June 5, 2003

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

Dear Mr. Cummins:

As you are aware, the U.S. Nuclear Regulatory Commission (NRC) staff is preparing the draft safety evaluation report (DSER) for the AP1000 design certification application submitted by Westinghouse Electric Company (Westinghouse) on March 28, 2002. The staff expects to issue the DSER in June, 2003. As of this date, the staff has identified nine potential open items for DSER Chapter 6, "Engineered Safety Features," which are enclosed for your information. Please note that the staff's review of the application will continue during preparation of the DSER, which may result in changes to the potential open items identified in the enclosure, or the addition of other open items.

Three of the potential open items in the enclosure are new issues. The six other potential open items in the enclosure have their original request for additional information (RAI) number included for reference. If the staff cannot resolve the potential open items before the issuance of the DSER, these items will be issued as DSER open items and will be tracked with a corresponding open item number.

Previously, Westinghouse committed to provide responses to all identified open items within 9 weeks after the issuance of the DSER. The staff will be prepared to review your responses to the open items and have conference calls and meetings with your staff, as appropriate, after the DSER is issued. If Westinghouse chooses to address some or all of these open items before the issuance of the DSER, the staff may not have sufficient time to evaluate every response to the potential open items that Westinghouse submits to the NRC and make changes to the DSER before the scheduled DSER issuance in June, 2003.

Please contact one of the following members of the AP1000 project management team if you have any questions or comments concerning this matter: Mr. John Segala (Lead Project Manager) at (301) 415-1858 or jps1@nrc.gov, Mr. Joseph Colaccino at (301) 415-2752 or jxc1@nrc.gov, or Ms. Joelle Starefos at (301) 415-8488 or jls1@nrc.gov.

Sincerely,

/RA/

James E. Lyons, Director
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

Docket No. 52-006

Enclosure: As stated

cc: See next page

June 5, 2003

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

Dear Mr. Cummins:

As you are aware, the U.S. Nuclear Regulatory Commission (NRC) staff is preparing the draft safety evaluation report (DSER) for the AP1000 design certification application submitted by Westinghouse Electric Company (Westinghouse) on March 28, 2002. The staff expects to issue the DSER in June, 2003. As of this date, the staff has identified nine potential open items for DSER Chapter 6, "Engineered Safety Features," which are enclosed for your information. Please note that the staff's review of the application will continue during preparation of the DSER, which may result in changes to the potential open items identified in the enclosure, or the addition of other open items.

Three of the potential open items in the enclosure are new issues. The six other potential open items in the enclosure have their original request for additional information (RAI) number included for reference. If the staff cannot resolve the potential open items before the issuance of the DSER, these items will be issued as DSER open items and will be tracked with a corresponding open item number.

Previously, Westinghouse committed to provide responses to all identified open items within 9 weeks after the issuance of the DSER. The staff will be prepared to review your responses to the open items and have conference calls and meetings with your staff, as appropriate, after the DSER is issued. If Westinghouse chooses to address some or all of these open items before the issuance of the DSER, the staff may not have sufficient time to evaluate every response to the potential open items that Westinghouse submits to the NRC and make changes to the DSER before the scheduled DSER issuance in June, 2003.

Please contact one of the following members of the AP1000 project management team if you have any questions or comments concerning this matter: Mr. John Segala (Lead Project Manager) at (301) 415-1858 or jps1@nrc.gov, Mr. Joseph Colaccino at (301) 415-2752 or jxc1@nrc.gov, or Ms. Joelle Starefos at (301) 415-8488 or jls1@nrc.gov.

Sincerely,

/RA/

James E. Lyons, Director
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

Docket No. 52-006

Enclosure: As stated
cc: See next page

Distribution:

Hard Copy		E-Mail		
MGamberoni	JLyons	SCollins	SBlack	AP1000SCs
JSegala	JColaccino	RBorchardt	GTracy	AP1000BCs
PUBLIC	NRLPO R/F	ACRS	RBarret	
JStarefos		AP1000 reviewers	BBoger	
		OGC	DMatthews	

ADAMS ACCESSION NUMBER: ML031540385

OFFICE	PM:NRLPO	DD:NRLPO	D:NRLPO
NAME	JSebrosky	MGamberoni	JLyons
DATE	6/5/03	6/5/03	6/5/03

OFFICIAL RECORD COPY

Westinghouse AP1000
Draft Safety Evaluation Report
Potential Open Items
Chapter 6
Engineered Safety Features

Open Item Number: 6.1.1-1

Original RAI(s): None

Summary of Issue: The AP1000 design control document (DCD) Tier 2 Section 6.1.1 indicates that DCD Tier 2 Section 6.2.5 contains the hydrogen production analysis for a post accident analysis. However, this statement is incorrect since the AP1000 DCD does not contain a hydrogen generation analysis in anticipation of NRC completion of a rule change that would eliminate the design-basis hydrogen accident. Since this is not consistent with the current rule, the staff is not able to complete a review of the corrosion rates and consequent hydrogen generation. Therefore, this is draft safety evaluation report (DSER) Open Item 6.1.1-1. Additional discussion related to this issue is contained in Section 6.2.5 of this report.

General Design Criteria (GDC) 41 requires that containment atmosphere clean-up systems be provided to control fission products, hydrogen, oxygen, and other substances that may be released into the reactor containment. The AP1000 design does not have a safety-related containment spray system. The staff review of the Engineered Safety Features (ESF) with respect to control of hydrogen production for post-accident conditions, and thus conformance with GDC 41, is pending resolution of DSER Open Item 6.1.1-1.

Open Item Number: 6.2.1.8.1-1

Original RAI(s): None

Summary of Issue: The zones considered by the applicant to be vulnerable to damage by jet impingement are defined in DCD Tier 2 Section 6.3.2.2.7.1. The boundaries of these zones, from which fibrous material would be excluded, are based on calculations performed for the NRC staff by Science and Engineering Associates, Inc. (SEA), and data taken from tests performed by the Boiling Water Reactor Owners' Group (BWROG) and described in its Utility Resolution Guidance report NEDO-32686. In regions of containment where there are no intervening structures, the SEA calculations and BWROG tests show that fibrous insulation can be degraded into readily transportable pieces up to distances equivalent to 45 times the inner diameter of the ruptured pipe. As the applicant's

definition of the vulnerability zone for regions of containment that do not contain intervening materials is consistent with the testing and analysis described in this paragraph, the NRC staff finds it to be acceptable.

For containment regions in which jet impingement will be reflected and attenuated by intervening structures, the staff has previously considered a spherical jet impingement model to be a reasonable approximation for estimating a volume of generated debris. The NRC staff's SER on the BWROG's report NEDO-32686 states that a spherical impingement model appears logical for congested zones of containment, and it may be the best approximation for estimating the amount of debris in congested zones. However the staff's SER also indicates that the precision of the spherical model is unsupported by either analytical modeling or experimental evidence.

Consistent with the SER on NEDO-32686, the NRC staff considers the spherical jet impingement model to have limited applicability for the AP1000. Specifically, the NRC staff agrees that systematically excluding fibrous insulation from spherical volumes (with a radius equal to 12 inside pipe diameters) surrounding postulated break locations will greatly minimize the amount of debris generated from fibrous insulation. However, the staff is unable to conclude that the applicant's controls regarding fibrous insulation will ensure that no debris would be generated from fibrous insulation by breaks in congested zones of containment.

As demonstrated in the citation above, DCD Tier 2 Section 6.3.2.2.7.1 models containment congestion as an all-or-nothing condition. It is unclear to the staff that such a binary model is capable of accurately predicting jet impingement for break locations with only mild or directional structural congestion. Under these conditions, for example, the shape of the jet impingement could resemble partially obstructed opposing cones that extend beyond the spherical boundary assumed in the DCD. Additionally, uncertainty exists relative to the spherical impingement model, even in areas of high structural congestion, due to possible variations in parameters such as the offsets of ruptured pipes and the degree of intervening material present in the various directions about a pipe break. Thus, the staff expects that the zones actually affected by jet impingement would not be precisely spherical and concludes that portions of actual jet impingement boundaries could exceed 12 pipe diameters, even in the presence of intervening structures. For this reason, the staff concludes that the applicant has not sufficiently demonstrated that actual jet impingement zones in the presence of intervening structures would not result in the generation of debris from fibrous insulation that is located beyond a 12 pipe diameter sphere. This is DSER Open Item 6.2.1.8.1-1.

Open Item Number: 6.2.1.8.2-1

Original RAI(s): 650.004

Summary of Issue: The applicant's February 21, 2003, response to RAI 650.004 also included an analysis of the incontainment refueling water storage tank (IRWST) screens' capability to accommodate debris accumulation. The staff's review of the applicant's analysis showed that the mass of resident debris assumed by the applicant (i.e., 227 kg, or 500 lb) was consistent with estimates made for current generation PWRs in the Generic Safety Issue (GSI) 191 parametric study (NUREG/CR-6772). However, the staff could not accept this analysis, primarily because the applicant assumed that a single density value is valid for all density-dependent calculations involving resident fibrous debris. According to the physical properties of analyzed types of fibrous materials, potentially different density values may be required to correctly determine the settling velocity (i.e., the material density), to calculate a volume from the assumed mass (i.e., the "as-found" density), and to determine the thickness and porosity of the associated debris bed (i.e., the rubblized density). As a result of the applicant's single-density assumption, which deviated significantly from the material properties of the low-density fiberglass on which the head loss data referenced by the applicant was based, the NRC staff concluded that the calculation was unacceptable. During a teleconference on April 3, 2003, the applicant agreed to resubmit its response to RAI 650.004, in light of the staff's concern. Pending an acceptable resolution of this concern, the staff considers the capability of the AP1000 IRWST screens to accommodate anticipated debris loadings to be DSER Open Item 6.2.1.8.2-1.

(Note: Westinghouse provided a revised response to RAI 650.004 in a April 24, 2003, letter. The staff did not have enough time to consider this revised response in the draft safety evaluation report. However, the staff did perform a cursory review of the response and based on the cursory review still considers this item to be open.)

Open Item Number: 6.2.1.8.3-1

Original RAI(s): 650.001

Summary of Issue: The staff issued RAI 650.001 to request additional information concerning the potential for entrained debris to cause blockage at flow restrictions within the reactor coolant system (RCS) once flow begins entering through the break location after flood-up (i.e., bypassing the recirculation screens). In a letter dated February 21, 2003, the applicant responded to RAI 650.001 by submitting an analysis which concluded that reflective metallic insulation debris is incapable of causing such blockage. Although the applicant's response partially addressed the staff's RAI, it was not complete because it did not address the potential for other sources of debris, such as fibrous debris and floatable debris, to

enter the RCS through the break location and block requisite core cooling flowpaths. Pending the complete resolution of this concern, the staff considers debris blockage in the RCS to be DSER Open Item 6.2.1.8.3-1.

(Note: Westinghouse provided a revised response to RAI 650.001 in a April 24, 2003, letter. The staff did not have enough time to consider this revised response in the draft safety evaluation report. However, the staff did perform a cursory review of the response and based on the cursory review still considers this item to be open.)

Open Item Number: 6.2.1.8.3-2

Original RAI(s): 650.006

Summary of Issue: In RAI 650.006, the staff questioned whether non-safety-related coatings inside the containment could disbond and subsequently block the containment recirculation screens. In a letter dated February 21, 2003, the applicant responded to RAI 650.006 by submitting calculations of the trajectories of settling paint particles to provide confidence that the particles are incapable of passing around the protective screen plate and blocking a significant fraction of the recirculation sump screen surface. The applicant's RAI response further stated that no coating debris can approach the recirculation screens without passing around the protective plates because coatings are not permitted on the surfaces inside the plates. Inspections, Tests, Analyses, and Acceptance criteria (ITAAC) commitment 8.c(x) in DCD Tier 1 Table 2.2.3-4 states that the applicant will verify that the dry film density of non-safety-related coating materials is consistent with the assumed value in the settling calculation (i.e., $\geq$ 1600 kg/m^3, or 100 lb/ft^3). The particle sizes and settling rates assumed in the applicant's calculation are similar to or more conservative than those previously accepted by the staff in its review of the AP600 (NUREG-1512) and the Comanche Peak Steam Electric Station Units 1 and 2 (NUREG-0797, Supplement No. 9, dated March 1985). However, according to recent evidence that resident fibrous material may exist in containments and considering operational experience and test data concerning coating failures, the staff considers that paint particles significantly smaller than 200 mils in diameter could become trapped in the interstitial locations of a fibrous debris bed and contribute to the blockage of the recirculation screens. Therefore, in a teleconference on April 3, 2003, the staff requested additional justification from the applicant to support the assumption that paint particles smaller than 200 mils are not a blockage concern for the containment recirculation screens. The staff considers the response to RAI 650.006 to be an open item pending the resolution of this concern. This is DSER Open Item 6.2.1.8.3-2.

(Note: Westinghouse provided a revised response to RAI 650.006 in a April 24, 2003, letter. The staff did not have enough time to consider this revised response in the draft safety evaluation report. However, the staff

did perform a cursory review of the response and based on the cursory review still considers this item to be open.)

Open Item Number: 6.2.1.8.3-3

Original RAI(s): 650.005

Summary of Issue: The staff's review found that insufficient information was available in the DCD to determine whether the containment recirculation screens are capable of tolerating anticipated post-accident debris loadings. Therefore, in RAI 650.005, the staff requested additional information from the applicant to determine the debris-blockage failure criterion of the containment recirculation screens. The applicant responded to RAI 650.005 in a letter dated February 21, 2003, by providing an analysis intended to demonstrate that the AP1000 recirculation screens could accommodate a mass of resident debris (i.e., 227 kg, or 500 lb) that is equivalent to estimates made for current generation PWRs in the GSI-191 parametric study (NUREG/CR-6772). However, the staff could not accept this analysis, primarily because the applicant assumed that a single density value is valid for all density-dependent calculations regarding resident fibrous debris. According to the physical properties of analyzed types of fibrous materials, potentially different density values may be required to correctly determine the settling velocity (i.e., the material density), to calculate a volume from the assumed mass (i.e., the "as-found" density), and to determine the thickness and porosity of the associated debris bed (i.e., the rubblized density). As a result of the applicant's single-density assumption, which deviated significantly from the material properties of the low-density fiberglass on which the head loss data referenced by the applicant was based, the NRC staff concluded that the calculation was unacceptable. During a teleconference on April 3, 2003, the applicant agreed to resubmit its response to RAI 650.005, in light of the staff's concern. Pending an acceptable resolution of this concern, the staff considers the capability of the AP1000 containment recirculation screens to accommodate anticipated debris loadings to be DSER Open Item 6.2.1.8.3-3.

(Note: Westinghouse provided a revised response to RAI 650.006 in a April 24, 2003, letter. The staff did not have enough time to consider this revised response in the draft safety evaluation report. However, the staff did perform a cursory review of the response and based on the cursory review still considers this item to be open.)

Open Item Number: 6.2.5-1

Original RAI(s): None

Summary of Issue: The NRC has proposed major changes to 10 CFR 50.44, "Standards for Combustible Gas Control System in Light-Water-Cooled Power

Reactors," and related changes to 10 CFR 50.34 and 10 CFR 52.47, along with the creation of a new rule, 10 CFR 50.46a (see 67 FR 50374, August 2, 2002). These proposed changes are meant to risk-inform the combustible gas control requirements, and constitute significant relaxations of the requirements. The staff plans to finalize the rule changes during 2003.

The AP1000 DCD is written in anticipation of these rule changes. As such, it is not in compliance with the current, more-restrictive regulations. Furthermore, until the proposed rule changes are final and effective, the staff cannot know for certain if the DCD will comply with the revised rule. Therefore, the issue of containment combustible gas control must remain open at this time. This is DSER Open Item 6.2.5-1.

Open Item Number: 6.2.6.4-1

Original RAI(s): 480.010

Summary of Issue: In RAI 480.010, the staff requested that Westinghouse provide justification for why the AP1000 differed from the AP600 in the treatment of P_a (the peak calculated containment internal pressure for the design basis loss of coolant accident) in the Technical Specifications. Westinghouse provided a response to this concern in a letter dated April 11, 2003 (ADAMS Accession No. ML031050025). However, the item remains open, as discussed below.

In a response to RAI 480.010, dated April 11, 2003, Westinghouse provided the following as justification for not placing the numerical value of P_a into the Technical Specifications:

1. It is simpler and reduces future changes to the DCD, and is consistent with the overall TS improvement strategy to minimize the need for a plant license amendment or Bases update for parameters that are expected to change due to re-analysis.

2. It is not clear that Appendix J specifically requires that the numerical value for P_a be included in the Technical Specifications. Appendix J, Option B, states that P_a is specified "...in the Technical Specifications." Westinghouse assumes that this is a reference to the entire Technical Specifications document, which includes the individual technical specifications and the associated bases.

3. The definition of P_a in Option B, "...the calculated peak containment internal pressure related to the design basis loss-of-coolant accident...", is incorrect for AP1000, since the limiting calculated peak containment internal pressure in DCD 6.2 occurs for a steamline break accident.

To resolve the issue, Westinghouse plans to revise the TS Bases to state the numerical value of P_a.

The staff carefully considered the requirements of Appendix J and the objectives of the TS improvement program when developing the latest revision of the Standard Technical Specifications. The staff determined that, despite the inconvenience for future plant-specific license amendments, Appendix J, Option B, requires the numerical value of P_a to be stated in the Technical Specifications, not in the Bases. This is reflected in the Standard Technical Specifications. Westinghouse's proposed resolution of this issue is therefore unacceptable.

Also, Westinghouse's assertion, that the definition of P_a in Option B is incorrect for AP1000, is in error. P_a is not meant to bound the calculated peak containment internal pressures of all postulated accidents. P_a is a parameter specifically established for the purpose of radiological consequence analysis and containment leakage rate testing. For this reason, only accidents that produce a significant radioactive source term in the containment are considered when the value of P_a is determined. Steamline breaks in the AP1000 do not produce a significant radioactive source term in the containment. Of course, containment design pressure must bound the calculated peak containment internal pressures of all postulated accidents, but containment design pressure is not the same as P_a. Thus, the design basis loss-of-coolant accident pressure is the correct parameter for determining the value of P_a. For the reasons stated above, this is DSER Open Item 6.2.6.4-1.

Open Item Number: 6.4-1

Original RAI(s): None directly - RAIs related to open item 15.3-1 are 470.009 and 470.011.

Summary of Issue: The staff has not completed its review of the dose to MCR personnel during the design-basis accidents at this time. The staff will complete its review once issues with the assumed aerosol removal rates in the containment, as discussed in DSER Open Item 15.3-1 have been resolved. Additionally, the staff has not completed its review of the applicant's control room atmospheric dispersion factors (see Section 2.3.4 of this report). These factors are an input to the radiological analyses. Pending resolution of the staff's concerns with the hypothetical reference control room χ/Q values, review of the control room habitability radiological consequences analyses for design basis accidents is also incomplete as discussed in DSER Open Item 15.3-2. Therefore, the resolution of issues associated with the analysis of the dose to MCR personnel during design-basis accidents is DSER Open Item 6.4-1.

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

Mr. Michael M. Corletti
Passive Plant Projects & Development
AP600 & AP1000 Projects
Westinghouse Electric Company
P. O. Box 355
Pittsburgh, PA 15230-0355