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# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

## PILGRIM NUCLEAR POWER STATION, UNIT 1

## DOCKET NO. 50-293

## BWR FEEDWATER AND CRD RETURN LINE MODIFICATIONS

### 1.0 Introduction

NUREG-0619[1] summarizes the work performed by the NRC staff to resolve Generic Activity A-10, "The cracking of feedwater and CRD return line nozzles." The triple-sleeve sparger configuration recommended by General Electric (GE) is different from previous designs. It protects the feedwater nozzle against the high frequency thermal cycles which are responsible for postulated crack initiation and growth mechanism in nozzles. The removal of cladding from the nozzles results in about a factor of two reduction in cyclic thermal stress at the surface of the metal. It also facilitates interpretation of UT signals by eliminating the interface between the cladding and the metal.

Guidance in NUREG-0619 recommends that the performance of the triple-sleeve sparger be monitored for leakage. Based on a conservative evaluation of test results, a minimal rate of leakage (of about one gallon per minute or less) will limit the initiation of cracks and crack growth rates to below ASME allowable depths during the life of the plant.

In addition to the triple-sleeve sparger, GE recommends some system and procedural changes, including rerouting the discharge of the Reactor Water Cleanup System (RWCU) to deliver the flow to each feedwater nozzle. Although NEDE-21821-02 shows that system changes in general do not make a large contribution to delaying crack initiation, it does show that rerouting the RWCU can decrease the usage factor with respect to crack initiation from 0.70 to 0.46. This represents a significant usage factor reduction in those plants where rerouting of the RWCU is feasible.

In connection with the control rod drive (CRD) return line nozzle, NUREG-0619 recommends inspection of bores and removal of cracks, plus one of the following actions: (1) valve out the return line; (2) reroute the return line to another system; or (3) cut and cap the return line.

### 2.0 Evaluation

The licensee (Boston Edison Company/BECo) has completed the feedwater nozzle clad removal and installation of triple-sleeve spargers in the reactor vessel at the Pilgrim Station[2]. As noted above, these measures will minimize thermal cycling effects on the nozzles and reduce the probability of crack initiation and crack growth. Following removal of the clad material, all four nozzles were dye-penetrant tested and showed no crack indications.

GE's fracture mechanics analysis[3], based on operating history and feedwater data collected at Pilgrim, shows that a postulated nozzle crack of 0.25-inch initial depth would not become greater than one inch during the remaining life of the plant. In making that determination, the secondary seal leakage around the triple-sleeve spargers was assumed to be approximately one gallon per minute when cold feedwater is injected at 25% of rated flow. This is a conservative assumption since the cold feedwater injections would typically occur at much less than 25% of rated flow and they would only last for a few seconds.

BECo has decided not to install a thermal sleeve bypass monitor at this time[2]. The monitor would provide on-line indications of leakage around the spargers. However, the staff believes that periodic inspections of the nozzles and spargers at the intervals specified in Table 2 of NUREG-0619 will suffice until there is evidence of crack growth that requires closer monitoring.

Based on the results of the above analysis, GE concluded that the existing low-flow control techniques at the Pilgrim Station have acceptable characteristics for limiting feedwater nozzle crack growth[3]. The licensee has, therefore, decided that installation of a new low-flow controller is unnecessary[2]. The staff agrees that the present low-flow controller, which is rated at 5% of feedwater flow under manual modes of operation, is adequate.

The RWCU system currently discharges into two of the four feedwater nozzles and routing the discharge to the other two nozzles as well was considered. However, the analyis indicated that the rerouting is unnecessary because the effects on crack growth would not be significant in view of the low-flow feedwater control techniques used at Pilgrim. The staff agrees that the present arrangement is satisfactory.

With regard to the CRD return line nozzle, the licensee inspected the nozzle bores and did not discover any cracks. The cause of any future cracks has been eliminated by cutting and capping the return line. This was done after analysis and testing demonstrated that sufficient flow exists through the CRD seals to obviate the need for the return line[4].

During refueling outage #6, BECo will complete the installation of equalizing valves between the cooling water header and the exhaust water header and the installation of flush and drain ports in the exhaust water header piping, as recommended by NUREG-0619. But, the stabilizing loop piping will not be replaced because BECo's analysis indicates that the same purpose (minimizing corrosion products being generated) can be achieved by valving out the stabilizing loop (this loop serves no purpose when the CRD return line has been cut and capped).

The licensee has committed to implementing the changes in operating procedures which are recommended in NUREG-0619. The staff understands that these changes will be made effective early in operating cycle #7.

## 3.0 Conclusion

The staff concludes that appropriate modifications have been, and are, being made at Pilgrim Unit 1 to limit crack growth in the feedwater nozzles. By cutting and capping the CRD return line, the licensee has eliminated potential cracking in the CRD return line nozzle.

The staff also concludes that rerouting of the RWCU return lines and the installation of a new low-flow feedwater controller are unnecessary while the leakage flow around the spargers is maintained at less than one gallon per minute. To ensure that crack growth does not exceed ASME limits, the licensee should continue to perform routine inspections of the feedwater nozzles and spargers at the intervals specified in Table 2 of NUREG-0619.

## 4.0 References

1 NUREG-0619, "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking," U. S. Nuclear Regulatory Commission, November 1980.

2 Letter from W. D. Harrington, Boston Edison Company, to D. B. Vassallo, NRC, July 26, 1983.

3 "Pilgrim Nuclear Power Station Unit 1 - Feedwater Nozzle Fracture Mechanics Analysis to Show Compliance with NUREG-0619," NEDE-30139-1, October 1983 (General Electric Company Proprietary Information).

4 Letter from A. V. Morisi, Boston Edison Company, to D. B. Vassallo, NRC, January 19, 1982.

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