January 28, 1997

APPLICANT: Westinghouse Electric Corporation

FACILITY: AP600

SUBJECT: SUMMARY OF MEETING TO DISCUSS WESTINGHOUSE AP600 SEISMIC MARGINS ANALYSIS

The subject meeting was held at the Westinghouse Electric Corporation (Westinghouse) office in Rockville, Maryland, on January 9, 1997. The purpose of the meeting was to review Westinghouse preliminary calculations and discuss pertinent open items related to the AP600 seismic margins analysis. Attachment 1 is a list of meeting participants. Attachment 2 is a summary of the reviewed documents and issues discussed at the meeting. The meeting summary was prepared with input from the Nuclear Regulatory Commission consultants.

The staff reviewed calculations in several sensitive areas and discussed the procedure of applying the high confidence in low probability of failure (HCLPF) methodology with Westinghouse. Many of the staff's questions were answered by Westinghouse, however, the staff raised several concerns that require additional information. The staff also requested that Westinghouse include part of Chapter 55, the HCLPF methodology and values, in the standard safety analysis report. Westinghouse stated that this would be considered. This item will be tracked as meeting open item 1.

original signed by:

Diane T. Jackson, Project Manager
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Docket No. 52-003

Attachments: As stated

cc w/attachments:
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Docket No. 52-003

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WESTINGHOUSE/NUCLEAR REGULATORY COMMISSION MEETING
SEISMIC MARGINS ANALYSIS
MEETING PARTICIPANTS
JANUARY 9, 1997

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Attachment 1

WESTINGHOUSE/NUCLEAR REGULATORY COMMISSION MEETING
SEISMIC MARGINS ANALYSIS
JANUARY 9, 1997

1. Overview by W. LaPay

A table of updated fragility parameters, i.e., median, β_u, β_r and HCLPF values, was presented together with a list of available documents for review. The final report on the seismic margin analysis (SMA) methodology will be provided in Chapter 55 of the AP600 probabilistic risk assessment (PRA) report in early March. Westinghouse stated that the floor response spectra used for the fragility analysis were the envelope of four spectra of different soil conditions. However, the spectra for a rock site dominate for almost the entire frequency range. Westinghouse stated that the time history analysis results for a rock site were used to represent the enveloping response values for components.

Meeting Open Item 2: The staff requested Westinghouse to provide an explanation demonstrating that the use of the time history analysis for the rock site was bounding for all AP600 soil sites.

2. Review of Motor Control Center (MCC)

The HCLPF calculations for an MCC were reviewed based on a document, SM96-9 Class 1E Equipment. The HCLPF values were determined based on the estimated lower bound of qualification test results. Information regarding critical failure modes (e.g., relay chatter) was not made available during the meeting. Variability values of $\beta_r \simeq 0.05$ and $\beta_u \simeq 0.10$ were used to establish the relationship between the median and HCLPF values. The staff considered these variability values to be too low, and it seems that the calculation procedure does not follow the acceptable SMA methodologies (deterministic or probabilistic). Another concern is the calculation of the ratio of Test Response Spectra to Required Response Spectra. This ratio, which was determined only at 4.6 Hz, should be calculated throughout the frequency range of interest.

Meeting Open Item 3: Westinghouse responded by proposing to eliminate all the median and β-values from the fragility table, and to calculate HCLPF values deterministically for electric equipment.

3. Review on Reactor Vessel Support Structure

The fragility calculations for the reactor vessel support structures were reviewed based on documents, SM96-1 (support structure), SM96-3 (nozzles), and several design drawings. In the fragility calculations, an inelastic energy absorbing factor of $F_\mu = 4.0$ was used for the support structure based on the estimated ductility factor of $\mu = 10.0$ for a plate bending failure. During a phone conversation with a Westinghouse engineer who performed the stress analysis for the support structure, it was found that the critical stress condition was a localized shear stress rather than an overall bending stress.

Attachment 2

The estimated ductility factor of μ = 10.0 is considered to be too high by the staff for such a stress condition. Moreover, the "local" ductility factor was directly used to estimate the inelastic energy absorption factor for the reactor vessel. In a fragility evaluation of a system which consists of several sub-components, e.g., anchor bolts and support structures, the deformation of each sub-system contributes only partially to the overall deformation of the system. As a result, the combined ductility factor for the whole system is usually much lower than the maximum ductility factor due to a localized deformation.

Meeting Open Item 4: Westinghouse responded to eliminate the inelastic energy absorbing factor altogether for the reactor vessel in an updated calculation.

Meeting Open Item 5: Westinghouse was requested to include the failure modes that were considered in each calculation and provide the staff a written explanation of the process Westinghouse uses to identify the possible critical failure modes.

Meeting Open Item 6: Westinghouse was requested explain how they consider local and system ductility in their calculations.

4. Other Issues

Almost all the estimated variabilities are considered to be too low, and the methodologies to evaluate the β-values are not consistent with the acceptable SMA evaluation practice. For example, in evaluating the building response factor, the variability of the damping value was ignored. According to Westinghouse, it was done so because a conservative damping value of 5 percent was used in the response analysis rather than a higher median-centered value (e.g., 7 percent). This was considered to be not acceptable, because the use of a slightly lower damping value does not guarantee a HCLPF margin. It was observed that both deterministic and probabilistic methods were somehow mixed together in the fragility estimate of a single component. The ratio of median to the HCLPF values calculated by Westinghouse were found to be low in comparison to the past SPRA (seismic probabilistic risk assessment) studies in which the ratios are 2.5 to 3.0.

Meeting Open Item 7: Westinghouse was requested to provide the rational for using lower bound median values and if the values was used in the PRA.