OMB No.: 3150-0011
NRCB 88-08, Supplement 2

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

August 4, 1988

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.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: Roger W. Woodruff, NRR
(301) 492-1180

Martin Hum, NRR
(301) 492-0932

Attachment: List of Recently Issued NRC Bulletins

Attachment
NRCB 88-08, Supplement 2
August 4, 1988

LIST OF RECENTLY ISSUED
NRC BULLETINS

Bulletin No.	Subject	Date of Issuance	Issued to
88-09	Thimble Tube Thinning in Westinghouse Reactors	7/26/88	All holders of OLs or CPs for W-designed nuclear power reactors that utilize bottom mounted instrumentation.
88-08, Supplement 1	Thermal Stresses in Piping Connected to Reactor Coolant Systems	6/24/88	All holders of OLs or CPs for light-water-cooled nuclear power reactors.
88-08	Thermal Stresses in Piping Connected to Reactor Coolant Systems	6/22/88	All holders of OLs or CPs for light-water-cooled nuclear power reactors.
88-05, Supplement 1	Nonconforming Materials Supplied by Piping Supplies, Inc. at Folsom, New Jersey and West Jersey Manufacturing Company at Williamstown, New Jersey	6/15/88	All holders of OLs or CPs for nuclear power reactors.
88-07	Power Oscillations in Boiling Water Reactors (BWRs)	6/15/88	All holders of OLs or CPs for BWRs.
88-06	Actions to be Taken for the Transportation of Model No. Spec 2-T Radiographic Exposure Device	6/14/88	All NRC licensees authorized to manufacture, distribute, or operate radiographic exposure devices or source changers.
87-02, Supplement 2	Fastener Testing to Determine Conformance with Applicable Material Specifications	6/10/88	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: Roger W. Woodruff, NRR
(301) 492-1180

Martin Hum, NRR
(301) 492-0932

Attachment: List of Recently Issued NRC Bulletins
*SEE PREVIOUS CONCURRENCE

*EAB:DOEA	*EAB:NRR	*RPB:ARM	*C:EAB:DOEA	*D:DEST:NRR	*C:OGCB:NRR
RWoodruff	DFischer		WLanning	LShao	CHBerlinger
7/22/88	7/22/88	7/26/88	7/22/88	7/25/88	7/29/88

D:DOEA:NRR
CERossi
7/29/88

This was coordinated w. H E. Jordan who agreed CRGR review not needed. W.D.L.

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 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.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: Roger W. Woodruff, NRR
(301) 492-1180

Martin Hum, NRR
(301) 492-0932

Attachment: List of Recently Issued NRC Bulletins

*SEE PREVIOUS CONCURRENCE

*EAB:DOEA	*EAB:NRR	*RPB:ARM	*C:EAB:DOEA	*D:DEST:NRR	C:OGCB:NRR
RWoodruff	DFischer		WLanning	LShao	CHBerlinger
/ /88	/ /88	/ /88	/ /88	/ /88	7/29/88

D:DOEA:NRR
CERossi
/ /88

Discussion:

Problems with intergranular stress corrosion cracking (IGSCC) in stainless steel piping at boiling-water reactors led to issuance of Generic Letter 88-01 (Attachment 1). This generic letter indicated that enhanced UT techniques and additional qualification of examination personnel are needed to reliably detect IGSCC in stainless steel. The experience at Farley 2 and Tihange 1 indicates that similar problems exist with detection of thermal fatigue cracks in stainless steel piping, fittings, and welds. For the UT procedure to reliably detect these cracks, it should be proven to be effective on cracked weldments and enhanced by (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 should describe the acceptance standards and methodology for sizing flaw indications in order to establish actual or conservative flaw dimensions.

Actions Requested:

Although the actions requested in NRC Bulletin 88-08 are unchanged, it should be noted that reliable examination of stainless steel piping requires specialized UT procedures and experienced personnel.

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 NRC regional office.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: Roger W. Woodruff, NRR
(301) 492-1180

Martin Hum, NRR
(301) 492-0932

Attachments:
1. Generic Letter 88-01 dated 1/25/88
2. List of Recently Issued NRC Bulletins

EAB:DOEA	EAB:NRR	TECH:ED	C:EAB:DOEA	D:DEST:NRR	C:OGCG:DOEA	D:DOEA
RWWoodruff	DFischer	BCalure	WDLanning	LShao	CHBerlinger	CERossi
7/22/88	7/22/88	7/26/88	7/22/88	7/ /88	7/ /88	7/ /88