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NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

GENERIC LETTER 95-07, "PRESSURE LOCKING AND THERMAL

BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES"

CLINTON POWER STATION

DOCKET NUMBER 50-461

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

The regulations at 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 those 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 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 October 16, 1995, Illinois Power Company (IP or the licensee) submitted its 60-day response to GL 95-07 for the Clinton Power Station, and IP submitted its 180-day response by letter dated February 9, 1996. The NRC staff reviewed the submittals and requested additional information in a letter dated May 23, 1996. In letters of June 27 and August 5, 1996, the licensee provided the additional information. On August 25, 1999, the licensee provided a response to a second request for additional information regarding GL 95-07 forwarded by the NRC staff on May 28, 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 Illinois Power Company letters of February 9, June 27, and August 5, 1996, and August 25, 1999, and Licensee Event Report 50-461/98-028-00, 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. 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 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. The licensee stated that the following valves were modified to eliminate the potential for pressure locking:

1E12-F014A/B	Residual Heat Removal (RHR) Heat Exchanger Inlet
1E12-F024A/B	RHR Test Return
1E12-F028A	RHR Containment Spray
1E12-F042A/B/C	Low Pressure Coolant Injection
1E12-F064A/B	RHR Pump Minimum Flow
1E12-F068A/B	RHR Heat Exchanger Outlet
1E21-F005	Low Pressure Core Spray Injection
1E22-F004	High Pressure Core Spray (HPCS) Injection
1E32-F006/007/008/009	Main Steam Isolation Valve Leakage Control
1E51-F013	Reactor Core Isolation Cooling (RCIC) Injection

The licensee stated that it planned to modify the RHR to containment spray valve, 1E12-F028B, to eliminate the potential for pressure locking. As short-term corrective action, the licensee is relying on an operability evaluation to demonstrate that the valve will operate during pressure-locking conditions. The staff finds that the short-term corrective action is acceptable until the modification to eliminate the potential for pressure locking is complete. The valve is scheduled to be modified during the fall 2000 refueling outage.

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 HPCS pump suppression pool suction valve, 1E22-F015, and the RCIC suppression pool suction valve, 1E51-F031, are susceptible to hydraulic induced pressure locking following a containment pressurization event. The licensee's analysis concluded that the actuator for each of these flexible wedge gate valves is capable of opening each valve during pressure-locking conditions. The basis for the licensee's conclusion was that the maximum bonnet pressure during pressure-locking conditions is significantly less than the GL 89-10 opening differential pressure. Therefore, the thrust required to open each valve during differential-pressure conditions significantly exceeds the thrust required to open each valve during pressure-locking conditions. The NRC staff compared the results of a modified industry gate valve thrust equation (doubling the disk area) that is used to calculate the thrust required to open flexible wedge gate valves during pressure-locking conditions. The results of the industry equation substantiated the licensee's analysis that 1E22-F015 and 1E51-F031 are capable of opening during pressure-locking conditions. The staff concludes that the licensee's action to address pressure locking of these flexible wedge gate valves is acceptable.

Pressure locking tests sponsored by the NRC were conducted by Idaho National Engineering and Environmental Laboratory on a flexible wedge 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 conservatively estimated the thrust required to open a pressure-locked flexible wedge gate valve.

- 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 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 Clinton Power Station 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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