May 8, 1997

Mr. Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Activities
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, PA 15230

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) ON THE AP600 ADVANCED REACTOR DESIGN IN THE CIVIL ENGINEERING AND GEOSCIENCES BRANCH (ECGB) REVIEW AREA

Dear Mr. Liparulo:

The Nuclear Regulatory Commission (NRC) ECGB staff has determined that it needs additional information in order to complete its review of the Westinghouse AP600 advanced reactor design. Enclosed are RAIs #230.133 - 230.138 regarding the ECGB review of the Westinghouse submittal, dated March 18, 1997, of a draft seismic margin analysis (SMA) chapter and the responses to RAIs. The staff notes that RAI #230.211 (OITS #3437 - draft safety evaluation report Section 19) was not answered in the March 18, 1997, letter and requests that the RAI be answered. To maintain the schedule, the staff believes Westinghouse needs to fully respond to the RAIs before the end of June to support a design review meeting in early July.

If you have any questions regarding this matter, you may contact me at (301) 415-8548.

Sincerely,

original signed by:
Diane T. Jackson, Project Manager
Standardization Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

Enclosure: As stated

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Docket No. 52-003
AP600

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REQUEST FOR ADDITIONAL INFORMATION
CIVIL ENGINEERING AND GEOSCIENCES BRANCH
PRA SSAR CHAPTER 55: SEISMIC MARGIN ANALYSIS
WESTINGHOUSE AP600
DOCKET NO. 52-003

230-133 Probabilistic Fragility Analysis

a. In the application of the probabilistic fragility analysis to the reactor pressure vessel (RPV) and steam generators, it appears that the variability of the floor responses are not properly accounted for. The calculated β_c values of 0.27 and 0.29 in Table 55-1 are considered to be too low in comparison with typical values of 0.5 to 0.6 from past, generic seismic probabilistic risk assessment (SPRA) studies.

   For the case of RPV, by assuming a β_c value of 0.50 and the median value of 1.44 g (Table 55-1), the corresponding HCLPF (high confidence, low probability of failure) value would be 0.46 g, which is about 40 percent lower than the calculated HCLPF value of 0.77 g. Westinghouse needs to provide the rationale for the nonconservative evaluation of variabilities. If it is intended to use conservative floor response spectra to compensate for this nonconservative assumption (i.e., low β_c), explain quantitatively that the net results for the HCLPF calculations are still conservative.

b. Westinghouse needs to provide the buckling equation used for the fragility analysis of containment vessel.

230-134 Conservative Deterministic Failure Margin (CDFM) Method

Westinghouse states that the inelastic energy absorbing factor, F_μ, is estimated for the column structural elements in the shield building roof, for which the EPRI CDFM approach is used. It also states that an additional margin factor is considered to account for a higher damping value due to inelastic responses. However, the formulation for the F_μ factor in the standard safety analysis report (SSAR) should be used to modify the linear responses for which a linear (lower) damping value (e.g., 7 percent for concrete structures) is used. To account for both the F_μ factor and a higher damping value is considered to be a double counting of the nonlinear response effects and should be avoided.

230-135 Test Results

Regarding the use of test data, the test response spectra should be used at about the 99-percent exceedance probability level for the capacity according to Appendix Q to Reference 1. This results

Enclosure

in a lower HCLPF value. Westinghouse needs to provide the rationale for not using the 99-percent exceedance probability level for test response spectra.

230-136 Generic Fragility Data

The use of generic data is indicated for several components based on Reference 2. However, the suggested generic fragility values are intended for a preliminary analysis only. These generic values should not be used for critical components which are important to plant risks. In addition, for components with new design features, it should be confirmed that the new design features do not potentially contribute to lowering fragility values. An example may include the fuel rods, for which some differences in design (e.g., different outside diameter and additional gas space below the fuel pellets) are observed compared with the typical four-loop design.

The use of generic data is considered inappropriate for the following components:

Reactor Internals:	Critical component (this component represents the plant HCLPF) and new design features.
CRDM:	Past PRA/SMA studies indicate significant variations in estimated fragility values of CRDM.
Valves:	Describe the classification (e.g., motor-operated or manual) and elevation of location.
Main Control Room Operation:	New design features should be addressed.

230-137 Response to OITS #3432

a. Westinghouse states that, "Response for structures (SG supports and RPV supports) is from time history analyses and not response spectra. Therefore, mode combination fragility parameters are not appropriate." If the time history simulation is used, Reference 3 (Page 3-20) recommends that the associated uncertainty (β_u) of $\frac{1}{3}\ln(Sa_{med}/Sa_{low})$ be used in the vicinity of the fundamental structure frequency. Westinghouse needs to provide the rationale for not using this uncertainty for the probabilistic fragility analysis.

b. Westinghouse states that, "The combination of earthquake components is not considered for the critical support structures because the seismic load is dependent primarily on a single earthquake component." Howe er, Reference 3

(Page 3-26) recommends that a randomness (β_r) for response be included in the fragility analysis since the actual response will be higher or lower and provides an upper bound value of β_r (0.18) for the cases where the response is primarily from a single direction and a typical value of β_r (0.15) for building response due to the effects of earthquake component combination. Provide the rationale for not using this randomness for the probabilistic fragility analysis.

230-138 Typographical Errors

a. Probabilistic Fragility Analysis

(1). A_m and X_i are stated as the mean peak ground capacity and the i-th design mean margin factor, respectively. However, should they represent median (not mean) values to use log-normal distributions?

(2). Sa_m is stated as the spectral acceleration value associated with mean-centered damping. However, should it be median-centered value to compute the median damping factor?

b. Conservative Deterministic Failure Margin Method

Put μ in the right hand side of F_μ equation.

c. Provide Sections 55.6 through 55.8

d. Table 55-1

(1). Clarify where the valve HCLPF value at Room Number 11400 is obtained. Is it from Reference 2 or deterministic approach?

(2). This table provides two HCLPFs (0.97g and 0.80g) for the main control room switch station. Westinghouse needs to clarify which one will be used.

REFERENCES

1. "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," Revision 1, EPRI NP-6041-SL, August 1991.

2. Advanced Light Water Reactor Utility Requirements Document, Volume III, ALWR Passive Plant, Chapter 1, Appendix A, PRA Key Assumptions and Groundrules. Revisions 5 & 6, Issued 12/93.

3. "Methodology for Developing Seismic Fragilities," EPRI TR-103959, June, 1994.

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