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

August 28, 1992

NRC INFORMATION NOTICE 92-64: NOZZLE RING SETTINGS ON LOW PRESSURE WATER-RELIEF VALVES

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 problems that could result from the inadequate control of maintenance of low pressure water-relief valves in operating nuclear power plants. 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.

Description of Circumstances

Shearon Harris

On August 8, 1991, at the Shearon Harris Nuclear Power Plant, an operator started a second component cooling water (CCW) pump to support diagnosing a problem with a flow indicator. The operator immediately noted a decreasing level in the CCW surge tank and began manually filling the system. Additional operators were dispatched to the area, and they reported that various CCW relief valves were lifting. Even though the control board operator initiated actions to reduce the system pressure from 140 psig to 120 psig (the reseat pressure for these valves was 135 psig in the vendor test reports), the leakage continued until the second CCW pump was secured and the system pressure dropped below 105 psig. These valves were manufactured by the Crosby Valve and Gage Company.

In its review, the licensee found that the nozzle rings on various CCW valves had incorrect settings which resulted in a reseat pressure lower than the system design specified. The licensee reviewed the maintenance history and found that these valves had been disassembled and rebuilt before the initial startup in 1986. During these activities, the nozzle rings had been improperly set. Procedural guidance on the setting of the nozzle rings was lacking and the manufacturer's design data and technical manual were difficult to interpret.

Subsequent to the event, the licensee identified 34 low pressure relief valves on various safety related systems that required verification of the nozzle ring settings. These valves were chosen because they had previously been subjected to maintenance which may have disturbed the nozzle ring settings. The 16 valves checked as of May 1992 all had incorrect settings varying from a few notches to over 170 notches (method used to set nozzle rings). The licensee intends to check the remaining valves during forthcoming plant/system outages.

Trojan

On July 23, 1991, at the Trojan Nuclear Plant, a CCW relief valve lifted during a system pressure surge and did not reseat until it was manually isolated. The licensee investigated the incident and found the nozzle ring settings in the relief valves in both CCW trains substantially different from the required setting. While conducting preliminary tests, the licensee found the reseat pressure to be from about 60 to 80 psig, while the expected value was 135 psig. This event was cited by NRC as part of a severity level III violation of 10 CFR Part 50, Appendix B, Criterion XVI.

The licensee found that the incorrect ring settings were the result of lack of procedural controls to set and maintain the nozzle ring settings on certain plant relief valves. In 1989, the licensee had established controls to return the nozzle rings to their "as-found" position after maintenance was performed. However, this was not sufficient to assure that ring settings were in accordance with vendor test data. Subsequent to this event, the licensee checked the nozzle ring settings on 54 low pressure relief valves in various safety related systems that previously had maintenance. Thirty valves had incorrect settings; twelve of these settings were significantly outside the tolerance band.

Braidwood

In December 1989, during operations to start up Unit 1 at the Braidwood Station, a suction relief valve in one of the RHR trains suddenly opened as the operators were drawing a bubble in the pressurizer. In the first 18 minutes after the valve opened, the pressure in the primary system dropped to about 270 psig, which was well below the expected reseat pressure for the suction relief valve. Approximately 67,000 gallons of reactor coolant system water were released to the radwaste holdup tanks before the operators isolated the RHR train having the open relief valve about 2 hours later.

About 18 months before the event, the licensee had performed maintenance on the affected RHR relief valve prior to its being installed in the plant. At that time, the licensee discovered four RHR suction relief valves at the site that had nozzle ring settings considerably different from those specified in the vendors's valve test package. A temporary set of instructions was developed to return the ring settings to the vendor's specified value using a different reference point and notch count instead of the "as found" setting and reference point as directed in the existing maintenance procedure. Both sets of instructions were contained in the same work package used to perform

the corrective maintenance for the valve that subsequently stayed open for an extended time. The mechanic apparently confused the two sets of instructions, adjusting the nozzle ring about 220 notches from its proper position.

Haddam Neck

In 1986, one of the RHR suction relief valves opened following a pressure spike to 380 psig and failed to reseat until the pressure decreased to 260 psig (expected reseat pressure was 342 psig) about 10 minutes later when the affected RHR train was isolated. Upon disassembling the valve, the licensee noted that the nozzle ring was unmovable. The nozzle ring was jammed in a locked position about 225 notches from its proper position.

Foreign Pressurized Water Reactor

In May 1985, about 25,000 gallons of reactor coolant were released to the containment sump through an RHR suction relief valve. The primary system pressure stopped decreasing about 30 minutes into the event when the RHR system was isolated. The event was attributed to an improperly set nozzle ring. The utility also found a broken disc insert pin when the valve was inspected.

Discussion

All of the valves involved in the referenced events were Crosby relief valves which are used in a number of nuclear plants in the U.S. The expected reseat pressure for these particular valves was about 90% of the valve lift set pressure. Other style relief valves, whether Crosby or another manufacturer, may have different reseat pressures relative to the lift set pressure.

Those relief valves that do have nozzle rings (or guide rings as the case may be) generally are set by counting notches on the ring from some specified reference point as it is rotated about the nozzle. The nozzle ring is initially set by the manufacturer during full-flow tests and locked into position by a set screw that engages a notch in the ring.

An incorrect nozzle ring setting on a relief valve adversely affects the valve's characteristics and can result in uncontrolled leakage or discharge from the valve. A low setting (high reseat pressure) may cause the valve to open and close intermittently, leading to valve failure and uncontrolled leakage. A very high nozzle ring setting (low reseat pressure) may delay the valve reseating until lower than expected pressures are reached as occurred in the events noted above.

Some of the potential problems observed in setting the nozzle rings are:

(1) If the relief valves were worked on during plant construction or other earlier operating period without adequate control of nozzle ring settings, there is high likelihood that they are misadjusted. Shearon Harris, Trojan, and Braidwood all found multiple, low pressure, relief valves with incorrect ring settings on various safety related systems.

(2) The misadjusted nozzle rings are not self-revealing until the valves are challenged by a plant transient as illustrated in all the events cited above.

(3) Procedures which require that ring settings be returned to their "as-found" positions may be inadequate. At Shearon Harris, Trojan, and Braidwood the "as-found" ring settings were incorrect as a result of some previous incorrect maintenance or test activity. The licensees found it necessary to go back to the manufacturer's specified nozzle setting after maintenance or testing is performed. 10 CFR Part 50 Appendix B, Section III, addresses configuration control which includes the nozzle ring setting on these valves. The ASME test code (PTC 25.3) for relief valves directs that the rings be set to their original test data. Trojan specifically flagged this problem.

(4) There may be confusion introduced by the use of two different reference points (location from which to start notch count) in the vendor's documentation for setting the nozzle rings. The reference points in some cases may also be difficult to establish in the field.

(5) Specific directions for adjusting nozzle ring settings may cause confusion. Including two different instructions for setting the nozzle ring in the same work package may contribute to the confusion. Terms such as counter-clockwise and up and down may not be adequate directions when looking edgewise at a slowly moving ring. These problems are discussed in the NRC staff's report AEOD/E90-02, "Crosby Low Pressure Relief Valve Ring Problems," February 1990.

The licensees, noted above, have generally modified/improved their procedures and instituted personnel training to address nozzle ring setting. To eliminate errors, the valve manufacturer suggested training maintenance personnel on the specific valve before they attempt to adjust it.

The Trojan plant found that procedures, even with the manufacturer's nozzle ring setting stamped on the valve body, were not sufficient to preclude errors in maintaining their steam safety valves. A mechanical location indicator or similar device might preclude the gross errors observed in the ring settings and also provide a means of independently verifying the ring position without dislocating it.

At Braidwood, a picture, taken through the valve discharge port while it was on the bench, was used in conjunction with the valve drawing to determine that the nozzle ring was set too high. However, Trojan and Shearon Harris checked most of their ring settings with the relief valves in place so only the small ring adjustment hole was available for observing the ring position. Fiberoptic technology could be useful where the only opening to observe the nozzle ring is small.

Related Generic Communications

Information Notice 90-18, "Potential Problem with Crosby Safety Relief Valves Used on Diesel Generator Air Start Receiver Tanks"

Information Notice 90-05, "Inter-System Discharge of Reactor Coolant"

A more detailed account of problems with nozzle ring settings is contained in the NRC staff's report AEOD/E90-02, "Crosby Low Pressure Relief Valve Ring Problems," February 1990.

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.

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NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
92-63	Cracked Insulators in ASL Dry Type Transformers Manufactured by Westinghouse Electric Corporation	08/26/92	All holders of OLs or CPs for nuclear power reactors.
92-62	Emergency Response Information Requirements for Radioactive Material Shipments	08/24/92	All U.S. Nuclear Regulatory Commission licensees.
92-61	Loss of High Head Safety Injection	08/20/92	All holders of OLs or CPs for nuclear power reactors.
92-60	Valve Stem Failure Caused by Embrittlement	08/20/92	All holders of OLs or CPs for pressurized water reactors (PWRs).
92-59	Horizontally-Installed Motor-Operated Gate Valves	08/18/92	All holders of OLs or CPs for nuclear power reactors.
92-58	Uranium Hexafluoride Cylinders - Deviations in Coupling Welds	08/12/92	All Fuel Cycle Licensees.
92-57	Radial Cracking of Shroud Support Access Hole Cover Welds	08/11/92	All holders of OLs or CPs for boiling water reactors (BWRs).
92-56	Counterfeit Valves in the Commercial Grade Supply System	08/06/92	All holders of OLs or CPs for nuclear power reactors.
92-55	Current Fire Endurance Test Results for Thermo-Lag Fire Barrier Material	07/27/92	All holders of OLs or CPs for nuclear power reactors.
92-54	Level Instrumentation Inaccuracies Caused by Rapid Depressurization	07/24/92	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit