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

November 20, 1990

Project No. 669

Mr. E. E. Kintner, Chairman
ALWR Utility Steering Committee
GPU Nuclear Corporation
One Upper Pond Road
Parsippany, New Jersey 07054

Dear Mr. Kintner:

SUBJECT: DISCUSSION QUESTIONS FOR THE NOVEMBER 29-30, 1990 MEETING ON THE EPRI PASSIVE ALWR REQUIREMENTS DOCUMENT

In order to facilitate the November 29-30, 1990 meeting on the EPRI Requirements Document for advanced light-water reactors with passive safety systems, I am forwarding the enclosed discussion questions to inform you of some of the questions that the staff has raised during its preliminary reviews of the Passive Plant Requirements Document and the conceptual designs of Westinghouse Electric Corporation's AP-600 and General Electric Company's SBWR. This early feedback will assist in the development of the final agenda for the meeting so that we can have thorough technical discussions.

Some of these questions concern details of the designs that go beyond the scope of the Requirements Document. However, due to the close relationship of the requirements to the actual designs, the staff believes that it is important that the industry be aware of the staff's current thinking on these matters. Note that these questions represent the preliminary views of the staff and have not been presented to the Commission for approval as agency views.

Because the staff has not completed its determination regarding EPRI's September 6, 1990 request that the entire Passive Plant Requirements Document be withheld from public disclosure, the staff expects that most of the meeting will be closed. Please be prepared to provide both proprietary and non-proprietary

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versions of any discussion material that will be presented at the meeting. If you have any questions concerning this matter, please contact the project manager, T. J. Kenyon, at (301) 492-1120.

Sincerely,

ORIGINAL SIGNED BY CMILLER

Charles L. Miller, Director
Standardization Project Directorate
Division of Reactor Projects - III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Enclosure:
As stated

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DOCUMENT NAME: QUESTIONS FOR PASSIVE MTG

Mr. E. E. Kintner, Chairman
ALWR Utility Steering Committee

Project No. 669
EPRI

cc: Mr. William Sugnet
Nuclear Power Division
Electric Power Research Institute
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ENCLOSURE
DISCUSSION QUESTIONS FOR THE NOVEMBER 29-30, 1990
MEETING ON THE EPRI PASSIVE ALWR REQUIREMENTS DOCUMENT

General

What design considerations in SECY-90-016 will be incorporated into the passive designs? What will not? What is the justification for non-inclusion of these design considerations into the passive designs? What makes the passive plant designs different from the evolutionary designs? (Note: Chapters 5, 6, and 9 of the passive plant Requirements Document do not appear to reflect the Commission direction for fire protection enhancements.

How should non-safety systems that used to be considered safety systems be treated? Are the passive systems sufficient to replace the active systems?

Examples:

Safety-related ac power

- emergency diesel generator requirement
- offsite power requirements
- control room habitability
- battery charging (after 72 hours)
- ability to reach cold shutdown
- spent fuel pool cooling
- heaters for PCCS

Passive RHR in lieu of emergency feedwater

Passive injection systems in lieu of active safety injection systems

How much credit should be given for non-safety systems? What portions of Appendix B of 10 CFR Part 50 will these systems be required to meet?

Why shouldn't the single failure criteria be applied to passive components in fluid systems (such as check valves)? Should a multiple failure analysis be performed for selected systems? Are there failure modes unique to passive designs? Should one train of an active system be required to be available to work in conjunction with the passive systems to account for unknown events?

Will there be anything unique in the ALWR maintenance program? Should specific, detailed maintenance requirements be included in the certification? Will the designer provide a specific maintenance and component replacement program that includes the frequency of testing and inspection of components? Does the maintenance program include consideration of human factors early in its development?

Is there a need for a prototype? Are facilities available that can be used for benchmarking codes? Will the unique design of the control room require a prototype? Is a simulator necessary for the control room before certification?

Clarify what is meant in section 11.2.2 of Chapter 1 and 3.2 and 4.1.3.3 of Chapter 10 of the passive Requirements Document.

Passive ALWR Analytical Issues

What is the basis for determining the adequacy of the vendor's models to evaluate passive plant reactor behavior?

Adequacy of vendor's separate effects testing for the passive designs - Are separate effects tests adequate and sufficient? Is an integral system test necessary? If so, is semiscale testing adequate?

Is some type of natural circulation testing necessary for new configurations?

Are best estimate calculations adequate? What conservatism is being employed in these analysis?

Thermal-Hydraulic Issues

W AP-600

What is effect of non-condensible gases on

- heat transfer in passive RHR heat exchanger
- heat transfer to the containment surface
- variation of non-condensible fraction throughout containment

SBWR

Due to differences in geometrical design, is an integral vessel test of the SBWR necessary to demonstrate its stability?

Containment Analysis

Will codes be available to model heat rejection flow paths with natural circulation flow patterns rather than forced flow conditions?

W AP-600

What is the effect of local hot spots or thermal gradients on the containment surface due to internal structures and thermal stratification of the atmosphere?

What is the effect of revaporization of condensate inside containment on heat transfer from break to inner shell and equipment qualification?

Address how the natural circulation flow patterns could be disrupted and heat sources or sinks could be created in the containment by:

- initiation of containment spray flow
- location of structures
- presence of a standing flame

How is the external passive containment cooling system performance affected by

- film thickness and stability of the water on the containment
- external containment coatings and surface wetability
- presence of chemical additives
- surface discontinuities (weld beads, structural reinforcement and penetrations, plate alignment)
- velocity and distribution of air flow
- water entrainment in the air flow

How do you maintain wetting characteristics over the life of the plant?

Are heaters necessary in the PCCS (for freeze protection of a safety-related system)? If so, do they need to be safety grade and/or dc powered?

GE SBWR

What is effect of non-condensible gases in the isolation condenser on

- condensation heat transfer
- potential to interrupt flow
- effectiveness of vent to suppression pool

What is the effect of thermal stratification in the suppression pool?

Is a test necessary to assess mixing between separate pools inside containment (drywell, suppression pool regions)?

Instrumentation and Control Issues

How will the batteries be sized to be able to support

- the control room
- analog control panel
- chillers
- environmental control of the control room
- heaters for the PCCS

Can computer failure (due to software unreliability) result in the loss of the main control room? Will an analog backup system be provided?

Are advanced safety-related I&C designs with common software more susceptible to common mode failure? Discuss proposed verification and validation programs. Is more diversity necessary for safety systems?

What separation and independence requirements for digital systems are you proposing?

What requirements for on-line testing and self-diagnostics are you proposing?

How do the advanced safety-related I&C designs reduce the effects of electromagnetic interference (EMI, RFI, EMP, and SWC)?

To what extent do the passive designs intend to incorporate expert/artificial intelligence systems into the designs?

Can use of the CAD/CAM systems introduce common mode failures?

Human Factors

The staff believes that human factors considerations must be included early in the design process. How are such considerations being included early in the design stages of the passive designs? How are the man-machine interfaces being addressed for the entire plant operation, maintenance, refueling operations, etc.?

Are job task analyses (JTA) being performed for the passive designs?

Given the increased automation of the facility, what new approaches may be required to maintain operator vigilance? What is the appropriate level of staffing and qualification for operators?

What qualifications and education do you intend to require for the operating staff?

After an event, should the operator be allowed to intervene with the automatic safety systems and operate the plant immediately or be required to take no action for a given amount of time? Should the operator be operating equipment at the component level? or at the systems level?

Reliability, Testability, & Inspectability

What should be included in a Reliability Assurance Program? How should reliability goals be established? How should the applicant keep track of actual equipment reliability values to ensure the validity of the reliability values assumed in the design analysis are maintained? How does the applicant ensure it stays within the reliability envelope? What actions must be taken by the applicant should the plant fall below the reliability levels?

What should be the criteria to specify testing and inspection frequency?

Should a comparative reliability analysis be required (passive to evolutionary)? What credit (or debit) should be given for human factors/human interactions?

Industry experience suggests that component reliability may not be at the level necessary to support a design employing so few components. What measures are being employed to improve component reliability (in testing, design, and maintenance practices)? Should there be more reliance on diversity and redundancy to improve the reliability of the safety function?

How is the industry demonstrating the reliability of motor-operated valves (see Generic Letter 89-10 for current facilities)?

Check valves are relied on for accident mitigation. These valves may prove less reliable than those in current facilities since there is a low delta P

across the valves and there are no pumps to provide a driving force to open the valve. Is qualification testing necessary? Should it be done before certification?

The reactor vessel, pumps, valves, steam generator tubing (PWRs), and component supports should be designed early in the development of the facility to be fully inspectable and to include the capability to perform ASME Code, Section XI inservice testing. Should the reactor internals be required to be periodically inspected as well to ensure no flow blockage?

How do you assure that the check valves will operate? Should the applicant perform on-line monitoring of check valves, full-flow testing, and/or back flow leak testing? Should non-safety related pumps and valves be tested?

Should the squib valves that are used in the safety depressurization system and in the SLCS undergo additional testing to verify operability? Should they be replaced on a periodic basis to ensure reliability? Should other valve designs be considered for these purposes to allow for testing, yet have the same reliability with zero leakage?

Structural Engineering

Large variations in actual thickness, may occur in the unstiffened steel containment (shell thickness = 1 3/4") which, in combination with large openings, may result in lower buckling strength than that predicted analytically. Is the industry proposing improved manufacturing methods to control the actual thickness of the containment? Is some testing of the design contemplated to address seismic interaction concerns?

Is the Lawrence Livermore seismic hazard curve being included in the generic hazard curve proposed by EPRI? EPRI should address inclusion of the LLNL results in the development of a generic (regional) best estimate hazard curve.

Materials Engineering

The ALWRs should use improved materials in the designs to reduce intergranular stress corrosion cracking (IGSCC) and secondary side corrosion (i.e., using nuclear grade stainless steel for IGSCC prevention and Inconel 690 for SG tubes). Why are certain, less corrosion-resistant materials allowed to be used in the EPRI Requirements Document.

Should the secondary water chemistry control limits (PWRs) and primary water chemistry control limits (BWRs) be included in the certification?

What design features reduce unanticipated embrittlement due to low flux neutron irradiation of an RPV support near the beltline?

In light of your commitment to ALARA, is the industry considering the use of other materials (i.e., EPRI NOREM alloys) in lieu of stellite for hard-facing?