



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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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"

ST. LUCIE PLANT, UNIT 1

DOCKET NUMBER 50-335

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, 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 U.S. 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 those safety-related

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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 configurations. 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, Florida Power & Light Company (FPL or licensee) submitted its 180-day response to GL 95-07 for St. Lucie, Unit 1. The NRC staff reviewed the licensee's submittal and requested additional information in a letter dated June 26, 1996. In a letter of July 31, 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 50-335, 389/97-11. In a letter dated February 25, 1999, the NRC staff requested additional information. The licensee provided the additional information in a letter dated May 20, 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 FP&L letters of February 13, and July 31, 1996, and May 20, 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. 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 configurations. 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. A flexible wedge pressure locking thrust prediction methodology was used to calculate the thrust required to open the shutdown cooling hot leg suction valves, V-3480, V-3481, V-3651, and V-3652, during pressure-locking conditions. The results of the licensee's flexible wedge pressure locking thrust prediction methodology demonstrates that there is adequate margin between calculated pressure locking thrust and actuator capability.

The licensee stated that the margin between actuator capability and calculated pressure-locking thrust for valves V-3481, V-3651, and V-3652 was less than that required for long-term corrective action. As corrective action, the actuators will be modified to increase actuator capability to obtain the desired margin. These corrective actions are scheduled to be implemented during the Fall 1999 Unit 1 refueling outage.

Pressure locking tests sponsored by the NRC were conducted by Idaho National Engineering and Environmental Laboratory. The results of this testing are documented in NUREG/CR-6611, "Results of Pressure Locking and Thermal Binding Tests of Gate Valves." NUREG/CR-6611 test results demonstrate that the licensee's pressure locking thrust prediction methodology conservatively estimates the thrust required to open a pressure locked flexible wedge gate valve. The staff finds that the licensee's pressure locking thrust prediction methodology provides reasonable assurance that flexible wedge gate valves susceptible to pressure locking are capable of performing their intended safety-related function. 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 pressure locking thrust prediction methodology requirements and revisions are properly implemented. Until more definitive industry criteria are developed, the staff concludes that the licensee's action to address pressure locking of these flexible wedge gate valves is acceptable.

- b. 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 pressurizer power operated relief block valves, V-1403 and V-1405, exceed these temperature thresholds. These valves are position seated which reduces the potential for thermal binding and the licensee stated that specific operational history demonstrated that the valves are not susceptible to thermal binding. Operating conditions for the shutdown cooling hot leg suction valves V-3480, V-3481, V-3651 and V-3652; and shutdown cooling heat exchanger isolation valves V-3452, V-3453, V-3456, and V-3457, also exceed these temperature

thresholds. The licensee stated that specific operational history demonstrated that the valves are not susceptible to thermal binding.

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 St. Lucie, Unit 1, that are susceptible to pressure locking or thermal binding. In addition, the NRC 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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