



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"  
BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2  
DOCKET NUMBERS 50-325 AND 50-324

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

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.

Enclosure

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 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 generic letter (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 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 Company (CP&L) submitted its 180-day response to GL 95-07 for the Brunswick Steam Electric Plant, Units 1 and 2. In a letter dated April 26, 1996, the licensee supplemented its 180-day response to GL 95-07. The NRC staff reviewed the licensee's submittals and requested additional information in a letter of May 16, 1996. In a letter of June 20, 1996, the licensee provided the additional information. On March 31 and November 3, 1999, the licensee responded to a second request for additional information forwarded by the NRC staff on December 21, 1998.

### 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. CP&L letters of February 13, April 26, and June 20, 1996, and March 31 and November 3, 1999, described the scope of valves evaluated in response to GL 95-07. Normally open, safety-related power-operated gate valves which are closed for test or surveillance but must return to the open position were evaluated within the scope of GL 95-07 except in the instances when the system/train is declared inoperable in accordance with technical specifications.

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 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 are not susceptible to pressure locking because there is a hole in the high pressure side of the disk, or the valve is equipped with a bonnet pressure equalizing line:

2-E11-F007A/B	Residual Heat Removal (RHR) Pump Minimum Flow
1(2)-E11-F015A/B	RHR Low Pressure Core Injection (LPCI)
1(2)-E21-F005A/B	Core Spray Injection
1(2)-E41-F001	High Pressure Core Injection (HPCI) Steam Admission
1(2)-E41-F006	HPCI Injection
1(2)-E51-F013	Reactor Core Isolation Cooling Injection

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 following valves will be modified to eliminate the potential for pressure locking during the Unit 1 refueling outage scheduled for 2000 or the Unit 2 refueling outage scheduled for 2001:

1-E11-F007A/B	RHR Pump Minimum Flow
1(2)-E11-F028A/B	RHR Torus Discharge
1(2)-E41-F042	HPCI Suppression Pool Suction

An analysis performed by the licensee and operational experience were used to demonstrate that the valves are operable until modified. The staff finds that these provide 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.

- c. 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. The operating conditions for RHR minimum flow bypass valves, 1(2)-E11-F007A/B, and the LPCI injection valves, 1(2)-E11-15A/B, exceeded these temperature thresholds. Operating experience demonstrated that 1(2)-E11-F007A/B are not susceptible to thermal binding. The licensee stated that procedures were modified to close alternate valves that are not susceptible to thermal binding instead of closing 1(2)-E11-15A/B when the valves are at elevated temperatures.

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

#### 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 the Brunswick Steam Electric Plant, Units 1 and 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.

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