

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
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September 20, 1991

NRC INFORMATION NOTICE 91-58: DEPENDENCY OF OFFSET DISC BUTTERFLY VALVE'S
OPERATION ON ORIENTATION WITH RESPECT TO FLOW

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission is issuing this information notice to alert addressees to the possibility that offset disc butterfly motor-operated valves (MOV) may not function properly under design differential pressure and flow conditions because the orientation of the valve to the direction of flow can affect the operating characteristics of the valve. 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 27, 1991, three service water MOVs that isolate the recirculation spray heat exchangers (RSHXs) at the North Anna Power Station, Unit 1, failed a special test when they did not fully open on demand. The Virginia Electric and Power Company (the licensee) was conducting the test under high flow and differential pressure conditions to respond to NRC Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." The unit was in cold shutdown for refueling when the failures occurred.

The valves are 16-inch, 150-pound offset disc butterfly MOVs. The licensee determined that the valves had been installed in an orientation such that the service water flow was toward the curved (shaft) side of the disc instead of toward the flat side of the disc as intended (see Figure 1). This orientation resulted in the need for a much higher torque than anticipated in order to open the valves under the conditions established for the test.

Discussion

The licensee had recently performed modifications that reduced the torque switch settings on the valves to values that ensured that the maximum torque achieved would be within the actuator's rating. The licensee also calculated

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the required torque values for the system application using the American Water Works Association (AWWA) Standard for Rubber-Seated Butterfly Valves (C504-80). The calculation indicated that the expected unseating torque was greater than the dynamic torque (letter from W. L. Stewart, VEPCO, to NRC Document Control Desk, "Reverse Installation of Safety Related Motor Operated Offset Disc Butterfly Valves," May 31, 1991). However, the vendor-supplied valve coefficients used in the calculation were for a disc of a different type than that installed, leading to an error in the calculation.

The affected MOVs are normally shut, and the intended safety function of the valves is to open during an accident to supply cooling water to the RSHXs. Under normal conditions, these valves should not experience significant flow or differential pressure during the opening stroke because of another set of isolation valves upstream. However, responding to Generic Letter 89-10, the licensee developed a test to demonstrate that the valves could reopen under worst-case flow and differential pressure conditions. On February 27, 1991, the licensee conducted the tests and challenged each valve individually to open against a maximum differential pressure of approximately 75 pounds per square inch (psid) and a maximum flow of approximately 9000 gallons per minute (gpm). The three valves in question failed to fully open because the torque switches opened at roughly mid-position. The licensee noted that the orientation of the three failed valves was such that the service water flowed toward the curved (shaft) side of the disc (see Figure 1). Five other similar valves in the system which were properly oriented with respect to the service water flow were tested successfully.

For this type of valve disc, when flow is toward the flat side of the disc, the maximum torque on the opening stroke occurs during valve unseating, and the actuator rating and torque switch setting should be selected to achieve this torque. However, if the service water flows toward the curved (shaft) side of the disc, the hydrodynamic torque developed as the flow increases acts against the opening motion, and, thus, a much higher actuator torque is required to fully open the valve (see Figure 2). The actuators were not adequately sized and rated for this situation, and the torque switches operated to prevent damage to the actuators before the valves reached the fully open position.

The licensee indicated that the valves were probably installed correctly by the architect/engineer with service water flow toward the flat side of the disc. The licensee concluded that a lack of maintenance controls most likely caused the reversal in the orientation. The licensee has also identified weaknesses in the torque calculation method such as poor modeling assumptions and a lack of consideration of the differences between the coefficients for symmetrical and offset discs.

The licensee removed the three valves and reversed them so that the service water would flow toward the flat side of the disc. The licensee marked the valves and the associated piping to indicate the direction of flow. Subsequent testing of the valves was satisfactory. The licensee is also reviewing and evaluating the models used for the service water system and the related calculations.

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 project manager.

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Attachments:

1. Butterfly Valve Figures 1 and 2
2. List of Recently Issued NRC Information Notices: *see jacket*

Figure 1

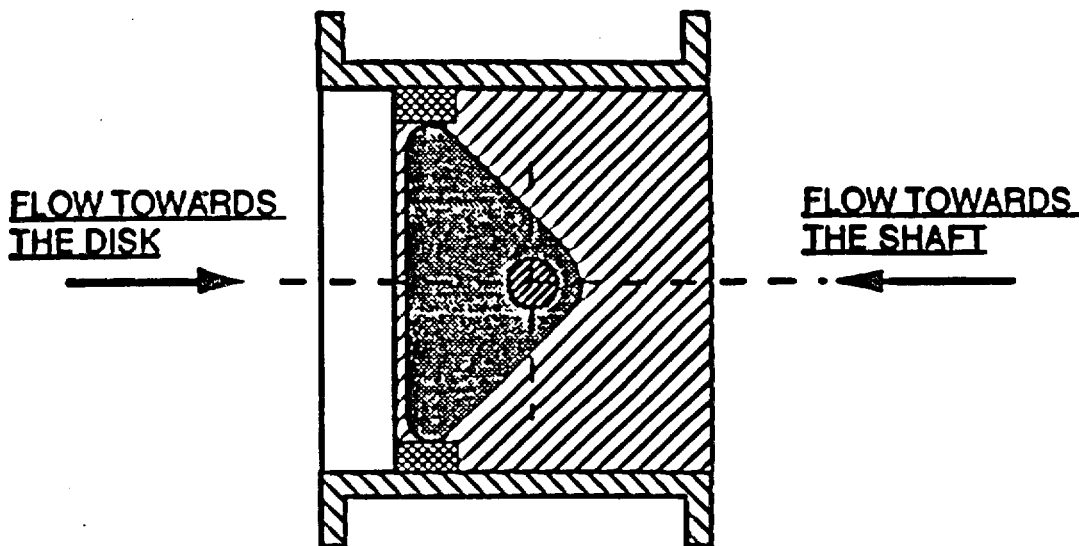
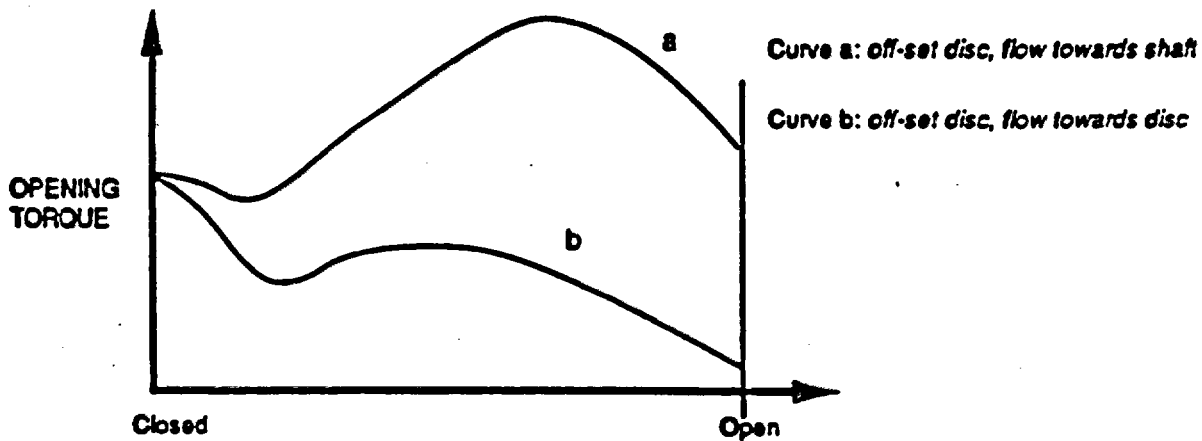


Figure 2
Typical Opening Torques for Offset Disc Butterfly Valves



LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-57	Operational Experience on Bus Transfers	09/19/91	All holders of OLs or CPs for nuclear power reactors.
91-56	Potential Radioactive Leakage to Tank Vented to Atmosphere	09/19/91	All holders of OLs or CPs for nuclear power reactors.
91-55	Failures Caused by An Improperly Adjusted Test Link In 4.16 KV General Electric Switchgear	09/16/91	All holders of OLs or CPs for nuclear power reactors.
85-18, Supp. 1	Failures of Undervoltage Output Circuit Boards In the Westinghouse-Designed Solid State Protection System	09/10/91	All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors.
91-54	Foreign Experience Regarding Boron Dilution	09/06/91	All holders of OLs or CPs for pressurized water reactors (PWRs).
89-90, Supp. 2	Pressurizer Safety Valve Lift Setpoint Shift	09/05/91	All holders of OLs or CPs for nuclear power reactors.
91-53	Failure of Remote Shutdown System Instrumentation Because of Incorrectly Installed Components	09/04/91	All holders of OLs or CPs for nuclear power reactors.
91-52	Nonconservative Errors In Overtemperature Delta-Temperature (OTΔT) Setpoint Caused by Improper Gain Settings	08/29/91	All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors.
86-14, Supp. 2	Overspeed Trips of AFW, HPCI and RCIC Turbines	08/26/91	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
 CP = Construction Permit