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

August 1, 2005

INFORMATION NOTICE 2005-23: VIBRATION-INDUCED DEGRADATION OF BUTTERFLY VALVES

ADDRESSEES

All holders for operating licenses for nuclear power reactors except those who have permanently ceased operation and have certified that fuel has been permanently removed from the vessel.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the degradation of butterfly valves supplied by Fisher Controls and other manufacturers. 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

On February 10, 2005, Southern California Edison declared component cooling water (CCW) outlet isolation valve 2HV6500 for the Train B shutdown cooling (SDC) heat exchanger in Unit 2 at the San Onofre Nuclear Generating Station (SONGS) inoperable in response to an abnormal reduction in flow through the valve. Valve 2HV6500 is an 18-inch butterfly valve manufactured by Fisher Controls. The operability of the containment spray (CS) system at SONGS Unit 2 depends on the availability of the SDC heat exchanger. Therefore, the licensee started a manual shutdown of SONGS Unit 2 on February 14, 2005, to repair the valve.

The licensee disassembled the valve and found that it could not fully open as a result of losing two taper pins that connect the valve disc to the valve stem. During the original installation, the taper pins are impact-driven into holes in the valve disc and stem and are intended to be held in place by the interference fit. The licensee could not determine the exact cause of the loss of the taper pins during plant operation. As corrective action, the licensee installed new taper pins and staked the pins to the valve disc to make them more secure.

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Since 1993, five Fisher Controls 28-inch butterfly valves in the CCW systems of SONGS Units 2 and 3 have lost one of the taper pins used to connect the valve disc to the valve stem. The licensee has also found additional Fisher Controls butterfly valves with improperly seated taper pins during internal inspections.

The design of the Fisher Controls butterfly valves can allow leakage through the valve if a taper pin is lost. For example, SONGS experienced leakage rates of approximately 50 gallons per minute (gpm) through 28-inch Fisher Controls butterfly valves in the CCW system in 1998 and 2004. After disassembling the butterfly valves, the licensee identified the cause of the leakage as the loss of a single taper pin in each of the valves.

Taper pins that come loose from butterfly valves can be carried with the system fluid and interfere with the operation of other plant equipment. For example, one of the missing taper pins from 2HV6500 at SONGS Unit 2 became lodged in train "B" CCW pump manual discharge isolation valve 2HCV6509, which is normally locked open and closed only for maintenance purposes. After maintenance on the train "B" CCW pump, the licensee had difficulty opening 2HCV6509 because of the taper pin lodged in the valve.

The licensee plans to review all butterfly valves in safety-related applications where loss of valve function or leakage because of a missing taper pin cannot be tolerated. On the basis of the review, the licensee will determine which butterfly valves to inspect during the upcoming refueling outages at SONGS Units 2 and 3. As part of the valve inspections, the licensee will stake the taper pins in the butterfly valves to ensure the pins remain in place during plant operation.

DISCUSSION

Over the years, nuclear power plants have experienced vibration-induced degradation of plant equipment during operation at the original licensed power and under power uprate conditions. The NRC has issued several information notices on vibration-induced degradation of plant equipment. For example, the NRC issued Information Notice (IN) No. 83-70, "Vibration-Induced Valve Failures," on October 25, 1983, to alert nuclear power plant licensees to valve failures and system inoperability as a result of normal operational vibration.

The degradation of Fisher Controls butterfly valves as a result of the loss of their taper pins at SONGS Units 2 and 3 is another example of vibration-induced degradation during plant operations. There have also been problems with the taper pins that connect the valve disc to the stem in butterfly valves supplied by other manufacturers. In 1989 Turkey Point Nuclear Plant, Unit 4, lost taper pins in a 36-inch intake cooling water head isolation butterfly valve manufactured by the Henry Pratt Company. In 2003 Davis-Besse Nuclear Power Station, Unit 1, lost taper pins in a 10-inch decay heat cooler butterfly valve with the brand name Valtek marketed by the Flowserve Corporation.

Depending on the valve design, the loss of a taper pin from a butterfly valve may result in significant leakage through the valve before interfering with valve operation. The size of the taper pin and fluid conditions can cause the leakage limits for the applicable plant system to be exceeded. In addition, leakage through a valve can be masked by another closed valve in the system until the second valve is opened.

Taper pins that come loose from butterfly valves can be carried with the system fluid and interfere with the operation of other plant equipment. The example of 2HCV6509 at SONGS Unit 2 had low safety significance because this valve is only used for maintenance at the plant.

Some nuclear power plants have experienced more severe vibration-induced degradation of equipment under power uprate conditions. For example, the NRC staff described vibration-induced degradation of plant equipment during power uprate operation in IN 2002-26, Supplement 2, "Additional Flow-Induced Vibration Failures After a Recent Power Uprate" (January 9, 2004). Increased steam and feedwater flow during power uprate operation can increase vibration of plant equipment, including valves and valve actuators. The higher vibration levels can impact the appropriate inspection intervals for some plant components.

In summary, degradation of butterfly valves supplied by Fisher Controls and other manufacturers has occurred during plant operation as a result of the loss of taper pins used to connect the valve disc to stem. The degradation can involve leakage and affect valve operation. Taper pins lost from butterfly valves can also interfere with the operation of other plant components in fluid systems. The cause of the loss of valve taper pins is not known for certain, but operating experience suggests that the most likely cause is vibration-induced degradation. Staking the taper pins after their installation in the butterfly valves is one method of providing a more secure interference fit of the pins. The increased steam and feedwater flow during power uprate operation can accelerate vibration-induced degradation of plant equipment, including valves and valve actuators.

RELATED GENERIC COMMUNICATIONS

NRC Information Notice 83-70, "Vibration-Induced Valve Failures," October 25, 1983.

NRC Information Notice 2002-26, Supplement 2, "Additional Flow-Induced Vibration Failures After a Recent Power Uprate," January 9, 2004.

This information notice requires no specific action or written response. However, recipients are reminded that they are required by 10 CFR 50.65 to consider industry-wide operating experience (including information presented in NRC information notices) where practical, when setting goals and performing periodic evaluations.

CONTACT

Please direct any questions about this matter to the technical contact(s) listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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Note: NRC generic communications may be found on the NRC public Website, http://www.nrc.gov, under Electronic Reading Room/Document Collections.

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ADAMS ACCESSION NUMBER: ML051740299

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