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January 5, 2000

Mr. Andrew Drake, Project Manager
Westinghouse Owners Group
Westinghouse Electric Corporation
Mail Stop ECE 5-16
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: REVIEW OF TOPICAL REPORT, WCAP-10541, REVISION 2,
"WESTINGHOUSE OWNERS GROUP REPORT, REACTOR COOLANT PUMP
SEAL PERFORMANCE FOLLOWING A LOSS OF ALL AC POWER," (TAC NO.
MA6294)

Dear Mr. Drake:

By letter dated December 10, 1986, the Westinghouse Owners Group (WOG) submitted Topical Report WCAP-10541, Revision 2, "Westinghouse Owners Group Report, Reactor Coolant Pump Seal Performance Following a Loss of All AC Power," for NRC review and approval. At the time, the Office of Nuclear Regulatory Research (RES), was working with the industry on the resolution of Generic Safety Issue 23 (GSI-23), "Reactor Coolant Pump Seal Failure." The topical report was used by RES in its evaluation of issues associated with GSI-23. The RES efforts included a peer review of the WOG topical report and additional confirmatory research in the late 1980's and early 1990's. The primary published documents resulting from this work are referenced in this letter and listed in the enclosure.

The formal closure of the generic aspects of GSI-23 was documented in a memorandum from the RES Office Director to the Executive Director of Operations on November 8, 1999. The closure of GSI-23 considered the loss of all AC power and concluded: (1) no further generic action was needed, (2) the current assumptions used for the station blackout coping analysis did not need to be modified, and (3) all other generic open items associated with GSI-23 are closed. Although, the staff is continuing with further plant specific studies that are not related to loss of all AC power, no generic action is being pursued. Subsequent to the closure of GSI-23, the WOG, in a senior management meeting, requested formal disposition of the topical report. As a result, the staff has prepared this evaluation, summarizing the past NRC review of the WOG topical report.

The NRC review of the WOG topical report was performed and documented primarily in three documents. The first is an Atomic Energy of Canada Limited (AECL) study entitled, NUREG/CR-4906P, "Review of Westinghouse Owners Group Report WCAP-10541, Revision 2, 'Reactor Coolant Pump Seal Performance Following a Loss of All AC Power,'" which contains the results of a review of the overall report and a summary of some of the previous work that had occurred. The second is an Energy Technology Engineering Center (ETEC) study entitled NUREG/CR-4294, "Leak Rate Analysis of Westinghouse Reactor Coolant Pump,"

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which reviewed the leakage rates associated with the different reactor coolant pump (RCP) seal failure modes. The third is the EG&G study, entitled NUREG/CR-4821, "Reactor Coolant Pump Shaft Stability During Station Blackout," which further explores some of the RCP seal failure modes of interest and the associated probabilities. Additionally, a SCIENTEC report entitled, NUREG/CR-5167, "Cost/Benefit Analysis for Generic Issue 23: Reactor Coolant Pump Seal Failure," provides information on RCP seal failures and presents the staff's best estimate seal failure model, which is based on the Westinghouse model presented in the WOG topical report. The work performed by the staff and its contractors concluded that the overall framework of the seal failure model presented in the WOG topical report is acceptable, including the different RCP seal failure modes. Additionally, the calculated RCP seal leakage flows associated with each of the failure modes are also acceptable. However, the staff believes that for some of the failure modes, the WOG topical report underestimates the failure probabilities.

For some of the RCP seal failure modes, there is very little data to develop failure probabilities, and as a result, there are considerable uncertainties associated with such probabilities. The staff believes that for some failure modes, the failure probabilities chosen in the topical report do not adequately characterize the level of uncertainty. The failure modes that the staff believes are underestimated are: (1) the assumed failure probability of the unqualified seal O-ring material, (2) the assumed failure probability of the improved O-ring material given a seal stage is experiencing full system differential pressure (the other qualified O-ring failure probabilities are acceptable), (3) the assumed failure probability of the number three seal stage given the failure of another seal stage, and (4) the assumed "pop-open" failure of the number two seal stage. The staff finds acceptable the other probabilities associated with the seal failure model. Additional detail regarding the failure probabilities and the basis for the staff conclusions can be found in the references. For the seal failure modes where there is little data derived from either operating experience or testing that can be applied to determining the appropriate failure probabilities, expert opinion of the staff and its contractors is applied to determine appropriate failure probabilities. Should new data or tests results be presented to the staff that would indicate the seal failure probabilities are lower or there is less uncertainty in these probabilities, the staff will reconsider its position regarding such seal failure probabilities.

Based on the above and the information in the referenced documents, the staff cannot approve the WOG topical report and it should not be used in license amendment applications. However, it should be noted that the event tree methodology and the seal leak rates of the WOG topical report have been utilized in developing the framework for risk assessments of RCP seal failures. The staff has developed a seal failure model that is based on the model presented in the WOG topical report. This model, the so-called Rhodes model, is documented in Appendix A to NUREG/CR-5167. The staff believes that this is an acceptable model for use in probabilistic risk assessments supporting licensing actions according to the guidance in Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." If the WOG topical report probabilities rather than those of the Rhodes model are used to support a licensing

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action, a sensitivity study should be performed to demonstrate that the risk associated with the change being contemplated is not overly sensitive to the probability of RCP seal failure.

Sincerely,
/s/

Stuart A. Richards, Director
Project Directorate IV and Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: List of References

cc w/encl: See next page

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action, a sensitivity study should be performed to demonstrate that the risk associated with the change being contemplated is not overly sensitive to the probability of RCP seal failure.

Sincerely,

A handwritten signature in black ink, appearing to read 'S. A. Richards', with a large, stylized flourish at the end.

Stuart A. Richards, Director
Project Directorate IV and Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: List of References

cc w/encl: See next page

Westinghouse Owners Group

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REFERENCES

1. Letter from L. D. Butterfield, Chairman, Westinghouse Owners Group, to U. S. Nuclear Regulator Commission, Attention Document Control Desk, Subject, "Westinghouse Owners Group, Transmittal of WCAP-10541 Revision 2, 'Westinghouse Reactor Coolant Pump Seal Performance following a Loss of All AC Power,'" dated December 10, 1986.
2. Memorandum from Thadani, A. C., to Travers, W. D, Subject, "CLOSEOUT OF GENERIC SAFETY ISSUE 23, 'REACTOR COOLANT PUMP SEAL FAILURE,'" November 8, 1999.
3. NUREG/CR-4906P, AECL Report CI-S-263, D. B. Rhodes, "REVIEW OF WESTINGHOUSE OWNERS GROUP REPORT WCAP-10541, REVISION 2, 'REACTOR COOLANT PUMP SEAL PERFORMANCE FOLLOWING A LOSS OF ALL AC POWER,'" dated January 1988.
4. NUREG/CR-4294, 85-ETEC-DRF-1714, T. Boardman, N Jeanmougin, R. Lofaro, J. Prevost, "Leak Rate Analysis of Westinghouse Reactor Coolant Pump," dated June 1986.
5. NUREG/CR-4821, EGG-2492, AECL-9342, David B. Rhodes, Robert C. Hill, Ron G. Wensel, "Reactor Coolant Pump Shaft Stability During Station Blackout," dated May 1987.
6. NUREG/CR-5167, R. G. Neve, H. W. Heiselmann, "Cost/Benefit Analysis for Generic Issue 23: Reactor Coolant Pump Seal Failure," April 1991.
7. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," July 1998.

Enclosure