



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, D. C. 20555

August 17, 1992

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

Dear Mr. Taylor:

SUBJECT: ISSUES PERTAINING TO EVOLUTIONARY AND PASSIVE LIGHT WATER  
REACTORS AND THEIR RELATIONSHIP TO CURRENT REGULATORY  
REQUIREMENTS

During the 386th, 387th, and 388th meetings of the Advisory Committee on Reactor Safeguards, June 4-5, July 9-11, and August 6-8, 1992, we discussed with representatives of the NRC staff the staff's positions, recommendations, and resolution schedules concerning the certification issues for evolutionary and passive light water reactors contained in the draft SECY paper dated February 7, 1992. This supplements our letter of May 13, 1992, and provides our comments and recommendations on some of the staff's positions for the passive light water reactors. The section titles and letter designations correspond to those in the draft SECY paper.

I. SECY-90-016 Issues (For Passive Plants)

E. Fire Protection

The NRC staff is seeking Commission approval to use the enhanced fire protection criteria previously approved for evolutionary Advanced Light Water Reactor (ALWR) plants by the Commission's Staff Requirements Memorandum (SRM) of June 26, 1990. This SRM approved the staff's position on fire protection as presented in SECY-90-016 and supplemented by the staff's April 27, 1990 response to our report on the SECY. We recommended separate Heating, Ventilating, and Air Conditioning (HVAC) systems for each division as an important step toward ensuring adequate environmental separation of safety systems. The staff agreed that consideration of smoke, heat, and fire suppressant migration may result in separate HVAC systems, but other options may be available to the designer. Our report to the Commission of April 13, 1992, on the Draft Safety Evaluation Report for the ABWR identified the adequacy of physical separation as a continuing issue for the

ABWR, due in part to the use of a shared HVAC system for multiple trains of redundant safety systems during normal plant operation.

Our concern with shared HVAC systems is related to the need for adequate isolation of such systems during certain disruptive events (e.g., fires, floods, or pipe breaks). If the isolation is not adequate, the HVAC arrangement may become a pathway whereby effluents from the event are conducted to locations where required safe shutdown equipment is located. This is not a concern if either (1) the HVAC isolation provisions are able to withstand the event consequences (e.g., pipe whip, jet impingement, static and dynamic pressure, and elevated temperature) during and after closure with consideration of single active component failures and acceptable leakage, or (2) the safe shutdown equipment is qualified for the environmental exposure resulting from a release of the adverse environment at any credible location along the HVAC pathway such as duct openings or blowout locations.

Except for the concern with shared HVAC, we support the staff recommendation that the passive plants should be reviewed against the enhanced fire protection criteria approved in the Commission's SRM.

#### F. Intersystem Loss-of-Coolant-Accident

The staff's position is that designing these low-pressure fluid systems that interface the reactor coolant system (RCS) to withstand full RCS pressure (to the extent practicable) is an acceptable means for resolving this issue. For those systems that have not been designed to withstand full RCS pressure, the staff indicates that other measures will be required. We recommend approval of the proposed staff resolution, provided consideration is given to all elements of the low pressure piping system (e.g., instrument lines, pump seals, heat exchanger tubes, and valve bonnets).

#### G. Hydrogen Control

The staff recommends that the evolutionary LWR designs provide a system for hydrogen control that can safely accommodate hydrogen generated by the reaction of steam with 100 percent of the fuel cladding surrounding the active fuel. (Note: This is not 100 percent of the reactive metal in the core.) We support the staff's recommendation.

The staff also recommends that the system be capable of precluding uniform containment concentrations of hydrogen greater than 10 percent. We are aware of analytical work in

support of the resolution of Generic Issue 106, "Piping and the Use of Highly Combustible Gases in Vital Areas," that suggests the possibility of transition to detonation at average concentrations as low as 12 percent. We recommend that the staff do a similar analysis of the impact of hydrogen combustion, and possible detonation including stratification, before establishing a limit for the average hydrogen concentration. This is of particular importance to steel-shell containments.

#### I. High Pressure Core Melt Ejection

To cope with the possible effects of direct containment heating (DCH), the staff concludes "... that ALWR design should include a depressurization system and cavity design features to contain ejected core debris."

DCH is an extremely improbable event, and we see no need to require two modes of coping with the possibility. Either depressurization or cavity design provisions alone should be adequate. Because of possible safety benefits for other events, reliable depressurization is the preferred approach.

#### J. Containment Performance

The staff has not yet developed an adequate technical position relating to requirements for containment performance in passive LWRs. We agree that the proposed value of 0.1 for a conditional containment-failure probability (CCFP) is reasonable but, as we stated in our letter of April 26, 1990, regarding "Evolutionary Light Water Reactor Certification Issues and Their Relationship to Current Regulatory Requirements," this value is defined only within the context of a family of initiating events. It should be used by the staff in the development of its requirements and not merely passed on to applicants.

The deterministic criterion proposed by the staff is not a simple alternative to the CCFP. It could be used more logically as a complement. Using ASME Code Service Level C stress limits is not unreasonable given a known loading for which the containment is to be designed. However, determination of the appropriate loading is the hard part of the problem and the suggested deterministic criterion is essentially meaningless without it. The staff states that "applicants using the deterministic approach will be required to define the challenges considered in this evaluation." The staff takes no position on what those challenges should be or how they are to be quantified. Apparently the intent is to default to a "design specific review." This approach leaves

the applicant without any real guidance from the Commission on this important topic.

We acknowledge that it is a very difficult task to establish containment performance criteria but is important. We suggested what we believe to be the best approach in our letter of May 17, 1991, "Proposed Criteria to Accommodate Severe Accidents in Containment Design."

K. Dedicated Containment Vent Penetration

The staff proposes that the decision on the need for a containment vent for passive designs should not be made at this time but should wait until specific plant designs are evaluated. We believe that the Commission should make a generic judgment about the acceptability of containment vents for LWRs. This should be a part of establishing general criteria for containment design as proposed in our letter of May 17, 1991.

L. Equipment Survivability

We agree with the staff's recommendation that features provided only for severe-accident mitigation for the passive plant designs not be subject to the environmental qualification requirements of 10 CFR 50.49, quality assurance requirement of 10 CFR 50, Appendix B, and redundancy/diversity requirements of 10 CFR 50, Appendix A.

N. In-Service Testing of Pumps and Valves

We support the staff recommendation that the special pump and valve design, testing, and inspection provisions be imposed on all safety-related pumps and valves for the passive ALWRs.

III.E - Control Room Habitability

There were several significant differences between the staff and EPRI at the time the staff drafted this policy issue. EPRI has subsequently made a proposal to modify its Utility Requirements Document to include a requirement for a passive, safety grade, control room pressurization system that would use a bottled air supply to maintain operator doses within regulatory limits for the first 72 hours following an accident. (The regulations require that operator doses be so limited for the duration of the accident.) The pressurization system proposed by EPRI would be designed to be replenished by off-site portable supplies after 72 hours if needed. Accordingly, EPRI has recommended that the staff close this issue.

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We discussed this matter with the staff and EPRI during our June 4-5, 1992 meeting. The staff told us that it is currently evaluating the EPRI proposal and is not prepared to close this issue. ACRS had several comments regarding design features of the passive control room pressurization system proposed by EPRI. We believe that the staff should take these comments into account in its evaluation. We may provide additional recommendations after the staff has completed its evaluation.

Sincerely,



David A. Ward  
Chairman

References:

1. Draft SECY Paper dated February 7, 1992, from James M. Taylor, Executive Director for Operations, NRC, for the Commissioners, Subject: Issues Pertaining to Evolutionary and Passive Light Water Reactors and Their Relationship to Current Regulatory Requirements
2. SECY-90-016 dated January 12, 1990, from James M. Taylor, Executive Director for Operations, for the Commissioners, Subject: Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements
3. Memorandum dated April 27, 1990 from James M. Taylor, Executive Director for Operations, NRC, for NRC Commission, Subject: Staff Response to ACRS Conclusions Regarding Evolutionary Light Water Reactor Certification Issues