UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ACTIONS TAKEN IN RESPONSE TO NRC LETTER OF MAY 25, 1979 ON CRACKING IN FEEDWATER SYSTEM PIPING

FOR

OCONEE NUCLEAR STATION, UNITS 1, 2 AND 3 (ONS)

DUKE POWER COMPANY (DPC OR THE LICENSEE)

DOCKETS NOS. 50-269, 270 & 287

Background and Discussion

On May 20, 1979 Indiana and Michigan Power Company notified the NRC of pipe cracks in two feedwater lines at their D. C. Cook Unit 2 facility. Pipe cracks were discovered following a shutdown on May 19 to investigate leakage inside containment. Circumferential cracks were identified as leaking in the 16-inch feedwater elbows adjacent to two steam generator nozzle to elbow welds. Subsequent radiographic examinations revealed cracks in all eight steam generator feedwater lines at this location on both Units 1 and 2.

On May 25, 1979, a letter was sent to all PWR licensees by the Office of Nuclear Reactor Regulation which informed licensees of the D. C. Cook failures and requested specific information on feedwater system design, fabrication, inspection and operating histories. To further explore the generic nature of the cracking problems, the Office of Inspection and Enforcement requested licensees of PWR plants in current outages to immediately conduct volumetric examination of certain feedwater pipe welds. As a result of these actions several other licensees reported cracking in the steam generator nozzle to feedwater piping weld vicinity. On June 25, 1979, IE Bulletin 79-13 was issued. The Bulletin required inspection of the steam generator nozzle-to-pipe welds and adjacent areas to be conducted within 90 days. The Bulletin also required an expanded inspection program to be conducted during the next refueling outage consisting of the reinspection of all previously inspected welds, main feedwater pipe welds to the first support, main feedwater pipe welds to the containment penetration and auxiliary feedwater pipe joining the main feedwater pipe.

Instrumentation was installed at several plants which had experienced feedwater pipe cracking. As a result of this instrumentation and other modeling and analysis by a Westinghouse Owners's Group, significant cyclic stresses were discovered to have occurred in the feedwater piping in the vicinity of the steam generator nozzle. The cyclic stresses were caused by mixing and stratification of cold auxiliary feedwater with hot water from the steam generator in the feedwater piping during low flow conditions. Metallurgical analysis of the cracked feedwater piping has identified the mode of failure as fatigue assisted by corrosion which supports the findings of the Westinghouse Owner's Group.

In an August 24, 1979 meeting with the Babcock & Wilcox (B&W) Owner's Group at Bethesda, Maryland, the group identified steam generator design differences between those fabricated by B&W and those fabricated by Westinghouse and Combustion Engineering. Furthermore, operating conditions of the B&W plants precludes the occurrences of stratification of cold auxiliary feedwater with hot water from the steam generator. In addition, the B&W Owner's Group reported that 95 welds in the main and auxiliary feedwater piping at Crystal River Unit No. 3 and at Davis-Besse 1 had been radiographically examined and no cracks had been detected.

By letters dated June 18 and July 27, 1979 the licensee responded to our May 25, 1979 letter on the feedwater pipe cracks as they relate to ONS, a B&W fabricated facility. In the response DPC addressed the design, fabrication, preservice/inservice inspections and operating history of the feedwater system. Furthermore, the presentation given by B&W Owner's Group on August 24, 1979 describing the B&W facility design applies to ONS.

Evaluation

Based upon the identified mode of cracking of the feedwater to nozzle weld, the operating and design characteristics of the B&W steam generator, the satisfactory inspection results on welds in the main and auxiliary feedwater piping on Crystal River Unit No. 3 and on Davis-Besse 1, and the review of the licensee's response, we conclude that feedwater nozzle cracks are unique to the Westinghouse and Combustion Engineering fabricated facilities.

Furthermore, stratification of the cold and hot water is impossible to occur under all modes of plant operation (including analyzed accident conditions) at the B&W fabricated facilities including ONS because the cold auxiliary feedwater enters the steam generator through a separate line, and thus cannot mix with the hot water that would backup from steam generator into the main feedwater pipe where cracks have been observed. This is the case for the B&W main feedwater system because the licensee has indicated that main feedwater is always preheated before entering the steam generator for all modes of high temperature operation ($\sim$>360°F). In addition, the velocities are high enough ($\sim$>10 ft/sec.) to prevent the high temperature water or steam from backing up from the steam generator into the feedwater lines. On this basis, we have concluded that feedwater pipe cracks caused by thermal cycling similar to those observed at the Westinghouse fabricated facilities will not occur at the B&W fabricated facilities (including ONS). For this reason, we have exempted the B&W fabricated facilities from the augmented inspection program under I&E Bulletin 79-13. This decision was conveyed to all licensees by issuing a revision to Bulletin 79-13. On this basis, ONS is exempted from the inspection requirements of Bulletin 79-13. We conclude that granting the exemption from Bulletin 79-13 will not in any way endanger public health and safety.

Feedwater nozzle to pipe weld cracking is still under generic review by the staff. Should the staff determine that actions beyond those stated in IE Bulletin 79-13 are necessary to ensure adequate feedwater line integrity, the licensee will be notified at that time.

Dated: December 9, 1980