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ENCLOSURE 4

SAFETY EVALUATION

DOCKET NO. 50-302

CRYSTAL RIVER UNIT 3

GENERIC LETTER 83-28, ITEM 4.5.3

REACTOR TRIP SYSTEM RELIABILITY, ON LINE TESTING

INTRODUCTION

On February 25, 1983, both of the scram circuit breakers at Unit 1 of the Salem Nuclear Power Plant failed to open upon an automatic reactor trip signal from the reactor protection system (RPS). This incident was terminated manually by the operator about 30 seconds after the initiation of the automatic trip signal. The failure of the circuit breakers was determined to be related to the sticking of the undervoltage trip attachment. Prior to this incident, on February 22, 1983, at Unit 1 of the Salem Nuclear Power Plant, an automatic trip signal was generated based on steam generator low-low level during plant startup. In this case, the reactor was tripped manually by the operator almost coincidentally with the automatic trip.

Following these incidents, on February 28, 1983, the NRC Executive Director for Operations (EDO) directed the staff to investigate and report on the generic implications of these occurrences at Unit 1 of the Salem Nuclear Power Plant. The results of the staff's inquiry into the generic implications of the Salem Unit 1 incidents are reported in NUREG-1000, "Generic Implications of the ATWS Events at the Salem Nuclear Power Plant." As a result of this investigation, the Commission (NRC) requested (by Generic Letter 83-28 dated July 8, 1983) all licensees of operating reactors, applicants for an operating license, and holders of construction permits to respond to generic issues raised by the analyses of these two ATWS events.

The licensees were required by Generic Letter 83-28, Item 4.5.3 to confirm that on-line functional testing of the reactor trip system (RTS), including independent testing of the diverse trip features, was being performed at all plants.

Existing intervals for on-line functional testing required by Technical Specifications were to be reviewed to determine if the test intervals were adequate for achieving high RTS availability when accounting for considerations such as: (1) uncertainties in component failure rates; (2) uncertainties in common mode failure rates; (3) reduced redundancy during testing; (4) operator error during testing; and (5) component "wear-out" caused by the testing.

EVALUATION

The NRC's contractor, Idaho National Engineering Laboratory (INEL), reviewed the licensee's Owners Group availability analyses and evaluated the adequacy of the existing test intervals, with a consideration of the above five items, for all plants. The result of this review are reported in detail in EGG-NTA-8341,

"A Review of Reactor Trip System Availability Analyses for Generic Letter 83-28, Item 4.5.3 Resolution," dated March 1989 and summarized in this report. The results of our evaluation of Item 4.5.3 and our review of EGG-NTA-8341 are presented below.

The Babcock & Wilcox (B&W), Combustion Engineering (CE), General Electric (GE), and Westinghouse (W) Owners Groups have submitted topical reports either in response to GL 83-28, Item 4.5.3 or to provide a basis for requesting Technical Specification changes to extend RTS surveillance test intervals. The owners groups' analyses addressed the adequacy of the existing intervals for on-line functional testing of the RTS, with the considerations required by Item 4.5.3, by quantitatively estimating the unavailability of the RTS. These analyses found that the RTS was very reliable and that the unavailability was dominated by common cause failure and human error.

The ability to accurately estimate unavailability for very reliable systems was considered extensively in NUREG-0460, "Anticipated Transients Without Scram for Light Water Reactors," and the ATWS rulemaking. The uncertainties of such estimates are large, because the systems are highly reliable, very little experience exists to support the estimates, and common cause failure probabilities are difficult to estimate. Therefore we believe that the RTS unavailability estimates in these studies, while useful for evaluating test intervals, must be used with caution.

NUREG-0460 also states that for systems with low failure probability, such as the RTS, common mode failures tend to predominate, and, for a number of reasons, additional testing will not appreciably lower RTS unavailability. First, testing more frequently than weekly is generally impractical, and even so the increased testing could at best lower the failure probability by less than a factor of four compared to monthly testing. Secondly, increased testing could possibly increase the probability of a common mode failure through increased stress on the system. Finally, not all potential failures are detectable by testing. In summary, NUREG-0460 provides additional justification to demonstrate that the current monthly test intervals are adequate to maintain high RTS availability.

CONCLUSION

All four vendors' topical reports have shown the currently configured RTS to be highly reliable with the current monthly test intervals. Our contractor has reviewed these analyses and performed independent estimates of their own which conclude that the current test intervals provide high reliability. In addition, the analyses in NUREG-0460 have shown that for a number of reasons, more frequent testing than monthly will not appreciably lower the estimates of failure probability.

Based on our review of the Owners Group topical reports, our contractor's independent analysis, and the findings noted in NUREG-0460, we conclude that the existing intervals, as recommended in the topical reports, for on-line functional testing are consistent with achieving high RTS availability at all operating reactors.

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