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IN 85-20

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

March 12, 1985

IE INFORMATION NOTICE NO. 85-20: MOTOR-OPERATED VALVE FAILURES DUE TO HAMMERING EFFECT

Addressees:

All nuclear power reactor facilities holding an operating license (OL) or construction permit (CP).

Purpose:

This information notice is provided to alert recipients of a potentially significant problem pertaining to motor-operated valve failures due to the hammering that may result when a fully closed (opened) valve continues to receive a close (open) signal at the valve operator. It is expected that recipients will review the information for applicability to their facilities and consider actions, if appropriate, to preclude a similar problem occurring at their facilities. However, suggestions contained in this notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On March 19, 1984, and September 25, 1984, Commonwealth Edison reported [licensee event report (LER) 84-003] the failure of a core spray valve to operate from the control room at the Dresden Nuclear Power Station Unit 2. The immediate cause of failure was a mechanical failure of the gear housing of the valve, probably caused by mechanical overloading during operation.

The same LER identified the failure of a second core spray valve. In this case, the immediate cause of failure was a cracked bearing race and gear housing. Metallurgical analysis by the licensee indicated that the valve gear housing had failed as a result of a mechanical overload. In addition, the valve thermal overload breaker had tripped.

Further investigation by the licensee showed that these mechanical overloads were the result of the valve being repeatedly hammered closed by the valve operator. This hammering would continue as long as the valve operator continued to receive a close demand signal.

In general, the sequence of events would be:

1. On receiving a close signal, power would be applied to the valve motor and the valve would begin closing.

2. Once closed, torque would build up and the torque switch would open removing power from the valve motor.

3. With the power removed, the valve motor would stop and the torque on the valve would relax.

4. With torque removed, the torque switch would reset.

5. Once the torque switch reset, if a close signal was still present at the valve motor operator, power would be re-applied to the valve motor and the valve would be driven further closed.

6. Since the valve was already closed, torque would immediately begin to build up and the torque switch would open removing power from the valve motor.

The last four steps would then repeat over and over. However, the torque switch would not stop the motor instantaneously. Thus, the loads would gradually build up in the valve until either something failed or the close signal was removed from the valve motor controller. The potential for "valve hammering" exists if the automatic or manual valve-close demand signal continues after the torque switch has been activated open. That is, if the valve full close limit switch is out of calibration. A similar condition could occur on valve opening, if backseating loads are limited by a torque switch.

Recognizing this condition as a possible common mode failure mechanism for all valves with this particular valve motor controller logic, the NRC's Office of Analysis and Evaluation of Operational Data (AEOD) performed a search of LERs on the Sequence Coding and Search System for the 1983 through 1984 time period (AEOD Engineering Evaluation Report No. AEOD/E501). Although they did not find any events attributed to hammering, they did find 47 events which had symptoms indicative of the hammering problem. Among these were failure and damage due to mechanical overloading, overheating of the valve operator motor, repeated cycling and failure of the starter contactors, thermal overloading, circuit breaker trips, and valve seat jamming. From this, AEOD concluded that licensees have not consistently identified the root cause of motor-operated valve failures, but rather have only identified the symptomatic ones. (This concept has been previously addressed in IE Information Notice No. 82-10, "Following up Symptomatic Repairs to Assure Resolution of Problem.")

As a part of their corrective action for the valve failures at Dresden, the licensee plans on modifying the control circuitry of the valves to prevent this hammering effect. This action will be taken on the valves in both units. In the interim, caution cards have been put on the valves to warn the operators not to hold on to the control switch when closing the valves.

It is important that any modifications made to the valve's motor controller logic not adversely affect the valve's safety-related functioning. For instance, simply locking out a close signal once the torque switch opens will result in improper valve operation if the valve should experience momentarily high friction loads from either tight packing or high pressure differential across the valve.

LER 84-014 submitted by Commonwealth Edison on August 14, 1984, described the failure of both low pressure coolant injection valves to open at Quad Cities Nuclear Power Station Unit 1. In 1980 the motor control logic for these valves was modified to prevent hammering. However, some time later, when the brakes on the valve motors were removed, it became apparent that the modification had not eliminated the problem. This is indicative of the difficulty involved in performing this type of modification.

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

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and Engineering Response
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Attachment: List of Recently Issued IE Information Notices

LIST OF RECENTLY ISSUED IE INFORMATION NOTICES

Information Notice No.	Subject	Date of Issue	Issued to
85-19	Alleged Falsification Of Certifications And Alteration Of Markings On Piping, Valves And Fittings	3/11/85	All power reactor facilities holding an OL or CP
84-18	Failures Of Undervoltage Output Circuit Boards In The Westinghouse-Designed Solid State Protection System	3/7/85	All power reactor facilities holding an OL or CP
83-70 Sup. 1	Vibration-Induced Valve Failures	3/4/85	All power reactor facilities holding an OL or CP
85-17	Possible Sticking Of ASCO Solenoid Valves	3/1/85	All power reactor facilities holding an OL or CP
85-16	Time/Current Trip Curve Discrepancy Of ITE/Siemens-Allis Molded Case Circuit Breaker	2/27/85	All power reactor facilities holding an OL or CP
85-15	Nonconforming Structural Steel For Safety-Related Use	2/22/85	All power reactor facilities holding an OL or CP
85-14	Failure Of A Heavy Control Rod (B4C) Drive Assembly To Insert On A Trip Signal	2/22/85	All power reactor facilities holding an OL or CP
85-13	Consequences Of Using Soluble Dams	2/21/85	All BWR and PWR facilities holding an OL or CP
85-12	Recent Fuel Handling Events	2/11/85	All power reactor facilities holding an OL or CP
85-11	Licensee Programs For Inspection Of Electrical Raceway And Cable Installation	2/11/85	All power reactor facilities holding a CP

OL = Operating License
CP = Construction Permit