

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

December 4, 1998

NRC INFORMATION NOTICE 98-43: LEAKS IN THE EMERGENCY DIESEL GENERATOR
LUBRICATING OIL AND JACKET COOLING WATER
PIPING

Addressees

All holders of operating licenses for nuclear power reactors, except those licensees that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the potential for leaks in the skid-mounted lubricating oil piping of Fairbanks Morse emergency diesel generators (EDGs) resulting from fatigue failures of welded pipe joints. It is expected that recipients will review the industry operating experience contained in this information notice to determine if it is applicable to their facility. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

The Vermont Yankee and Millstone Unit 2 facilities have experienced leaks in the lubricating oil system piping of their Fairbanks Morse EDGs. These leaks resulted from fatigue cracks in the welded joints that were induced by engine vibration. Fairbanks Morse EDGs are installed at 15 plants. There are approximately 200 welds on the skid-mounted piping of typical Fairbanks Morse EDGs.

In 1995, the Vermont Yankee plant experienced a leak on a welded joint in the lubricating oil piping of one of its Fairbanks Morse EDGs. The licensee concluded that the weld crack had initiated from a slag inclusion of approximately 3/16 inch in the face of this weld and had propagated as a result of engine vibration. Corrective actions included grinding out the slag inclusion (and other weld defects) and rewelding of the joint. In 1997, the Vermont Yankee plant experienced another leak in a welded joint in the EDG lubricating oil system piping. The licensee determined that the fatigue cracking was due to a lack of full penetration and a general lack in quality of the welds during manufacture. To correct the problem, the licensee replaced a section of the lubricating oil piping with new piping that conforms to the vendor's latest fabrication requirements, which specify full-penetration welds. The licensee also added some piping supports to reduce the vibration.

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At Millstone Unit 2, one of the EDGs experienced a through-wall crack in a piping welded joint, which resulted in a lubricating oil leak. The failure was due to vibration-induced fatigue during diesel operation. As a corrective action, the licensee replaced most of vibration-prone piping with new piping that conforms to the vendor's latest fabrication and installation specifications, which require full-penetration welds. In addition, the welds on all remaining piping were cut out and replaced with full-penetration welds.

While preparing for a power upgrade of their Fairbanks Morse EDGs, the Crystal River licensee found partial penetration welds in some of the cooling water system piping. To eliminate the potential of future leaks, the licensee replaced a majority of the skid-mounted piping using full penetration welds.

Discussion

As part of its root cause investigation, the Vermont Yankee licensee performed a review to determine whether the EDGs had been manufactured in accordance with the procurement specifications. These specifications required the vendor to deliver a seismically qualified EDG package on a skid that met Vermont Yankee's specific requirements, including that the EDGs be capable of performing their intended safety function during a seismic event. In accordance with Fairbanks Morse practice at the time, the piping was fabricated using its own internal procedures and processes, which were believed to be equivalent to commercial standards and good industry practice. These standards did not require full-penetration welds. The procurement specifications did not require that the skid-mounted piping meet the American National Standards Institute (ANSI) B31.1 Power Piping Code. The Vermont Yankee licensee concluded that the EDGs had been manufactured in accordance with the original EDG procurement specifications.

To determine the cause of the cracks at Vermont Yankee, the licensee performed metallurgical examination and destructive load testing of a sample of three partial-penetration welded joints removed from the EDG lubricating oil system. The welds that were selected were from the section of piping between the lubricating oil pump discharge and the oil filter. They were chosen because the licensee determined that they were the most highly stressed and susceptible to fatigue failure. Both axial and bending loads were applied during the tests. The results confirmed that the installed partial penetration welds would withstand loads greater than the yield strength of the piping material and that they had significant strength with respect to the design loads and the ANSI B31.1 Power Piping Code allowable stresses. However, the licensee also concluded that these partial penetration welds were not sufficient to prevent cracks from propagating as a result of vibration-induced fatigue.

The skid-mounted piping on Fairbanks Morse EDGs at some of the other nuclear plants in the country, as well as a number of Pielstick EDGs provided by the same manufacturer, were fabricated in accordance with the requirements of ASME Code Section III, Class 3. This section of the code requires a higher standard for weld quality (including the requirement for full-penetration welds) than either ANSI B31.1 or the manufacturer's internal procedures. The Fairbanks Morse EDG Owners Group has taken the position that EDGs fabricated in accordance with Section III of the ASME Code are not as subject to the weld fatigue concerns as those fabricated using ANSI B31.1 or the manufacturer's internal procedures. In addition,

plants such as Vermont Yankee that have EDGs that were not fabricated in accordance with the ASME Section III Code, but whose licensee have subsequently taken appropriate corrective action, are not subject to the concerns described in this information notice.

Regardless of which codes and standards were used during manufacture, EDGs used in nuclear service are required to undergo preoperational and startup tests under the provisions of Section XI, "Test Control," of 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and vibration testing under the dynamic testing requirements of Standard Review Plan Section 3.9.2. However, it appears that these tests were not sufficient to identify all potentially vulnerable locations on EDG skid-mounted piping systems in the examples described in this information notice.

Coltec Industries, the vendor for Fairbanks Morse EDGs, and the Fairbanks Morse EDG Owners Group have been actively working with the 15 Fairbanks Morse EDG owners to address the problems described in this information notice. To date, they have issued four supplemental information letters dated December 18, 1997, and March 3, April 29, and June 24, 1998. In addition, they issued a report dated July 27, 1998, which provides the results of burst, tensile, and other tests of welded pipe joint strength with less than full penetration welds.

This information notice requires no specific action or written response. However, recipients are reminded that they are required by 10 CFR 50.65 to take industry-wide operating experience (including information presented in NRC information notices) into consideration, where practical, when setting goals and performing periodic evaluations. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) Project Manager.

Charles J. Miller for

Jack W. Roe, Acting Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

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LIST OF RECENTLY ISSUED
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Information Notice No.	Subject	Date of Issuance	Issued to
98-42	Implementation of 10 CFR 50.55a (g) Inservice Inspection Requirements	12/01/98	All holders of operating licenses for nuclear power reactors
98-41	Spurious Shutdown of Emergency Diesel Generators from Design Oversight	11/20/98	All holders of operating licenses for nuclear power reactors, except for those who have ceased operations and have certified that fuel has been permanently removed from the reactor vessel
98-40	Design Deficiencies Can Lead Reduced ECCS Pump Net Positive Suction Head During Design-Basis Accidents	10/26/98	All holders of operating licenses for nuclear power reactors, except those licensees who have permanently ceased operations and have certified that fuel has been permanently removed from the vessel
98-39	Summary of Fitness-for-Duty Program Performance Reports for Calendar Years 1996 and 1997	10/24/98	All holders of operating licenses for nuclear power reactors
98-38	Metal-Clad Circuit Breaker Maintenance Issued Identified By NRC Inspections	10/15/98	All holders of operating licenses for nuclear power reactors.
98-37	Eligibility of Operator License Applicants	10/01/98	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

OL = Operating License
CP = Construction Permit

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 Office of Nuclear Reactor Regulation

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