Docket File

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 10, 1997

Mr. Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Analysis
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, PA 15230

SUBJECT: DISCUSSION ITEMS ON SOURCE TERM RELATED ISSUES FOR THE AP600

Dear Mr. Liparulo:

As a result of its review of the June 1992 application for design certification of the AP600, the staff has determined that it needs additional information. Specifically, the enclosure to this letter contains discussion items on source term related issues for the AP600. We propose that the enclosed discussion items serve as agenda items for a currently unscheduled meeting on the matter. During this meeting the staff will determine which of the enclosed discussion items need to be formally addressed by Westinghouse.

In addition, during this meeting, the staff and its contractor (Sandia National Laboratory) will be available to discuss the issues that you raised in your letter dated December 3, 1996, concerning its technical evaluation report entitled, "Monte Carlo Uncertainty Analysis of Aerosol behaviors in the AP600 Reactor Containment."

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 Public Document Room.

DF03 1/1

If you have any questions regarding this matter, you may contact me at (301) 415-1120.

Sincerely,

original signed by:

Thomas J. Kenyon, Project Manager
Standardization Project Directorate
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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Docket No. 52-003
AP600

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Enclosure to be distributed to the following addressees after the result of the proprietary evaluation is received from Westinghouse:

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Discussion Items Related to the Source Term for the AP600

In anticipation of an upcoming meeting on source term related issues, Westinghouse should be prepared to discuss and provide the technical bases for consideration of aerosol behavior and removal in the proposed AP600 containment design and for consideration of radiological attributes. Several of these issues were raised in the two referenced sets of requests for additional information. The following discussion items will serve as agenda items for a currently unscheduled meeting on the matter. During this meeting the staff will determine which of the enclosed discussion items need to be formally addressed by Westinghouse.

Aerosol Behavior and Removal

(1) Present and discuss the particular version of the NAUA code used by Westinghouse to calculate aerosol removal coefficients. Identify the pedigree of the code from its origin in the public literature, and any unique customization performed, and rationale, for the proposed AP600 design. Provide the code validation and verification (V&V), quality assurance (QA), and code inputs used and outputs obtained in calculating the aerosol removal rates. Discuss the reliance on earlier V&V efforts and subsequent efforts in light of pedigree evolution.

(2) Provide a discussion of the sensitivity analyses that were performed for the NAUA code used by Westinghouse to consider uncertainties in processes and parameter values; for example, uncertainties associated with non-radioactive aerosol mass, aerosol particle sizes, particle shape factors, etc. Identify the set that may have been provided to NRC on the AP600 project or any other submittal, and those peculiar to the proposed AP600 design.

(3) Discuss the nodalization of the AP600 containment aerosol sedimentation area and geometry, the rationale for level of specification (e.g., lump compartment v. multi-compartment), and the bases for the boundary conditions for each node to determine aerosol removal coefficients.

(4) Discuss the rationale for assuming that the AP600 containment atmosphere would be homogeneously mixed following a postulated DBA. Regional stratification may limit the removal effectiveness of phoretic processes; discuss the effects of stratification on diffusiophoresis and thermophoresis. Provide the technical bases to demonstrate that stratification of non-condensible gases is not germane to the proposed AP600 design.

(5) The proposed AP600 design relies on removal of radioactive and non-radioactive aerosols from the containment atmosphere by gravitational settling, and by diffusiophoretic and thermophoretic

processes, occurring simultaneously. Provide any existing experimental data or published literature to demonstrate that the performance of these processes, both individually and collectively, are well-known under normal operating and harsh environmental conditions.

(6) In a letter to NRC dated August 5, 1996, Westinghouse provided specific values for aerosol removal coefficients for the proposed AP600 containment design following a postulated DBA:

0.63 per hour for the first 2 hours
0.81 per hour for the remainder of the first 24 hours

Discuss the technical bases for the analytic results presented; provide uncertainty distributions for these values and accompanying statistical measures that were considered to assess applicability for DBA calculations.

(7) Using a certain postulated design basis accident, i.e., the 3BE sequence, provide the time series of aerosol removal rates and associated uncertainty distribution for each time step (at a maximum time step of 0.1 hour over the first 24 hour period) after the start of the accident. Also, provide the time series of aerosol removal rates attributable to each of the processes (gravitational settling, diffusiophoresis, and thermophoresis) and uncertainty distribution for each time step along with the corresponding steam condensation rates. Discuss the rationale for assuming that the phoretic processes are insensitive to the higher steam condensation rates at later times (after 10 hours into the accident).

(8) Both CONTAIN and NAUAHYGROS codes use approximate models and do not consider wall boundary layer depletion effects, which could play an important role following an accident. Turbulent conditions are expected in the AP600 containment atmosphere following a DBA. A structured boundary layer is expected to form consisting of a laminar sub-layer containing non-condensible gases adjacent to the containment wall itself, a transition layer, and an outer layer. The aerosol mass transfer rates between these sub-layers may become more important than the parallel coupling assumed in all the aerosol codes. Discuss these phenomenological effects on boundary layer depletion and on phoretic processes under harsh environmental conditions.

Radiation Protection

(1) Table 12.2-20 and Table 12.2-21 in Chapter 12 of the AP600 SSAR presents "Core Melt Accident Source Strengths in Containment Atmosphere as a Function of Time", and "Core Melt Accident Integrated Source strengths in Containment Atmosphere, respectively;

discuss the assumptions and parameters used in the calculation. Provide an example calculation, including computer code input used and output obtained. Provide the distribution of radioactivity in gaseous and aqueous phases in the containment, including the effects of aerosol distribution in the containment.

(2) Figures 3D.5-2 and 3D.5-3 present instantaneous gamma and beta dose rates as a function of time after a LOCA. Section 3D.5.5.1.1 states that the radiation exposure inside containment is conservatively estimated by considering the dose in middle of the AP600 containment with no credit for the shielding provided by internal structures. Provide an example calculation used to determine instantaneous beta and gamma dose rates. Discuss the distribution of radioactivity in gaseous and aqueous phases in the containment including the effects of aerosol distribution in the containment in determining the dose rates.

REFERENCES:

(1) NRC Letter to Westinghouse dated October 2, 1996, Request for Additional Information on Aerosol Removal Mechanisms (470.38 through 470.40)

(2) NRC Letter to Westinghouse dated August 8, 1996, Request for Additional Information on Equipment Qualification (470.32 through 470.37)