



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RESPONSE TO GENERIC LETTER 95-07, "PRESSURE LOCKING
AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES"
MCGUIRE NUCLEAR STATION, UNITS 1 AND 2
DOCKET NOS. 50-369 AND 50-370

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

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 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

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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, Duke Power Company submitted its 180-day response to GL 95-07 for McGuire Nuclear Station. The NRC staff reviewed the licensee's submittal and requested additional information in a letter dated July 1, 1996. By letters dated July 31, 1996, and June 11, 1997, the licensee provided the additional information. Between December 9 and 12, 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 50-369, 370/97-11. The licensee responded to the inspection report findings in a letter dated February 3, 1997. The NRC staff has reviewed the licensee's four submittals as discussed in this safety evaluation.

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 Duke Power Company's letters of February 13 and July 31, 1996, and February 3, 1997, 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.

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 its 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 were evaluated for pressure locking and modified to eliminate that potential:

2	NI0121A, 0152B	Medium Head Injection Pumps to Hot Leg
1,2	NI0184B, 0185A	Containment Sump Isolation
1,2	SA0048A,B,C	Steam Generator C to Auxiliary Feedwater Pump
1,2	SA0049A,B	Steam Generator B to Auxiliary Feedwater Pump
1	FW0027A	Refueling Water Storage Tank Supply
1	ND0058A	Low Head Inj. Pump to High and Medium Injection
1	NI0121A, 0152B	Medium Head Injection Pump to Hot Leg
1	NI0136B	Low Head Injection Pump to Medium Injection
1	NI0183B	Low Head Injection Pump to Hot Leg
1	NS0001B, 0018A	Containment Spray Pump Sump Suction
1	NS0038B, 0043A	Low Head Injection to Auxiliary Spray
1	NV0221A, 0222B	High Head Injection Pump 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 following valves will be modified to eliminate the potential for pressure locking during the Unit 1 refueling outage, Cycle 12, scheduled for fall 1998, and the Unit 2 refueling outages, Cycles 11 and 12, scheduled for fall 1997 and spring 1999, respectively:

2	FW0027A	Refueling Water Storage Tank Supply
1,2	LD0108A, 0113B	Diesel Generator Lube Oil Filter Bypass
2	ND0058A	Low Head Inj. Pump to High and Medium Injection
1,2	NI0009A, 0010B	High Head Injection Pump to Cold Leg
2	NI0136B	Low Head Injection Pump to Medium Injection
2	NI0183B	Low Head Injection Pump to Hot Leg
2	NS0001B, 0018A	Containment Spray Pump Sump Suction
2	NS0038B, 0043A	Low Head Injection to Auxiliary Spray
2	NV0221A, 0222B	High Head Injection Pump Suction

Until these valves are modified, a methodology developed by the Commonwealth Edison Company (ComEd) to predict the thrust required to overcome pressure locking was used to demonstrate operability for valves 1,2 LDO108A, 0113B; 2 NIO183B; 2 NS0001B, 0018A; and 2 NV0221A, 0222B. Operational experience or testing representative of pressure-locking conditions was used to demonstrate operability for the remaining valves. 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. See paragraph 3.2.d for more discussion of the ComEd pressure-locking methodology. The licensee's commitment to modify these valves in the long-term is an acceptable final resolution.

- c. The licensee stated that procedures were modified to cycle the following valves following evolutions that could potentially create a pressure-locking condition:

1,2 NS0012B, 0015B	Containment Spray Pump Discharge to Header B
1,2 NS0029A, 0032A	Containment Spray Pump Discharge to Header A

The staff finds that the licensee's procedural changes to require cycling the valves provide assurance that pressure-locking conditions are adequately identified and eliminated, and are, thus, acceptable.

- d. The licensee stated that, for long-term corrective action, the ComEd thrust prediction methodology was used to demonstrate that the following valves would open under pressure-locking conditions:

1,2 NC0031B, 0033A, 0035B	Pressurizer Power-Operated Relief Valve (PORV) Block Valves
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Under certain conditions, 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. On April 9, 1997, a public meeting was held to discuss the ComEd pressure-locking thrust prediction methodology presented in the licensees' 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. For those valves identified in this safety evaluation that use the ComEd pressure-locking thrust prediction methodology for interim and long-term corrective action, the licensee should ensure that the margin between calculated pressure-locking thrust and actuator capability meets or exceeds these minimum requirements. At the meeting, ComEd indicated that its methodology is undergoing review and may be revised or enhanced. The licensee is responsible for ensuring that the thrust values calculated to overcome pressure locking for these valves remain valid following implementation of any revisions or enhancements to the ComEd methodology. The staff is reviewing the ComEd methodology and will issue a safety evaluation for the methodology.

- e. 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. These assumptions were based on industry experience. The licensee did not consider that gate valves in systems with a normal operating temperature less than 200 °F were susceptible to thermal binding. Further, the licensee did not consider that flexible wedge gate valves that are shut and that experience a cooldown differential temperature of less than 100 °F, and solid wedge gate valves that are shut and that experience a cooldown differential temperature of less than 50 °F prior to opening, were susceptible to thermal binding.

Operating conditions for the pressurizer PORV block valves 1,2 NC0031B, 0033A, and 0035B exceed these temperature thresholds. In the February 3, 1997, submittal, the licensee stated that valves 1,2 NC0031B, 0033A, and 0035B would be modified before or during the respective unit's Cycle 13 refueling outage. Operability until the valves are modified is demonstrated by the valve bodies and disks being made of the same material with the same coefficient of thermal expansion, the valve bodies being insulated, and favorable operational experience.

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 McGuire, 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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