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

March 12, 1991

NRC INFORMATION NOTICE NO. 91-19: STEAM GENERATOR FEEDWATER DISTRIBUTION PIPING DAMAGE

Addressees:

All holders of operating licenses or construction permits for pressurized water reactors (PWRs).

Purpose:

This information notice is intended to alert addressees to potential problems resulting from degradation of feedwater distribution piping in steam generators due to thermal stress, cracking, erosion and corrosion. Depending on the design of the steam generator feedwater system, these problems may affect operation of the auxiliary feedwater system. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Background:

The degradation noted below of the feedwater distribution system piping in the steam generators at San Onofre Units 2 and 3 may be applicable to Combustion Engineering steam generator designs predating the System 80 design and to similar designs in other steam generators at other nuclear power plants. This matter is considered safety-significant because the feedwater distribution system piping degradation may affect the delivery of auxiliary feedwater flow in some of these steam generators and because of the potential for consequential damage to the steam generator tubes from resulting debris. The NRC has issued several generic communications dealing with one or more aspects of such degradation (Attachment 3).

At San Onofre Units 2 and 3, both main feedwater and auxiliary feedwater enter the steam generators through a feedwater nozzle. The feedwater enters a distribution box and 12-inch diameter piping (feedring) that distributes the flow through top-mounted discharge elbows (J-tubes) around the periphery of the steam generator shell (Figure 1). The feedring is attached by two U-bolts at each of four supports that are welded to the shell wall. A 3-inch elbow and tee vent assembly is attached to the upper portion of the innermost (toward the interior of the steam generator) end of the distribution box (Figure 2).

Combustion Engineering originally designed the distribution box without the vent assembly. However, in 1980 during preoperational testing at San Onofre Unit 2, a test of the auxiliary feedwater system caused a partial vacuum within both halves of the feedring in one of the steam generators, and the feedring collapsed. The licensee, Southern California Edison Co., determined that the inadequate flow area of the discharge elbows and the relatively thin-walled Schedule 40 piping constituting the feedring had contributed to the feedring collapse. Corrective actions included replacing most of the feedring with Schedule 120 piping (except for 9-inch segments on each side of the distribution box), enlarging the diameter of the discharge elbows from 1.5 inches to 3.5 inches, and installing the vent assembly on the distribution box.

Description of Circumstances:

San Onofre Unit 3:

On May 10, 1990, the licensee found several pieces of carbon steel debris during a routine inspection of the secondary side of the tubesheet of one steam generator (LER 50-362/90-05-01). During further inspection of the internal components of this and the other steam generator, the licensee found material missing from the lower portion of the feedring at its intersection with the distribution box, surface cracks in the heat-affected zone at the toe of the weld at that intersection, erosion and corrosion indications on the interior surfaces of the distribution boxes, erosion of the vent assemblies, "T" section tops missing from the vent assemblies, and deformation of several U-bolt supports.

San Onofre Unit 2:

On July 23, 1990, the licensee shut down Unit 2 to perform a similar inspection. The damage found was significantly less than on Unit 3. No material was found missing from the distribution box-feedring junction. One U-bolt was fractured.

Discussion:

The licensee determined the root cause contributing to the degradation of the feedwater distribution system piping to be inadequate design of the feedring and feedring supports. The design did not adequately consider the thermal stresses resulting from normal operating conditions, in particular the batch process of auxiliary feedwater addition during startup operations. In addition, the design of the vent assembly had not properly considered the potential for erosion and corrosion resulting from localized high velocity flow. The corrective actions taken by the licensee included replacing the remaining Schedule 40 piping material with Schedule 120 piping material, replacing the distribution box-feedring weld configuration with weld-o-let forgings, removing the distribution box vents from the design, repairing local thinning of the distribution box by weld buildup and removal of local interior surface discontinuities, modifying the feedring supports to provide flexibility for thermal expansion, and using stronger U-bolts. The licensee had previously modified the auxiliary feedwater system to provide continuous feeding of the steam generator rather than the batch feeding that was used during startup operations.

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On September 20, 1990, the steam generator vendor, Combustion Engineering, issued an information bulletin (Combustion Engineering Infobulletin 90-04, "Feedwater Distribution System Degradation"), recommending that its client utilities perform a baseline inspection during their next refueling outage to detect wall thinning in the feedwater distribution system.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate NRR project manager.

Charles E. Rossi

Charles E. Rossi, Director
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Office of Nuclear Reactor Regulation

Technical Contacts: Vern Hodge, NRR
(301) 492-1861

Lawrence E. Kokajko, NRR
(301) 492-1380

Attachments:
1. Figure 1. Top View of the Feedwater Distribution Piping
2. Figure 2. Side View of the Feedwater Distribution Piping
3. List of References
4. List of Recently Issued NRC Information Notices

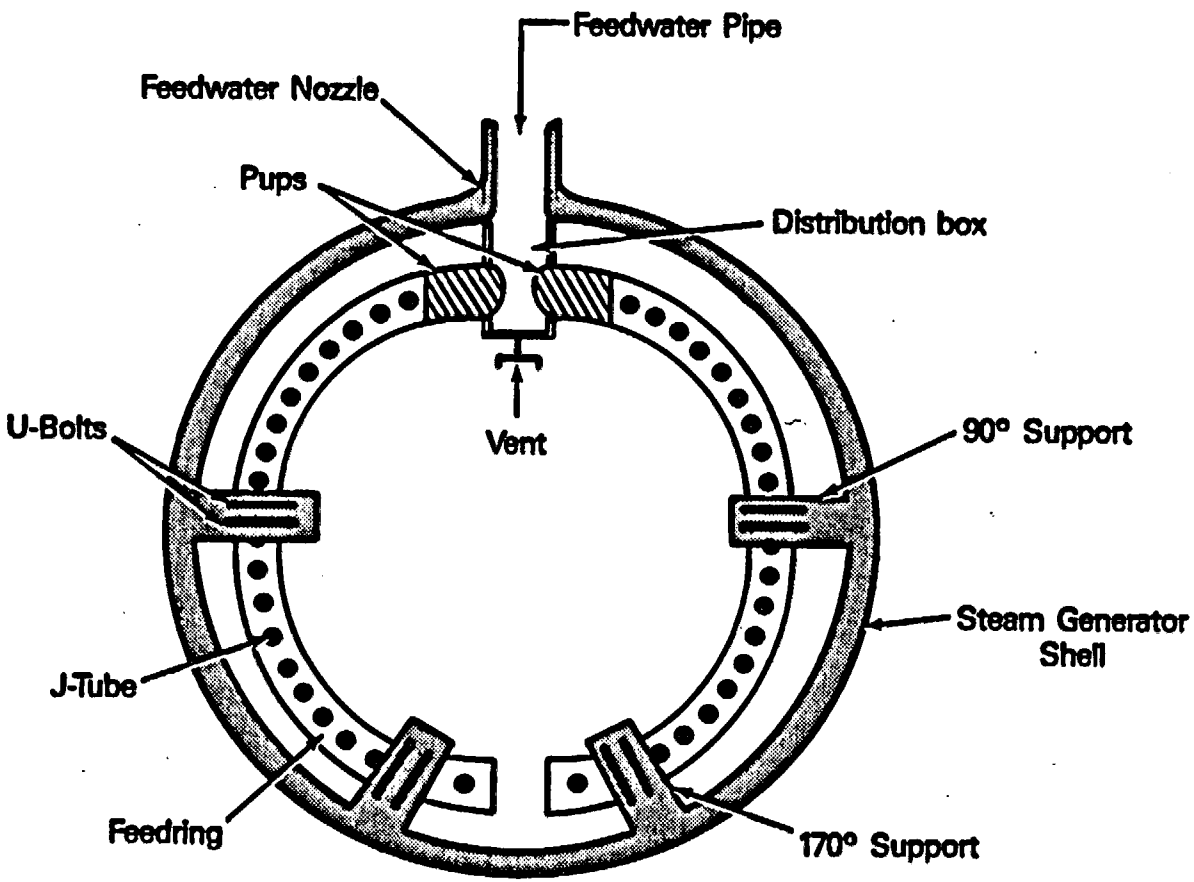

Figure 1: Top View of the Feedwater Distribution Piping

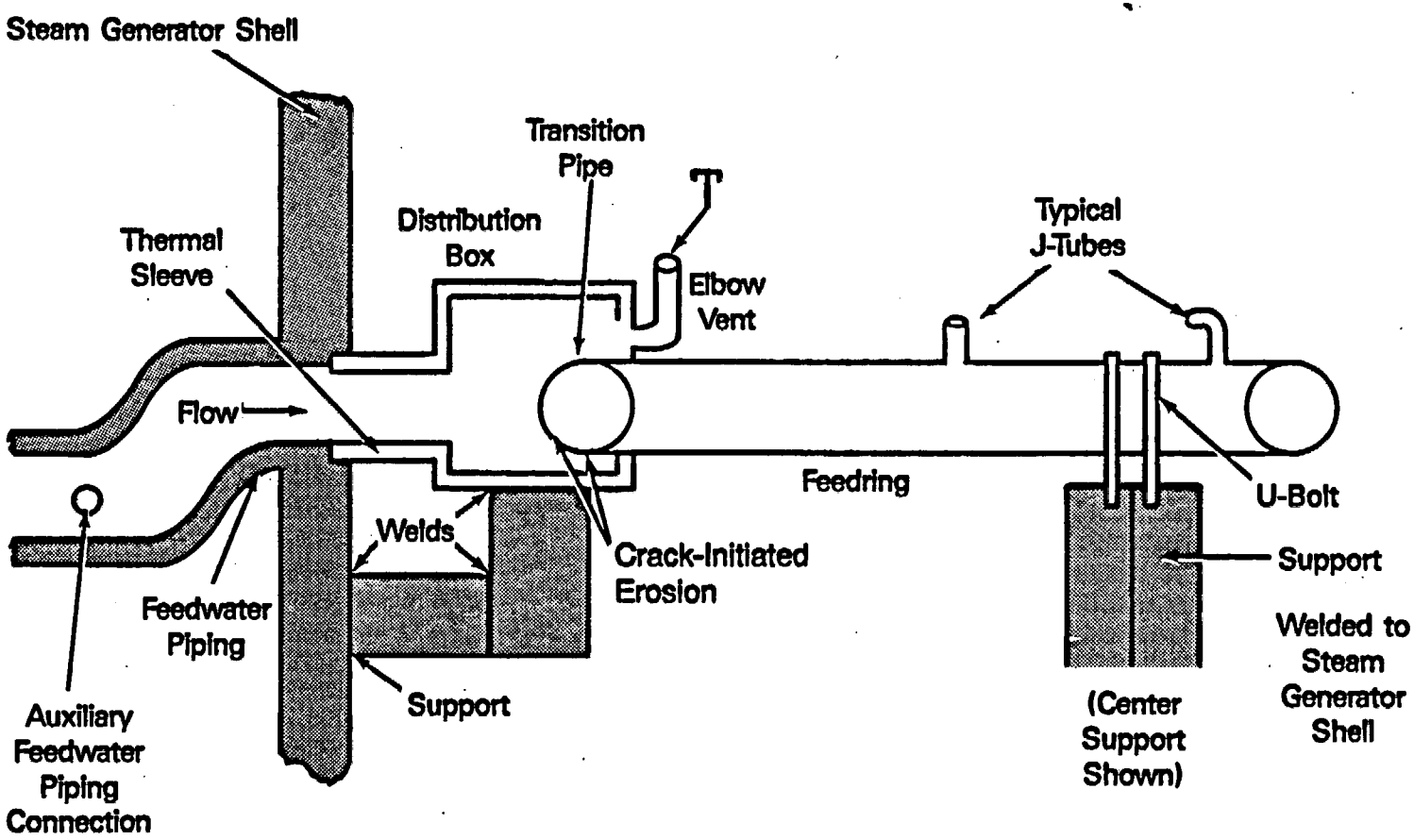

Figure 2: Side View of the Feedwater Distribution Piping

LIST OF REFERENCES

1. Bulletin No. 87-01: "Thinning of Pipe Walls in Nuclear Power Plants," July 9, 1987

2. Bulletin No. 79-13: "Cracking in Feedwater System Piping," June 25, 1979

3. Ibid., Revision No. 1: "Cracking in Feedwater System Piping," August 30, 1979

4. Ibid., Revision No. 2: "Cracking in Feedwater System Piping," October 16, 1979

5. Generic Letter No. 89-08: "Erosion/Corrosion-Induced Pipe Wall Thinning," May 2, 1989

6. Generic Letter No. 79-20: Untitled, on Cracking In Feedwater Lines, May 25, 1979

7. Information Notice No. 88-17: "Summary of Responses to NRC Bulletin 87-01, 'Thinning of Pipe Walls in Nuclear Power Plants,'" April 22, 1988

8. Information Notice No. 87-36: "Significant Unexpected Erosion of Feedwater Lines," August 4, 1987

9. Information Notice No. 86-106: "Feedwater Line Break," December 16, 1986

10. Ibid., Supplement 1: "Feedwater Line Break," February 13, 1987

11. Ibid., Supplement 3: "Feedwater Line Break," November 10, 1988

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-18	High-Energy Piping Failures Caused by Wall Thinning	03/12/91	All holders of OLs or CPs for nuclear power reactors.
90-25, Supp. 1	Loss of Vital AC Power with Subsequent Reactor Coolant System Heat-Up	03/11/91	All holders of OLs or CPs for nuclear power reactors.
91-17	Fire Safety of Temporary Installations or Services	03/11/91	All holders of OLs or CPs for nuclear power reactors.
91-16	Unmonitored Release Pathways from Slightly Contaminated Recycle and Recirculation Water Systems at A Fuel Facility	03/06/91	All fuel cycle facilities.
91-15	Incorrect Configuration of Breaker Operating Springs in General Electric AK-Series Metal-Clad Circuit Breakers	03/06/91	All holders of OLs or CPs for nuclear power reactors.
91-14	Recent Safety-Related Incidents at Large Irradiators	03/05/91	All Nuclear Regulatory Commission (NRC) licensees authorized to possess and use sealed sources at large irradiators.
91-13	Inadequate Testing of Emergency Diesel Generators (EDGs)	03/04/91	All holders of OLs or CPs for nuclear power reactors.
91-12	Potential Loss of Net Positive Suction Head (NPSH) of Standby Liquid Control System Pumps	02/15/91	All holders of OLs or CPs for boiling water reactors (BWRs).

OL = Operating License
CP = Construction Permit