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MEMORANDUM FOR: Harold R. Denton, Director, Office of Nuclear Reactor Regulation

FROM: Thomas E. Murley, Director, Division of Safety Technology, NRR

SUBJECT: DST REVIEW OF NRC STAFF SAFETY EVALUATION REPORT ON BWR SCRAM DISCHARGE SYSTEM

References:
1. Memorandum for G. Lainas, T. Novak, R. Tedesco, USNRC from P. Check, USNRC, BWR Scram Discharge System Safety Evaluation, December 1, 1980.
2. Memorandum for Harold R. Denton, USNRC from M. Ernst, USNRC, DST Evaluation of the Automatic Air Header Dump on Boiling Water Reactors, December 8, 1980.
3. Anticipated Transients Without Scram for Light Water Reactors: Resolution of Unresolved Safety Issue TAP A-9, NUREG-0460, USNRC Staff.

The Division of Safety Technology has reviewed the NRC Staff Safety Evaluation Report (SER) entitled "BWR Scram Discharge System Safety Evaluation," of December 1, 1980 (Reference 1). We have previously (Reference 2) provided you with our comments on the installation of an interim automatic air header dump system recommended in that safety evaluation. We found that the addition of this system could provide an important increase in BWR safety.

Our comments on the remainder of the SER are given below.

The SER proposed a functional criterion and several safety criteria, operating criteria, design criteria and surveillance criteria for the BWR scram discharge syster. The intent of these criteria was to provide guidance to BWR licensees to assure that their scram discharge systems provide the degree of safety thought to be provided when these reactors were licensed. Rather than proposing specific solutions to the problems which were identified during the review of the Browns Ferry Unit 3 partial scram event, these criteria are to be used as guidance to allow the BWR licensees to resolve the problems in a way best suited to their specific designs.

These criteria were first proposed by a subcommittee of the Owners Group formed to work with the NRC on this problem. The NRC staff made one significant addition to the criteria by requiring that the scram level instrumentation be designed for common cause failure as well as random failure (by the addition of diversity into the design). We agree with this additional criterion since common cause failure modes are, in general, significant contributors to the overall loss of function and also since instances of common cause failure of this instrumentation were actually observed (e.g., crushed floats on level instrumentation).

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As noted above, the SER criteria for the Scram Discharge System were divided into safety criteria, design criteria, operating criteria and surveillance criteria. In at least one case it is not clear that the division of the criteria into different categories is useful. This case is Design Criterion 1 which states (in part):

> The scram discharge headers shall be...hydraulically coupled to the instrumented volume(s) in a manner to permit operability of the scram level instrumentation prior to loss of system function.

This appears to be a safety criterion as much as a design criterion. Care should be taken to assure that all criteria are met regardless of whether they are called safety criteria or given another designation.

We have reviewed these criteria and find that they adequately address all the issues raised during the investigation of the Browns Ferry event.

The SER lists appropriate ways of meeting these criteria (called "Acceptable Compliance") which will minimize subsequent staff review. We have reviewed these methods of complying with the criteria and find these to be appropriate with the exception of the two alternatives listed for acceptable compliance with the level instrumentation diversity requirement (pages 39-40 of the SER). The first alternative requires level sensors employing a different operating principle for automatic scram from those currently used. The second alternative requires that the cause of damaged floats be identified and corrected (or compensated for) and goes on to require either:

1. Additional (or substitute) level switches for automatic scram which are made by a different manufacturer; or

2. Demonstration that the diverse indication of SDV water accumulation provided to the operator by an alarmed continuous monitoring system can provide adequate backup protection if the level sensors (providing automatic scram) should fail. (The operator's response to a fast SDV fill event must be considered).

We recommend that the BWR licensees not be offered the alternative which involves operator action. A precedent for our recommendation is the ATWS requirement that no credit for operator action be given for at least 10 minutes (Reference 3). In addition, we consider it doubtful that the licensee could show that the operator could take timely action based on a level alarm. Therefore, we question whether this second alternative is really a choice at all. Furthermore, what choice would the operator actually have if the automatic system had not scrammed the reactor but the operator had received an alarm from the backup system? His only reasonable action would be to manually scram the reactor immediately. Since the reactor operator's first action upon receiving the alarm must be to manually trip the reactor, and he therefore will not have time to diagnose the cause of the alarm (e.g., to determine if it is spurious) when the reactor has not tripped automatically, the alarm does not seem to provide any benefit to the licensee.

The first alternative of two automatic scram systems based on sensors using different operating principles seems to us to be a better choice than level switches made by two different manufacturers because of the even greater diversity that it offers. Because of the importance of this system, we recommend that the licensees not be offered the choice of level switches made by a different manufacturer as an option to the first alternative of two sensors based on different operating principles.

Experience with a sensor operating on a different principle than the currently used level switches has been limited so far to ultrasonic techniques. There have been many operating problems with systems using ultrasonic transducers but progress is being made in solving them. In addition, at least one other diverse technique has been proposed. Therefore, it is our opinion that the first alternative of two diverse level sensing systems based on different operating principles in the scram discharge system is preferable.

We did not attempt a cost benefit analysis of methods of acceptable compliance with these criteria; however, it is our judgement that such an analysis would show that the safety benefit of implementing these criteria would justify the cost of implementation.

Original Signed by
T. E. Murley

Thomas E. Murley, Director
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