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

August 25, 1995

NRC INFORMATION NOTICE 95-34: AIR ACTUATOR AND SUPPLY AIR REGULATOR PROBLEMS IN COPES-VULCAN PRESSURIZER POWER-OPERATED RELIEF VALVES

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to problems caused by actuator degradation in Copes-Vulcan pressurizer power-operated relief valves (PORVs). 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

During an inservice testing surveillance at the Haddam Neck nuclear power plant on February 19, 1994, both pressurizer PORVs failed to open fully on demand. At the time of the event, the plant was in cold shutdown and the valves were not required to be operable. The cause was leaks in the air actuator assemblies of both PORVs. Reduced pressure output of the control air regulators compounded the problem.

Discussion

The Haddam Neck PORVs are 2-inch nominal size, air-operated plug valves manufactured by Copes-Vulcan (Model D-100-160). The portion of the control air system that supplies air to the PORVs serves a safety-related function. It is isolated from the remainder of the control air system by two safety-related check valves. It also includes a 405 liter [107-gallon] emergency air accumulator to support PORV operation in the event of a loss of the normal control air supply. Each of the air supply lines leading to the PORVs (see Attachment 1) is equipped with a pressure regulator that reduces the air pressure being supplied from 931 kPa [120 psig] to 690 kPa [85 psig]. An air relief valve on each PORV actuator will protect it from overpressurization if the supply line regulator fails open. These relief valves are set to open at 793 kPa [100 psig], which is the maximum design pressure of the PORV diaphragms.

The licensee determined that the primary cause of the unacceptable valve stroke performance was air leakage from the PORV air actuators caused by improper installation of the diaphragms. Both PORV diaphragms had been replaced by a new style during a 1993 refueling outage. The principal difference in the replacement diaphragms was a change in the material composition. The replacement diaphragm was made of EPDM (Part #264331); the old style diaphragm was made of BUNA-N (Part #080815). The licensee switched to the EPDM diaphragms because of a vendor recommendation that EPDM would provide enhanced performance under the temperature and radiation conditions experienced by the PORV. In addition, the EPDM diaphragms have a 24-bolt-hole configuration while the old style BUNA-N diaphragms only have a 12-bolt-hole configuration. The diaphragms also have slightly different shapes.

The licensee apparently had some difficulty installing the EPDM diaphragms because of the bolt hole pattern and shape differences between the EPDM and BUNA-N style diaphragms. The licensee believes that the sealing surfaces of the diaphragms were damaged as a consequence of the installation difficulties. Extrusion of the diaphragm from between the base and cover and away from the bolt holes led to small tears at several diaphragm bolt holes locations which ultimately resulted in the air leakage. The licensee has chosen to use the BUNA-N diaphragms to avoid the installation difficulties encountered with the EPDM diaphragms. A Copes-Vulcan representative indicated that they have no reports from other users on installation difficulties of either type of diaphragm.

A search of the Nuclear Plant Reliability Data System (NPRDS) in regard to the historical performance of the type of PORVs used at Haddam Neck revealed numerous air-actuator related problems affecting this model of Copes-Vulcan valves. The problems can be grouped into three categories:

(1) Actuator air leaks resulting from in-place diaphragm failures (e.g., holes, rips, and tears)

The plant-specific historical failure rates of these diaphragms should be readily ascertainable from an empirical analysis of the maintenance records. Recent failures of installed diaphragms may have implications for the preventive maintenance or refurbishment program for these valves at a particular licensee. Discussions with the Copes-Vulcan representative indicate that replacement frequency depends on service conditions such as temperature and valve usage. Diaphragm lifespan can range from 1 year to more than 10 years.

Regarding the specific diaphragm failure which occurred at Haddam Neck, no data was available to support any correlation between diaphragm failure and the type of diaphragm in use (EPDM versus BUNA-N).

(2) Actuator air leaks resulting from loose actuator cover bolts

Air leakage because of the loosening of air actuator cover bolts may reflect the effect of environmental conditions on the valves. Temperature variations can result in the thermal loosening of bolts. Routine maintenance can also contribute to this problem if the cover bolts are not tightened to manufacturer specifications whenever the valve actuators are serviced.

(3) Valve stroke malfunctions resulting from improper supply of air pressure from the air regulating valves

The air pressure regulators used at Haddam Neck are ITT Conoflow (Model GFH25XT2365G) and have contributed to the PORV problems on three separate occasions over the last several years. In 1993, one of the air pressure regulators failed high, subjecting one of the PORV diaphragms to the full air supply line pressure of 931 kPa [120 psig] which is greater than the diaphragm design pressure of 793 kPa [100 psig]. Although the PORV actuators are equipped with relief valves to protect the diaphragms from overpressurization, it is believed that the high pressure contributed to or caused premature failure of the diaphragm. In the other two instances, the air supply regulators had drifted low, resulting in inadequate stroke performance of the valves. The air pressure regulator setpoints for the Haddam Neck configuration are 690 kPa [85 psig]. The PORVs need 552 kPa [65 psig] to start opening and 690 kPa [85 psig] to open fully. An engineering evaluation by the licensee showed that the valves will come to the full open position with control air pressure reduced to 586 kPa [70 psig] and reactor coolant system pressure as low as 5895 kPa [840 psig].

Several causes of the air pressure regulator setpoint drift have been postulated: one is that moisture intrusion from the control air system can cause corrosion of the regulating mechanism, and the other is that the drift may be configuration related. At Haddam Neck, the air regulating valve is upstream of the (normally closed) solenoid operated valve, meaning that the air regulating valve is constantly subjected to system pressure. The air regulating valve vendor has indicated that this configuration may cause setpoint drift.

Related Generic Communications

The issue of pressurizer PORV reliability has been addressed in Generic Letter 90-06, "Resolution of Generic Issue 70, 'Power-Operated Relief Valve and Block Valve Reliability,' and Generic Issue 94, 'Additional Low-Temperature Overpressure Protection for Light-Water Reactors,'" in which the staff requested licensees to include the PORVs and PORV control air system in their American Society of Mechanical Engineers Section XI inservice testing program.

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.

Dennis M. Crutchfield

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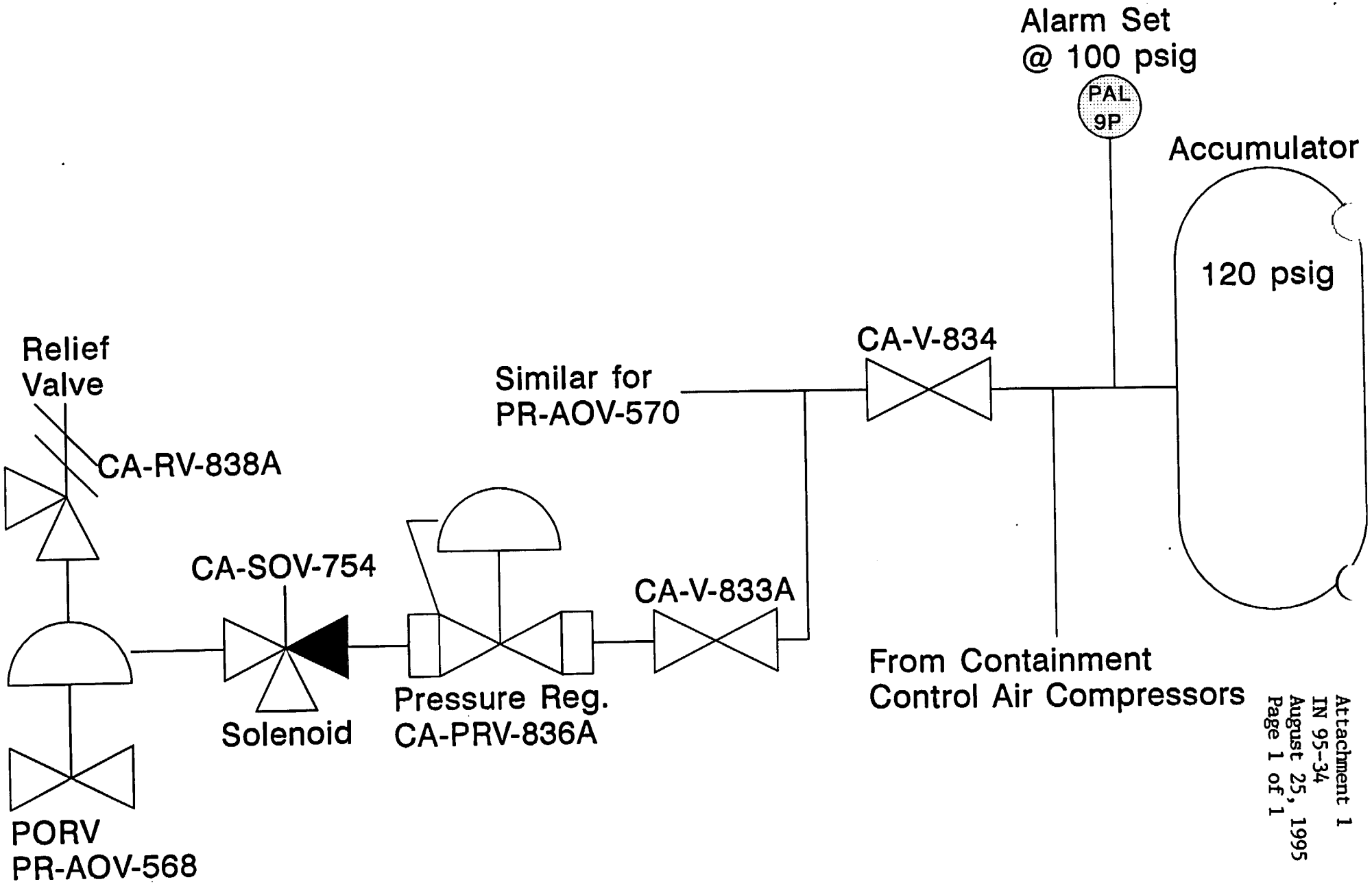
Attachments:
1. PORV Actuation System
2. List of Recently Issued NRC Information Notices

Attachments filed in Jacket

PORV Actuation System



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OL = Operating License
CP = Construction Permit

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