January 27, 2010

Mr. James Gresham, Manager
Regulatory Affairs and Licensing
Westinghouse Electric Company, LLC
P.O. Box 355
Pittsburg, PA 15230-0355

SUBJECT: REQUESTS FOR ADDITIONAL INFORMATION OF WESTINGHOUSE ELECTRIC COMPANY TOPICAL REPORT WCAP-16943-P, “ENHANCED GRCA (GRAY ROD CLUSTER ASSEMBLY) RODLET DESIGN”

Dear Mr. Gresham:

By letter dated June 09, 2008, Westinghouse submitted for U.S. Nuclear Regulatory Commission (NRC) staff review TR WCAP-16943-P, ”ENHANCED GRCA (Gray Rod Cluster Assembly) Rodlet Design.” Based on the staff’s review of your topical report, questions have arisen for which we require additional information and clarification. Please provide responses to the enclosed request for additional information within 30 days of the date of this letter. In accordance with 10 CFR 50.30(b), your response must be executed in a signed original under oath or affirmation. Following receipt of the additional information, we will continue our evaluation of your topical report.

If you have any further questions or comments on this manner, please contact Eileen McKenna at (301) 415-7110 or by email at Eileen.McKenna@nrc.gov.

Sincerely,

/RA/

Eileen McKenna, Chief
AP1000 Projects Branch 2
Division of New Reactor Licensing
Office of New Reactors

Enclosure:
As stated

cc w/encl: R. Sisk, Westinghouse
M. Riggs, Westinghouse

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OFFICE	NRO/DNRL/NWE2:LA	NRO/DNRL/NWE2:PM	NRO/DSRA/SRSB:BC	NRO/DNRL/NWE2: BC
NAME	RButler	PClark	JDonoghue	EMcKenna
DATE	1/27/10	1/27/10	1/27/10	1/27/10

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REQUEST FOR ADDITIONAL INFORMATION
WCAP-16943-P

1. Provide more details of the Gray Rod Cluster Assembly (GRCA) design including the following:
    a. Inner and outer diameters of cladding, sleeve, and tungsten
    b. Type of stainless steel used in the cladding
    c. Geometry of upper plenum regions of sleeve and cladding
    d. Helium fill pressure of cladding and sleeve

2. Section 4.0 documents the material properties of Tungsten
    a. Are these properties used for all safety analyses documented in Section 5?
    b. Section 4.1.1 gives 2 values for melting point and boiling point. Which of these values is used in the safety analyses?
    c. Section 4.1.3 gives 3 correlations for specific heat. Which of these correlations is used in the safety analyses?
    d. Section 4.2.2, and 4.2.3 show tensile stress and hardness data. Are these data used in a quantitative way in any safety analysis?
    e. Describe how the tungsten absorber material is manufactured including specifications on impurities and any alloying additions.

3. Provide data that shows the stainless steel cladding and sleeve will maintain sufficient ductility up to the target fast neutron fluence level. Section 5.2.3 states that the sleeve will have sufficient ductility at the irradiation damage saturation. Provide data to support this claim and that ductility saturates. Also provide any material properties for stainless steel cladding and sleeve that are used in mechanical design evaluations.

4. Figure 4.4-1 shows swelling data for W and W-25% Re. What is the expected operating temperature of the W? It has been observed for some materials that swelling increases with decreasing temperature due to a lack of annealing at lower temperature. If the expected operating temperature is below 430°C, what data can be used to justify the assumption that linear swelling will be less than that calculated?

5. Section 4.4 discusses the impact of the build-in of rhenium on the material properties. No discussion was made of the expected impact of the build-in of osmium. However, it was shown in Section 3.4 that the end-of life osmium concentrations are close to that of rhenium. Discuss the impact of the build-in of osmium on the material properties. It should be noted that the solubility of Os in W is only 6 wt%.

6. The evaluations for the mechanical design bases did not provide sufficient detail to ensure that the safety limits are met. The following areas need more information:
    a. 5.2.1. Provide a sample calculation demonstrating that at the expected component temperature, the thermal expansion will not cause gap closure for the cladding sleeve gap or the sleeve tungsten gap.
    b. Also document what gamma and neutron heating values are assumed for each component.

7. Figures 3.4-1 and 3.4-2 show the difference in average transmutation and surface transmutation. Please provide a plot that shows the expected flux profile across the radius of the GRCA rodlet.

8. The operational monitoring program is presented in Section 7 and discusses startup physics testing and post-irradiation examination of the hardware. Provide a more detailed schedule of planned non-destructive and destructive examinations including the fluence levels at which inspections will be performed on the GRCAs in this program.

9. Provide the ORIGEN calculation inputs that were used to provide input to the depletion calculations.

10. Section 4.4.3 provides a discussion regarding irradiation effects in tungsten and includes a study of available databases. Provide a comparison of the material composition with the Westinghouse GRCA design.

11. WCAP-16943 provides transmutation chains and supporting evidence from industry data. However, the relevance of fast reactor data to the thermal reactor conditions representative of the AP1000 reactor design is debatable. What additional data can be provided to improve the support for the transmutation chains and worth estimates as listed in WCAP-16943 (e.g. Idaho National Laboratory's advanced test reactor program or a lead test assembly program)? If there is no additional data available at the current date, how will the inspection program be used to obtain this supporting information before the end of life?

12. Due to the long in-reactor residence time of the GRCAs and the stainless steel cladding design, there exists a potential for shadow corrosion between the stainless steel gray rod and the ZIRLO™ guide tubes. Is there an increased corrosion rate (and hydrogen pickup) that would result? If so, what are the effects on the mechanical properties of the guide tubes (e.g. higher assembly growth)?