



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"
VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2
DOCKET NUMBERS 50-424 AND 50-425

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.

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

Enclosure

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 8, 1996, Southern Nuclear Operating Company, Inc., submitted its 180-day response to GL 95-07 for Vogtle Electric Generating Plant, Units 1 and 2. The NRC staff reviewed the licensee's 180-day response and requested additional information in a letter dated May 30, 1996. In letters of June 28 and July 26, 1996, the licensee provided the additional information. 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. 50-424, 425/97-04. The licensee responded to the inspection report findings in a letter dated February 9, 1998. On October 1, 1999, the licensee provided a response to a second request for additional information regarding GL 95-07 forwarded by the NRC staff on July 23, 1999.

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 Southern Nuclear Operating Company, Inc., letters of February 8, June 28, and July 26, 1996, February 9, 1998, and October 1, 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 residual heat removal (RHR) hot leg injection valves, 1/2HV-8840, were considered susceptible to pressure locking. However, the licensee revised their design/licensing basis to not require that these valves be opened during an accident. The NRC considers revising design/licensing basis in accordance with 10 CFR 50.59 an acceptable resolution for eliminating the valves from the scope of 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.

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 were modified to eliminate the potential for pressure locking:

1/2HV-8716A/B	RHR Header Cross-Connect
1/2HV-8802A/B	Safety Injection (SI) to Reactor Coolant System Hot Leg
1/2HV-8811A/B	Containment Sump to RHR
1/2HV-9002A/B	Containment Spray 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 it used a thrust-prediction methodology developed by Commonwealth Edison Company (ComEd) to demonstrate that the following valves are capable of opening during pressure locking conditions:

1/2HV-8000A/B	Pressurizer Power Operated Relief Valve Block
1/2HV-8801A/B	Boron Injection Tank Discharge Isolation
1/2HV-8804A/B	RHR to Charging and SI Pump Suction

The margin between actuator capability and the required thrust for 1/2HV-8801A/B was less than that required for long-term corrective action. As long-term corrective action, the actuators will be replaced with larger actuators to increase the margin to an acceptable value. The actuators are scheduled to be replaced during the Unit 1 refueling outage scheduled for 2000 and the Unit 2 refueling outage scheduled for 1999.

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 long-term corrective action 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. The staff also considers use of the ComEd pressure locking methodology acceptable short-term corrective action provided that there is a positive margin between actuator capability and the thrust required to open the valve during pressure-locking conditions.

- c. The licensee stated that the RHR pump mini-flow valves, 1/2HV-0610 and 1/2HV-0611, are susceptible to pressure locking. As corrective action, the actuator control logic for each valve was modified to utilize the limit switch to minimize the travel of the valve disk into the seat when closing the valve. The valves are set up to shutoff flow but not be leak tight. Procedures were revised to require that diagnostic traces be reviewed to verify that there is not an unwedging load. The NRC staff considers that this is acceptable corrective action to prevent the valves from pressure locking
- d. The licensee stated that procedures were modified to cycle the containment spray pump discharge isolation valves, 1/2HV-9001A/B, following evolutions that could potentially create a pressure-locking condition. 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.
- e. The licensee stated that the RHR loop suction valves, 1/2HV-8701A/B and 1/2HV-8702A/B, are susceptible to thermal induced pressure locking. Plant data demonstrates that the temperature of the valves trends with reactor coolant system (RCS) temperature. The temperature of the valves located adjacent to the RCS (1/2HV-8701B and 1/2HV-8702B) approaches 620°F during a plant heatup. However, prior to opening these valves to place the RHR system in service, the RCS is cooled down to less than 350 °F. The reduction in RCS temperature causes the fluid trapped inside the bonnet of each valve to cool and contract and relieve the pressure inside the bonnet of each valve. The licensee's analysis concluded that valve structural limits and the American Society of Mechanical Engineers Code design stress limits for the body to bonnet fasteners

on valves 1/2HV-8701A/B and 1/2HV-8702A/B are not exceeded. The licensee also stated that operational history demonstrates that these valves have not failed to open due to pressure locking. The NRC staff finds that the analysis and operational history results used by the licensee provide an acceptable approach for resolving 1/2HV-8701A/B and 1/2HV-8702A/B pressure-locking concerns.

- f. 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 licensee stated that the operating conditions for the RHR pump mini-flow valves, 1/2HV-0610 and 1/2HV-0611, exceeded these temperature limitations. The actuator control logic for each valve was modified to utilize the limit switch to minimize the travel of the valve disk into the seat when closing the valve which reduces the potential for the valve to thermally bind. The operating conditions for the turbine driven auxiliary feedwater pump steam admission valves, 1/2HV-5106, also exceeded these temperature limitations. The licensee stated that operating experience demonstrates that these valves are not susceptible to thermal binding.

The screening criteria and operational history results 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 Vogtle Electric Generating 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, the 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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