

D910718

Mr. James M. Taylor  
Executive Director for Operations  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Mr. Taylor:

SUBJECT: CONCERNS RELATED TO THE GENERAL ELECTRIC ADVANCED BOILING  
WATER REACTOR DESIGN

During the 375th meeting of the Advisory Committee on Reactor Safeguards, July 11-13, 1991, we discussed the status of the Advanced Boiling Water Reactor (ABWR) design, described in the Standard Safety Analysis Report (SSAR), for which the General Electric Company (GE) has applied for design certification in accordance with 10 CFR Part 50, Appendix O. Our Subcommittee on Advanced Boiling Water Reactors also discussed this matter during its meetings on October 31, 1990, and May 30, 1991, with representatives of GE and the NRC staff. We also had the benefit of the documents referenced.

Our previous letter to you concerning the ABWR design was dated November 24, 1989, and conveyed our comments on Module 1 of the Draft Safety Evaluation Report (DSER). Since this letter, we have been kept apprised of the design and the status of the review while awaiting receipt of additional DSERs. The staff now says that DSER preparation by modules will be discontinued in favor of preparation by SSAR chapters and Standard Review Plan (SRP) sections.

To ensure the completeness of our review, it will be necessary to account for any additions or revisions to each DSER as forwarded by a SECY subsequent to issuance of our respective comment letter. An arrangement acceptable to us is needed to ensure the identification of any additions or revisions, and we should agree on an appropriate time for their review. Our comments will not be complete, however, until we have submitted a report to the Commission concerning the final SER on which we expect to comment by mid-November 1992.

Our activities subsequent to the completion of our November 1989 letter have focused on several design concerns that were discussed with GE and the NRC staff in an effort to ensure an early awareness and understanding. We believe that it is appropriate to document them here for timely consideration and resolution in appropriate DSER sections. We expect to have additional items later. We do not expect separate replies to our concerns provided the staff responds in the appropriate DSER.

1. Control Building Flooding

The proposed ABWR design locates the Reactor Building Cooling Water (RBCW) System at the lowest elevation in the control building with the essential 250-V. DC battery rooms immediate-

ly above, and the main control room at the next higher elevation. This arrangement places the main control room below ground grade. Our concern with this arrangement is the potential for control building flooding due to an unisolated break in the open-cycle cooling water piping or components inside the building. The ultimate heat sink (cooling pond) is likely to provide sufficient water to flood the building to near ground grade.

## 2. Physical Separation Barriers

Internal plant flooding and external events such as fire are of major concern if their effects cannot be confined to a single division of required safe-shutdown equipment. We believe that the key to confinement is the provision of an appropriate separation barrier. However, a classical barrier such as the 3-hour-rated fire barrier may not of itself, be sufficient to ensure divisional separation under the combined effects of pressure, heat, smoke, and flooding which accompany a fire and its mitigation. Also, it would appear from the SRP that the effects of delayed suppression on room temperature, pressure, and barrier leakage need to be considered when determining that safe shutdown can be achieved. We remain unconvinced that divisional separation barriers for the ABWR have been adequately prescribed for the range of events and conditions during which they must provide separation.

Of particular concern is a diesel fuel fire which may be subject to delayed suppression in the ABWR diesel generator rooms which are located inside the reactor building. It is not clear how these rooms will be qualified by design or testing to withstand burning fuel if spread across the floor by a fuel line rupture. Furthermore, it is not apparent how the compartment doors will be qualified for this condition or whether they can confine the fuel to the room. If manual mitigation is required, a fire barrier door must be opened. It is not certain that this can be achieved safely or that the external environmental effects of a prolonged opening of the door have been considered.

## 3. Environmental Protection for Solid-State Electronics

The ABWR makes extensive use of solid-state electronic components for essential protection, control, and data transmission functions. Such components are known to be susceptible to adverse environmental changes, particularly temperature extremes. We are concerned that a number of these components may be located in plant areas where postulated events such as pipe rupture, fire, internal flooding, or loss of room cooling may create an adverse environment. The response of such components to the environmental change may be unpredictable and lead to unacceptable system interactions or responses. The behavior of solid state electronic components in environments created by off-normal or accident situations needs to be considered before the adequacy of any physical separation and environmental control measures can be evaluated.

#### 4. Review of Chilled-Water Systems

The ABWR makes extensive use of large chilled-water systems to provide essential environmental cooling functions including those for the solid-state electronics. Since there is no SRP for chilled-water systems, the staff uses other guidance such as SRP Section 9.2.2 (Reactor Auxiliary Cooling Water Systems) when performing its safety evaluation. This guidance does not include evaluation of the large refrigeration equipment that is required for chilling the closed-cycle cooling water.

The NRC staff and GE need to evaluate the safety implications of chilled-water systems, including performance under varying accident heat loads, loss-of-offsite-power loading characteristics, and ability to restart and function after a prolonged station blackout. The NRC staff should develop appropriate guidance for such reviews by preparing a suitable SRP now.

#### 5. Use of Leak-Before-Break Methodology Outside of Primary Containment

In our report of March 14, 1989 to then NRC Chairman Zech on "Additional Applications of Leak-Before-Break Technology," we expressed our belief that an avenue for consideration of further extension of the leak-before-break (LBB) concept should exist. This is still our position. We are concerned that the NRC staff is not giving serious consideration to GE proposals to extend the concept to systems outside of the primary containment because the staff feels constrained by General Design Criterion 4 which does not propose review of methodology.

We would like to see a renewed effort by GE and the NRC staff to determine if a real potential for substantial safety and/or economic benefits can be realized in applying properly the LBB concept outside of the primary containment.

#### 6. Use of Integral Low-Pressure Turbine Rotors

The catastrophic failure of a low-pressure (LP) turbine rotor can lead to high-energy missiles that are capable of damaging safety-related equipment. The domestic turbine manufacturers (General Electric and Westinghouse) have been using an LP turbine design for large turbine generators consisting of a relatively small-diameter bored shaft with shrunk-on and keyway locked blade ring disks. The manufacturers are now offering an integral LP turbine rotor machined from a single large-diameter forging. A rotor of this design would operate at much higher stresses than the shaft of a shrunk-on disk rotor.

We were told by the Electric Power Research Institute (EPRI) representatives that a decision has not as yet been made with respect to a requirement in the ALWR Utility Requirements Document for boring the LP turbine rotors. Boring has

historically been performed to remove impurity inclusions near the forging centerline. Such inclusions are stress risers and have led in the past to a number of catastrophic turbine and generator rotor failures in fossil-fueled power plants. Modern forging practices minimize such inclusions and present-day nondestructive examination and evaluation techniques provide much greater assurance of the soundness of turbine-generator rotors.

The NRC staff should follow this issue closely since the use of integral LP turbine rotors, particularly if they are not bored, will require the development of an entirely new set of preoperational and periodic operational inspection, evaluation, and acceptance requirements to protect against turbine missiles. (The staff should also consider this issue for LP turbine rotor replacement programs for currently operating plants.)

7. Cavity-Floor Area Beneath Reactor Vessel

The layout of the containment for the proposed ABWR design makes use of a cavity floor area beneath the reactor vessel to deal with core/concrete interaction. This area is based on an EPRI requirement of 0.02m<sup>2</sup> per MWt. If a larger area is required, major changes to the containment sizing and layout may be needed. Timely development of a Commission position on this issue is important not only to this design but also to the design of all Advanced Light Water Reactor designs.

Sincerely,

David A. Ward  
Chairman

References:

1. Letter dated August 17, 1989 from Charles L. Miller, Office of Nuclear Reactor Regulation, NRC, to Patrick W. Marriott, General Electric Company, enclosing Draft Safety Evaluation Report Related to the Final Design Approval and Design Certification of the Advanced Boiling Water Reactor, dated August 1989.
2. Letter dated August 7, 1987 from Thomas E. Murley, Office of Nuclear Reactor Regulation, NRC, to Ricardo Artigas, General Electric Company, enclosing GE Advanced Boiling Water Reactor, Licensing Review Bases, dated August 1987.
3. GE Nuclear Energy, Standard Safety Analysis Report, Advanced Boiling Water Reactor, Chapters 1 through 20.