December 15, 1994

MEMORANDUM TO: Richard W. Borchardt, Director
Standardization Project Directorate
Associate Directorate
for Advanced Reactors and License Renewal

FROM: Gary M. Holahan, Director
Division of Systems Safety and Analysis

SUBJECT: DSSA INPUT TO AP600 TOP 50 ISSUES

As a result of the November 22, 1994, E-team briefing on the AP600 DSER, the Division of Systems Safety and Analysis has prepared the attached list of issues for consideration for inclusion in the top 50 issues.

Attachment: As stated

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DSSA INPUT TO AP600 TOP 50 ISSUES

1. Emergency Response Guidelines:

   Westinghouse, in response to a staff request for AP600 ERG submittal, stated that the low-pressure reference plant's ERG in combination with a design difference report, identification of high level operator action strategies, and the AP600 system/event matrices are sufficient for design certification. The staff does not agree with this Westinghouse position because the passive safety system philosophy differs significantly from current plants. The staff has sent a position paper to Westinghouse to request AP600 ERG submittal as part of DC. We are still waiting for the submittal.

2. Regulatory Treatment of Non-safety Systems (RTNSS):

   a. Westinghouse RTNSS evaluation (WCAP-13856) concluded that passive safety systems alone meet safety goals. It identified (1) the diverse actuation system, and non-class 1E dc and UPS system as needed to mitigate ATWS events (turbine trip and PRHR actuation), and (2) the normal RHR system and its power supply (offsite power, main ac, standby diesel) and support systems (CCW, SW systems) are important with respect to the initiating events frequencies of LOOP and loss of DHR during shutdown conditions. It recommended administrative control to ensure short term availability of these systems.

   b. There are many issues involved in the RTNSS issue. The key one is the acceptability of the baseline PRA, including passive system reliability and T/H uncertainty treatment, etc. The evaluation of the focused PRA and its conclusion are meaningless without an acceptable baseline PRA. SPSB is working with Westinghouse to resolve the PRA issues.

   c. Other issues are, e.g., (1) adverse systems interactions, (2) post-72 hour support actions. The PXSs are designed with sufficient capability to maintain safe shutdown conditions for 72 hours without operator actions or onsite and offsite power. After 72 hours, the plant relies on safety-related connections for use with transportable equipment and supplies to provide extended support actions for safety-related functions. Though the extended support actions are part of COL site emergency response plan, Westinghouse should define R/A missions and requirements for the transportable equipment, and site emergency procedure guidelines to ensure equipment availability.

   d. The Commission's policy statement on TS improvement stated that an SSC which operating experience or PSA has shown to be significant to public health and safety should be included in TS (Criterion 4). We are evaluating the need for TS LCO for the important systems identified by the RTNSS process. Westinghouse believes that those systems identified by its RTNSS evaluation do not meet the TS criteria.

ATTACHMENT

e. We also need to know how the RTNSS and defense-in-depth (DID) systems are protected from internal and external floods, internally-generated missiles (inside and outside containment), externally-generated missiles and missiles generated by natural phenomena, and pipe failures.

f. The maintenance rule implementation for the RTNSS and DID systems needs to be clarified.

3. Shutdown and Low power Operation:

Experience of events occurring during shutdown operation indicates that substantial safety improvements are warranted for low power and shutdown operations. Westinghouse responses to RAIs regarding shutdown risk issue are mostly qualitative without quantitative analysis. We are also requesting Westinghouse to provide a systematic evaluation of the AP600 design against the issues identified in NUREG-1449.

4. Containment Bypass - SGTR:

SECY-93-087 required DC applicants to assess design features to mitigate containment bypass due to SGTR events, and recommended 3 features for consideration. Responding to an RAI, Westinghouse indicated that it would perform an analysis of SGTR events involving up to 5-tube ruptures. Quantitative transient analyses were not provided, however. Rather, Westinghouse provided a qualitative description of levels of defense available for SGTR events (AP600 systems/event operation matrix), and stated that its 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. We 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.

5. Passive Safety System Test Program and Code Documentation/Qualification:

Vendor's test programs are needed to study the thermal-hydraulic phenomena related to the containment system, and passive containment and core cooling systems. Tests are likewise necessary to verify and validate the licensing codes which are used for the analyses of Chapter 6 and Chapter 15 design basis events to demonstrate passive safety system and containment capability.

In particular, for the WGOTHIC V/V program, the NRC is considering:

- o Adequacy of Test Program
- o Scaling
- o Stratification
- o Jets and Plumes
- o Mass Condensation and Evaporation
- o Buoyancy-Driven Flows in Annulus Region
- o Water Coverage on Exterior of Shell

6. ITAAC and Initial Test for Passive Safety Systems:

The ITAAC for passive safety systems includes 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 high delta P; tests to verify correct power supply division to each valve; hydraulic test to determine piping flow resistance; and heat removal performance test for PRHR heat exchanger heat transfer rate. AP600 is the first passive plant for ITAAC development. Certain areas of concern are not addressed by Westinghouse.

(1) Certain phenomena such as natural circulation need a heat source for proper testing. Because ITAAC is performed prior to fuel loading, we need to evaluate the relationship between ITAAC, Chapter 14 initial tests, and vendor's test program including scaling effects.

(2) The passive systems having relatively small driving force are sensitive to certain parameters, e.g., (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 should perform sensitivity analyses of these parameters to develop acceptable bands for ITAAC verification.

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7. IEEE 323-1983 vs 1974 Version for Compliance with 10 CFR 50.49.

Westinghouse is using IEEE 323-1983 in the AP600 design instead of the 1974 version the staff endorses as the primary standard to demonstrate compliance with the requirements of 10 CFR 50.49 (EQ). There are differences between the 1974 and 1983 versions of the standard in the areas of:

1. Testing
2. Ageing
3. Margin
4. Qualified life

The NRC staff has reviewed the 1983 version of the standard and concluded it departs from previously approved technical positions. Acceptance of the 1984 version would affect license renewal efforts.

8. Equipment Qualification:

Temperatures in containment following a DBA may remain elevated for much longer than current plants. This could affect the ability to procure equipment qualified to the conditions in containment following a DBA.

9. Emergency Habitability System:

The Emergency Habitability System (VES) consists of two, 100% capacity independent trains with four air bottles/train (166 ft^3/bottle). The VES initiates on a High-High radiation level detected by the nuclear island non-radioactive ventilation system (VBS) and supplies 20 CFM air flow for pressurization and breathing in the Main Control Room Envelope (42,000 ft^3). The staff is concerned with the following:

- Design leakages are much less than current designs (<20 scfm versus hundreds of scfm)
- Passive heat removal allows for a 15 °F increase in 72 hours
- Assumes only 5 people in main control room for 72 hours following accident (additional analysis is being performed by Westinghouse)

The non-safety-related MCR/TSC subsystem of the VBS isolates the MCR envelope and starts the VES on High-High Radiation Level. It provides the first line of defense by providing air filtration on high radiation, containment isolation, or manual actuation; operating in the recirculate mode during toxic releases and external fires; and providing smoke removal capability during internal fires. The MCR/TSC Subsystem consists of two, 100% capacity trains with common ductwork. There is a single air intake with a tornado damper, redundant smoke detectors in the intake duct, redundant safety-related radiation monitors in the MCR supply duct, and redundant safety-related seismic Category I isolation dampers for the MCR envelope. The MCR/TSC subsystem is automatically transfer to the standby diesel on LOOP.

10. Spent Fuel Pool Cooling System Not Meeting SRP 9.1.3:

The Spent Fuel Pool Cooling System is not safety-related and does not meet the alternate criteria of SRP 9.1.3. The SRP 9.1.3 acceptance criteria for compliance with GDCs 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.

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11. Passive Systems Reliability:

Westinghouse should provide better justification and documentation of the success criteria assumed for the various systems and operator actions modeled in the event tree top events (related to the passive system reliability issue).

12. Applicability of Failure Data:

The generic failure data used in the AP600 PRA are representative of components used in previous PRAs for operating reactors but the applicability of some of these data to the AP600 environment and operating conditions must be justified. An example is the failure rate used for the check valves in the IRWST injection lines. Westinghouse must investigate and document the applicability of generic failure data to risk important AP600 components (based on their risk achievement and risk reduction worths).

13. Treatment of Common Cause Failures (CCF):

The multiple Greek letter (MGL) factors used in calculating the CCF probability of the IRWST gravity injection line check valves are significantly lower than those recommended by EPRI. This has a significant impact on the CCF probability estimate as well as on the estimate of the CDF for the plant. Westinghouse must justify the assumed MGL factors.

14. Digital Instrumentation and Controls:

Westinghouse must justify and document the logic and instrumentation failure data for the microprocessor-based components (circuit boards and cards) derived from Westinghouse data.

15. Human Reliability Analysis:

Westinghouse must revise its human reliability analysis (HRA) to follow proper HRA modeling techniques and procedures and must submit clear documentation with references for the revised analysis. In addition, Westinghouse must state clearly all assumptions made in the HRA about the control room design as well as about the emergency operating procedures for all risk important human actions modeled in the PRA. Any task analysis performed must justify the time required to perform the procedure as well as the time available to complete the procedure

16. PRA Major Assumptions and Insights:

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 ITAACs, RAP, Technical Specifications, administrative controls, procedures) as well as COL and interface requirements.

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17. External Cooling of Reactor Pressure Vessel

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.

18. Hydrogen Control

As currently docketed, the AP600 relies on thermal recombiners for DBA hydrogen control. However, those recombiners are powered from Non-Safety-Related AC Power.

For severe accident hydrogen control, the AP600 relies on 56 igniters. The issues here are adequacy of igniter coverage within the containment, and diversity of power supplies to the igniters. The AP600 igniters have only non-safety AC power supplies. None of the igniters are DC powered.

19. Debris in IRWST and Containment Sumps

The issue is clogging of the strainers in the IRWST and containment sumps. Important factors are the use of non-safety related coatings in the AP600, and possible additional sensitivity in this design to screen clogging because of dependence on gravity-driven flows.

20. Containment Isolation

Many systems that have traditionally been safety-related systems are now non-safety systems in the AP600. Upon a containment isolation signal, non-safety systems are automatically isolated. In the AP600, Westinghouse wishes not to isolate certain non-safety systems, such as the normal RHR. The safety significance is that by failing to isolate a non-safety system the potential exists for containment bypass.

21. Sparger / IRWST Performance

Stages 1, 2, and 3 of the ADS system blow down into the IRWST through the spargers. Condensation loads and air-clearing loads have to be examined for acceptability. Potential water loads on the lines from the ADS to the IRWST must be considered. Water hammer must be considered. The staff is reviewing the adequacy of the testing at the Vapore facility.

22. Non-Safety Related Containment Spray Ring Header and Piping

SCSB will discuss with Westinghouse the possibility of integrating a non-safety related containment spray ring header and piping into the AP600 design. Allowance for water source to the spray would be through a single containment penetration.

While this proposal has not been specifically discussed with Westinghouse, the issue of the lack of containment sprays appeared in the DSER on page 6-15, Open Item 6.2.1-2.