Flowserve – Anchor Darling
Pump Turbine Exhaust Check Valves

Pump Turbine Exhaust Check Valves

Problem

Damage and failure to pump turbine exhaust check valves.

Solution

A specially designed Flowserve Anchor/Darling lift check valve that performs successfully during all operating modes.

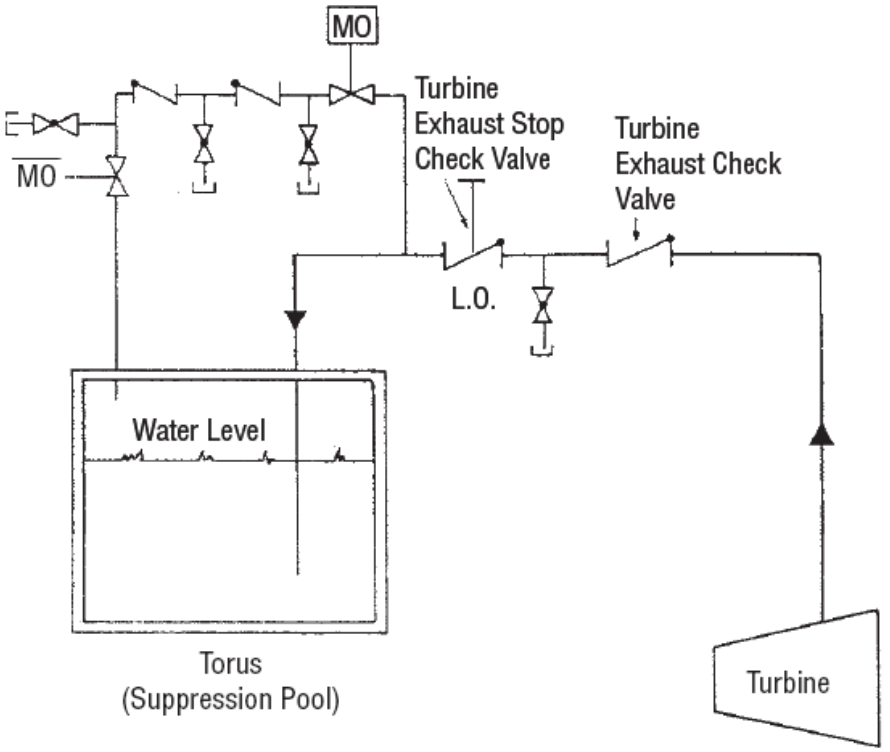
Boiling Water Reactors utilize turbine-driven pumps in their emergency core cooling systems (ECCS). Steam from the main steam line is used. The turbine steam travels through two block valves and a turbine control valve, and then the steam is exhausted from the turbine to the suppression pool through a check valve and a stop check valve.

The first check valve downstream of the pump turbine is the turbine exhaust check valve. This valve is also used for containment isolation. Both swing check and tilting-disc check valves have been tried in this service. Regardless of the type of valve used—or the manufacturer—the valve presents a constant maintenance problem. There has been severe damage to both the hinges and seating surfaces and, in several instances, discs have separated from the hinge and been found lodged in the downstream piping.

Flowserve Anchor/Darling Valves, having supplied valves for this service, investigated the operating conditions to determine the cause and possible resolution. Our discussions with both system operations and plant maintenance personnel revealed that the damage is the result of two separate operating modes not identified in the original valve specification:

1. One form of periodic testing of the system is to subject the pump turbine to a fast start. The quick opening of the throttle valve causes the disc on the turbine exhaust check valve to slam into the full open position. The repeated impact of the disc against the body puts a strain on the hinge assembly and leads to eventual hinge failure.
2. In a second form of periodic testing the pump turbine throttle is partially opened. Since the turbine exhaust check valves must be sized for full flow, operation at low flow causes the disc to flutter on the seat. This repeated action causes cracking in both the disc and seat ring seating surfaces. As a result, the valve is unable to pass the Local Leak Rate Tests (LLRT) required for containment isolation valves.

Turbine Exhaust Check Valve Location



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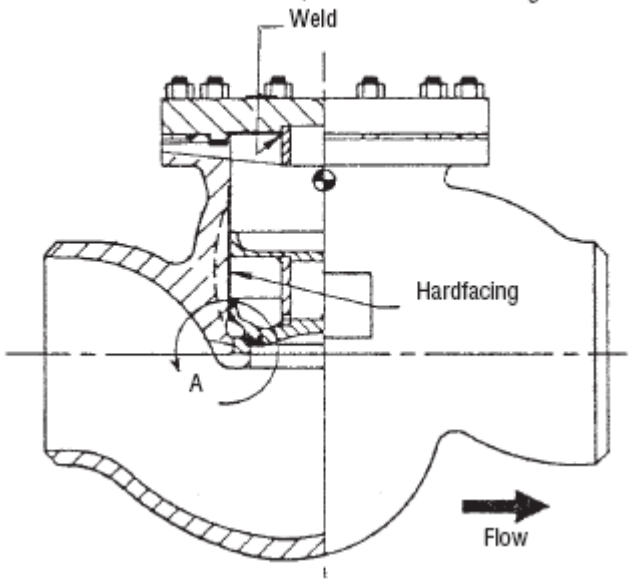
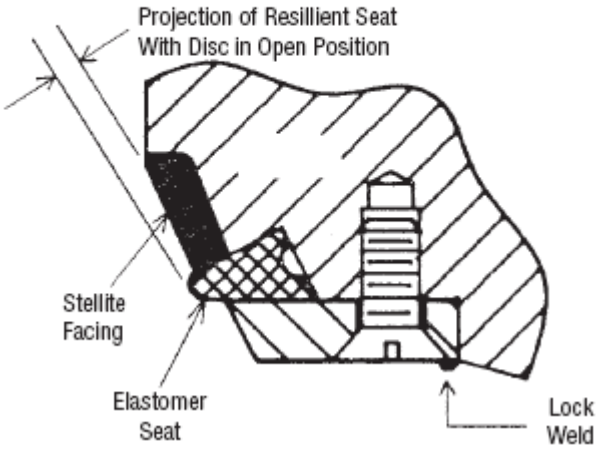
Using this information, Flowserve Anchor/Darling Valves engineering determined that the best value design for the service is a specially designed lift check valve. The basic lift check design was selected because of its inherent damping action in the opening position. The area over the plug as it is raised into the body neck acts as a dashpot, in effect snubbing the opening motion of the disc. Because of concerns about turbine back pressure, a specially configured lightweight disc was incorporated. Finally, in order to assure seat integrity during LLTR, a dual-seat design was incorporated in the disc. It consists of a primary seat of Stellite for a normal service and a secondary seat made of a radiation-resistant polymer. This secondary seat (originally proven in BWR feedwater isolation check service) assures a tight seal under the stringent low-pressure air testing requirements of Appendix J10CFR50.

Solving this turbine exhaust check valve problem is another example of Anchor/Darling's continuing commitment to provide equipment which functions as required to meet the actual service conditions found in operating nuclear power plants.

Turbine Exhaust Check Valve, With Dual-Seat Design



Detail A



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