

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

June 24, 1997

**NRC INFORMATION NOTICE 97-38: LEVEL-SENSING SYSTEM INITIATES COMMON-MODE FAILURE OF HIGH-PRESSURE-INJECTION PUMPS**

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a recent incident in which two high-pressure-injection (HPI) pumps were damaged as a result of an inaccurate letdown storage tank (LDST) level-sensing system. The inaccuracy was caused by a drained reference leg. As a result, an incorrect level was displayed, permitting the pumps to take suction from an empty tank. 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.

Description of Circumstances

On May 3, 1997, the licensee for Oconee Unit 3 was conducting a planned shutdown to inspect an HPI line. During cooldown of the plant, HPI pump 3B was operating in the reactor coolant system (RCS) makeup mode. The pump's discharge pressure dropped to the "low" pressure setpoint initiating the automatic start of standby HPI pump 3A. The operators later secured pump 3A when reactor coolant pump (RCP) seal injection flow indicated "high". The HPI header pressure decreased again. HPI pump 3A automatically restarted. The pump's motor current began oscillating. The operators secured HPI pump 3B because of an indication of low motor current. Shortly afterwards, HPI pump 3A was also secured when its motor current decreased sharply. The licensee issued a Notification of an Unusual Event because of the loss of two of the three HPI pumps.

The licensee later concluded that both HPI pumps became hydrogen bound and possibly damaged when they took suction from an empty LDST even though adequate tank inventory was indicated.

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### Discussion

The HPI pumps at Oconee perform the dual functions of RCS makeup and high-pressure safety injection. These pumps normally take suction from the LDST (also referred to as the makeup or volume control tank by other vendors). A 25-psi (172.4 kPa) hydrogen overpressure is maintained in this tank to scavenge oxygen from the RCS.

During this event, two level transmitters monitored tank level. These transmitters produce level alarms in the control room. The alarms alert operators to initiate makeup to the LDST. Both level transmitters shared a common reference leg. Because the shared reference leg was partially drained, the indicated letdown tank level remained at 9 inches above the low-level alarm setpoint. The tank was actually empty, its contents having been depleted during normal charging. Letdown tank level was investigated only after both HPI pumps developed problems.

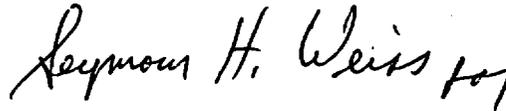
Indicated level in the control room was derived from the equivalent pressure difference between the drained reference leg and the back pressure from the 25 psi hydrogen overpressure in the LDST. Because both level instruments shared the common reference leg, both gave the same erroneous indication. Therefore, operators failed to provide makeup inventory to the LDST. Two of the three HPI pumps became gas-bound, cavitated, and, as a result, were structurally damaged.

If an actual safety injection actuation occurs, the suction isolation valve to the LDST remains open while the suction isolation valve to the borated water storage tank (BWST) opens on the safety injection signal. All three HPI pumps receive a start signal and take suction on both the LDST and the BWST. With the two tanks cross-tied, the potential existed for this event to have caused the loss of all HPI pumps as a result of gas binding. Loss of all three HPI pumps could prevent the successful mitigation of a loss of coolant accident. During normal operations, loss of all HPI pumps would result in the loss of reactor coolant pump seal injection, normal RCS makeup, and normal boration.

The level transmitters were last calibrated in February 1997. Sometime between that last calibration and the event, a leak developed from a scored cap on a test connection that drained the reference leg. The cap was used to isolate the test connection. A drained reference leg or a reference leg with entrained air can result in incorrect level indication. Incorrect level indication will prevent appropriate setpoints being reached when process conditions demand, defeat critical automatic safety functions, and could mislead plant operators into taking less than conservative actions.

Pressure and level sensors, in any safety-related application, that rely on a reference leg for a differential pressure reading, are sensitive to changes in reference leg level. Normal surveillances that include only channel checks with other instruments sharing the reference leg or transmitter calibrations with external hydrostatic test sets will not reveal the true condition of the reference leg. In the absence of an automatic reference leg fill system, periodic verification of reference leg level based on the plant-specific environment is needed to ensure the operational integrity of the critical systems that are relied upon for manual and automatic functions.

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 Office of Nuclear Reactor Regulation (NRR) project manager.



Marylee M. Slosson, Acting Director  
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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 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
97-34	Deficiencies in Licensee Submittals Regarding Terminology for Radiological Emergency Action Levels in Accordance With the New Part 20	06/12/97	All holders of OLs or CPs for test and research reactors

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OL = Operating License  
CP = Construction Permit

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Tech Editor has reviewed and concurred on 5/14/97

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*mlm 6/17/97*

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