



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
LICENSEE RESPONSE TO GENERIC LETTER 95-07, "PRESSURE LOCKING
AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES"
SUSQUEHANNA STEAM ELECTRIC STATION (SSES), UNITS 1 AND 2
DOCKET NOS. 50-387 AND 50-388

1.0 INTRODUCTION

Pressure locking and thermal binding represent potential common-cause failure mechanisms that can render redundant safety systems incapable of performing their safety functions. The identification of susceptible valves and the determination of when the phenomena might occur require a thorough knowledge of components, systems, and plant operations. Pressure locking occurs in flexible-wedge and double-disk gate valves when fluid becomes pressurized inside the valve bonnet and the actuator is not capable of overcoming the additional thrust requirements resulting from the differential pressure created across both valve disks by the pressurized fluid in the valve bonnet. Thermal binding is generally associated with a wedge gate valve that is closed while the system is hot and then is allowed to cool before an attempt is made to open the valve.

Pressure locking or thermal binding occurs as a result of the valve design characteristics (wedge and valve body configuration, flexibility, and material thermal coefficients) when the valve is subjected to specific pressures and temperatures during various modes of plant operation. Operating experience indicates that these situations were not always considered in many plants as part of the design basis for valves.

2.0 REGULATORY REQUIREMENTS

Pursuant to Title 10 of the Code of Federal Regulations (10 CFR) Part 50 (Appendix A, General Design Criteria 1 and 4) and plant licensing safety analyses, it is required or committed (or both) that licensees design and test safety-related components and systems to provide adequate assurance that those systems can perform their safety functions. Other individual criteria in Appendix A to 10 CFR Part 50 apply to specific systems. In accordance with those regulations and licensing commitments, and under the additional provisions of 10 CFR Part 50 (Appendix B, Criterion XVI), licensees are expected to act to ensure that safety-related power-operated gate valves susceptible to pressure locking or thermal binding are capable of performing their required safety functions.

Enclosure

On August 17, 1995, the Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," to request that licensees take certain actions to ensure that safety-related power-operated gate valves that are susceptible to pressure locking or thermal binding are capable of performing their safety functions within the current licensing bases of the facility. GL 95-07 requested that each licensee, within 180 days of the date of issuance of the GL (1) evaluate the operational configurations of safety-related power-operated gate valves in its plant to identify valves that are susceptible to pressure locking or thermal binding; and (2) perform further analyses and take needed corrective actions (or justify longer schedules) to ensure that the susceptible valves, identified in (1) above, are capable of performing their intended safety functions under all modes of plant operation, including test configuration. In addition, GL 95-07 requested that licensees, within 180 days of the date of issuance of the generic letter, provide to the NRC a summary description of (1) the susceptibility evaluation used to determine that valves are or are not susceptible to pressure locking or thermal binding; (2) the results of the susceptibility evaluation, including a listing of the susceptible valves identified; and (3) the corrective actions, or other dispositive actions, for the valves identified as susceptible to pressure locking or thermal binding. The NRC issued GL 95-07 as a "compliance backfit" pursuant to 10 CFR 50.109(a)(4)(i) because modification may be necessary to bring facilities into compliance with the rules of the Commission referenced above.

In a letter of February 13, 1996, PP&L, Inc. (the licensee) submitted its 180-day response to GL 95-07 for SSES Units 1 and 2. The staff reviewed the licensee's submittal and requested additional information in a letter dated June 10, 1996. In a letter of July 11, 1996, the licensee provided the additional information. In letters of November 7, 1996, April 29, 1997, and July 1, 1998, the licensee supplemented its 180-day response. In a September 7, 1999, letter, the licensee provided a response to a second NRC request for additional information dated May 26, 1999, regarding GL 95-07.

3.0 STAFF EVALUATION

3.1 Scope of Licensee's Review

GL 95-07 requested that licensees evaluate the operational configurations of safety-related power-operated gate valves in their plants to identify valves that are susceptible to pressure locking or thermal binding. The licensee's letters of February 13, July 11, and November 7, 1996, April 29, 1997, July 1, 1998, and September 7, 1999, described the scope of valves evaluated in response to GL 95-07. The staff has reviewed the scope of the licensee's susceptibility evaluation performed in response to GL 95-07 and found it complete and acceptable.

Normally open, safety-related power-operated gate valves which are closed for tests or surveillances but must return to the open position were evaluated within the scope of GL 95-07 unless the system/train is declared inoperable and plant technical specifications are followed when the valves susceptible to pressure locking and thermal binding are closed. The staff finds the criteria for determining the scope of power-operated valves for GL 95-07 are consistent with the staff's acceptance of the scope of motor-operated valves associated with GL 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance."

Enclosure

3.2 Corrective Actions

GL 95-07 requested that licensees, within 180 days, perform further analyses as appropriate, and take appropriate corrective actions (or justify longer schedules), to ensure that the susceptible valves identified are capable of performing their intended safety function under all modes of plant operation, including test configuration. The licensee's submittals discussed corrective actions to address potential pressure-locking and thermal-binding problems. The staff's evaluation of the licensee's actions is discussed in the following paragraphs:

- a. The licensee stated that the following valves were modified to eliminate the potential for pressure locking:

HV-1(2)49-F013	Reactor Core Isolation Cooling Injection
HV-1(2)51-F005A/B	Residual Heat Removal (RHR) Pump Suppression Pool Suction
HV-1(2)51-F028A/B	RHR Suppression Pool Return Isolation
HV-1(2)51-F015A/B/C/D	Low Pressure Coolant Injection Isolation
HV-1(2)52-F005A/B	Core Spray Injection
HV-1(2)55-F006	High Pressure Coolant Injection (HPCI) Isolation
HV-1(2)55-F042	HPCI Suppression Pool Suction

The staff finds that physical modification to valves susceptible to pressure locking is an appropriate corrective action to ensure operability of the valves and is thus acceptable.

- b. The licensee stated that the RHR pump minimum flow return valves, HV-1(2)51-F007A/B, are susceptible to pressure locking when opened to realign the RHR system from the shutdown cooling to the emergency core cooling mode of operation. The licensee stated that procedures were modified to require that HV-1(2)51-F007A/B not be opened during the realignment of the RHR system from the shutdown cooling to emergency core cooling mode of operation. The staff finds that the licensee's procedural changes to require not operating the valves provide assurance that pressure-locking conditions are eliminated, and are thus acceptable.
- c. The licensee stated that the RHR Heat Exchanger inlet valve, HV-1(2)51-F047A/B, is susceptible to pressure locking if the RHR pump trips when the valve is closed during the shutdown cooling mode of operation. As a corrective action, procedures were revised to instruct operators to restart the RHR pump prior to opening the valve. The staff finds that the licensee's procedure change to sequence restart of a pump prior to opening the valve provides assurance that pressure-locking conditions are adequately eliminated, and is thus acceptable.
- d. The licensee stated that all flexible and solid wedge gate valves in the scope of GL 95-07 were evaluated for thermal binding. When evaluating whether valves were susceptible to thermal binding, the licensee assumed that thermal binding would not occur below specific temperature thresholds.

Operating conditions for the HPCI turbine steam admission valves, HV-1(2)55-F001, exceed these temperature limitations. The licensee developed a thermal binding

calculation that determined the amount of additional stem thrust that is required to open the valves during thermal-binding conditions. The licensee stated that the Unit 2 HPCI turbine steam admission valve was tested and testing demonstrated that the results of the thermal binding calculation were conservative.

The licensee stated that the RHR heat exchanger inlet and outlet valves, HV-1(2)-F047A/B and HV-1(2)51-F003A/B, are susceptible to thermal binding during the shutdown cooling mode of operation. Procedures were revised to require that the valves not be closed when hot.

The screening criteria used by the licensee appear to provide a reasonable approach to identify those valves that might be susceptible to thermal binding. Until more definitive industry criteria are developed, the staff concludes that the licensee's actions to address thermal binding of gate valves are acceptable.

4.0 CONCLUSION

On the basis of this evaluation, the staff finds that the licensee has performed appropriate evaluations of the operational configurations of safety-related power-operated gate valves to identify valves at the SSES Units 1 and 2, that are susceptible to pressure locking or thermal binding. In addition, the staff finds that the licensee has taken appropriate corrective actions to ensure that these valves are capable of performing their intended safety functions. Therefore, the staff concludes that the licensee has adequately addressed the requested actions discussed in GL 95-07.

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