D950215

Mr. James M. Taylor
Executive Director for Operations
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Taylor:

SUBJECT: REACTOR WATER CLEANUP SYSTEM LINE BREAK FOR OPERATING BWRS

During the 418th meeting of the Advisory Committee on Reactor Safeguards, February 9-10, 1995, we held discussions with representatives of the NRC staff concerning Issue 3 [Reactor Water Cleanup (RWCU) Systems Safety] from our letter to you dated July 13, 1994 (Reference 1). In our letter, we pointed out that an added RWCU isolation valve inside primary containment provides long-term post-accident isolation of the ABWR if the primary containment isolation valves fail to close fully under blowdown conditions resulting from an RWCU line break outside of primary containment. We suggested that operating plants may not have a similar capability and recommended that this issue be investigated.

In your September 9, 1994 response (Reference 2), you stated that the staff will perform a study to determine whether the environmental conditions in secondary containment resulting from an RWCU line break would create an environment bounded by the current analyses for operating plants. We discussed this response with the NRC staff members. They assured us that the environmental conditions would include those associated with the postulated event described below.

> For this event, a pipe break is postulated in the safety or non-safety portion of the RWCU system outside of primary containment. A blowdown of reactor coolant and steam to the break occurs until the break is isolated by containment isolation valves. If these valves are unable to close completely due to the severity of simultaneous mechanical and electrical demands on both valves under blowdown flow conditions, the reactor will continue to discharge a portion of its coolant and steam inventory to the break indefinitely.
>
> It is likely that several remotely operated relief valves on the reactor steam lines will be opened to divert a portion of the steam directly to the suppression pool. However, for a typical BWR-4 (and perhaps for many other BWRs) these relief valves will close at about 50 psig even if they are externally actuated to open. The valves will not reopen until the reactor repressurizes to about 85 psig.
>
> If the ECCS pumps are operating, the water flowing into the reactor vessel may increase the vessel pressure

sufficiently to lift and hold open the remotely operated relief valves. This should ensure adequate core cooling while the pumps are running, but a significant portion of the ECCS flow will be diverted to the unisolated break thereby depleting the water inventory needed to ensure proper pump operation during long-term core cooling. In addition, the diverted water will be released inside of secondary containment where it can gravitate to the lowest level where the ECCS pumps and drivers are located. The resulting water cascading and flooding may jeopardize the continued availability of the ECCS pumps and equipment during long-term core cooling.

If adequate ECCS flow is not maintained, core uncovery to below the level of the jet pump throat (2/3 core level) is a certainty. (The reactor coolant loss will be greater if the reactor vessel bottom drain line is open and cannot be closed.) If the ECCS pumps are not operating, the relief valves will cycle in the 50-85 psig range. Still, a portion of the reactor coolant will be diverted to the break. Eventually, the fuel decay heat will be insufficient to repressurize the reactor to 85 psig. Thereafter, the relief valves will remain closed and any ECCS flow and resulting steam will be directed to the break.

Various corrective actions or features might be considered to mitigate this event, but most have shortcomings. For example, one could provide remotely operated relief valves which can be kept open during the event. Since the relief valves exhaust to the suppression pool, the reactor pressure must be sufficient to overcome the drywell pressure and the pressure equivalent of the relief valve sparger submersion depth. Although dependent on the piping arrangement to the break, the reactor pressure may be sufficient to direct most ECCS water and steam from the core to the break. Provisions for relieving directly to the containment atmosphere could overcome this problem only if the containment is maintained at essentially the same pressure as at the break location and if the piping arrangement to the break is not conducive to siphoning. Opening the main steam lines to a functional main condenser (if operating at partial vacuum) might be a solution if it were possible to arrange when subject to the human and equipment limitations created by the break and harsh environment in primary and secondary containment. Other solutions may be proposed.

We believe that the primary containment isolation valves for the RWCU system must be able to perform their safety function while subjected to the conditions present when the valves are required to operate. We agree that the ability of these valves to perform their design function was considered in the resolution of Generic Issue 87, "HPCI Steam Line Break Without Isolation." We also agree that the implementation of Generic Letter No. 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," should improve the likelihood of proper valve functioning under design-basis conditions. We are concerned, however, that sufficient test data under actual blowdown flow conditions and realistic geometries are not available to validate the valve reliability used in current probabilistic risk assessments.

We are concerned that the risk associated with an RWCU pipe break outside of primary containment has been underestimated and that a need may exist for additional isolation capability in the RWCU line inside of primary containment. We look forward to seeing the results of the current investigations. We recommend that similar studies be undertaken of the risk significance of failure to isolate high energy line breaks outside primary containment in the High Pressure Coolant Injection and Reactor Core Isolation Cooling Systems.

Sincerely,

T. S. Kress
Chairman

References:

1. Letter dated July 13, 1994, from T. S. Kress, ACRS Chairman, to James M. Taylor, NRC Executive Director for Operations, Subject: Some Areas for Potential Staff Consideration for Operating Nuclear Power Plants and the Review of Future Plant Designs Resulting from the ACRS Review of the Evolutionary Light Water Reactors
2. Memorandum dated September 9, 1994, from James M. Taylor, NRC Executive Director for Operations, to T. S. Kress, ACRS Chairman, Subject: Some Areas for Potential Staff Consideration for Operating Nuclear Power Plants and the Review of Future Plant Designs Resulting from the ACRS Review of the Evolutionary Light Water Reactors