March 28, 2003

MEMORANDUM TO: Marsha Gamberoni, Deputy Director
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

FROM: Joseph Colaccino, Senior Project Manager ***/RA/***
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

SUBJECT: MARCH 4, 2003, TELEPHONE CONFERENCE CALL SUMMARY

On Tuesday, March 4, 2003, a telephone conference call was held with Westinghouse Electric Company (Westinghouse) representatives and Nuclear Regulatory Commission (NRC) staff to discuss several requests for additional information (RAIs). The following RAIs were discussed: 280.001, 280.008, and 280.011. Westinghouse submitted responses to these RAIs on November 26, 2002 (ADAMS Accession No. ML023360097). A list of call participants is included in Attachment 1. Attachment 2 contains NRC staff comments regarding the subject RAIs that were sent to Mr. Michael Corletti of Westinghouse via electronic mail on February 20, 2003. These comments were used to facilitate discussions during the telephone conference call.

Following is a brief summary of the discussions regarding the identified RAIs (see comments in Attachment 2):

RAI 280.001

Westinghouse agreed to modify the RAI response to address the issues presented by the NRC staff.

RAI 280.008

Westinghouse agreed to modify the RAI response to state that they are using thermoset cables and would reference the Electric Power Research Institute (EPRI) report.

RAI 280.011

Westinghouse agreed to modify the RAI response to further describe its use of the FIVE methodology for use in the containment area and revise the probabilistic risk assessment if necessary.

Docket No. 52-006

Attachment: As stated

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MARCH 4, 2003
TELEPHONE CONFERENCE CALLS SUMMARY
LIST OF PARTICIPANTS

Nuclear Regulatory Commission	Westinghouse
Joseph Colaccino	Mike Corletti
Tanya Mensah	Jim Winters
Nick Saltos	Frederic Talieu
Ed Throm	Tom Hayes
Narinder Trehan	F.T. Johnson
	Richard Orr

Attachment 1

NUCLEAR REGULATORY COMMISSION STAFF
COMMENTS THAT WERE SENT TO WESTINGHOUSE TO
FACILITATE DISCUSSIONS OF THE RAI RESPONSES
FOR CALL HELD ON MARCH 4, 2003

280.001

In RAI 280.001, the staff stated that Section 9.5.1.2.1.1 and Item 55 of Table 9.5.1-1 of the AP1000 Design Control Document (DCD) notes that the stairwells outside of the primary containment serving as escape routes, access for firefighting, or access routes to areas containing equipment necessary for safe shutdown have not been enclosed in masonry or concrete towers with a minimum fire rating of two hours as specified in Position C.5.a.6. of CMEB 9.5.1. The staff previously granted Deviation 9.5.1-2 for the use of gypsum stair towers in lieu of concrete or masonry for the AP600 in NUREG-1512, "Final Safety Analysis Report [FSER] Related to Certification of the AP600 Standard Design," on the basis that there were no missile hazards in the vicinity of the subject stairwells. External missile hazards were not considered in the staff's original evaluation of the AP600 stairwells.

Following the events of September 11, 2001, the Federal Emergency Management Agency (FEMA) issued report FEMA 403, "World Trade Center Building Performance Study: Data Collection, Preliminary Observations and Recommendations," dated May 2002. Based on the performance of the gypsum stairwell enclosures in the World Trade Center following the aircraft impacts, Section 8.2.2.1 of the FEMA report recommends the use of impact-resistant enclosures around egress paths, such as stairwells. This guidance is consistent with the guidance specified in Position C.5.a.6 of CMEB 9.5.1. Therefore, the staff has re-considered its previous acceptance of gypsum stairwell enclosures in lieu of the concrete or masonry enclosure specified in the Branch Technical Position (BTP).

During the December 17, 2002, meeting with the NRC staff, Westinghouse stated that they were taking credit for existing structures or buildings within close proximity to those stairwells which meet the guidance in Position C.5.a.6 of CMEB 9.5.1. On that basis, Westinghouse only partially enclosed some stairwells with concrete. The NRC staff stated again that CMEB 9.5.1 requires protection of stairwells by enclosing them completely in concrete if they meet the criteria outlined in the CMEB. The guidance does not state that stairwells located underground, or surrounded by existing structures, are not required to meet the guidance in Position C.5.a.6 of CMEB 9.5.1.

Therefore, for those stairwells that are serving as escape routes, access for firefighting, or access routes to areas containing equipment necessary for safe shutdown that have not been enclosed in masonry or concrete towers with a minimum fire rating of two hours as specified in Position C.5.a.6 of CMEB 9.5.1, provide a revision to the DCD to incorporate the original BTP guidance for the use of concrete or masonry enclosures.

280.008:

This RAI concerns the Westinghouse assumption that the probability of a spurious signal impacting the automatic depressurization system (ADS) inside containment can be considered as an independent failure. During the December 17, 2002, meeting with Westinghouse, the staff asked Westinghouse for their technical basis. Westinghouse referenced to an EPRI report titled, "Spurious Actuation of Electrical Circuits Due To Cable Fires." The probabilistic risk assessment (PRA) specialist asked Westinghouse what testing, if any, was done, to support the expert panel views. The fire protection staff has reviewed this report which contains the results of an expert elicitation. Page 7-11 of the report states that a series of Omega Point test data was used to extract meaningful understandings and to support development of correlations. Page 5-1 of this report explains the EPRI/NEI Omega Point Test series where a test rig was constructed, with cables located several feet above the floor in either cable trays or conduit. In particular, the expert panel offers guidance based on the EPRI/NEI Omega Point test data, on the issue of independence. For example, on page 7-11 of the report, the panel states that if you have two different cable failures occur, where each cable failure is associated with a different conductor, then these events can be taken as independent events, provided that the phenomena really do occur in different conductors. The Westinghouse RAI response in summary states that:

> For ADS Stages 1, 2, and 3, the conductors are not only different, but they are also in different cables. For ADS Stage 4, the arm and fire circuits also are different cables and therefore there is independence between arm and fire circuits.

The EPRI report titled, "Spurious Actuation of Electrical Circuits Due To Cable Fires" states that the above conclusion of independence would also hold true if different cables are located in the same cable tray. The staff notes that Westinghouse did not address this point in the RAI response. However, based on this report, even if the cables for ADS Stages 1, 2, 3, and 4 were located in the same cable tray, it would appear from this report that no further analysis is warranted and that independence could still be assumed for purposes of the PRA.

However, EPRI Report 1003396, "Characterization of Fire-Induced Circuit Faults" dated December 2002, which is a more recent report, provides additional insights into the EPRI/NEI Omega Point Test series. Section 12.2.2.2, "Cable-to-Cable Interaction Test Results" states that spurious actuations from cable-to-cable interactions are a credible occurrence and cannot be excluded from consideration. The conclusions for cable-to-cable interactions state that such interactions appear highly dependent upon the cable type (armored, thermoset, thermoplastic). Particularly, themoplastic cables (typically non- IEEE-383 rated cables) melt at high temperatures, the cables lose their form, allowing the conductors to essentially lump together. This increases the likelihood of conductors from separate cables coming into close proximity to each other. In light of the insights reported in EPRI Report 1003396, the staff requests that Westinghouse address if cables for ADS Stages 1, 2, 3, and 4 are separated or routed in the same cable trays (or enclosures). If they are routed in the same cable tray (or a common enclosure), provide an analysis which addresses cable-to-cable interactions, and the issue of independence, considering the insights and conclusions presented in Section 12.2.2.2 of EPRI Report 1003396.

280.011:

To discuss technical concerns related to this RAI, the staff had a teleconference with Westinghouse on December 17, 2002, which resulted in the following technical concerns.

> With respect to the general design of fire areas in Containment, Westinghouse confirmed during the call that the screening criteria applied for the fire PRA assumes that if the total combustible loading in each fire area is less than 20,000 Btu/ft^2, that the fire area was screened out using the FIVE methodology. On Page 5-8 of the EPRI report which explains the FIVE methodology, Bullet 4 states that a fire area can be screened out if it has less then 20,000 BTU per sq. ft. Westinghouse also stated that this is considered a very low quantity of combustible loading per the National Fire Protection Association (NFPA) Fire Protection Handbook (FPH). However, Westinghouse did not address that Page 7-78 of the FPH, 18th Edition, also states that "the original concepts of fire severity and fire load (combustible load) are very important even though they are technically obsolete." The information contained in the FPH regarding combustible loading was first published in 1997, and the FIVE methodology, which makes use of the "combustible loading" concept was published as a final in 1992.
>
> Combustible load is a measure of the maximum heat that would be released if all the combustibles in a given fire area burned and does not consider other factors such as heat release rate (HRR), room configuration, ventilation rate, or other parameters which describe the fire dynamics over a period of time. The National Institute of Standards and Technology (NIST) Technical Report NISTIR 5842[1], page ix, also identifies that the technical shortcomings of this method are the following:
>
> - no technical basis for the equal-area hypothesis[2]
> - real room fire intensities are not a sole function of fire (combustible) load
> - temperatures of real fires can rise much faster then the standard time-temperature curve[3]

NISTIR 5842, page ix, also states that the NFPA acknowledges that the fire load method is technically obsolete. Westinghouse stated during the call that NFPA 805, which is the latest industry performance-based standard for fire protection endorsed by the NRC, permits the use of the FIVE methodology. FIVE was approved by the NRC in the early 1990's primarily as a tool to provide a qualitative assessment of fire risk for the IPEEE to perform fire PRAs.

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[1]NISTIR 5842, "Methodology for Developing and Implementing Alternative Temperature-Time Curves for Testing the Fire Resistance of Barriers for Nuclear Power Plant Applications," by Cooper, L., and Steckler, K. May 1996, page 3.

[2]The equal-area hypothesis is that the area beneath a temperature-time curve is a measure of the intensity or severity of a fire, and all fires with equal-area exposures are equally severe.

[3]ASTM E 119-98, "Standard Test Methods for Fire Tests of Building Construction and Materials," ASTM Fie Test Standard, Fifth Edition, American Society of Testing and Materials, West Conshohocken, PA, 1999, pp 793-813.

Appendix Section C.2.2., "Fire Model Features and Limitations" of NFPA 805 specifically states that the limitations of each fire model should be taken into consideration in order to produce reliable results that will be useful in decision making. This section specifically states that *"Some models may not be appropriate for certain conditions and can produce erroneous results if applied incorrectly."* The intent of the Appendix C, Table C.2.2.(b) which lists all of the fire models, is to compare the features available in each mathematical model. This enables the user to select the appropriate model for a particular fire area, in order to obtain useful estimates to best approximate the conditions within an enclosure as a result of an internal fire. Table C.2.2.(b) of NFPA 805, compares the following features available for ten different mathematical models:

- What type of program is it (Zone, CFD, Network Flow)
- Number of rooms that can be modeled
- Wall heat transfer
- Lower Level Gas Temperature
- Heat Targets
- Fire
- Gas Concentrations
- Oxygen depletion
- Vertical connections
- HVAC Fans and Ducts

<u>The staff notes the following technical concerns with the use of the FIVE methodology for the Containment area</u>:

- Section 2.0, "Definitions," of the FIVE report provide definitions for "fire area boundary." Typically, a fire area boundary is completely sealed with floor-to-ceiling and/or wall-to-wall fire barriers. The FIVE methodology is limited in that large open areas, such as those in containment, are not capable of being realistically modeled. The AP1000 DCD identifies that there are open areas in containment, specifically for fire zones 1100 AF 111204, 1100 AF 11206, 1100 AF 11207, 1100 AF 11208, 1100 AF 11300A, 1100 AF 11300B, 1100 AF 11301, 1100 AF 11302, and 1100 AF 11500. The safe shutdown evaluation provided in the DCD for these zones discuss the migration of hot gases beyond the area of fire origin and make deterministic assumptions that a fire will not propagate beyond the zone without technical justification. Hot gases and flames could also damage seals in the area of fire origin which would open a path for propagation to adjacent fire zones. However, without the proper selection of a fire model which allows the user to input more realistic data to estimate fire growth, Westinghouse may not have realistically demonstrated that propagation will not occur within certain zones in Containment, on the basis of "combustible load" assumptions. The state-of-the-art for fire protection has increased since the development of FIVE, and where practical mathematical fire modeling should be used to reduce unnecessary conservatism.

  Furthermore, selection of a fire model solely on the basis that it is allowed by NFPA 805, without analyzing the limitations of each fire model for certain conditions could produce erroneous and unreliable results. Please note that NFPA 805 does not recommend any specific fire model over another. In fact, it only states that the limitations of each fire model should be taken into consideration in order to produce reliable results that will be useful in

decision making. Using the FIVE methodology, Westinghouse has screened out areas in Containment on the basis of the combustible loading concept when other computer fire modeling techniques are available, which allow the user to input more useful data to make realistic determinations regarding fire growth and smoke propagation. In light of the limitations noted with the combustible loading method and the inability of FIVE to model large, open areas, the staff requests that Westinghouse address the appropriateness of the FIVE methodology to screen out large open areas such as Containment for the AP1000 Fire Protection review.

AP 1000

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