UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

November 18, 2004

Mr. Luis A. Reyes
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: LESSONS LEARNED FROM THE ACRS REVIEW OF THE AP1000 DESIGN

Dear Mr. Reyes:

During the 517th meeting of the Advisory Committee on Reactor Safeguards, November 4-6, 2004, we completed our deliberations regarding lessons learned from the review of the AP1000 design. As noted in our July 20, 2004 report, issues on the safety aspects of the AP1000 design certification application were resolved to our satisfaction. As has been our practice with previous certification reviews, we have developed a number of lessons learned that could be relevant to reviews of future applications or to operating plants. These are listed below in no particular order of significance along with explanations. We also had the benefit of the documents referenced.

Lessons Learned

1. Aerosol Removal in Containment: Westinghouse used the STARNAUA code for the limiting sequence to determine an appropriate average lambda for aerosol removal from containment. The staff used the MELCOR code for the same purpose and obtained reasonable agreement. In light-water reactors, in general, the lambda is dominated by gravitational settling. In AP1000, however, lambda is dominated by thermophoresis and diffusiophoresis. The modeling of these two phenomena is generally the least validated of the aerosol models and hence the model predictions are subject to significant uncertainty. In future certifications, it is likely that the applicant will rely on the MAAP code for determination of aerosol behavior in containment. These aerosol models in MAAP code need to be reviewed and the calculations need to be accompanied by sufficient uncertainty/sensitivity analyses.

2. Pi Groups: Validation of the computer codes relied on in the certification process depends on the use of scaling analyses to demonstrate that the results from small scale integral tests performed to validate the codes are applicable to the full-scale design. The degree of fidelity of the scaled facilities is evaluated using dimensionless parameters referred to as Pi groups. In theory, values of unity for the ratios of Pi groups represent perfect scaling. In reality, these ratios will differ somewhat from unity. There does not seem to be a technical basis for how much these can differ from unity and still represent acceptable scaling. The staff has said it will investigate whether such a technical basis can be developed. This study should be completed before the next design certification.

3. In-Vessel Retention/Fuel Coolant Interaction (FCI): Advanced reactor designs sometimes have severe accident management features (e.g., the in-vessel retention feature of AP1000 and the "core-catcher" feature of EPR) that may increase the potential for an energetic FCI. These features may invalidate the current resolution of this issue, which

relies on the expected very low frequency of occurrence. If so, the current FCI models, in our view, have insufficient experimental validation to rely on their predictions of the occurrence of an energetic thermal interaction and the magnitude of the energy release if such an interaction is judged to occur. Consequently, in such cases, it will be important to conduct sufficient sensitivity analyses on such parameters as: delayed trigger time; quantity of metallic components in the melt; system pressure; coolant characteristics, and initial conditions.

4. TRACE Code: The staff plans to rely increasingly on the TRACE thermal-hydraulic code to assess the design capability of a reactor to cope with LOCAs and transients. It is important that TRACE be made fully operational promptly. Assurance of the fidelity of any new models should be provided.

5. Safety Evaluation Reports (SERs): We have seen a steady improvement in the detail that has been included in SERs to make them a more complete and useful documentation of the extent of the staff's review and the bases for its decisions. The staff should maintain this high standard.

6. Phenomena Identification and Ranking Table (PIRT) Process: The increasing use of the PIRT process in design certification is a positive development. It will be especially important for designs such as the ACR-700 where the thermal-hydraulic phenomena are less well understood and less familiar.

7. Control Room Staffing: The operators of advanced plants will rely more on automatic controls and may operate a number of modular reactors from one control room. The staff needs to develop criteria and policy on the requisite control room staffing levels for these plants.

Sincerely,

/RA/

Mario V. Bonaca
Chairman

References:

1. Report dated July 20, 2004, from Mario V. Bonaca, Chairman, ACRS, to Nils J. Diaz, NRC Chairman, Subject: Report on the Safety Aspects of the Westinghouse Electric Company Application for Certification of the AP1000 Passive Plant Design.

2. Letter dated March 17, 2004, from Mario V. Bonaca, Chairman, ACRS, to William D. Travers, Executive Director for Operations, NRC, Subject: ACRS Reviews of the Westinghouse Electric Company Application for Certification of the AP1000 Plant Design-Interim Letter.

3. U.S. Nuclear Regulatory Commission, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," Volumes 1 and 2, dated September 13, 2004.

4. Westinghouse Electric Company, AP1000 Design Control Document (DCD), APP-GW-GL-700, Revision 11, dated May 20, 2004.