

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

October 6, 2003

NRC INFORMATION NOTICE 2003-19: UNANALYZED CONDITION OF REACTOR
COOLANT PUMP SEAL LEAKOFF LINE DURING
POSTULATED FIRE SCENARIOS OR STATION
BLACKOUT

Addressees

All holders of operating licenses or construction permits for pressurized water reactors (PWRs).

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert addressees to the recent identification of an unanalyzed condition involving the design of the reactor coolant pump (RCP) seal leakoff line. The NRC anticipates that recipients will review the information for applicability to their facilities and consider taking appropriate actions. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On January 13, 2003 the Millstone Unit 3 licensee identified that an over-pressurization of RCP seal leakoff lines could result from an extended loss of seal cooling following station blackout (SBO) scenarios or postulated fires in specific plant areas coincident with a loss of offsite power. Specifically, the licensee relies on operators to isolate the low pressure portion of the seal leakoff to prevent the line from over-pressurizing. The licensee determined this expectation may not be achievable because the valve used to isolate the low pressure portion of the seal leakoff line is an air-operated valve. This valve is designed to fail open upon loss of electrical power or instrument air, either of which could occur during a SBO or a loss of offsite power coincident with a postulated fire event.

The seal return line for RCPs is designed to recover leakoff volume, at low pressure and temperature, and return it to the volume control tank or charging pump suction. In the event of a fire in the cable spreading area, main control room, or instrument rack rooms, coincident with a loss of offsite power, a loss of RCP seal cooling could result. This situation can lead to a significant increase in RCP seal leakage which would increase the pressure and fluid temperature in the seal return line. This over pressurization could result in a pressure boundary failure of the seal return line, further increasing the RCP seal leakage beyond that assumed in the safe shutdown analysis.

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The resulting rupture would divert more of the credited boric acid storage tank (BAST) volume than was assumed in the development of the licensee's fire safe-shutdown strategies. Therefore, the strategies may not be adequate to achieve safe-shutdown.

Discussion

The licensee identified this issue while reviewing a Westinghouse (W) document on RCP seal performance during loss of RCP seal cooling events, OG-00-009, "Transmittal of RCP Operation During Loss of Seal Cooling (MUHP-1063)," dated February 11, 2000. The W document states that up to 21 gallons per minute (gpm) leakoff from each RCP could occur for loss of seal cooling events following postulated fire or Station Blackout (SBO) events, which exceeds the 3 gpm assumed in the Millstone Unit 3 fire safe shutdown analysis. Therefore, the licensee concluded that the fire safe shutdown analysis was invalid, but the SBO analysis, which assumes 25 gpm leakoff, was valid.

Upon further investigation, the licensee determined that a loss of seal cooling event could not be mitigated successfully because the seal leakoff line could not be isolated by the air-operated valves (AOVs) located in the RCP seal return piping. These AOVs cannot be credited to close because they are not fed by a safety-related air system, and they are designed to fail open. As a result of the loss of seal cooling and fire scenarios described above, pressures in the seal leakoff line would reach approximately 800 to 2000 psig. Since the piping segment downstream of each AOV and upstream of the flow restriction orifice is designed 150 psig, this portion of the leakoff line could rupture, inducing leakoff flow rates in excess of the 21 gpm identified in the W document. These flow rates severely challenge the credited contents of the BAST and the requirements for achieving and maintaining safe shutdown in accordance with the applicable licensing basis.

The licensee had been aware of the potential for over pressurization of the seal leakoff line from a 1992 Westinghouse Technical Bulletin, NSD-TB-91-07-R1, "Over pressurization of RCP #1 Seal Leakoff Line." However, while the licensee had implemented specific recommendations contained in the bulletin, the licensee had not considered the potential for the AOVs in the seal leakoff line to be open. Therefore, the licensee did not consider a potential pressure boundary failure in the leakoff line that would divert the BAST contents credited for achieving and maintaining safe shutdown.

To mitigate and resolve the events described in this IN the licensee has: (1) instituted compensatory measures for the degraded condition, including continuous fire watches, placement of additional fire extinguishers in the three affected plant areas, and administratively controlling transient combustibles; (2) initiated plant design changes involving the RCP seal leak-off lines to preclude the possibility of rupture during loss-of-all-seal cooling events, i.e., replacement of susceptible valves and flanges; (3) performed engineering analyses regarding the event's impact on charging pumps and pressurizer level during the event; and (4) revised fire shutdown strategies to effectively mitigate the event.

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.

/RA/

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2003-17	Reduced Service Life of Automatic Switch Company (ASCO) Solenoid Valves With Buna-N Material	09/29/2003	All holders of operating licenses for nuclear power reactors.
2003-16	Icing Conditions Between Bottom of Dry Storage System and Storage Pad	Pending	All 10 CFR Part 72 licensees and certificate holders.
2003-15	Importance of Followup Activities in Resolving Maintenance Issues	09/05/2003	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.
2003-14	Potential Vulnerability of Plant Computer Network to Worm Infection	08/29/2003	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.

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