



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"

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DOCKET NUMBER 50-261

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 requires 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

10 CFR Part 50 (Appendix A, General Design Criteria 1 and 4) and plant licensing safety analyses require or commit (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.

On August 17, 1995, the 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

Enclosure

9904260021 990420
PDR ADOCK 05000261
P PDR

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 GL, 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 dispositioning, 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, Carolina Power & Light (CP&L) submitted its 180-day response to GL 95-07 for the H. B. Robinson Steam Electric Plant, Unit No. 2. The NRC staff reviewed the licensee's 180-day response and requested additional information in a letter dated July 3, 1996. In a letter of August 12, 1996, the licensee notified the NRC that the requested information would be provided on November 22, 1996. In letters of November 22, 1996, and February 19, 1997, the licensee provided the additional information. In letters dated July 11, 1996, April 3, 1998, and February 5, 1999, the licensee supplemented its 180-day response to GL 95-07. During the period of November 4 through 8, 1996, the NRC staff performed an inspection to review specific aspects of information summarized in the licensee's responses to GL 95-07. This inspection is documented in NRC Inspection Report No. 50-261/96-12.

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 CP&L letters of February 13, July 11 and November 22, 1996, February 19, 1997, April 3, 1998, and February 5, 1999, described the scope of valves evaluated in response to GL 95-07. The NRC staff has reviewed the scope of the licensee's susceptibility evaluation performed in response to GL 95-07 and found it complete and acceptable.

The licensee did not include shutdown cooling hot leg suction valves, RHR-750 and RHR-751, in the scope of GL 95-07 because these valves are used during plant conditions below hot shutdown. This is acceptable because the licensing basis for H. B. Robinson is hot shutdown. 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."

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 proposed 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 have been modified to eliminate the potential for pressure locking:

AFW-V2-14A/B/C	Steam Driven Auxiliary Feedwater (AFW) Pump Discharge
AFW-V2-16A/B/C	Motor Driven AFW Pump Discharge
RHR-744A/B	Residual Heat Removal (RHR) to Cold Leg
SI-860A/B	Containment Sump Recirculation
SI-861A/B	Containment Sump Recirculation
SI-862A/B	Reactor Water Storage Tank to RHR Loop Isolation
SI-863A/B	RHR Loop Recirculation

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 it used a thrust-prediction methodology developed by Commonwealth Edison Company (ComEd) to demonstrate that the Power-Operated Relief Valve (PORV) Block Valves RC-535/536 could open under pressure-locking conditions. On April 9, 1997, the staff held a public meeting to discuss the technical adequacy of the ComEd pressure-locking thrust prediction methodology and its generic use by licensees in their submittals responding to GL 95-07. The minutes of the public meeting were issued on April 25, 1997. At the public meeting, ComEd recommended that, when using its methodology, minimum margins should be applied between calculated pressure-locking thrust and actuator capability. These margins, along with diagnostic equipment accuracy and methodology limitations, are defined in a letter from ComEd to the NRC dated May 29, 1998 (Accession Number 9806040184). The NRC considers the use of the ComEd pressure-locking methodology acceptable provided these margins, diagnostic equipment accuracy requirements, and methodology limitations are incorporated into the pressure-locking calculations. ComEd indicated that its methodology may be revised. The staff considers that calculations that are used to demonstrate that valves can overcome pressure locking are required to meet the requirements of 10 CFR Part 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants, and therefore, controls are required to be in place to ensure that any

industry pressure-locking thrust prediction methodology requirements and revisions are properly implemented. Under this condition, the staff finds that the ComEd methodology provides a technically sound basis for assuring that valves susceptible to pressure locking are capable of performing their intended safety-related function.

- c. The licensee stated that the steam admission valves to the AFW pump, MS-V1-8A/B/C, will be modified to eliminate the potential for pressure locking during the refueling outage scheduled for Fall 1999. Until these valves are modified, an industry double disk area gate valve thrust calculation was used to demonstrate that the actuators are capable of developing the thrust required to open these double disk gate valves during pressure-locking conditions. The staff finds that this calculation provides reasonable assurance that the valves will be operable until the planned modifications to prevent pressure locking are completed as scheduled. The licensee's commitment to modify these valves in the long term is an acceptable final resolution.
- d. The licensee stated that the boron injection tank isolation valves, SI-870A/B, are susceptible to pressure locking. A modified industry gate valve thrust equation (double disk area) was used to calculate the thrust required to open these double disk gate valves during pressure-locking conditions. Pressure-locking tests sponsored by the NRC were conducted by the Idaho National Engineering and Environmental Laboratory on a double disk gate valve. The results of this testing are documented in NUREG/CR-6611, "Results of Pressure Locking and Thermal Binding Tests of Gate Valves." Test data demonstrated that the modified industry gate valve thrust equation trended with the pressure-locking test results but generally underestimated the thrust required to open a pressure-locked valve. The staff finds that the modified industry gate valve thrust equation provides reasonable assurance that valves susceptible to pressure locking are capable of performing their intended safety-related function provided that the margin between calculated pressure-locking thrust and actuator capability exceeds 40%. Until more definitive industry criteria are developed, the staff concludes that the licensee's action to address pressure locking of gate valves SI-870A/B is acceptable.
- e. The licensee stated that valves within 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. The PORV Block Valves, RC-535/536, and the Residual Heat Removal (RHR) cold leg injection valves, RHR-744A/B, exceeded these temperature limitations. The actuators for these valves are equipped with spring compensators which reduce the potential for the valves to thermally bind.

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 NRC staff finds that the licensee has performed appropriate evaluations of the operational configurations of safety-related power-operated gate valves to identify valves at H. B. Robinson Steam Electric Plant, Unit No. 2, that are susceptible to pressure locking or thermal binding. In addition, the NRC staff finds that the licensee has taken, or is scheduled to take, 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.

Principal Contributor: S. Tingen, NRR

Date: April 20, 1999