

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

March 26, 2004

NRC INFORMATION NOTICE 2004-06: LOSS OF FEEDWATER ISOKINETIC SAMPLING
PROBES AT DRESDEN UNITS 2 AND 3

Addressees:

All holders of operating licenses for nuclear power reactors except those who have permanently ceased operation 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 recent experience in which feedwater isokinetic sampling probes were broken off and lost in feedwater spargers. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background:

In 1971, to expand its water chemistry program, the Dresden licensee installed three sample probes in each of the Unit 2 and 3 feedwater and condensate systems. In each unit, the probes were installed at the discharge of the condensate pump (condensate sample probe), at the suction of the condensate booster pump (condensate demineralizer effluent sample probe), and at the discharge of the feedwater heaters to the feedwater spargers in the reactor vessel (feedwater sample probe). These probes were designed for isokinetic sampling, in which the water sample drawn in the probe is representative of the fluid in the process stream.

Each stainless steel probe was joined to the condensate or feedwater pipe by a carbon steel collar. The collar was joined to the probe by a weld on the outside of the collar and to the condensate or feedwater pipe by a weld to a carbon steel weldolet on the pipe. The collar allows welding of dissimilar materials in the shop; field welding then only needs to be done on similar materials. The crevice made by a small clearance between the collar and outside diameter of the probe is exposed to water flow. Typically, these probes are about 0.3 meter (1 foot) long and about 2 centimeters (3/4 inch) in diameter.

In 1977, the nuclear steam supply system vendor, General Electric (GE), issued a generic communication ("Improved Feedwater Sample Probe," Service Information Letter (SIL) No. 257, December 30, 1977) to report failures at two boiling water reactor nuclear power plants in which feedwater probes broke and lodged in downstream valves. The failure mechanism was determined to be transgranular stress corrosion in the crevice between the collar and the probe. GE recommended an improved probe design in which a seal weld would protect the crevice from the water flow.

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In 1990, GE issued a generic communication ("Improved Recirculation Water Chemistry Sample Probe," SIL No. 518, August 6, 1990) to document potential failure of a recirculation system sample probe due to mechanical, high-cycle fatigue induced by flow vibrations.

Description of Circumstances:

In 2001, the Dresden licensee became aware of GE SIL 257 and planned inspections of the Unit 2 and Unit 3 feedwater sample probes.

Dresden Unit 2:

During the refueling outage in 2001 (D2R17), the licensee found the feedwater sample probe missing. The licensee evaluation determined that the missing probe was most likely in a feedwater sparger and did not present a safety concern. Another probe was installed to replace the missing probe in accordance with GE SIL 257.

During the refueling outage in 2003 (D2R18), the licensee found three holes in the N4C 240° sparger nozzle and a sample probe resting in the sparger. The licensee inferred that the probe was the missing feedwater sample probe and that the probe apparently caused the sparger damage, although the physical phenomenon acting on the probe that could cause such damage to the sparger was (and still is) unclear. The licensee removed the resting probe and repaired the sparger. During a forced outage in December 2003 (D2F40), ultrasonic testing indicated that the probe installed in 2001 was missing. Based on a GE evaluation, the licensee determined that the probes apparently failed from mechanical, high-cycle fatigue induced by flow vibrations during their respective service periods. The licensee evaluation determined that the potential for lost parts in the reactor vessel did not compromise reactor safety.

Also during pre-outage work to support D2R18, the licensee found the condensate demineralizer effluent sample probe in a condensate booster pump casing. The licensee evaluation determined that pieces missing from this probe presented a moderate risk of fuel fretting but no fuel or control rod drive safety concerns.

A new condensate demineralizer effluent probe, modified in accordance with GE SIL 257, was installed in Unit 2 during the D2R18 outage.

Dresden Unit 3:

During the refueling outage in 2002 (D3R17), the licensee likewise found the feedwater sample probe missing. The licensee evaluation determined that the missing probe was most likely in a feedwater sparger and did not present a safety concern. Another probe was installed to replace the missing probe in accordance with GE SIL 257.

In response to the experience at Unit 2, the licensee planned internal and external inspections of all Unit 3 spargers to locate the missing probe. During the Unit 3 outage for steam dryer maintenance in 2003 (D3M10), the licensee conducted the planned inspections and found no sparger damage but did find two probes resting in the N4B 150° sparger. Based on a GE evaluation, the licensee determined that the probes failed from mechanical, high-cycle fatigue

induced by flow vibrations during their respective service periods. The licensee evaluation determined that the potential for lost parts in the reactor vessel did not compromise reactor safety.

During maintenance outage D3M10, a new condensate demineralizer effluent probe, modified in accordance with GE SIL 257, was installed in Unit 3 to replace the previous probe that was found intact.

Discussion:

In reviewing related operating experience and conferring with GE, the Dresden licensee found that similar probe failures had occurred at the Perry, Braidwood, Browns Ferry, and Grand Gulf nuclear power plants during the years 1990-2001. In 1996 and 1997, the licensee for Quad Cities Units 1 and 2 replaced the similarly located isokinetic feedwater sampling probes in accordance with GE SIL 257.

The GE evaluation, performed for the Dresden licensee, indicated that the natural frequency of the initial unmodified feedwater sample probe was within the range to lock into the vortex shedding frequency of the pre-EPU flow rate. The natural frequency of the SIL 257-modified feedwater sample probe was within the range to lock into the vortex shedding frequency of the post-EPU flow rate. The licensee found no indication of pre-installation design analysis for flow-induced vibration in the initial installation of the sample probes and the licensee reported that the SIL 257-modified probe was not analyzed for the increased flow rates associated with EPU prior to installation. The GE analysis indicated that the SIL 257-modified feedwater sample probe natural frequency would not have locked into the pre-EPU flow rate vortex shedding frequency had it been installed pre-EPU.

The BWR Owners Group is coordinating the overall industry response to potentially adverse flow effects from power uprate operation, including sample probe performance.

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

/RA/

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Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
2004-05	Spent Fuel Pool Leakage to Onsite Groundwater	03/03/2004	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) and for research and test reactors, and all holders of fuel storage licenses and construction permits.
2004-04	Fuel Damage During Cleaning at a Foreign Pressurized Water Reactor	02/24/2004	All holders of operating licenses for light-water reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.
2004-03	Radiation Exposures to Members of the Public in Excess of Regulatory Limits Caused by Failures to Perform Appropriate Radiation Surveys During Well-logging Operations	02/24/2004	All well-logging licensees.
2004-02	Strontium-90 Eye Applicators New Calibration Values and Use	02/05/2004	All U.S. Nuclear Regulatory Commission (NRC) medical-use licensees and NRC master materials license medical-use Permittees.

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