

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

January 25, 1989

NRC INFORMATION NOTICE NO. 89-07: FAILURES OF SMALL-DIAMETER TUBING IN
CONTROL AIR, FUEL OIL, AND LUBE OIL
SYSTEMS WHICH RENDER EMERGENCY DIESEL
GENERATORS INOPERABLE

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

This information notice is being provided to alert addressees to events involving breaks or cracking of small-diameter tubing which can render emergency diesel generators (EDGs) inoperable. Failures apparently caused by vibration have occurred in the tubing of the instrumentation and control air system as well as in the fuel oil and lube oil systems of EDGs. These events have significant safety implications because of the loss of, or the potential loss of, ability of safety-related equipment to perform its intended safety function. 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.

Description of Circumstances:

Cooper Nuclear Station

During an operability surveillance test of an emergency diesel generator on October 21, 1988, at Cooper Station (Nebraska Public Power District), a loss of control air pressure occurred and the "Turbo Bearing Wear" annunciator alarmed. The control air system is a subsystem of the starting air system. The starting air goes through two pressure-reducing valves, set at 80 psi and 30 psi, respectively, to supply 30 psi control air. The control air subsystem maintains the engine at a set speed regardless of engine load and protects the engine from abnormal conditions through protective trip functions. During engine operation the control air supplies 80 psi air to hold the fuel racks in position. If control air is shut off or if any of the diesel generator trips occur, the 80 psi air flow to the fuel shutoff cylinder is stopped, dumping the fuel racks and tripping the EDG.

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After the overspeed shutdown relay and the valve associated with maintaining a constant air pressure for the various EDG protective trip mechanisms were rebuilt, the control air pressure still could not be sustained. Subsequently, the licensee identified a circumferential crack in a $\frac{1}{2}$ -inch stainless steel instrument line during a walkdown inspection of the control air system. The cracked line allowed the 30 psi control air to bleed off, reducing pressure on the safety trip valve solenoid which shut down the EDG. Approximately 1 inch of the line was removed and replaced with a compression fitting. The EDG was restarted, and the test was successfully completed.

Nebraska Public Power District forwarded the cracked piece of stainless steel tubing to a testing laboratory for analysis to determine the cause of the failure. At this time, engine vibration is assumed to be the cause of the failure. The licensee has introduced design changes to relocate all engine-mounted instruments subject to high vibration from the engine onto instrument racks. The modifications are scheduled for the next refueling outage.

Similar events in the instrumentation and control air system previously occurred at Cooper Station in both 1975 and 1981. These problems were thought to have been resolved by replacement of the original copper tubing with stainless steel tubing. The EDGs at Cooper Station were manufactured by Cooper Energy Systems of Cooper Industries (so-called Cooper-Bessemer EDGs).

Wolf Creek Generating Station

A break in the fuel oil line of an EDG at Wolf Creek Generating Station resulted in a fire on November 27, 1988. A fuel oil leak emanated from a compression fitting on a $\frac{1}{2}$ -inch surge tank line. The leak quickly increased from a drip to a spray over approximately 45 minutes. Since the leak appeared to be between the nut and the ferrule and was believed to be correctable with the unit in service, and because the EDG was undergoing a 24-hour endurance test, operations personnel did not shut down the EDG.

When the attending personnel discovered that the leak had increased significantly, they notified the shift supervisor, and, consequently, the EDG was secured by a control room operator. As the load was reduced, the attending personnel noted flames, reported the fire to control room and security personnel, and actuated the fire alarm. Within about 3 minutes from the time the attending personnel first noticed the fire, the fire was out.

Severe fretting on a horizontal section of the damaged $\frac{1}{2}$ -inch fuel line was observed when the section was removed for repair. The fretting apparently was caused by vibration-induced rubbing against the larger line to which the fuel line was attached. The broken line also appeared to have been previously broken and repaired in the same place. At that time, the fuel line had been shortened, which could have introduced additional stresses at the location of the new break. A post-event walkdown inspection of the EDG revealed further evidence of inadequate support and fretting of other small fluid lines.

Previously, on December 4, 1986, a similar event occurred at Wolf Creek that involved the same fuel line on one of the other EDGs, also during a 24-hour

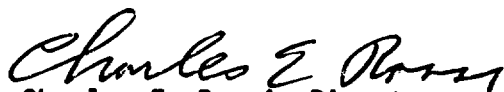
endurance test. In this instance, the leak through the wall of the 1/4-inch fuel line was caused by fretting similar to that observed on the fuel line that failed in the event previously described. In addition, a number of other problems have occurred involving small-diameter fluid lines on the EDGs as a result of vibration. In January 1985, two fuel oil leaks resulted from holes rubbed in a section of 1/4-inch steel tubing. In February 1985, sections of both the control air system and the fuel oil lines failed to meet minimum wall thickness requirements because of wear from vibration. In December 1987, a cracked lube oil line fitting caused the EDG to shut down after 10 hours of a 24-hour endurance test. The Wolf Creek EDGs were manufactured by Colt-Pielstick/Colt Industries.

Discussion:

These events indicate that small-diameter tubing installed on EDGs is susceptible to vibration-induced failures which could render the EDGs inoperable. The vibration-induced failures may appear as cracking or breaks as well as holes and wall thinning caused by rubbing of components that contact. These failures are not limited just to specific manufacturers, systems, or materials. The common underlying cause of the failures is the inadequate design or installation of the supports for the small-diameter tubing in a vibration environment.

As the potential unavailability of an EDG has such a significant impact on reactor safety, addressees may wish to review the small-diameter tubing of the instrumentation and control air system as well as the tubing of the fuel oil and lube oil systems of their EDGs. It is important to determine whether vibration can introduce cracks or breaks and whether these failures could lead to inoperability of the EDGs.

No specific action or written response is required by this information notice. If you have any questions about 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: G. L. Constable, RIV
(817) 860-8151

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(301) 492-1167

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(817) 860-8148

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