January 29, 1997

APPLICANT: Westinghouse Electric Corporation

FACILITY: AP600

SUBJECT: SUMMARY OF DECEMBER 18, 1996, MEETING TO DISCUSS ISSUES RELATED TO THE FIRE PROBABILISTIC RISK ASSESSMENT (PRA) FOR THE AP600

The Nuclear Regulatory Commission (NRC) staff and representatives of Westinghouse Electric Corporation held a meeting on December 18, 1996, at Westinghouse's office in Rockville, Maryland, to discuss issues associated with the fire PRA for the AP600. Attachment 1 is a list of meeting attendees. Attachment 2 is a copy of handouts provided by Westinghouse.

The meeting began with Westinghouse providing an overview of how they performed their fire PRA including the assumptions and fire scenarios that were used. The fire PRA requests for additional information (RAI) were then discussed. The RAIs were sent to Westinghouse in letters dated September 18, 1996, and December 2, 1996. The September 18, 1996, letter concerned the at-power portion of the fire PRA while the December 2, 1996, letter concentrated on the shutdown portion of the fire PRA. Westinghouse provided draft responses to the at-power portion of the fire PRA questions in a December 9, 1996, letter.

Each draft response in the December 9, 1996, letter was discussed. The staff found some of the responses acceptable, while others were determined to need more information. In some cases the staff needed to look at the response in more detail before it determined if the response was acceptable. Attachment 3 was provided to the staff during the discussion of RAI 720.345. The diagram was used to explain how transfer to the Remote Shutdown Workstation from the Main Control Room would be accomplished in the event of a fire.

original signed by:
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Docket No. 52-003

Attachments: As stated

cc w/attachments:
See next page

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WESTINGHOUSE AP600 FIRE PRA
MEETING ATTENDEES
December 18, 1996

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JIM WINTERS	WESTINGHOUSE
BARRY SLOANE	WESTINGHOUSE
KEN DEUTSCH	WESTINGHOUSE
CINDY HAAG	WESTINGHOUSE
AMIR AFZALI	WESTINGHOUSE CONSULTANT
HULBERT LI	NRR/DRCH/HICB
NATHAN SIU	INEL
MARIO GARERI	NRR/DRCH/HICB
NICK SALTOS	NRR/DSSA/SPSB
MARIE POHIDA	NRR/DSSA/SPSB
JOHN FLACK	NRR/DSSA/SPSB
JEFF HOLMES (PART TIME)	NRR/DSSA/SPSB
JOE SEBROSKY	NRR/DRPM/PDST

Attachment 1

Westinghouse Electric Corporation

AP600 INTERNAL FIRE RISK ANALYSIS

December 18, 1996

Attachment 2

AGENDA

- Summary of Fire PRA
  - Assumptions
  - Fire scenarios
- Discussion of RAIs
  - Power conditions
  - Shutdown conditions
- Summary / Conclusion

AP600 Internal Fire Analysis
Basic Approach

- Perform a qualitative assessment of the internal fires impact on systems required for normal and safe shutdown of the plant
- Quantify the risk posed by the postulated impact in terms of core damage frequency
- Analyze the results for sensibility and insights

Major Steps in Qualitative Assessment

- Analysis of fire area vs. plant trip/safe shutdown equipment damage was performed.
  - For fire areas with no credible fire propagation mechanism, the analysis was performed assuming that all equipment and cables in the exposing fire area were damaged.
  - For fire areas where fire propagation from them was determined to be possible, the analysis was performed assuming that all equipment and cables in both the exposing and the exposed fire areas were damaged.

Major Steps in Qualitative Assessment

- A fire area was screened out from further analysis based on the following criteria:

  - If a fire originating in that fire area was not expected to create a demand for safe shutdown under normal plant operating conditions, and if none of the PRA-credited equipment were considered damaged.

  - If the fire was expected to cause a plant shutdown due to technical specification requirements but was not postulated to impact operability of any PRA-credited shutdown systems.

- For those areas that did not screen out, a qualitative assessment of the consequences of the fire was performed. As a part of this qualitative evaluation, the consequences of different fire-induced cable failure modes (open or short) were considered.

TABLE 1C - AP600 FIRE AREA/ZONE QUALITATIVE EVALUATION		
Fire Area Number: 1201 AF 02	**Fire Area Description: Division B Batteries**	
Fire Zone Number:	Fire Zone Description:	
Combustible Loading (BTU/sq. ft.): 69,286	Detection: Smoke	Fixed Suppression: Hose Station
1. Does area/zone contain equipment and/or cable required to achieve hot shutdown per PRA? (Yes/No) YES. Division B Batteries		
2. Is there a requirement for plant shutdown given fire damage for fires contained within the area/zone? (Yes/No) YES. See Assumptions. See assumption #12 N.A 4/5/96		
3. Is fire propagation credible for fires initiated in this area/zone? (Yes/No) YES. Fire propagation is assumed to be possible for fires originating in fire areas with internal combustible loadings of greater than 20,000 BTU/sq. ft. Table 1E presents a list of potentially at risk fire areas. The worst case possible fire propagation scenario would be a fire spread to the division B DC equipment room (fire area 1222 AF 01), since spreading to 1201 AF 03 is not considered possible.		
4. Is there a requirement for plant shutdown given fire propagation from this area/zone? (Yes/No) Since a fire in this area is assumed to result in a plant trip, this question is not relevant.		
5. Can this area be qualitatively screened out? (Yes/No) NO.		

TABLE 1C - AP600 FIRE AREA/ZONE QUALITATIVE EVALUATION		
Fire Area Number: 1201 AF 02	**Fire Area Description: Division B Batteries**	
Fire Zone Number:	Fire Zone Description:	
Combustible Loading (BTU/sq. ft.): 69,286	Detection: Smoke	Fixed Suppression: Hose Station

6. Postulated fire scenario? (Applicable/Not Applicable)

--For fires confined within the area, the B division of power and control is assumed lost with no other systems or equipment impacted. Fire damage state (FDS) 1AB4 is designated to represent the damage caused by the above described fire scenario.

--For fires propagating out of this area, the following scenarios are postulated:

Fire Scenario 1- The impact of fires covered under this fire scenario will be bounded by the loss of the equipment discussed for FDS 1AB4. Fire damage state (FDS) 1AB4 is also designated to represent the damage caused by the above described fire scenario.

Fire Scenario 2- The impact of fires covered under this fire scenario will be bounded by the loss of the equipment discussed for FDS 1AB4 plus spurious opening of the ADS valves due to the fire induced damage to division B related cabling utilized to support ADS valves. Fire damage state (FDS) 1AB5 is designated to represent the damage caused by this fire scenario.

Major Steps in Quantitative Assessment

- For each fire area surviving the qualitative screening, core damage frequency due to fire damage, coincident with fire unrelated unavailability of redundant/alternate safe shutdown equipment was evaluated.

- CDF was evaluated based on the assumption that all fires damaged all potential targets in one step.

- An initiating event was assigned to each scenario based on the information collected during the qualitative analysis, together with potential damage to the PRA-credited safe shutdown systems.

Fire Propagation

- Fire propagation to more than one fire area was considered, but sequential fire propagation (from a fire area to an unconnected fire area via an intermediatory fire area) or simultaneous fire propagation to more than one fire area were judged not to be credible.

- Fire Propagation Possibility -

  - Fire propagation across a fire area boundary without sealed openings (e.g., walls with doors, vent louvers, cable penetrations, etc.) was judged not to be credible.

  - Fire propagation across a barrier was judged not to be credible if the deterministic fire protection assessment had credited the barrier as being capable of preventing fire propagation, unless:

    i. The barrier's integrity had been compromised by a barrier element failure (e.g., penetration seal failure)

    AND

    ii. If the fire suppression activities in the exposing location were to fail to contain the fire within the area.

Fire Propagation

- Fire Propagation Probability -

  - Probability of fire propagation was calculated based on the failure probability of the fire barrier and fire suppression system in the exposing fire area.

    i. Fire suppression was not credited to limit fire damage within an area

    ii. Manual fire suppression was not credited for preventing propagation to other fire areas.

    iii. Automatic fire suppression system in the exposed fire area was not credited to prevent fire propagation to that area or limit the consequences of the fire.

Fire Propagation

- Fire propagation across the containment inter-zone fire barriers was not considered to be credible on the basis that

  i. Per deterministic fire analysis, each fire zone is physically separated from the other fire zones by structural barriers, or in one case by large distance, such that fire propagation across a fire zone boundary can be dismissed.

  AND

  ii. The containment inter-zone barriers are designed not to contain sealed openings (e.g. doors or penetration seals).

Fire-Induced Spurious Actuation

- Probability of a specific fire-induced fault occurring was calculated based on the nature of the fault.

  Based on NUREG/CR-2258 evaluation, the best estimate conditional probability of a hot short event was estimated as 0.06. Note that for large LOCA at least two hot shorts are required. Thus, the conditional probability of a fire-induced large LOCA was estimated to be 3.6E-3.

Fire Analysis Conservatism

Conservatism used in the AP600 fire analysis include:

- The fire frequency was estimated based on the fire events which have occurred in the existing plants. The AP600 design is such that the number of potential ignition sources is significantly less than that in a conventional plant (less pumps, less MOVs, less MCCs/switchgears, etc.)

- A fire originating from any ignition source in an area is assumed to disable all equipment located in the fire area. A review of the historical evidence indicates that most fires are localized fires with limited severity. In most fire PRAs, a fire severity factor is usually used to adjust the fire frequency to a more realistic value.

- Manual fire suppression is not credited to limited the extent of damage in an area nor to prevent fire propagation to an adjoining area. Again historical evidence indicates that the majority of suppressed fires were manually suppressed with little or no additional damage.

Fire Analysis Conservatism

- Automatic fire suppression system in the exposed fire area was not credited to prevent fire propagation to the area or limit the consequences of the fire.

- During the quantification process, the nonsafety- related systems (e.g. main feedwater, normal RHR, offsite power, etc.) are not credited. However, fires in only a few AP600 fire areas would be capable of disabling all the nonsafety-related systems.

Design Features

Design features that minimize risk from fire include:

- The AP600 fire protection design provides, to the extent possible, for separation of the alternate safety-related shutdown component and cabling using three hour rated fire barriers without any penetrations.

- The high reliability of the shutdown systems as determined by the internal events model and passive nature of these system, making them less susceptible to fire-induced failure mechanism (e.g., loss of power).

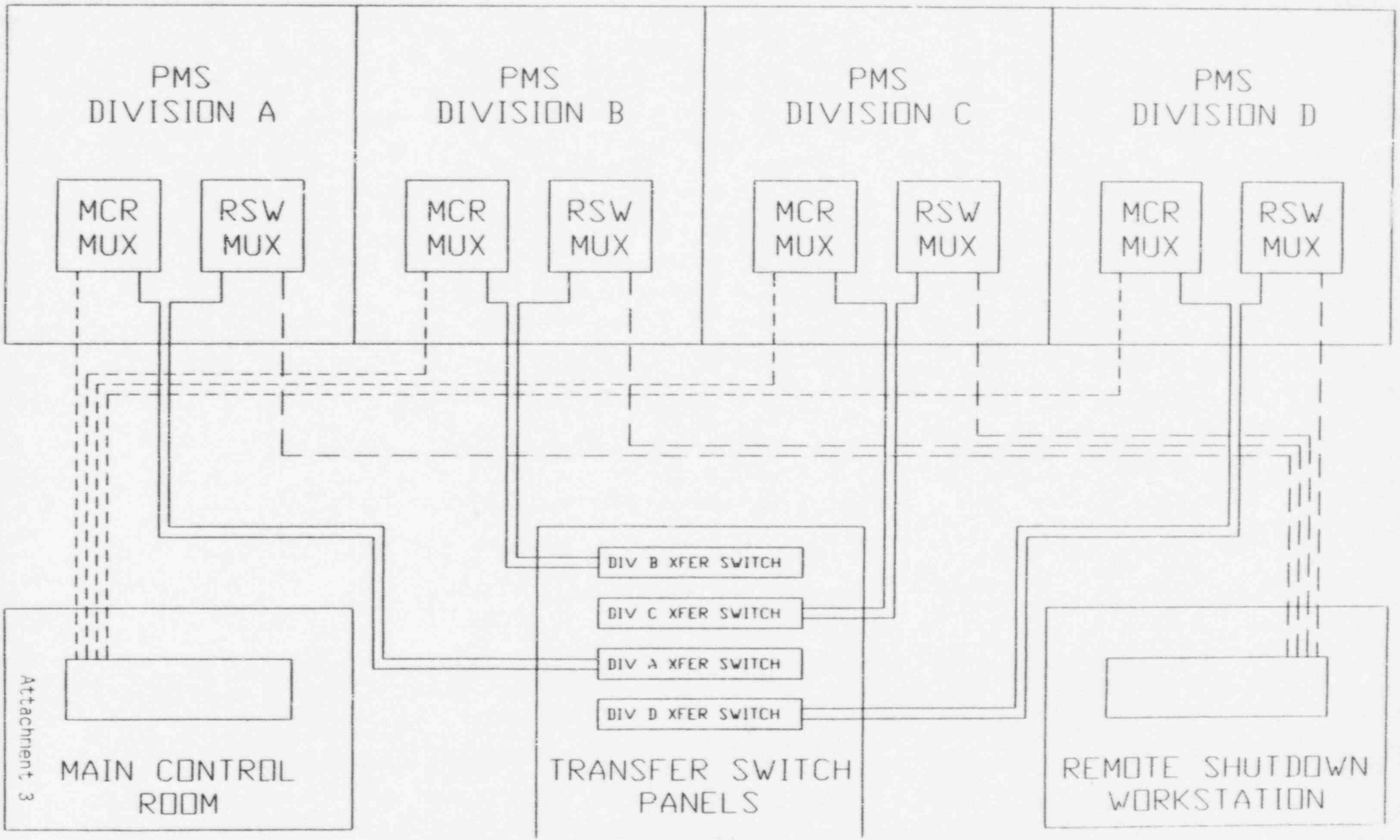
Summary of AP600 Fire Analysis Results

AT-POWER	
Plant	3.5E-07 /yr
Control Room	5.7E-11 /yr
Containment	3.0E-07 /yr
Total	6.5E-07 / yr

SAFE SHUTDOWN	
Plant	2.5E-08 /yr
Control Room	9.9E-09 /yr
Containment	3.0E-10 /yr
Total	3.5E-08 / yr

MID-LOOP	
Plant	2.6E-07 /yr
Control Room	7.8E-10 /yr
Containment	5.1E-08 /yr
Total	3.1E-07 / yr

AP600 MCR/RSW TRANSFER



Attachment 3