from irradiated **[ ]** up to the hydrogen limit requested.

10. The submittal requests that **[ ]** be substituted for **[ ]** The topical report states (Section 2.2) that the former and latter **[**(α-material and β-quench)**]** have similar corrosion resistance including that due to shadow corrosion. Please provide a comparison of **[ ]** shadow corrosion data along with a discussion for **[ ]** Is the secondary phase particle (SPP) size controlled for **[ ]** If not, why not, it is known that SPP is important for controlling nodular corrosion.

11. Please provide a description of the new strength specifications for **[ ]** along with the stress and load limits for channel application. Also, provide analysis for limiting normal operation and anticipated operation occurrence events involving case of channel overpressure.