October 18, 1995

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

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) RELATED TO THE AP600 PROBABILISTIC RISK ASSESSMENT (PRA)

Dear Mr. Liparulo:

Enclosed are the Nuclear Regulatory Commission's (NRC) staff comments on the AP600 PRA. The enclosure contains RAIs related to the level 1 PRA for internal events and the at power flooding analysis. Please note that RAIs on flooding during shutdown operations will be issued when the staff completes its review of the shutdown analysis.

You are requested to provide a response to these questions and comments within sixty days of receipt of this letter.

These followon questions affect nine or fewer respondents, and therefore are not subject to review by the Office of Management and Budget under P.L. 96-511. If you have any questions regarding this matter, you may contact me at (301) 415-8465.

Sincerely,
original signed by:
Michael X. Franovich, Project Manager
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Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

Enclosure: As stated

cc w/enclosure:
See next page

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Westinghouse Electric Corporation

Docket No. 52-003
AP600

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AP600 PRA REVIEW
RAIs on Software Common Cause Failures, Maintenance, and Flooding

RAI Related to DSER Open Item 19.1.3.1-15

1. The staff was unable to find in the revised PRA submittal how the software common-cause failure probabilities were calculated. The following statement is made (see pages 26-25 and 28-20):

> "The software common-cause failure evaluations are based on a model that incorporates a number of factors that can affect the development and implementation of software modules. This model yields a resultant software common mode unavailability of 1.1E-05 failures/demand for any particular software module, and a software common mode unavailability of 1.2E-06 failures/demand for software failures that would manifest themselves across all types of software modules derived from the same basic design program in all applications."

The above statement does not provide adequate information to the staff to understand how software failures were modeled in the PRA. Please explain the "model" and the "particular software modules" you are referring to in your statement. Also, please explain how the common mode unavailabilities (1.1E-05 and 1.2E-06) were obtained.

RAI Related to DSER Open Item 19.1.3.1-16

1. It is not clear whether unscheduled maintenance that could affect the unavailability of safety-related "passive" systems is modeled in the PRA. For example, it is mentioned (Table 9-5) that the normally closed air-operated valves in the Core Makeup Tanks are exercise-tested every three months. Although failure unavailabilities are based on quarterly testing, which implies that faulty valves will be repaired upon detection, the valve unavailability due to such unscheduled maintenance is not modeled in the PRA (neither a justification for not modeling it is provided). This seems true, also, for several other systems, such as the PRHR and the ADS. Please address unscheduled maintenance in the PRA.

RAIs Related to DSER Open Item 19.1.3.2-15

1. The PRA includes layout drawings of the containment and auxiliary buildings only. Please include layout drawings of the annex and turbine buildings.

2. The potential flooding sources in each area are now given by system name. Please provide the maximum water available from each of these flooding sources. For those areas where credit is taken for mitigation actions or drainage through the drain system, please also provide the assumed break flow rates.

Enclosure

3. The SSAR (page 9.5-2) indicates that the fire suppression water system must be able to supply a minimum of 500 gpm for fire hoses plus the demand of any automatic sprinkler. Page 56-11 of the PRA states that fire hose stations in the Annex building are assumed to deliver 125 gpm. Please provide an explanation of the difference between these values and if the assumption of a maximum 125 gpm instead of 500 gpm flow rate has an impact on the result of the flooding analysis.

4. Doors in the AP600 flooding analysis are assumed to remain intact in their normal position (page 56-8). Due to uncertainties in door loading and strengths, and the movement of personnel, this assumption may be optimistic: that is, the door may be open, or fail to remain closed; or the door may be closed, or mistakenly closed by personnel; or due to pressure from the flood water it may not be possible to open or close a door. Please identify the scenarios where the assumption that the doors remain intact in their normal position mitigates the effects of flooding, and justify the assumption that the door will remain intact in that position.

5. The Flood Zones and Barriers Plans in the flooding PRA include a '+' symbol indicating "WATER TIGHT FLOOR/ROOF." Please clarify if this indicates that the rooms with that symbol on a given level have a watertight floor, roof, or both. Some cases, assuming that both the floor and roof are water tight, result in inconsistencies between the different level drawings. If such a symbol does not exist for a room, has the possibility of water running through pipe and electrical penetrations between floors been considered?

6. On page 56-10 of the PRA, "t - Assumptions made about the Annex building," states that in Section 3.4 of the SSAR, no credit is taken for floor drains. In the referenced SSAR section on page 3.4-22, however, floor drains are discussed and credited with routing water away from adjacent rooms. Please clarify this apparent discrepancy and identify what impact, if any, the clarification might have on the PRA analysis.

7. Please justify the assumption that 1" line breaks can be neglected in the flooding analysis.

<u>RAIs Related to DSER Open Item 19.1.3.2-17</u>

1. The SSAR indicates that the fire suppression water system must be able to supply a minimum of 500 gpm for fire hoses plus the demand of any automatic sprinkler. It further states that there are 2, 2000 gpm rated pumps and that pressure switches are used to start the pumps to maintain full line pressure. When the 8" fire line in Annex Building 135'-3" North Handling Equipment Area Ruptures, two hours is allowed for the security guard and operators to mitigate the event before the 1E DC batteries in Auxiliary Building non-RCA 66'-6" level would fail. Please identify and justify the flow rate used to estimate this 2 hour time interval, and address the sensitivity of these flow rates on the flood induced DC power failure probability.

RAIs Related to DSER Open Item 19.1.3.2-18

1. The assumption that human actions in the control room, credited in the internal events models and thus credited in the flooding analysis, are not seriously impacted by the flood is reasonable. Some human actions credited in the internal event PRA are, however, actions taken outside of the control room. These actions include CCN-MAN02, CVN-MAN04, REG-MAN00, and TCB-MAN02. Please verify that the human actions which are performed outside of the control room are;

   a) not credited in the models used in the flood analysis,
   b) not in an area impacted by the flood if they are used,
   c) or that the impact of flooding on the probability of successfully completing the action, will be negligible.

RAIs Related to DSER Open Item 19.1.3.2-19

1. The flooding CDF was quantified using approximately 2,500 applicable cut sets from the internal events analysis. A flooding event changes the failure probability of many normally reliable components to 1.0, and major changes to the dominant cut sets can be expected. Please provide the results of the final flooding scenarios based on quantification of the original logic models, not on the reduced set of 2,500 cut sets.

RAIs Related to DSER Open Item 19.1.3.2-20

1. Please verify that, when selecting which initiating event to use in Table 56-5 (e.g. scenario 1 vs. 2 ; 3 vs. 4 ; 5 vs. 6 vs. 7 ; etc.), identical component/system failures were used and only the event trees were changed to identify the most conservative IE to use.

   Unlike the scenarios in the selection process above, Scenarios 15 and 16 are quantified using the same initiating event and initiating event frequency, but 15 has a much wider propagation and many more component failures. It is not surprising that sequence 15 has a greater CDF. If 16 is intended to model the partial flood event assuming successful actions to prevent flood propagation to the auxiliary building, it should have a higher initiating event frequency. Please clarify the reason for evaluating both scenarios 15 and 16 in Table 56-5.

RAIs Related to DSER Open Item 19.1.3.2-22

1. Due in large part to assumed human mitigating actions, the frequency of flooding the non-RCA Auxiliary building 66'-6" level and failing the 24 hour 1E DC batteries is estimated to be 4.4E-08/yr. Since this appears to be the lowest level in the plant, flooding events caused by check valve failures and backflow through the drain system may occur with comparable or higher frequency. Please provide a discussion indicating why drainage to this lowest level is expected to be less frequent than 4E-08/yr.

2. The PRA states that the site is to be chosen such that the annual frequency of occurrence of a flooding event is less then 10E-06 year and thus external flooding need not be evaluated. The staff notes that the 1E DC battery rooms are at 66'-6" (the lowest level) in the non-RCA part of the Auxiliary building. The 1E DC Buses are at 82'-6", one level higher. Grade level is 100' so both areas are below grade. Consequently, extreme measures would be necessary to prevent external flooding from failing all 1E DC and preventing any foreseeable recovery. Chapter 2, Site Characteristics, of the SSAR discusses the 10E-06 per year criteria on page 2-2, but appears to exclude external floods from consideration under this criteria. Floods are discussed separately on page 2-6, where information collection requirements are discussed but no criteria are given. Please explain why an external flood will not lead to "severe consequences", or identify where the maximum acceptable annual frequency of 10E-6 for external floods will be addressed in the AP600 documentation.