LaSalle Unit 2 HPCS Injection Valve Failure during the February 2017 Refueling Outage

On February 11, 2017, the Unit 2 HPCS injection valve stem was found to be separated from the upper wedge/disc assembly during a fill and vent activity[1]. Prior to the failure, the valve had successfully passed a local leak rate test where the valve had cycled successfully several times. Valve disassembly and inspection revealed the wedge pin had sheared and the valve stem threads were damaged. This valve was an Anchor/Darling 12 inch Double Disc Gate Valve (ADDDGV) and was included in those valves associated with the Flowserve and Browns Ferry Part 21 reports submitted in 2013 (ADAMS ML13008A321 and ML13064A012). The licensee was addressing the Part 21 reports by using industry guidance provided by the Boiling Water Reactor Owners Group (BWROG) prior to the failure. Following the identification of the separation, the licensee redesigned and repaired the failed Unit 2 HPCS Injection valve.

Preliminary LaSalle Observations Related to ADDDGV Part 21s

1. A December 2016 Update to the BWROG Guidance (BWROG-TP-13-006, "Recommendations to Resolve Flowserve 10 CFR Part 21 Notification Affecting Anchor Darling double Disc Gate Valve Wedge Pin Failures,") associated with the Part 21 Reports, documented that another utility disassembled and inspected similar valves associated with the Part 21 Report and identified that 24 of the 26 valves stems and upper wedges were not properly torqued prior to installation. As a result, the stem could be unthreaded from the upper wedge by hand after the wedge pin was removed. None of these inspected valves were noted to have broken or sheared wedge pins.

2. Valves with operating torques greater than the stem-disc assembly pre-installation torques can result in the wedge pins experiencing excessive load and pin failure. Therefore, for valves that may have been inadequately torqued, the NRC questions whether an operability evaluation should consider the load carrying capability of the wedge pin versus the operating torque.

3. The NRC is questioning whether the use of the MOV diagnostic testing (i.e., stem strain trace measurements) and the stem rotation deflection check reliably demonstrate that wedge pins remain intact, that prior over-torqueing did not occur, or that stem / wedge thread degradation has not already occurred. Specifically, if the stem has been over torqued into the wedge in the closed direction, the wedge pin may have been sheared, the force may have caused an unknown thread geometry and material condition between the stem and wedge threads without the valve behaving abnormally for a period of time prior to failure.

4. For valves susceptible to wedge pin failure, simple unthreading of the stem and wedge could occur in addition to galling of the threads with unknown thread geometry. As a result, it may be difficult to justify how the shear analysis and friction coefficient of the threads can be used to prove operability.

5. Based on the experience for the failed Unit 2 HPCS valve, the methods described in BWROG-TP-13-006 combined with thread shear analysis, the NRC is questioning if this approach is sufficient to demonstrate operability of valves within the scope of the Part 21 notifications.

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[1] See LER 50-374/2017-003-00, "High Pressure Core Spray System Inoperable due to Injection Valve Stem-Disc Separation" (ADAMS ML17102B424).

Figure 1: As Found Pictures of Failed Unit 2 HPCS Injection Valve Stem to Wedge Connection