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

May 13, 1988

NRC INFORMATION NOTICE NO. 88-24: FAILURES OF AIR-OPERATED VALVES AFFECTING SAFETY-RELATED SYSTEMS

Addressees:

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

Purpose:

This information notice is being provided to alert addressees to potential problems with air-operated valves in safety-related systems. These problems result from overpressurization failures of solenoid valves caused by the installation of solenoid valves that may not operate against the supplied air pressure. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

Kewaunee: On February 8, 1988 the licensee, Wisconsin Public Service Corporation, notified the NRC in Licensee Event Report 50-305/87-12 of a potentially generic problem. During a periodic inservice timing test required by technical specifications, the licensee observed that one of the redundant pressurizer relief tank makeup isolation valves and one of the redundant reactor coolant drain tank discharge header isolation valves failed to close on loss of electric power to their respective 3-way solenoid valves. The isolation valves perform a containment isolation function and since their source of actuator power, the instrument air system, is not a safety-related system, they are designed to fail closed on loss of either air or electrical power.

For this application, when the solenoid valve is deenergized, its internal spring moves the valve core so that the inlet port from the instrument air system is blocked. This action simultaneously opens a flow path connecting the solenoid valve outlet and exhaust ports, permitting the air pressure on the actuator diaphragm to decrease, and causing the isolation valve to close.

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Investigation revealed that the regulated inlet air pressure of 80 psi was forcing the solenoid valve core away from the inlet port seat; as a result the flow path to the actuator diaphragm was being maintained. This happened because the supply pressure exceeded the rating for the internal spring (70 psi). This rating is called the design maximum operating pressure differential (MOPD).

After the internal spring and core assembly were replaced in the failed solenoid valves and the supply air pressure was reduced to 60 psi, the solenoid valves and hence the containment isolation valves worked satisfactorily. The licensee inspected ratings for other solenoid valves and did find instances where the solenoid valve had an MOPD less than the supplied air pressure.

In September 1987, the licensee had decided to replace a number of solenoid valves to upgrade their level of environmental qualification. For both the failed solenoid valves discussed above, the licensee found that whereas the original valves had MOPD ratings greater than the supplied air pressure, the replacement valves had MOPD ratings less than the supplied air pressure.

The licensee's investigation disclosed the following data:

Original solenoid valves	ASCO Model No. LB83146 Catalog 26 (late 1960s vintage) General-purpose enclosure MOPD: 100 psi
Replacement solenoid valves	ASCO Model No. NP8314C13E Catalog 30A (1980s vintage) Watertight and explosion-proof enclosure MOPD: 70 psi

According to the catalog, the letter "C" in the model number "indicates a major design change affecting spare parts kits, rebuild kits and coils." Apparently, one of the changes made by ASCO (the vendor) to the original Model No. 831413 valve, currently listed as a Model No. 8314C13 valve, involved the internal spring and core assembly and resulted in a reduced MOPD.

On seeing the difference in MOPD between the original and replacement solenoid valves, the design engineer assigned the task of upgrading the environmental qualification of these valves contacted the vendor for advice on which model was a direct nuclear grade replacement for the LB83146 model. The vendor recommended that model number NP8314C13E be used. The design engineer questioned the vendor on the significance of the MOPD difference. The vendor responded in writing essentially that if the supply pressure exceeded the MOPD rating, the solenoid valve would not operate correctly (in the way described above).

The design engineer and engineering supervisor discussed this letter and concluded that if the solenoid valve were exposed to 100 psi instrument air pressure when deenergized, there would be some air leakage from the inlet to the outlet ports, but some venting to atmosphere through the exhaust port would also occur. This would pressurize the control valve diaphragm, but equilibrium would occur at a pressure below that required for control valve actuation. Their conclusion was heavily influenced by their belief that the original solenoid valves were actually rated for 70 psi and had been operating successfully for approximately 13 years.

Based on this interpretation, the design review package made available to the second level reviewer did not include a reference to this correspondence with the vendor. Thus, an independent assessment of the interpretation was not performed.

To see if other safety-related control valves and damper actuators could be vulnerable to the same failure, the licensee inspected all the containment isolation solenoid valves and those solenoid valves included in the list of systems and components that prevent or mitigate the consequences of postulated accidents. The licensee recorded the solenoid valve and air regulator nameplate data and the air regulator settings. For those valves with insufficient MOPD, the licensee determined the reason for the purchase and installation of incorrect solenoid valves. They also reviewed the functional operability of the instrument air regulators to provide assurance they will not fail high and thus overpressurize the solenoid valves.

Calvert Cliffs Unit 2: On April 14, 1988, the licensee, Baltimore Gas and Electric Company, notified the NRC in a 10 CFR 50.72 report that several safety systems were vulnerable to a single failure of the air supply pressure regulating system: the auxiliary feedwater system, the safety injection fill and vent system, the containment isolation system, and the steam generator blowdown isolation system. Investigation had shown that those air regulators located in a harsh environment after a postulated accident can fail in a way that applies high pressure to solenoid valves. If such solenoid valves are not rated for sufficient MOPD, then the solenoid valves will affect the correct post accident alignment of the system valves they control. To correct this problem, the licensee will expand emergency procedures to include local operation of affected valves and will replace the affected solenoid valves with valves rated for higher MOPD.

Discussion:

In many plants, the air supply systems for safety-related components are not designed as safety-related systems. Hence, safety-related components that depend on the air system are designed to assume a fail safe condition on loss of air; however, the converse condition of air overpressurization may not always be considered. Such a condition could render the affected safety-related components inoperable.

Quality assurance requirements include procurement of materials, equipment, and services (10 CFR 50.34 and Appendix B). The similarity of part numbers for components with different operating characteristics illustrates how a qualified component or system can be degraded if controls over the design and procurement of replacement parts are not adequate.

Other events in which air system failures have affected safety-related systems are discussed in Information Notice 87-28, "Air System Problems at U.S. Light Water Reactors," and Information Notice 87-28, Supplement 1, of the same title. The supplement notice transmitted copies of NUREG-1275, Vol. 2, "Operating Experience Feedback Report - Air Systems Problems."

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: Vern Hodge, NRR
(301) 492-1169

I. Villalva, Region III
(312) 790-5763

R. Nelson, Region III
(414) 388-3156

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
88-23	Potential for Gas Binding of High-Pressure Safety Injection Pumps During a Loss-of-Coolant Accident	5/12/88	All holders of OLs or CPs for PWRs.
88-22	Disposal of Sludge from Onsite Sewage Treatment Facilities at Nuclear Power Stations	5/12/88	All holders of OLs or CPs for nuclear power reactors.
88-21	Inadvertent Criticality Events at Oskarshamn and at U.S. Nuclear Power Plants	5/9/88	All holders of OLs or CPs for nuclear power reactors.
88-20	Unauthorized Individuals Manipulating Controls and Performing Control Room Activities	5/5/88	All holders of OLs or CPs for nuclear power, test and research reactors, and all licensed operators.
88-19	Questionable Certification of Class 1E Components	4/26/88	All holders of OLs or CPs for nuclear power reactors.
88-18	Malfunction of Lockbox on Radiography Device	4/25/88	All NRC licensees authorized to manufacture, distribute, and/or operate radiographic exposure devices.
88-17	Summary of Responses to NRC Bulletin 87-01, "Thinning of Pipe Walls in Nuclear Power Plants"	4/22/88	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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See previous concurrence page concerning transmittal of this notice from Region III

*SEE PREVIOUS CONCURRENCES

		D/DOEA:NRR	*C/OGCB:DOEA:NRR	*PPMB:ARM
		CERossi	CHBerlinger	TechEd
		05/9/88	05/06/88	04/18/88
*OGCB:DOEA:NRR	*RIII	*D/DEST:NRR	*D/DSP:AEOD	*EAB:DOEA:NRR
CVHodge	RNelson	LCShao	TNovak	RKarsch
04/04/88	03/28/88	04/14/88	04/22/88	4/27/88

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A draft of this information notice was sent by memo dated March 17, 1988 from E. G. Greenman, Region III, to C. E. Rossi, DOEA.

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		D/DOEA:NRR	C/OGCB:DOEA:NRR	*PPMB:ARM
		CERossi	CHBerlinger	TechEd
		05/ /88	05/06/88	04/18/88
*OGCB:DOEA:NRR	*RIII	*D/DEST:NRR	*D/DSP:AEOD	*EAB:DOEA:NRR
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04/04/88	03/28/88	04/14/88	04/22/88	4/27/88

of the instrument air regulators to document that they will not fail high and detrimentally affect the performance of the solenoid valves. Future corrective actions include the replacement of 27 of 130 solenoid valves inspected and the establishment of a program for instrument air regulator settings.

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