UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

June 26, 1997

NRC INFORMATION NOTICE 97-40: POTENTIAL NITROGEN ACCUMULATION RESULTING FROM BACKLEAKAGE FROM SAFETY INJECTION TANKS

Addressees

All holders of operating licenses or construction permits for pressurized-water reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to potential nitrogen accumulation in interfacing systems resulting from backleakage from safety injection tanks (SITs). 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

Waterford

On November 19 and 21, 1996, Waterford Generating Station, Unit 3, experienced waterhammer events on the low-pressure safety injection (LPSI) B train. On November 19, 1996, the control room pressure gauge was observed to spike to approximately 3.55 MPa [500 psig] (normal operating pressure is approximately 1.2 MPa [160 psig]). On November 21, 1996, the train B piping was vented, and a strip chart recorder was installed to monitor pressure. A pressure of 4.65 MPa [660 psig] was observed following the start of the pump. Shortly thereafter, the LPSI train B flow control valve was found partially open because of a valve mispositioning error by the operations crew. The valve was closed, and the pump started without a pressure transient. Apparently no structural damage resulted from the waterhammer events.

On December 13, 1996, LPSI train A experienced a waterhammer event. During a routine surveillance run of LPSI pump A, the pressure spiked to approximately 2.3 MPa [317 psig]. The licensee's investigation after this event utilized ultrasonic testing (UT) to inspect high points in the LPSI piping. The licensee identified gas voiding in the horizontal run of the two A train injection lines of 30.5 cm [12 inches] and 35.5 cm [14 inches] of arc. The injection lines are 20 cm [8 inches] in diameter. The gas was sampled and found to be approximately 97 percent nitrogen. The licensee concluded that nitrogen-saturated water from the SIT (the

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The gas was vented from the A train of LPSI, and LPSI was declared operable on December 14, 1996. On December 18, 1996, voiding was found in LPSI train B piping, with arcs of 28 cm [11 inches] and 25.4 cm [10 inches]. Because of the location of these gas pockets, the licensee was unable to vent these lines. The licensee performed an operability evaluation and concluded that the B train remained operable but instituted a UT surveillance program to inspect the voids every 3 days and identified acceptance criteria for an acceptable arc length. Furthermore, the licensee was pursuing a design modification to install high-point vents.

In February 1997, the licensee noted that one of its SITs was experiencing a lowering in level. Upon investigation, the licensee found that a LPSI system containment isolation valve was off its shut seat. The licensee surmised that water was leaking from the SIT past check valves and the partially open isolation valve in the LPSI to the refueling water storage pool (RWSP). On February 20, 1997, the licensee conducted testing on the isolation valve to investigate why the valve was not shut. The licensee cycled the valve several times during the course of this testing. At the completion of the testing, the licensee performed UT of the A LPSI injection line to check for voiding.

The licensee found that the high horizontal run of piping was dry and that a void extended 203 cm [80 inches] down the vertical run of piping. In response to the large void, the licensee used a vacuum pump to draw water into the line until the voiding was reduced to a 12.7-cm [5-inch] arc. The reduced arc was within the licensee's acceptance criteria for this line, and LPSI was declared operable.

The licensee also postulated that the shutdown cooling heat exchanger isolation valves may be susceptible to waterhammer-induced pressure locking. The isolation valves had been previously evaluated for a trapped bonnet pressure of 2.2 MPa [300 psig] and found to be operable. However, there is no assurance that bonnet pressure would not exceed 2.2 MPa [300 psig] when subjected to a waterhammer pressure surge. There is no evidence that this pressure locking has occurred in the past, and the licensee believes that this scenario is unlikely. However, the postulated phenomenon could result in common-mode failure of the heat exchangers, and the licensee has installed bonnet pressure relief devices.

Sequoyah

In January 1995, during a Sequoyah Unit 1 scheduled quarterly residual heat removal (RHR) pump test, a loud metallic noise was heard and movement of the refueling water storage tank (RWST) suction piping was observed. At the time when the noise was heard and pipe movement observed, personnel were performing a walkdown of a previously identified damaged RHR pipe hanger. The RHR system piping was subsequently inspected for gas voids and approximately .23 cubic meters [8 cubic feet] of gas was identified. A sample taken of the vented gas determined the gas to be approximately 98 percent nitrogen. The license believed that the source of the gas was one or more of the Emergency Core Cooling System (ECCS) Cold Leg Accumulators (CLA) and that there were two potential leakage paths that water could travel from the CLAs to the RHR injection piping where the nitrogen gas came out of solution: through the Safety Injection System (SIS) test header and/or through the secondary check valves on the RHR cold leg injection lines to the Reactor Coolant System (RCS). The licensee performed an operability evaluation which determined that the gas did not affect operability of the RHR system either in normal or accident conditions.

Over the course of the next several months the licensee periodically vented the RHR piping, monitored the rate of gas accumulation and calculated the gas volume in the RHR piping, and tracked the level decrease of the CLAs. To date, the licensee has not been successful in identifying and correcting leaking isolation valves in the SIS test header. The Sequoyah RHR system design and layout may have contributed to the gas accumulation due to the lack of high point vents in the RHR system and the difficult accessibility of those vents which were available. In November 1996, the licensee installed a manual vent in the Unit 1 A train RHR system in a 49 meter [160 foot] section of piping which previously was not completely ventable.

In October 1996, an analysis of the Unit 1 RHR piping system was performed to determine the imposed forces resulting from system operation with various volumes of gas in the piping system. The analysis concluded that the hydraulic forces built up are higher with increasing volumes of gas but level off when the gas volumes go beyond more than .28 cubic meters [10 cubic feet]. The measured volumes of gas in the Unit 1 RHR system have varied from approximately .23 cubic meters [8 cubic feet] to .4 cubic meters [14 cubic feet]. The licensee also calculated that for each gallon of water released from the CLAs, approximately 2.1 liters [0.073 cubic feet] of gas is released.

Discussion

If SITs or CLAs lose water level, nitrogen gas accumulation could be occurring in interfacing systems. The presence of large amounts of gas in discharge piping creates the possibility of waterhammer with potentially significant consequences. Waterhammer of sufficient magnitude can cause common-mode failure of safety injection trains. Structural failure of the discharge piping could create a containment bypass release path in addition to preventing safety injection flow. Additionally, a waterhammer event could potentially cause pressure locking in some valves. A plant's susceptibility to nitrogen accumulation in the ECCS lines is dependent on a number of plant-specific factors, including operating pressure of the SITs or CLAs, elevations and orientation of ECCS injection lines, and the elevation of the RWSP or RWST. Licensees may wish to evaluate the possibility and effect of gas accumulation on potentially susceptible systems. Licensees may also wish to evaluate the design of these systems to ensure adequate venting capability.

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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Information Notice No.	Subject	Date of Issuance	Issued to
97-39	Inadequate 10 CFR 72.48 Safety Evaluations of Independent Spent Fuel Storage Installations	06/26/97	All holders of OLs or CPs for nuclear power reactors. All holders of licenses for independent spent fuel storage installations
97-38	Level-Sensing System Initiates Common-Mode Failure of High-Pressure-Injection Pumps	06/24/97	All holders of OLs or CPs for nuclear power reactors
96-53, Supp. 1	Retrofit to Amersham 660 Posilock Radiography Camera to Correct Inconsistency in 10 CFR Part 34 Compatibility	06/23/97	All industrial radiography licensees
97-37	Main Transformer Fault with Ensuing Oil Spill into Turbine Building	06/20/97	All holders of OLs or CPs for nuclear power reactors
97-36	Unplanned Intakes by Worker of Transuranic Airborne Radioactive Materials and External Exposure Due to Inadequate Control of Work	06/20/97	All holders of OLs and CPs permits. All licensees of of nuclear power reactors in the decommissioning stage and fuel cycle
97-35	Retrofit to Industrial Nuclear Company (INC) IR100 Radiography Camera to Correct Inconsistency in 10 CFR Part 34 Compatibility	06/18/97	All industrial radiography licensees

OL = Operating License
CP = Construction Permit

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DATE	04/22/87	05/11/97	06/04/97	06/20/97

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NOTE: PMs for Waterford + Sequoyah reviewed and had no comment/observation.
ALD 5/20/97

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