

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

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NRC INFORMATION NOTICE 2002-26: FAILURE OF STEAM DRYER COVER PLATE
AFTER A RECENT POWER UPRATE

Addressees

All holders of operating license or construction permits for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a recent failure of a steam dryer cover plate during operations following a power uprate at a boiling water reactor (BWR). It is expected that the 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

In March 2002, Quad Cities Unit 2, a BWR, completed a refueling outage. The outage included a modification to add baffle plates to the steam dryer to reduce the excessive moisture carryover expected as a result of an extended power uprate from 2511 MWt to 2957 MWt (17.8% increase). On June 7, 2002, the unit began experiencing fluctuations in steam flow, reactor pressure and level, and moisture carryover in the main steam lines. After more fluctuations in June and July, the licensee conducted an engineering evaluation of one of the fluctuations, and concluded that the steam flow irregularities could be caused by loose parts in the steam line, and that the loose parts could impair the proper functioning of safety systems.

Initially, the licensee believed that the newly installed baffle plates were the source of the loose parts. However, after shutting down the unit and removing the reactor pressure vessel head, the licensee discovered that a dryer cover plate on the outside of the steam dryer had broken loose. The cover plate separates the steam exit region from the steam dryer and separator space below. One piece of the dryer cover plate had fallen onto the separator, causing no apparent damage. Another piece was found in the dryer, and a third piece had lodged in the A main steam line flow venturi (upstream of the main steam isolation valves). Subsequent inspections by the licensee discovered that several other pieces had been swept down the A main steam line downstream of the main steam isolation valves into a turbine stop valve strainer. Other than minor scratches and gouges to the main steam nozzle and piping, there was no damage.

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The licensee stated that the preliminary results of scale model testing by General Electric indicated that the failure of the plate was due to high cycle fatigue. This fatigue was attributed to excessive vibration caused by the synchronization of the cover plate resonance frequency, the nozzle chamber standing acoustic wave frequency, and the vortex shedding frequency. The first two frequencies depend on the construction and geometry of the dryer. The vortex shedding frequency depends on the geometry and construction of the dryer and the flow rate of the steam passing through the dryer area. The licensee concluded that the three frequencies synchronized in a very narrow band of steam flow at or near the steam flow required to reach full power under the power uprate.

Discussion

General Electric and the licensee did not foresee this phenomenon. Because of design and manufacturing differences, General Electric believes that only a few BWRs are susceptible to this event. Licensees should be aware of similar unanticipated effects from increasing flow, power, or differential pressure associated with a major modification such as an extended power uprate.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

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