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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

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NRC BULLETIN NO. 88-08, SUPPLEMENT 2: THERMAL STRESSES IN PIPING CONNECTED TO REACTOR COOLANT SYSTEMS

Addressees:

All holders of operating licenses or construction permits for light-water-cooled nuclear power reactors.

Purpose:

This supplement emphasizes the need for enhanced ultrasonic testing (UT) and for experienced examination personnel to detect cracks in stainless steel piping. No new requirements are included in this supplement.

Description of Circumstances:

On the basis of changes in containment atmospheres at Farley 2 and Tihange 1, operators found leakage of reactor coolant from cracks in the first upstream elbow of emergency core coolant system (ECCS) piping connected to the reactor coolant systems. The cracked pipe at both plants was fabricated from 6-inch, type 304, stainless steel components, except for a check valve body at Tihange 1 that was cast, type 316, stainless steel. At Farley 2, the through-wall crack was in the upstream weld and in the heat-affected zones on both sides of the weld. At Tihange 1, the through-wall crack was in the base metal of the elbow. Other cracks at Tihange 1 were found in the pipe spool connected to one side of the elbow and in the body of the check valve connected to the other side. The maximum depth of these cracks was 30 percent of the wall thickness. During repair of the piping, cracks in the check valve body were found by using dye-penetrant testing, and the depth was determined by grinding.

At Farley 2, the weld that failed had been examined on April 17, 1986, as part of the inservice inspection program using the UT technique required by Section XI of the ASME Boiler and Pressure Vessel Code. No reportable flaw indications were found. The same UT procedure was used again after the plant was shut down on December 9, 1987, and again no rejectable flaw indications were reported. After supplementing the UT technique with a 60-degree shear

wave transducer and increasing the gain with the 45-degree transducer by 8 db, the through-wall crack was identified. To detect the through-wall crack and other cracks in the Tihange 1 elbow and spool, an instrumentation gain 24 db higher than ASME Code sensitivity was required.

Discussion:

The experience at Farley 2 and Tihange 1 indicates that problems could exist with detection of thermal fatigue cracks in stainless steel piping, fittings, and welds. For the UT procedure to reliably detect these cracks, the practices that were found to provide reliable detection include (1) using sufficient instrument gain so that cracks can be distinguished from non-relevant reflectors, (2) using multiple-angle beam transducers on surfaces that have geometric discontinuities or weld conditions that limit scanning, (3) recording any indication of a suspected flaw regardless of amplitude, and (4) using examination personnel with demonstrated ability to detect and evaluate cracked stainless steel welds.

Personnel training and experience are important considering the elevated scanning sensitivity and the reliance on signal interpretation for reporting and characterizing flaws. The examination procedure describes the acceptance standards and methodology for sizing flaw indications in order to establish actual or conservative flaw dimensions. A UT procedure that has been shown to be capable of detecting and sizing intergranular stress corrosion cracking at boiling water reactors has been demonstrated to be effective in detecting thermal fatigue cracks.

Actions Requested:

Although the actions requested in NRC Bulletin 88-08 are unchanged, reliable examination of stainless steel piping requires specialized UT techniques.

Reporting Requirements:

The reporting requirements set forth in NRC Bulletin 88-08 remain unchanged.

If you have any questions regarding this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

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Attachment: List of Recently Issued NRC Bulletins

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