Second round of the Requests for Additional Information (RAIs) WCAP-16182-P-A, Revision 1, "Westinghouse Boiling Water Reactor Control Rod CR 99 Licensing Report - Update to Mechanical Design Limits."

1. Follow up to RAI-1a and RAI-11 on helium release and control rod pressure. **[ ]** release data points have been provided to justify the helium release fraction as defined by Equation 6.2 of the submittal. This equation has very little conservatism in relation to the small amount of release data provided. Traditionally the NRC has required the pressures in fuel rods to be calculated from a 95/95 upper bound tolerance. The helium release calculated from Equation 6.2 is approximately a factor of **[ ]** than the 95/95 bounding value from the **[ ]** (assumes **[ ]** degrees of freedom) data provided. Please justify (based on data comparisons) why the rod pressures calculated for the CR-99 design are conservative particularly given the response to RAI-11 that suggests that the ideal gas law **[ ]** rod pressure for the CR-99 design and the use of **[ ]** for calculating initial void volume (response to RAI-2b). Also see RAI-17 below and RAI-18 that suggest the proposed B_4C pin welling model is significantly lower than the traditional 95/95 upper bound that will not result in a 95/95 lower bound on void volume with ^{10}B depletion.

2. The recent paper by G. Ledberger, P. Seltborg and B. Rebensdorft "Mechanical Performance of the Westinghouse BWR CR 99 Control Rod at High Depletion Levels", presented at the 2011 Water Reactor Fuel Performance Meeting in Changdu, China notes that cracking has been observed in the Generation 2 CR 99 design. The subject topical report states that the Generation 3 CR 99 was a redesign of Generation 2 to provide additional volume to prevent contact between the B_4C pins and the blade wall. There are three concerns associated with the analyses presented in the current submittal for the Generation 3 CR 99 design:

1) The analysis of gap size appears to be based on the same upper bound B_4C pin swelling model used for Generation 2 design that resulted in gap closure and cracking;

2) See Item 3 below that suggests the upper bound swelling model does not meet the traditional 95/95 upper bound traditionally used for licensing analyses; and

3) The depletion limit for Generation 3 appears to be in terms of average ^{10}B depletion **[ ]** while the paper notes that peak local ^{10}B depletion can be considerably higher than the average resulting in peak swelling significantly higher than the average depletion level. This paper further notes that cracking first appeared in the locations of peak depletion. Please explain why a limit should not be established for a peak depletion level in the CR 99 Generation 3 control rod in addition to an average depletion. Did the peak depletion locations in Generation 2 **[ ]** ^{10}B depletion?

Also, from this paper it appears that free (non-constrained) swelling has been measured in the KKL pins but this swelling data has not been discussed in this submittal, please discuss this data in relation to its relevance to this submittal.

ENCLOSURE 1

3. Follow up to RAI-1b. [ ] swelling data have been provided to justify the B_4C swelling as defined by Equation 6.12 of the submittal. A 95/95 upper bound based on the [ ] data points (assuming [ ] degrees of freedom) is over a factor of [ ] than the value applied in Equation 6.12. Therefore, the bounding Equation 6.12 provides [ ] bound than the traditional 95/95 bound of the data used in licensing analyses; please discuss why this is acceptable.

4. Follow up to RAI-7 of the first round of RAIs. In light of the small amount of helium release and swelling data provided and the cracking problems with the Generation 2 CR 99 design, the initial response appears inadequate. Please provide more comprehensive inspection and surveillance program or elaborate the reason otherwise.

5. Follow up to RAI-8. Was the control blade evaluated for bending loads, such as a seismic channel bow load case? If evaluated please discuss, if not please provide justification why the bending loads were not considered.

6. Follow up to RAI-12:

(1) Mechanical Criterion 5 requires the control rod to be insertable into the core without structural damage during certain specified oscillatory fuel channel deflection. Does this analysis take into account possible creep strains in the control rods that could affect the insertion?

(2) The proof of insertion appears to be that the CR-99 rod is more compatible than the CR-85 rod, and the CR-85 rod was found to be able to insert during testing. However, the CR-99 appears to be operating at a higher stress state and insertion stresses could increase with rod compatibility, leading to a more potentially damaging mechanism for the CR-99. How does the requirement of no structural damage address this concern?

7. Follow up to RAI-15. What is the allowable design limit (Sm) value for stainless steel used in the CR-99 evaluation? What is the difference in Sm values using [ ] stress criteria? What are the sources of material data used to determine Sm? Also justify the reduced stress conversion factor for the fatigue calculation (Equation 6.7) from that provided in Reference 2.

8. Follow up to RAI-8. Do stresses in the structural finite element models exceed the elastic range? If so, is plastic material behavior modeled? If plastic is modeled please provide a description of the model.