September 18, 1996

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

SUBJECT: FOLLOWON QUESTIONS REGARDING THE INTERNAL FIRE RISK ANALYSIS FOR THE AP600

Dear Mr. Liparulo:

As a result of its review of documentation to support the June 1992 application for design certification of the AP600, the staff has determined that it needs additional information. Specifically, the enclosed questions concern the draft markup of the internal fire analysis for the AP600 (Chapter 57 of the probabilistic risk assessment).

You have requested that portions of the information submitted in the June 1992 application for design certification be exempt from mandatory public disclosure. While the staff has not completed its review of your request in accordance with the requirements of 10 CFR 2.790, that portion of the submitted information is being withheld from public disclosure pending the staff's final determination. The staff concludes that these followon questions do not contain those portions of the information for which exemption is sought. However, the staff will withhold this letter from public disclosure for 30 calendar days from the date of this letter to allow Westinghouse the opportunity to verify the staff's conclusions. If, after that time, you do not request that all or portions of the information in the enclosures be withheld from public disclosure in accordance with 10 CFR 2.790, this letter will be placed in the NRC's Public Document Room.

If you have any questions regarding this matter, you can contact me at (301) 415-1132.

Sincerely,

original signed by:

Joseph M. Sebrosky, Project Manager
Standardization Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

DF03'/1

Enclosure: As stated

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DOCUMENT NAME: A:FIRE PRA.RAI (8H AP600 DISK) *See previous concurrence
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Docket No. 52-003
AP600

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REQUEST FOR ADDITIONAL INFORMATION
RAIs ON THE AP600 INTERNAL FIRE RISK ANALYSIS (August 9, 1996, DRAFT MARKUP)

720.334 The information documented in the submittal (Chapter 57, August 9, 1996, Internal Fire Analysis Draft Markup) does not state clearly the major assumptions made in modeling containment fires. The containment is a single fire area which is made up of several compartments, called fire "zones" (see Table 57-5). It appears that the several fire zones, included in the single containment fire area, are treated in the analysis similarly to the fire areas for fires outside the containment. However, it is not clear whether and how fire propagation between fire zones is modeled and what is the technical basis for distinguishing the different fire scenarios. Please provide this information, including relevant assumptions, in Chapter 57 of the PRA.

720.335 One item of concern in the certification of advanced reactor designs is the impact of smoke, hot gases, and fire suppressants on safe shutdown equipment (especially due to sensitive electronics) and on operator actions. The issue is amplified when these elements migrate into other fire areas. Please address this issue in the internal fire PRA.

720.336 Burning liquids in the AP600 turbine building could fall on the floor at elevation 100 feet. It is not clear where they would go. Is it possible that the oil could enter the Auxiliary Building? Experience (the Vandellos turbine building fire) has shown that burning oil can spread away from the point of origin. Is it possible that an important scenario, which involves damage to other fire areas within the Auxiliary Building, was not analyzed because of the analysis groundrule preventing treatment of scenarios involving fire spread to multiple zones? Please explain and identify the specific design features that prevent this from happening.

720.337 Westinghouse claims that a conservative "bounding" assessment of the impact of fire-induced "hot shorts" was performed. The staff, however, cannot conclude that Westinghouse's analysis is bounding (based on the information provided in the submittal) because (a) the probability of a hot short (from NUREG/CR-2258) is based on judgment, (b) it is assumed that the probability of multiple hot short events is state-of-knowledge independent, and (c) the analysis does not refer to the specific AP600 PRA I&C models and logic diagrams to recognize any important features, and/or operational requirements, that are incorporated into the design to prevent fire-induced hot shorts from causing spurious actuations which in turn could have a significant impact on plant safety. Please explain the mechanism of fire-induced spurious actuations using the AP600 PRA I&C models, the location of the various I&C cabinets, the location of power source

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interfaces and assumptions made on cable characteristics and routing. Also, please list important design features, and/or operational requirements, that prevent fire-induced hot shorts from causing spurious actuations.

720.338 Successful injection of core makeup tanks (CMTs) requires trip of all reactor coolant pumps (RCPs). Please address in your analysis the impact of an inadvertent RCP start (after initial trip) and whether this can occur in the same scenario with other fire-induced failures of safety equipment, such as spurious actuation of ADS valves, and/or with fire-induced control room indications.

720.339 Fire-induced failure of containment isolation valves was not treated in the analysis. It was assumed that such failure has no effect on core damage frequency (see item h, page 57-15) because "the PRA core damage success criteria are specified assuming failure of containment isolation." However, based on information presented in Appendix A of the AP600 PRA, it does not appear that containment isolation failure was assumed in determining success criteria for sump recirculation. Furthermore, the frequency of a core damage scenario with containment isolation failure should be investigated to determine its contribution to offsite consequences. Please explain.

720.340 The barrier failure probabilities used in the analysis (see Table 57-3) assume certain inspection program for the barriers, which includes a sampling scheme and timing. Please include this information in Chapter 57 (internal fires) of the AP600 PRA.

720.341 The first paragraph of Section 57.2 implies that probabilistic criteria allow screening of compartments with high fuel loading which do not contain PRA-credited equipment, regardless of propagation potential. However, the analysis does consider rooms where the only concern appears to be fire spread (e.g., the lube oil room in the turbine building). Is the statement in Section 57.2 correct? Please explain.

720.342 The basis for defining the fire scenarios in Table 57-4 is not always clear, given the groundrules established in qualitative analysis Step 10. For example, what is the basis for distinguishing between scenarios 1 and 2 for Fire Area 1200 AF 01? Both do not seem to involve spurious signals. Does one involve propagation out of the area? Scenarios involving propagation out of the fire area should indicate explicitly which adjacent fire area is being treated (especially since the second bullet on page 57-4 states that simultaneous propagation to multiple areas is not treated). Please explain.

720.343 Note 2 in Table 57-8 indicates that some components modeled in the focused PRA are failed for some initiators. Does this refer to the

damage listed in the 4th column of the table, or are there additional component losses not explicitly identified? Please explain.

720.344 Does the Remote Shutdown Workstation (RSW) panel have identical controls and displays of plant status information needed during accidents as the Main Control Room (MCR) panels? If the answer is no, please list the major differences and explain how they affect safety system redundancy and reliability, including operator actions.

720.345 Could a fire in the Main Control Room (MCR) affect the transferring of control to the Remote Shutdown Workstation (RSW) panel? Could control be inadvertently transferred back to the MCR? If the answer to these questions is no, please explain by referring to design features and characteristics (e.g., fiber optic switches and location of power sources to the light transmitters and receivers) and to emergency operating procedures and criteria for transferring control to the RSW. If the answer to any of the above two questions is yes, please model the failure to transfer control in the PRA.

720.346 The Main Control Room (MCR) evacuation scenario related to fire in the overhead mimic panel (scenario CR5) appears to be relevant for all control room panels, not just the overhead mimic panel. If all panels are included, the contribution from CR5-like scenarios should be around a factor of 30 higher. Please explain why fires in other control room panels are not postulated to lead to MCR evacuation and plant shutdown via the Remote Shutdown Workstation.

720.347 The frequency of fires in the AP600 Main Control Room (MCR) was assumed to be a factor of 10 smaller than the frequency of fires in a conventional control room. This was based on the observation that most of the cables in the AP600 MCR are low voltage as compared with conventional control room cables. Although it appears reasonable to postulate some reduction in fire frequency as compared with conventional control rooms, is there any data to support the reduction factor used? It is mentioned (page 57-26) that Westinghouse cable heatup calculations have shown that ignition is very improbable because low-voltage cables do not produce enough energy to heat up the cables. Do, the above mentioned Westinghouse calculations, account for insulation aging or the presence of dust? How many of the 12 MCR fires in the NSAC/178L database were initiated by electrical faults leading to ignition of the insulation? Please provide a breakdown of causes. Also, for each event, please provide: an event description, the basis for determining that the fire was not severe and the suppression time.

720.348 The analysis of scenarios CR4 and CR4A (which treat the spurious actuation of both divisions of the ADS Stage 1 valves due to a fire in the Dedicated Control Panel) and Scenario CR4B (which treats the

spurious opening of the Stage 4 valves) does not explain the mechanisms of spurious actuation using PRA I&C models and SAR I&C logic diagrams and does not state assumptions made. Furthermore, this analysis does not identify important features, and/or operational requirements, that are incorporated into the design to prevent fire-induced hot shorts from causing spurious actuations which in turn could have a significant impact on plant safety. Please provide this information. In your response please include answers to the following questions:

- Is Scenario CR4B properly labeled as a sensitivity case? Or should its results be added into the total CDF for the MCR?

- Can a fire that has grown past the incipient stage in the panel affect all ADS valves? If so, is there a technical basis for analyzing only a subset of fire effects?

- The effective spurious actuation probability for all three MCR scenarios (CR4, CR4A and CR4B) is 0.01. On the other hand, for scenarios outside the MCR, a value of 0.06 is used for a single spurious actuation of an ADS Stage 4 valve (leading to an medium LOCA) and a value of 0.0036 is used for the spurious actuation of both ADS Stage 4 valves (leading to a large LOCA). Is there a difference between the MCR and ex-MCR scenarios necessitating the different approaches to quantify the likelihood of spurious actuations?

720.349 The analysis assumes that MCR fires will not affect multiple cabinets, at least until control is transferred to the remote shutdown workstation. What design features are provided to ensure that fires do not propagate from one cabinet/panel to another?

720.350 It is not clear which model was used to estimate the non-suppression probability. The analysis text refers to EPRI's HCR model, but the reference supplied is for ASEP (see page 57-33, Ref. 57-6).

a) Please explain how the non-suppression probability of 0.0034 (used in the analysis) was obtained.

b) Aside from questions of its applicability to the analysis of fire suppression activities, the ASEP model deals with diagnosis (and non-response), as does EPRI's HCR model. Some time is required to actually extinguish the fire. Analysis of suppression time data indicates a mean suppression time of about 8 minutes. Does the AP600 analysis address the time required to extinguish the fire? Please explain.

c) Westinghouse's interpretation of the Sandia cabinet fire tests appears to differ from Sandia's interpretation. In questions to the utility regarding the South Texas fire risk assessment,

the Sandia team stated that "Sandia sponsored large scale enclosure tests have shown that cabinet fires generate such intense smoke that within 6-8 minutes control of the plant from the control room would be virtually impossible. These tests were conducted with control room ventilation rates of up to ten room changes per hour." Please explain the basis for selecting a 15 minute time window (before control room evacuation is required).

d. Are there procedures dealing with control room evacuation? If so, what are the criteria used for determining when evacuation should/must take place?

720.351 A fire in the MCR might cause spurious indications as well as spurious equipment operation. Such spurious indications could prompt incorrect operator actions ("errors of commission"). Please discuss the likelihood and potential consequences of such fire-induced errors. In your discussion please list important design features and operational requirements which help prevent such "errors of commission."

720.352 The Auxiliary Building contains the MCR as well as various I&C, battery and electrical equipment areas. Do any of the later areas share a common ventilation system and/or air intake system with the control room? If the answer is yes, please explain what barriers (including operator actions) prevent smoke, hot gases and fire suppressants from reaching the MCR and how such barriers can be defeated.

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