December 6, 1996

Mr. Nicholas J. Liparulo, Manager
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Westinghouse Electric Corporation
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SUBJECT: LIST OF KEY LICENSING ISSUES ON THE AP600 DESIGN

Dear Mr. Liparulo:

The staff has updated its March 1995, list of issues that it believes are potential critical path issues on the design of the AP600. Enclosed is the list with a description of the issue and the lead Nuclear Regulatory Commission review branch.

The staff will work with Westinghouse to develop a common list to be used to monitor the progress of issue resolution in the months ahead. This list is a "living document," that will change as resolutions of issues are reached or new issues are identified. We are forwarding you this list so that we can better focus our attention on obtaining prompt resolution of these issues.

If you have any questions, you can call Tom Kenyon at (301) 415-1120.

Sincerely,

original signed by: Dave B. Matthews

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

Enclosure: As stated

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Docket No. 52-003
AP600

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Consolidated AP600 "Key Issues" List
November 26, 1996

1. Content of the SSAR (All branches)

10 CFR 52.47(b)(2)(i) states that

> Certification of a standard design which.... utilizes simplified, inherent, passive, or other innovative means to accomplish its safety functions will be granted only if....
>
> (4) The scope of the design is complete except for site-specific elements....

The staff has stated that applications for the evolutionary and passive LWRs must be for an essentially complete plant. SECYs-90-241 and 90-377, and the subsequent February 15, 1991 SRM, address the level of detail required for the staff to complete its safety review.

Between March and August 1996, Westinghouse removed design information from the AP600 SSAR that had been approved in the 1994 DSER without prior notification. In addition, Westinghouse has notified the staff that it no longer intends to include responses to RAIs as a separate section of the SSAR. Because of the amount of missing information, the staff no longer believes that the AP600 design application is essentially complete. The staff continues its rereview of the SSAR to ensure that necessary information, including design descriptions, P&IDs, and tables, that have either been removed or were never included are (re)inserted into the SSAR.

2. Regulatory Treatment of Non-Safety Related Systems (RTNSS) (SRXB lead)

The issue includes several related issues, including:

a. Passive System Thermal-Hydraulic Performance Reliability (SRXB) (Discussed in SECY-96-128, dated June 12, 1996) (see Item 21)

b. Acceptability of Baseline & Focused Probabilistic Risk Assessment (SPSB, SCSB)

   The staff is having difficulty coming to agreement on issues to achieve a Baseline PRA that the staff can approve. The Focused PRA (basically a sensitivity study using the Baseline PRA where only the passive safety systems work) effort should follow after an acceptable Baseline PRA is approved.

c. Adverse Systems Interactions (SRXB) (see Item 25)

d. Post-72 Hour Support Actions (Discussed in SECY-96-128, dated June 12, 1996) (SRXB) (see Item 9)

Enclosure

e. Safe Shutdown End-State (Discussed in SECY-96-128, dated June 12, 1996) (SRXB, OTSB) (see Item 19)

f. Other RTNSS Concerns

- protection of RTNSS and Defense-in-Depth systems from internal and external floods, internally-generated missiles (inside and outside containment), externally-generated missiles and missiles generated by natural phenomena, and pipe failures.

- The staff needs to define the criteria for what type of oversight is appropriate for a system that falls under the RTNSS process.

3. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) (All branches)

The ITAAC for passive safety systems include inspection of the as-built system configuration (sizing and elevation); functional testing to verify isolation valve operation upon receipt of actuation signals, valve stroke time and valve operation at design differential pressures, tests to verify correct divisional power supply to each valve; hydraulic test to determine piping flow resistance; and heat removal performance test for PRHR heat exchanger heat transfer rate. The AP600 is the first passive plant for ITAAC development. Westinghouse submitted a complete replacement for the ITAAC on November 7, 1996. It appears that Westinghouse has taken a significantly different approach from that of the evolutionary LWRs based on the staff's preliminary review. The staff has the following preliminary concerns with the ITAAC:

a. Certain phenomena such as natural circulation, need a heat source for proper testing. Because ITAAC are performed before fuel loading, the staff needs to evaluate the relationship between ITAAC, Chapter 14 initial tests, and the vendor's test program, including scaling effects.

b. The passive systems that have relatively small driving forces are sensitive to certain parameters, such as (1) effect of relative elevations and piping configurations on gravity injection and natural circulation capability, and (2) effect of surface roughness, coating, striping, and water coverage on the containment exterior shell on passive containment cooling system heat transfer capability. Westinghouse will need to perform sensitivity analyses of these parameters to develop acceptable bands for ITAAC verification.

c. ITAAC will have to be developed for certain non-safety-related defense-in-depth systems based on their importance to the safe operation of the plant.

d. Inconsistencies with the evolutionary plant precedents need to be addressed by Westinghouse.

e. The Instrumentation and Control-related ITAAC provided by Westinghouse is not consistent with draft SRP Section 14.3. The needed detail has not been provided.

f. The Human Factors-related ITAAC provided by Westinghouse is not consistent with draft SRP Section 14.3. The needed detail has not been provided.

4. Leak-Before-Break (LBB) Design Criteria For Feedwater Piping System (ECGB)

Westinghouse proposes to apply LBB methodology to its feedwater piping system. The staff indicated in the DSER and a letter to Westinghouse dated November 4, 1996, that this proposal was not acceptable, and that LBB should not be applied to the feedwater piping system.

5. Soil/Structure/Seismic Interactions (ECGB)

In its November 4, 1996 letter, the staff informed Westinghouse that the AP600 seismic design capacity could be established through the use of a sufficient and necessary set of minimum seismic design response spectra by the COL applicant to complete its seismic design within the scope of the certified design. Suit- ability of a future site would then have to be established by demonstrating that the seismic demand spectra for the site are lower than the capacity spectra.

6. Site-Soil Variability (Basemat) (ECGB)

Westinghouse is proposing to use a 6-foot thick basemat versus a typical 10-foot or thicker structure. In its November 4, 1996 letter, the staff informed Westinghouse that the thinness of the basemat makes it unacceptable for the likely soil stiffness variability that can be reasonably expected to exist at a site.

7. DBA Radiological Consequences (PERB lead)

Westinghouse uses the EPRI source term for the AP600 10 CFR Part 100 calculations. Issues include

- fission product release fraction
- iodine chemical form
- aerosol deposition in containment
- pH control of water in containment
- use of floating window

(Discussed in SECY-96-128, dated June 12, 1996, also see Section 15.3 of the DSER.)

8. Prevention and Mitigation of Severe Accidents (SCSB lead, PERB)

The AP600 does not have a containment spray, which could be used to reduce containment pressure and atmospheric radioactivity concentrations

during a severe accident event. In lieu of a containment spray system, Westinghouse has proposed that natural processes for fission product removal, in combination with certain mitigative equipment, are sufficient for mitigation of the consequences of a severe accident. The staff disagrees, and has identified its concerns and potential alternatives in SECY-96-128, dated June 12, 1996. This matter is currently before the Commission for guidance.

9. Post-72 Hour Support Actions (SRXB lead)

The passive safety systems are designed with sufficient capability to mitigate all design basis events for 72 hours without operator actions and without non-safety-related onsite or offsite power. For long-term safety (post-72 hours), Westinghouse states that the AP600 design includes safety-related connections for use with transportable equipment and supplies to provide the extended support actions for safety-related functions. These support actions include, for example, using portable engine-driven pumps and ac generators that connect to safety-related connections for water makeup to passive cooling control system (PCS) and spent fuel pool inventories and electrical power to supply the post accident and spent fuel pool (SFP) monitoring instrumentation and air for control room habitability. In addition, these extended support actions are implemented as part of the combined license applicant's "Site Emergency Response Plan" to provide support for continued long-term operation of the passive safety systems. These actions are accomplished by the site support personnel, in coordination with the main control room operators, and are performed separate from but in parallel with other actions taken by the plant operators to directly mitigate the consequences of an event.

In SECY-96-128, the staff stated that local communities struggling with disaster response should not be given the additional burden of providing for nuclear power safety. In addition, the staff is concerned that equipment not under the plant operator's control may be susceptible to damage from environmental conditions. The staff recommended the Commission approve the position that the site be capable of sustaining all design basis events with onsite equipment and supplies for the long term. After 7 days, replenishment of consumables such as diesel fuel oil from offsite suppliers can be credited.

10. Containment Isolation (SCSB)

Many systems that have traditionally been safety-related systems are now non-safety-related systems in the AP600. Non-safety-related systems are typically automatically isolated on a containment isolation signal. The AP600 design does not isolate certain non-safety-related systems, such as the normal RHR. The staff is concerned with the potential for containment bypass because a non-safety-related system fails to isolate. (See DSER Open Items 3.11.3.1-1, 6.2.4.2-1, and 7.6.1-1.)

11. Systems Reliability of Hydrogen Mitigation Systems (SCSB)

The AP600 design uses passive hydrogen recombiners for design-basis accident (DBA) hydrogen control. The staff is reviewing the acceptability of the design.

For severe accident hydrogen control, the AP600 relies on 58 igniters. The staff is concerned with the adequacy of igniter coverage within the containment, and diversity of power supplies to the igniters. In a November 4, 1996 letter, Westinghouse has proposed a modification to the design of the ac power supplies.

12. Fire Protection Program (SPLB)

The staff has identified four key issues pertaining to the fire protection program for the AP600:

a. The staff is concerned that the containment fire water supply will compete with the water supply for the passive containment cooling system.

b. Zone-of-Influence Inside Containment - Westinghouse has not demonstrated that at least one shutdown path will be free of fire damage for a number of fire zones.

c. Westinghouse has not provided an adequate technical bases for why SSE is not needed to go to cold shutdown.

d. The staff is concerned with smoke control for the AP600 design.

13. Spent Fuel Pool Cooling System (SPLB)

The SFP cooling system is not safety-related and does not meet the alternate criteria of Section 9.1.3 of the standard review plan. Section 9.1.3 acceptance criteria for compliance with GDC 2 and 4 calls for a safety-related SFP cooling system, or a non-safety-related SFP cooling system with safety-related makeup and safety-related ventilation. The AP600 SFP cooling system is non-safety-related and has neither safety-related makeup or ventilation. Westinghouse states that the passive heat capacity of the water in the SFP is sufficient to cool the spent fuel for 72 hours. Non-safety-related makeup can be obtained from the IRWST or the demineralizer tank. (Discussed in SECY-96-128, dated June 12, 1996)

14. Overspeed Protection

The staff believes that the AP600 design should include mechanical overspeed protection for the turbine. Westinghouse believes that the electrical overspeed design that they propose is more reliable, and the AP600 design does not include a mechanical overspeed trip.

15. Proposed AP600 Security Plan (PSGB)

Westinghouse has submitted a revised securi' ' plan and vulnerability analysis employing a simplified safeguards concept using the plant structures as part of their security perimeters.

16. Initial Test Program (HQMB lead, All branches)

The staff believes that a rigorous initial test program (ITP) is required for the unique AP600 systems that are different from operating plants. Revision 9 of the SSAR (August 9, 1996) substantially modifies the content, format, and app: oach for the AP600 ITP. Major concerns identified thus far include:

a. conformance of the submittal with current SRP and RG 1.68;

b. acceptability of Westinghouse's new approach for the criteria of SSCs to be tested versus that of Position C.2 of RG 1.68;

c. treatment of SSCs not considered safety-related, defense-in-depth, or RTNSS-related;

d. ensuring that the scope of the ITP captures all AP600 passive design features or those not present in traditional designs;

e. the acceptability of test abstracts designated as first-plant-only by Westinghouse; and

f. the acceptability of the ITP for water hammer in the secondary systems.

17. Code Documentation and Qualification (V&V of Codes) Review Incorporating Testing Data Results (SCSB/SRXB)

The supplement to the DSER on Codes and Testing identified approximately 120 open issues concerning the AP600 testing and code validation program. Although the reactor system code effort is currently on an acceptable path to resolution, the staff continues to identify many significant problems with the documentation for the WGOTHIC containment analysis code.

18. Chapter 15 Accident Analysis (SRXB lead)

Although a preliminary Chapter 15 accident analysis was submitted by Westinghouse, the final revision to the SSAR is not expected until February 1997. The staff continues to review Code V&V reports and other supporting documentation. Because the review of the codes took precedence over the Chapter 15 review, there has been a hiatus in this area, and many open items remain.

19. Westinghouse's Proposed LCO 3.0.3 (OTSB)

In accordance with the staff's position in SECY-96-128, Westinghouse has proposed that, for unanticipated configurations, the safe shutdown end state for the AP600 should be defined as MODE 5 (cold shutdown). In addition, Westinghouse has agreed to include the use of the normal residual heat removal system (NRHR) in technical specification (TS) 3.0.3, in response to the staff's position for a "cold shutdown" default state. However, TS 3.0.3 specifically (by design) excludes any statement about the availability or operability of the NRHR system or any of its necessary support systems (i.e., ac power, cooling water, etc.). Although the staff concludes this is unacceptable, guidelines regarding the type of regulatory controls that should be applied to these RTNSS-identified systems need to be established. (See Item 2, RTNSS)

20. Integrated Use of PRA Insights (lead SPSB, HQMB)

Westinghouse must use insights from the sensitivity, uncertainty, and importance analyses in an integrated fashion, in conjunction with assumptions from the entire PRA, to identify design certification and operational requirements (such as ITAAC, RAP, TSs, administrative controls, procedures) as well as COL and interface requirements. The staff has not yet received the insights chapter from Westinghouse (See DSER Open Item 19.1.3.1-26.)

21. Passive System Thermal-Hydraulic Performance Reliability (formerly Passive System Reliability (SRXB)

Westinghouse has stated that the AP600 can respond in an acceptable manner to risk-significant PRA accident sequences by using only passive safety systems and that as a result, no regulatory oversight of active, non-safety-related systems is required. To support this statement, Westinghouse has proposed using the NOTRUMP small-break loss-of-coolant-accident (LOCA) computer code to perform sensitivity studies on accident sequences that are risk-significant in the focused PRA (which assumes no availability of active systems), using conservative, bounding inputs and assumptions, and to demonstrate thereby that there are large margins to core damage. The sequences to be analyzed will be selected using the MAAP4 computer code to "screen" sequences from the focused PRA. The margins approach is undertaken in lieu of attempting to quantify thermal-hydraulic uncertainties in the PRA, related to passive system performance.

The staff has requested further information from Westinghouse detailing how the approach will be implemented, including (1) complete documentation on how the NOTRUMP sensitivity analyses will be performed; (2) the basis by which the risk-significant sequences will be screened and selected; and (3) documentation of and justification for the selection of the bounding parameters for the sensitivity analyses. The staff is continuing to discuss this issue with Westinghouse and to review Westinghouse's documentation. Westinghouse has also agreed to address

how uncertainties associated with long-term cooling will be evaluated, but the staff has not yet received any information related to this issue. (Discussed in SECY-96-128, dated June 12, 1996)

22. Shutdown and Low Power Operations (SPSB)

Experience with events occurring during shutdown operation indicates that substantial safety improvements are warranted for low power and shutdown operations. Westinghouse responses to RAIs regarding the shutdown risk issue are mostly qualitative without quantitative analysis. The staff has also requested Westinghouse to provide a systematic evaluation of the AP600 design against the issues identified in NUREG-1449. Included in this issue is whether the proposed AP600 TS comply with SECY-93-190, "Regulatory Approach to Shutdown and Low-Power Operations," and NUREG-1449, "Shutdown and Low Power Operation at Commercial Nuclear Power Plants in the United Stated." (See Section 19.1 of the DSER.)

23. External Cooling of the Reactor Pressure Vessel/Severe Accidents (SCSB/ECGB)

The AP600 is the first of the advanced plants to take credit for external cooling of the reactor pressure vessel. The success (or failure) of this cooling mechanism has major implications concerning the progression of severe accident sequences. The staff's concerns include heat transfer correlations, reactor vessel insulation, timing of flooding, and consideration of debris superheat and crust formation in the transient analyses. Because of its proposal, Westinghouse felt that they did not need to address severe accident issues raised by the staff in SECYs-90-016 and 93-087, including ex-vessel cooling, hydrogen, core retention, and core-on-the-floor issues. The staff disagreed. In SECY-96-128, the staff recommended that the Commission approve the position that Westinghouse use a balanced approach, involving reliance on in-vessel retention of the core complemented with limited analytical evaluation of ex-vessel phenomena, to address the adequacy of the AP600 design for ex-vessel events. Westinghouse has since agreed to address ex-vessel phenomena, but this information has not yet been provided.

24. Containment Bypass/SGTR (SRXB)

SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," required design certification applicants to assess design features to mitigate containment bypass due to steam generator tube rupture (SGTR) events, and recommended 3 features for consideration. Westinghouse provided an analysis of SGTR events involving up to 5-tube ruptures in August 1995. Westinghouse provided a qualitative description of levels of defense available for SGTR events (AP600 systems/event operation matrix), and stated that its severe accident mitigation design alternatives (SAMDA) evaluation of design alternatives showed a risk reduction of 6.7E-4 man-rem/yr. None of the design alternatives provided a risk reduction that meets severe accident screening criteria. The staff will require Westinghouse to provide a detailed analysis and evaluation with respect

to mitigating design features, diagnostic instrumentation, available time for operator actions, ERG, TS, and ITAAC. (See DSER Open Items 15.3.5-1 and 19.2.3.3-8.)

25. Adverse Systems Interactions (SRXB)

Westinghouse should demonstrate that the AP600 design prevents adverse systems interactions between the non-safety-related systems and the safety-related systems. In addition, Westinghouse should demonstrate that the AP600 is designed to prevent adverse systems interactions from water intrusion, internal floods, seismic events, and pipe ruptures. Westinghouse has submitted WCAP-14477, "The AP600 Adverse Systems Interactions Evaluation Report," on which the staff has provided comments to Westinghouse. (See DSER Open Items 1.2.2.7-1, 7.3.2-1, and 20.2-5.)

26. Technical Specifications Review (OTSB)

Because issue preclusion for technical specifications is not provided by the design certification process, the staff must decide the extent of the review that it will perform on Westinghouse's proposed Technical Specifications.

27. Quality Classification of Systems (SPLB, ECGB)

Westinghouse proposes to use Quality Group E instead of Quality Group D for systems that could potentially contain radioactive material. This is not consistent with the SRP, and the staff does not believe that acceptable justification for deviation has been provided.