UNITED STATES
NUCLEAR REGULATORY COMMISSION
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ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO FRACTURE MECHANICS EVALUATION OF FLAWS IN

FEEDWATER SYSTEM CHECK VALVES

VERMONT YANKEE NUCLEAR POWER CORPORATION

VERMONT YANKEE NUCLEAR POWER STATION

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1.0 INTRODUCTION

In a letter dated December 19, 1991, the Vermont Yankee Nuclear Power Corporation (the licensee) requested that the staff evaluate a Brookhaven National Laboratory (BNL) destructive analysis (MT-L1529-3, Evaluation of Cracks Found in Stellite Valve Guides at Vermont Yankee Nuclear Power Station dated September 1991) of flaws to determine whether check valves V27B and V96B need to be replaced. The BNL analysis was of flaws in valve bodies V28A and V28B. Valve bodies V28A and V28B were fabricated by the same manufacturer as V27B and V96B and had similar flaws to those observed in V27B and V96B.

The licensee had previously submitted the results from its ultrasonic examination and fracture mechanics evaluation of flaws in these valve bodies. The licensees' ultrasonic examination and fracture mechanics evaluation were previously reviewed by the staff in letters to the licensee dated April 19, 1990 and October 10, 1990. The BNL destructive analysis was reviewed by the staff and that review is summarized below.

2.0 DISCUSSION

The staff reviewed the licensee's fracture mechanics analysis submitted in a letter dated April 19, 1990. In that evaluation the staff indicated that the check valves have adequate fracture toughness but were concerned about the long term integrity of a cracked valve body in a BWR reactor coolant environment. The staff was concerned that the combination of fatigue and stress corrosion could result in rapid crack growth. The staff recommended: (a) local leakage detection be installed, (b) valve V28B be replaced following the Cycle 13 outage, and (c) the three other similar valves (V28A, V27B, and V96B) receive augmented volumetric inspection to monitor flaw growth.

During the Cycle 14, Fall 1990 outage, the licensee replaced check valves V28A and V28B and reinspected valves V27B and V96B. As a result of the reinspection, the cracks in valves V27B and V96B were reported to be 0.5 inch and 0.15 inch

deep, respectively. The cracks in valve V27B exceed the acceptance limits of ASME Code Section XI, but the flaws in V96B do not. In a letter dated October 4, 1990, the licensee committed to replace valve V27B at the next reload outage (Spring 1992).

Valves V28A and V28B were sent to BNL for destructive analysis. The BNL analysis concluded, and we agreed with their conclusion, that the cracks were probably the result of the original welding process. The maximum depth of any observed crack was 0.28 inch. Since the fracture mechanics analysis for cracks was 0.65 inch in depth, the analysis bounds the observed flaw size from both the destructive analysis of valve bodies V28A and V28B and the ultrasonic examination of valve bodies V27B and V96B. In addition, BNL concluded, and we agreed with their conclusion, that there was a possibility of corrosion cracking into the ferritic base metal. The measured amount of corrosion crack growth, was 0.04 inches. Since the valve body had been in service for 20 years, this amount of growth is considered insignificant.

In their December 19, 1991 letter, the licensee concludes that the V27B and V96B check valves need not be replaced because the destructive analysis and fracture mechanics analysis indicate that the cracks are stable and static. The fracture mechanics analysis includes a fatigue crack growth analysis. The fatigue analysis indicated that after 10 years of service a 1.5 inches deep crack would only grow to 1.5035 inches deep. Thus the amount of fatigue crack growth predicted was considered insignificant.

CONCLUSIONS

1. Based on the licensee's fracture mechanics analysis and the BNL destructive analysis, the cracks in valve bodies V27B and V96B are stable and static and meet the safety factors in Article A-7000 in ASME Code Case N-463.

2. Since the flaws meet the safety factors in Article A-7000 in ASME Code Case N-463, the valve V27B need not be replaced. However, to monitor flaw growth, the licensee must perform augmented volumetric inspection of the flaws in valve V27B in accordance with the schedule in paragraph IWC-2420(b) of ASME Code Section XI.

3. Since the flaws in valve V96B meet the acceptance limits of ASME Code Section XI, the valve need not be replaced and augmented volumetric inspection is not required.

4. The ASME Code only requires visual inspection of valve bodies V96B and V27B because they are designated class 2. Since visual inspection cannot monitor crack depth, all ASME Code Section XI inservice inspections of valve bodies V96B and V27B must include volumetric examination of the cracks.

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