January 21, 2003

Mr. Michael M. Corletti
Passive Plant Projects & Development
AP600 & AP1000 Projects
Westinghouse Electric Company
Post Office Box 355
Pittsburgh, Pennsylvania 15230-0355

SUBJECT: REQUESTS FOR ADDITIONAL INFORMATION - AP1000 DESIGN CERTIFICATION REVIEW (TAC NO. MB5491)

Dear Mr. Corletti:

By letter dated March 28, 2002, Westinghouse Electric Company (Westinghouse) submitted its application for final design approval and standard design certification for the AP1000.

The Nuclear Regulatory Commission (NRC) staff is performing a detailed review of your design certification application to ensure that the information is sufficiently complete to enable the NRC staff to reach a final conclusion on all safety questions associated with the design before the certification is granted.

The NRC staff has determined that additional information is necessary to continue the review. The requests for additional information (RAIs) are included in the enclosure. The topics covered in these RAIs include the areas of resolution of unresolved safety issues/generic safety issues. These RAIs were sent to you via electronic mail on January 15, 2003. You agreed to provide your responses to these RAIs by February 21, 2003.

If you have any questions or comments concerning this matter, you may contact me at (301) 415-3053 or ljb@nrc.gov.

Sincerely,

/RA/

Lawrence J. Burkhart, AP1000 Project Manager
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

Docket No. 52-006

Enclosure: As stated

cc: See next page

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OFFICE	NRLPO/PM	SPLB/BC*	NRLPO/DD
NAME	LBurkhart:cn	JHannon	MGamberoni
DATE	1/21/03	1/16/03	1/21/03

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Requests for Additional Information (RAIs)
AP1000 Standard Design Certification
Series 650 - Unresolved Safety Issues/Generic Safety Issues (USIs/GSIs)

RAI 650.001

In Section 6.3.2.2.7.2 of the AP1000 Design Control Document (DCD), entitled "IRWST [in-containment refueling water storage tank] Screens," and Section 6.3.2.2.7.3, entitled "Containment Recirculation Screens," the applicant states that the clearance of the IRWST and containment recirculation screens prevents debris larger than 0.125 inches from infiltrating the reactor coolant system (RCS) and blocking fuel cooling passages. However, in Section 3.4.1.2.2.1, entitled "Containment Flooding Events," the DCD also states that, "following a loss-of-coolant accident (LOCA), the water level in containment would be sufficiently high to "provide water flow back into the reactor coolant system via the break location. . . ."

A breached RCS pipe would apparently present an unfiltered pathway into the primary system, through which pieces of debris orders of magnitude larger than 0.125 inches could infiltrate, because the IRWST and containment recirculation debris screens would be bypassed. Although the AP1000's safety-related core-cooling flowpaths do not contain the typical flow restrictions that have been considered for operating plants (e.g., pump clearances, spray nozzles, and throttle valves), the debris filters on the fuel assembly bottom nozzles appear (based upon the Nuclear Regulatory Commission (NRC) staff's review of Section 4.2.2 of the DCD, and accompanying figures) to present a potentially adverse debris accumulation point. Therefore, the NRC staff requests additional information from the applicant to ensure that the AP1000 design adequately considers the potential for debris to infiltrate the RCS through an unfiltered pathway (e.g., a ruptured pipe) and interrupt reactor core cooling by blocking requisite flowpaths.

RAI 650.002

In Section 6.3.2.2.7.1, entitled "General Screen Design Criteria," the DCD states that reflective metallic insulation "is used on ASME [American Society of Mechanical Engineers] Code class 1 piping lines because they are subject to loss-of-coolant accidents." Additionally, the DCD states that the potential targets of jet impingement from analyzed LOCA pipe breaks, including the reactor vessel, RCSs, steam generators, pressurizer, and unshielded piping lines, are also insulated with reflective metallic insulation or an equivalent type of insulation. The DCD then concludes that, "[a]s a result, fibrous debris is not generated by loss-of-coolant accidents."

On the basis of research and analysis undertaken to support the NRC staff's efforts in resolving Generic Safety Issue 191 (GSI-191), "Assessment of Debris Accumulation on PWR Sump Performance," the staff questions the validity of the conclusion that fibrous debris will not be generated by a LOCA at an AP1000 reactor. Specifically, the NRC staff and licensees of currently operating plants have identified that the loose dispersion of dust and dirt that resides on the surfaces of the components and structures within the containment can consist of significant amounts of fibrous material, even at plants that do not deploy fibrous insulation in the zones of insulation destruction for postulated pipe ruptures. It is thought that the constituents of this "resident" fibrous material originate from such items as cloth protective clothing and equipment covers, human hair, fines from fibrous material (e.g., thermal insulation and fire barriers) outside of destruction zones, and sources external to the containment (when the

equipment hatch or other containment apertures are open). This fine, dispersed "resident" fibrous material may be washed down toward the IRWST or containment recirculation screens by break flows, condensate droplets, or other containment drainage flows, and its fineness allows it to remain in suspension for extended periods in a pool of water, even at low turbulence conditions.

Operating experience at boiling-water reactors (BWRs) and NRC-sponsored research indicate that thin fibrous debris beds (i.e., as thin as 1/8-inch in thickness) are capable of filtering a significant fraction of influent particulate debris, which would lead to substantial increases in head loss if high particulate to fiber mass ratios were reached (Reference NUREG/CR-6762, "GSI-191 Technical Assessment: Parametric Evaluations for Pressurized Water Reactor Recirculation Sump Performance," Volume 1, dated August 2002, and NUREG/CR-6367, "Experimental Study of Head Loss and Filtration for LOCA Debris," dated February 1996, etc.). To cover a surface area equal to that of both the two IRWST screens and the two containment recirculation screens with a 1/8-inch-thick debris bed, an available volume of "resident" fibrous material of less than 3 cubic feet would be required. Conventional cleanliness programs notwithstanding, the NRC staff considers it improbable that even the cleanest of operating plant containments would contain an available quantity of "resident" fibrous material less than 3 cubic feet. Based upon the staff's review of the DCD, it does not appear that the AP1000 containment cleanliness programs is substantially different than the current industry standard; therefore, available quantities of "resident" fibrous material greater than 3 cubic feet existing in containment would also seem to be credible for the AP1000.

On the basis of the above observations, the NRC staff requests further information to determine whether the AP1000's IRWST and recirculation screen designs adequately account for the potential concern related to "resident" fibrous material, and also, "resident" particulate matter, such as dirt, which would seem inevitably to be present on containment surfaces.

RAI 650.003

Although the NRC's GSI-191 research program has indicated that fire barriers consisting of fibrous material may generally contribute a smaller volume of LOCA-generated debris than fibrous insulation materials, for the AP1000 (which does not employ fibrous insulation in destruction zones), fire barriers could conceivably contribute a significant fraction of the overall quantity of fibrous material generated by a LOCA. In Section 9.5.1.2.1.1, entitled "Plant Fire Prevention and Control Features," the DCD states that "[c]omplete fire barrier separation necessary to define a fire area is not provided throughout the primary containment fire area...," and that "[s]elected cables of a safety-related division which pass through a fire zone of an unrelated division are protected by fire barriers." The staff could not determine from the DCD (a) whether the fire barriers referred to in Section 9.5.1.2.1.1 would consist of fibrous material, and (b) whether these fire barriers would be located in a zone of destruction for a postulated pipe rupture. Please provide this additional information.

RAI 650.004

Section 6.3.2.2.3 of the DCD, entitled "In-Containment Refueling Water Storage Tank," states that "[t]he IRWST is stainless steel lined and does not contain material either in the tank or the recirculation path that could plug the outlet screens." Though the water in the IRWST would likely be relatively pure, the staff believes that it is not likely to be completely free of debris,

particularly considering the debris-concentrating potential afforded by the cycling of the IRWST inventory during refueling outages, and the opportunity for any suspended debris to settle to the IRWST floor during long periods of stagnation. The staff notes that as little as 1.5 cubic feet of fibrous debris could potentially cover both IRWST screens, which is a very small fraction of the tank's capacity of 73,900 cubic feet. If an automatic depressurization system (ADS) actuation occurs during an accident condition, any debris residing on the bottom of the tank (including heavier particulate matter) could be easily resuspended by the consequent induced turbulence. Considering these NRC staff observations, please provide further information to clarify why fibrous and particulate debris settling onto the tank floor is not a concern for the IRWST screens, and clarify that the analysis concerning debris transport and head loss provided accounts for the most limiting IRWST conditions (e.g., during potentially turbulent conditions and at reduced tank levels as the switchover to recirculation approaches).

650.005

Based upon its review of the DCD, the NRC staff was unable to locate an analysis of the debris-blockage failure criteria of the IRWST and recirculation screens. This apparent omission may be due to the fact that the applicant considers debris blockage failures to be incredible for design-basis events based upon the debris source control measures specified in the DCD. However, based upon the NRC staff's concerns related to "resident" fibrous material and other potential sources of fibrous debris (reference items 2 through 4 above), the staff believes it is possible that quantities of fibrous debris capable of blocking the entire surface areas of the IRWST and recirculation screens could be generated by a LOCA at an AP1000 facility. As such, the staff believes it is essential for the applicant to provide further detail concerning: (a) how large a pressure head is available from natural circulation to drive the required flow rates through the IRWST and recirculation screens; (b) the maximum postulated head loss across the IRWST and recirculation screens; and (c) how much margin exists between the values for items (a) and (b).

650.006

During the NRC staff's review of the AP600, an open item identified as OITS #6590 was generated. Westinghouse responded to this open item in three parts. Please confirm whether or not the second and third parts of the response to OITS #6590 also apply to the AP1000 design. Specifically address whether (a) the complete failure of the non-safety-related coatings would block any portion of the AP1000 recirculation screens, and (b) verify that a combined license (COL) action requirement exists regarding completion of an analysis of coating debris generation and transport that is based on appropriate test data.

AP 1000

cc:

Mr. W. Edward Cummins
AP600 and AP1000 Projects
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

Mr. H. A. Sepp
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230

Lynn Connor
Doc-Search Associates
2211 SW 1ST Ave - #1502
Portland, OR 97201

Barton Z. Cowan, Esq.
Eckert Seamans Cherin & Mellott, LLC
600 Grant Street 44th Floor
Pittsburgh, PA 15219

Mr. Ed Rodwell, Manager
Advanced Nuclear Plants' Systems
Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, CA 94304-1395

Charles Brinkman, Director
Washington Operations
Westinghouse Electric Company
12300 Twinbrook Parkway, Suite 330
Rockville, MD 20852

Mr. R. Simard
Nuclear Energy Institute
1776 I Street NW
Suite 400
Washington, DC 20006

Mr. Thomas P. Miller
U.S. Department of Energy
Headquarters - Germantown
19901 Germantown Road
Germantown, MD 20874-1290

Mr. David Lochbaum
Nuclear Safety Engineer
Union of Concerned Scientists
1707 H Street NW, Suite 600
Washington, DC 20006-3919

Mr. Paul Gunter
Nuclear Information & Resource Service
1424 16th Street, NW., Suite 404
Washington, DC 20036

Mr. Tom Clements
6703 Guide Avenue
Takoma Park, MD 20912

Mr. James Riccio
Greenpeace
702 H Street, NW, Suite 300
Washington, DC 20001

Mr. James F. Mallay, Director
Regulatory Affairs
FRAMATOME, ANP
3315 Old Forest Road
Lynchburg, VA 24501

Mr. Ed Wallace, General Manager
Project Management
Lake Buena Vista Bldg., 3rd Floor
1267 Gordon Hood Avenue
Centurion 0046
Republic of South Africa
PO Box 9396 Centurion 0046

Mr. Vince Langman
Licensing Manager
Atomic Energy of Canada Limited
2251 Speakman Drive
Mississauga, Ontario
Canada L5K 1B2

Mr. Gary Wright, Manager
Office of Nuclear Facility Safety
Illinois Department of Nuclear Safety
1035 Outer Park Drive
Springfield, IL 62704

Dr. Gail H. Marcus
U.S. Department of Energy
Room 5A-143
1000 Independence Ave., SW
Washington, DC 20585

Mr. Edwin Lyman
Nuclear Control Institute
1000 Connecticut Avenue, NW
Suite 410
Washington, DC 20036

Mr. Jack W. Roe
SCIENTECH, INC.
910 Clopper Road
Gaithersburg, MD 20878

Patricia Campbell
Winston & Strawn
1400 L Street, NW
Washington, DC 20005

Mr. David Ritter
Research Associate on Nuclear Energy
Public Citizens Critical Mass Energy
and Environmental Program
215 Pennsylvania Avenue, SE
Washington, DC 20003