October 2, 2003

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION – WCAP-15872, REVISION 00, "USE OF ALTERNATE DECAY HEAT REMOVAL IN MODE 6 REFUELING" (TAC NO. MB9020)

Dear Mr. Bischoff:

By letter dated May 12, 2003, the Westinghouse Owners Group submitted for staff review Topical Report (TR) WCAP-15872, Revision 00, "Use of Alternate Decay Heat Removal in Mode 6 Refueling." The staff has completed its preliminary review of the TR and has identified a number of items for which additional information is needed to continue its review. The staff discussed this request for additional information (RAI) with Virgil Paggen of your staff on October 2, 2003. WCAP-15872 is non-proprietary; therefore, the customary 10-day delay for placing an RAI in the Public Document Room does not apply in this case. As discussed with Mr. Paggen, please provide the requested information by November 14, 2003, so that the review can be completed in a timely manner. Partial submittals would be welcomed to minimize delays.

If you have any questions, please call me at (301) 415-1436.

Sincerely,

/RA/

Drew Holland, Project Manager, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Request for Additional Information

cc w/encl: See next page

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cc:
Mr. H. A. Sepp, Manager
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Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

REQUEST FOR ADDITIONAL INFORMATION

WCAP-15872, REVISION 00, "USE OF ALTERNATE DECAY HEAT REMOVAL

IN MODE 6 REFUELING"

WESTINGHOUSE OWNERS GROUP

PROJECT NO. 694

1. What is a shutdown cooling "train"? Describe the physical setting of the two "trains" mentioned in Section 2.2 of the topical report (TR) when they are inoperable at the time of the initiation of the alternate heat removal alignment, and when they are supplementing the shutdown cooling system.

2. Is your methodology predicated on the use of the spent fuel pool cooling system as the alternate heat removal system?

Appendix A: Algorithm for Natural Convection between Core and Refueling Pool

1. For the one-dimensional model of the core and refueling pool:

    a. Superimpose the nodalization that your methodology assumes on Figure A-1. Demonstrate that it is robust.

    b. What are the assumed mass, momentum and energy equations for the related control volumes?

    c. What is meant by "The effective mass is determined by *engineering judgement* ..."? How is the numerical value for use in the one-dimensional model computed?

    d, What results show that the mixing coefficient ε_{mix} is about 0.90?

        i. What are the parameters to which the value of ε_{mix} is most sensitive?

        ii. What is the sensitivity of ε_{mix} to these parameters?

    e. How is the value of the by-pass fraction ε_{bypass} computed?

        i. What "results show" that ε_{bypass} is close to 1.0? How close?

        ii. What is the sensitivity of ε_{bypass} to key parameters?

    f. Are ε_{bypass} (in the equations) and β (Table A-1) the same coefficient?

    g. Please show the derivation of the values of ε_{mix} and ε_{bypass} used in the results shown in Figures A-3 and A-4 for Case 2 and Case 3.

Appendix B: Comparison of Predictions with Test Data

1. Figure B-1 is confusing. Under the alternate cooling alignment, do you have a separate spent fuel pool (SFP) pump and heat exchanger for both the refueling pool and the SFP, or do these represent separate alignments? Please indicate the complete flow paths of fluid associated both with the refueling pool and core, and the SFP. In your figure, how and when do you get flow "from the refueling pool to the spent fuel pool"?

2. In Table B-1 what is SW?

3. You report average temperatures. These are averaged over what?

4. Tables B-2, B-3 and B-4 report time in days, hours and minutes, respectively. Also, the figures use two different time scales. Please resubmit for review, all tables and figures based on one time scale (if there is a specific reason such as clarifying a relationship, state so).

5. Please give a table describing the physical conditions associated with each of the five cases. That is, for each of the five cases, give the initial and final time and the corresponding initial, final and average shutdown cooling and SFP temperatures (computed and measured), flows and core decay powers. For average values give the explicit method by which they were computed.

Appendix C: Comparison of CCNPP Unit 2 Test Data with Computational Fluid Dynamics (CFD) Predictions

1. For these calculations please show the natural circulation flow path in the core region. That is, how is the core cooled?

2. The results from the lumped parameter model (core flow rate) are dependent on ε_{mix} and ε_{bypass}. These two coefficients are determined via a CFD calculation. How does the CFD calculation of ε_{mix} and ε_{bypass} differ from the CFD calculation in this appendix?

3. Is the CFD calculation in this appendix a steady-state calculation?

4. The data appear to show no temperature gradient at the flange level, while the CFD calculation shows a distinct gradient. Your proffered explanation in paragraph eight is not clear. Please provide a drawing indicating the flows and temperatures that support your argument.

5. How is the difference in mixing, described in 4 above, taken into account in your estimate of ε_{mix}?

Appendix D: Evaluation of Alternative Heat Removal Alignments

Please describe the simplified one-dimensional computational model and its relation to the two-dimensional computational fluid dynamics model. How does it differ from the one-dimensional model discussed in Appendix A? When you say computational fluid dynamics model (without

the adjective one-dimensional) in D.3, what are you referring to – A 3D model? Figures D-3 through D-6 give 2D results. So, how are you treating the situation in Figure D-2?

You say, "The one-dimensional evaluations based on perfect mixing ... are summarized in Table D-2," yet you show bypass flows that are not one-dimensional. In Table D-3 what is your point? The table indicates that the mixing coefficient is spatially dependent (given at different locations). How can that be when it is defined on page D3 in terms of pool average temperatures?

The key to your methodology is the estimation and validation of the mixing and bypass coefficients. Please define your terminology clearly; indicate the type of calculation and the results precisely so that the comparisons are clear.

Appendix E: CCNPP Specific Evaluation of Conditions for Alternate Decay Heat Removal in Mode 6

1. In Section E.1, your discussion of Figure E-3 is inconsistent with the text. The text indicates that the initial refueling pool temperature is 75°F, while the value in the figure at t = 0 is 90°F.

2. Where are the data that reflect the last statement on page E3? What is the basis for the "expected" high and low limits?

3. What is the purpose of footnote 1 on page E4? Where and what is Reference 6.1?

4. In the paragraph Limiting THS vs. TAS on page E4, Figure E-5 does not show a family of curves. What do you mean by a 90°F heat sink temperature when the refueling pool inlet temperature in also 90°F?

5. The time scale of minutes on the x-axis of the figures is inappropriate for the phenomena described on the figure. Please submit a revised figure that uses a consistent time scale (see Appendix B, question 1).

6. What is Reference 6.4 which gives the CFD analysis that establishes the maximum fluid velocity for the computation of the force on the fuel assembly?

7. How do you get from a one-dimensional model the flow rate in the core for a lateral velocity of 0.22ft/sec in the refueling pool? The precision is astounding.