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

June 11, 1997

NRC INFORMATION NOTICE 97-33: UNANTICIPATED EFFECT OF VENTILATION SYSTEM ON TANK LEVEL INDICATIONS AND ENGINEERING SAFETY FEATURES ACTUATION SYSTEM SETPOINT

Addresses

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 the potential to affect instrumentation output for certain transmitters by varying ambient pressure with the operation of plant ventilation equipment. 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.

Background

Loss-of-coolant accident (LOCA) mitigation design at most pressurized-water reactors involves the injection of borated makeup water from a safety-related tank into the reactor coolant system from emergency core cooling system (ECCS) pumps. When the tank level falls to a predetermined setpoint, a signal automatically shifts the suction source for the ECCS pumps to the containment safety injection sump for long-term recirculation. This swapover setpoint prevents the loss of net positive suction head (NPSH). A delay in the swapover to the containment sump could result in the common-mode failure of the ECCS pumps from cavitation or air binding, which would in turn result in the inability to mitigate the LOCA.

Description of Circumstances

On February 23, 1997, the controlled ventilation area system (CVAS) at Waterford Generating Station, Unit 3, was undergoing routine testing. The CVAS is a standby system designed to automatically start following a safety injection signal to provide high-efficiency particulate filtration and iodine absorption from areas within the reactor auxiliary building (RAB) subject to potential leakage of post-accident reactor coolant (i.e., high-pressure safety injection and low-pressure safety injection pump rooms, shutdown cooling heat exchanger rooms, etc.). The safety injection signal also simultaneously stops the RAB normal ventilation system fans. This action stops the flow of all normal ventilation air to the RAB to permit the CVAS to effectively evacuate its ventilation spaces to a negative pressure of at least 0.25 inch of water gauge.

During the CVAS test, control room operators observed an indicated change in refueling water storage pool (RWSP) level (source of injection water for ECCS) when a CVAS fan was started. The RWSP level trend recorder indicated a level increase of approximately 2 percent. The shift supervisor contacted the instrumentation and control (I&C) technician on duty to help investigate why the indicated RWSP level changed when a CVAS fan was started. The I&C technician determined that the four RWSP level transmitters (Rosemount Model 1152DP5A22PB) were located in valve gallery rooms that were part of the CVAS ventilation spaces. The technician also noted that the reference leg for these transmitters was vented to the valve gallery room, rather than being routed back to the RWSP, and that the RWSP was vented to the RAB normal ventilation inlet plenum (which was not subject to CVAS effects). The operators and the I&C technician determined that the observed level change had been caused by the slight vacuum produced in the valve gallery rooms by the CVAS operation; in that the vacuum on the reference leg affected the overall differential pressure output of the level transmitter. When the CVAS fan was secured, the shift personnel observed the RWSP indicated level return to its previous position. The control room operators recognized that the RWSP level instruments provide the input to the engineering safeguards actuation system to generate a recirculation actuation signal (RAS) at 10-percent RWSP level.

The licensee subsequently determined that the effect of CVAS operation on the RAS setpoint had not been considered when the setpoint was established. On March 8, the licensee conducted a series of tests to determine the extent of the interaction between CVAS and RWSP level instrument output. The tests consisted of running various combinations of RAB normal and CVAS ventilation trains and measuring the effect on the output of the four RWSP level transmitters. The tests revealed that, with one train of CVAS running, RAS would occur within the Technical Specifications allowable value of 9.08 percent. With both trains of CVAS running, the actual level at the RAS would be below the Technical Specifications requirements.

The licensee subsequently revised the instrument loop calibration data sheets for the RWSP instruments to account for/bound the CVAS ventilation effects, and calibrated all four channels using the new data sheets. The instruments were recalibrated to account for the worst-case scenario in terms of effect on the RAS; this scenario was determined to be both trains of CVAS running coincident with a failed makeup damper (would increase vacuum where instruments were vented). The calibration activity was an interim fix until the level transmitter reference legs could be rerouted to the RWSP during an outage.

The licensee performed additional tests which revealed that other safety-related system level indications were affected by ventilation system operation because of the venting arrangement of the level transmitters.

Discussion

Criterion 13, "Instrumentation and Control," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, requires that instrumentation be provided to monitor variables and systems and that controls be provided to maintain these variables and

systems within prescribed operating ranges. Criterion 20, "Protection System Functions," requires that the protection system be designed to initiate operation of appropriate systems to ensure that specified acceptable fuel design limits are not exceeded. Regulatory Guide 1.105, "Instrument Setpoints," Revision 1, states that the accuracy of all setpoints should be equal to or better than the accuracy assumed in the safety analysis, which considers the ambient temperature changes, vibration, and other environmental conditions.

Transmitters that monitor tank level typically route the reference leg tubing to the top of the tank in order to cancel the effect of tank overpressure on level indication. However, for tanks that are vented, the level instrument reference legs are often vented to the atmosphere. It is important that the reference leg accurately reflect the pressure that exists in the space above the fluid level in the tank so that false levels are not indicated. It does not appear that Waterford 3 appropriately accounted for the potential effects of different ventilation system lineups on the RWSP level instruments. Such failure to appropriately account for all potential environmental effects on protection system setpoints could result in an inability to mitigate certain accidents.

Because additional testing at Waterford revealed that safety-related systems other than RWSP level indications were affected by ventilation system operation, other licensees are reminded that the level instrumentation for many systems at their plant may be subject to similar problems.

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Seymour H. Weiss for

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Information Notice No.	Subject	Date of Issuance	Issued to
95-36, Supp. 1	Potential Problems with Post-Fire Emergency Lighting	06/10/97	All holders of OLs or CPs for nuclear power reactors
97-32	Defective Worm Shaft Clutch Gears in Limitorque Motor-Operated Valve Actuators	06/10/97	All holders of OLs or CPs for nuclear power reactors
97-31	Failures of Reactor Coolant Pump Thermal Barriers and Check Valves in Foreign Plants	06/03/97	All holders of OLs or CPs for pressurized-water reactor plants
97-30	Control of Licensed Material During Reorganizations, Employee-Management Disagreements, and Financial Crises	06/03/97	All material and fuel cycle licensees
97-29	Containment Inspection Rule	05/30/97	All holders of OLs or CPs for nuclear power reactors

OL = Operating License
CP = Construction Permit

systems within prescribed operating ranges. Criterion 20, "Protection System Functions," requires that the protection system be designed to initiate operation of appropriate systems to ensure that specified acceptable fuel design limits are not exceeded. Regulatory Guide 1.105, "Instrument Setpoints," Revision 1, states that the accuracy of all setpoints should be equal to or better than the accuracy assumed in the safety analysis, which considers the ambient temperature changes, vibration, and other environmental conditions.

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requires that the protection system be designed to initiate operation of appropriate systems to ensure that specified acceptable fuel design limits are not exceeded. Regulatory Guide 1.105, "Instrument Setpoints," Revision 1, states that the accuracy of all setpoints should be equal to or better than the accuracy assumed in the safety analysis, which considers the ambient temperature changes, vibration, and other environmental conditions.

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