UNITED STATES
NUCLEAR REGULATORY COMMISSION
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Generic Technical Activity A-10

Mr. Richard Gridley, Manager
Fuel and Services Licensing
General Electric Company
175 Curtner Avenue
San Jose, California 95215

Dear Mr. Gridley:

Since the initial discovery of cracking in boiling water reactor (BWR) control rod drive return line (CRDRL) nozzles in early 1977, General Electric (GE) has proposed a number of solutions to the problem in the course of which several documents were submitted for NRC staff review. These documents were as follows:

1. Letter of March 14, 1979, G. G. Sherwood (GE) to Y. Stello and R. Mattson (NRC) regarding calculation of CRD system return flow capacity;

2. Letter of April 9, 1979, G. G. Sherwood (GE) to Y. Stello and R. Mattson (NRC) forwarding results of CRD system solenoid valve endurance testing;

3. Letter of May 1, 1979, G. G. Sherwood (GE) to Y. Stello and R. Mattson (NRC) forwarding results of CRD system solenoid valve performance testing; and

4. Letter of November 2, 1979, G. G. Sherwood (GE) to R. P. Snaider (NRC) forwarding additional information as requested regarding CRD hydraulic system performance, especially with regard to corrosion products emanating from carbon steel piping.

All concerned the GE rationale for the latest proposed system modification to prevent nozzle cracking; namely, total removal of the CRDRL and cutting and capping of the CRDRL nozzle. Previous submittals had presented the bases for the other modification proposals discussed herein.

Specifically, your March 14, 1979 letter discussed the GE analysis performed after the NRC's selection of a base case for use in comparing capability to inject high pressure water into the reactor vessel when other water sources were isolated. This base case was the 1975 incident at Browns Ferry Unit No. 1, during which the CRD system sometimes was one of the only capable sources of high pressure water injection to keep the reactore core covered. The staff recognizes that the pressure of this capability had not been directly assumed in any previous safety analysis. However, the critical need for the system was again revealed during the early 1979 incident at the Oyster Creek Nuclear Generating Station. During this incident the reactor vessel also was isolated from other sources of high pressure water and the CRD system makeup capability helped prevent uncovering of the active fuel.

Your analysis of March 14, 1979, included several assumptions which the NRC staff has found acceptable. Principal among these was that concurrent operation of the two CRD pumps was possible at any plant. This of course implies that there will be no electrical supply limitations and no pump net positive suction head (NPSH) limits that will be reached. Licensees and applicants will be required to demonstrate this to be valid, by testing, prior to our approving CRD return line removal.

The letters of April 9, and May 1, 1979, discussed the solenoid valve testing program initiated in response to earlier NRC concerns. The original analysis of CRDRL removal without rerouting determined that return flow to the reactor vessel from drive operation would enter CRD cooling water lines and return to the vessel through the CRD mechanisms themselves. During testing, however, you discovered that the actual path would be a reverse flow path through the insert exhaust directional control valves of the non-actuated Hydraulic Control Units. The long-term cycling of the control valves in the reverse direction was a cause of NRC concern with regard to possible deleterious effects upon the operation of the CRD hydraulic system.

In response to this concern, GE tested ten valves which had been removed from an operating reactor on which the return line had been isolated for six months. These valves were then compared against tests performed on five new valves. The results showed that the reverse flow characteristics of all valves were similar and that degradation of the valves to the point of causing system malfunction would not be expected during long-term normal operation of the system. The NRC staff is satisfied with these results.

Simulated life cycle testing also was performed on five valves, resulting in the determination that no adverse effects were caused by the backflow. The NRC staff has found this acceptable.

Your final letter of November 2, 1979, discussed in detail your response to staff concerns regarding possible degradation of the CRD system and individual CRD mechanisms because of corrosion problems from carbon steel piping. Certain modifications were suggested to solve these problems. You also discussed your recommendations regarding the installation of pressure equalizing valves in the CRD system to prevent, under a hypothetical transient, a large pressure differential across the CRD system which could result in excessively fast movement of a selected control rod. The valves also prevent flow from the carbon steel piping of the normal exhaust water header to the drive cooling water header.

We have reviewed your submittals and have concluded the following:

1. Only licensees of the following classes of plants will be allowed at this time to implement the recommendation to cut and cap with no rerouting of the CRDRL and without further analysis. Each applicable plant must demonstrate, by testing, concurrent two CRD pump operation (with one exception), satisfactory CRD system operation, required flow capability, and each will be required to install the system modifications listed in 4. below.

   a. 218" BWR/6

   b. 251" BWR/6

   c. 183" BWR/4 (only one pump needed to satisfy base case requirement)

   d. 251" BWR/4

   No modifications should be performed on operating reactors prior to issuance of the "For Comment" issue of NUREG-0619, scheduled for release in January 1980.

2. We do not accept the hypothesis that the calculations for the above plants were bounding. Therefore, prior to our approval of modification of other plant classes, we shall require analysis similar to that performed on the plant classes of 1. above. The same testing and system modifications will also be required.

3. We found the 251" BWR/5 (the fifth class analyzed in the March 14, 1979 letter) presently to be unacceptable for modification in that its calculated flow fell below the acceptable base case value. Further analysis or plant-specific testing could prove flow capacity to be acceptable.

4. We will require that the following modifications be implemented on all plants requesting the removal of the CRDRL without rerouting and those which reroute but choose to operate with CRD return line flow valved out;

   a. Installation of equalizing valves between the cooling water header and the exhaust water header.

   b. Flush ports installed at high and low points of exhaust water header piping run if carbon steel piping is retained; and

   c. Replacement of carbon steel pipe in the flow stabilizer loop with stainless steel and rerouting directly to the cooling water header.

5. Each licensee must establish readily-available operating procedures for achieving maximum CRD flow to an otherwise isolated reactor vessel.

6. Licensees who choose to reroute the CRDRL, either with or without continuous return line flow to the system being tapped into, must add the GE-recommended pressure control station to the cooling water header. This station acts to buffer hydraulic perturbations from any connected system in order to prevent pressure fluctuations in the CRD system.

Modification 4.c is based upon our decision not to accept the "do nothing" alternative addressed in your November 2, 1979 letter. We consider the "more absolute solution" (your characterization) to be the correct one and agree with your recommendation, made in accordance with this "more absolute solution", that the carbon steel piping should be eliminated. We do not accept the option of filter installation as a means of trapping corrosion particles that have a deleterious effect on the CRD mechanisms. Our concern is that improperly maintained filters on the cooling water header could result in heatup of drive mechanisms and the possibility of multiple drive failures of a type not previously analyzed.

Note that we have discussed only the acceptability of the latest GE recommendation discussed in the four letters. We continue to accept CRDRL re-routing to a line outside containment that in turn provides the return flow to the reactor vessel (valving out after re-routing results in other requirements - see 4. and 6. above). We also find acceptable, as a strictly interim measure, the valving out of the CRDRL. However, this will require inspection, during each refueling outage, of that portion of the line containing stagnant water. No matter which option is chosen, we will require complete inspection, by dye penetrant techniques, of the CRDRL nozzle, the apron area beneath the nozzle, and the subsequent removal of any cracks found during the inspection.

For the BWRs undergoing licensing review and designed and constructed without the CRDRL and its nozzle or modified with the CRDRL cut and capped without rerouting, we will require testing (similar to that for operating plants) to prove satisfactory system operation, return flow capability equal to or in excess of the base case requirement discussed above, and two pump operation. Applicable modifications of 4. above also must be implemented. We shall require the establishment of operating procedures for achieving maximum CRD flow to an otherwise isolated vessel. Calculations with regard to base case return flow requirements should be submitted, but in lieu of such calculations, the staff may accept reference to a bounding analysis if necessary justification is provided.

Additional guidance on this subject will be contained in NUREG-0619. This document is tenatively scheduled for publication in February 1980.

Sincerely,

Darrell G. Eisenhut

Darrell G. Eisenhut, Acting Director
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