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"

SALEM GENERATING STATION, UNITS 1 AND 2

DOCKET NOS. 50-272 AND 50-311

1.0 INTRODUCTION

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 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. In GL 95-07 the NRC requested that, within 180 days of the date of issuance of the GL, each licensee: (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, the NRC staff 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 Commission rules.

In a letter of February 13, 1996, the Public Service Electric and Gas Company (the licensee) submitted its 180-day response to GL 95-07 for the Salem Nuclear Generating Station, Unit Nos. 1 and 2. The NRC staff reviewed the licensee's submittal and requested additional information in a letter dated July 1, 1996. By letters dated August 7 and 30, 1996, the licensee provided the additional information. During the period of January 13 through 24, 1997, the NRC staff performed an inspection to review specific aspects of the information summarized in the licensee's responses to GL 95-07. This inspection was documented in NRC Inspection Report No. 50-272, 311/97-03, dated April 3, 1997. Subsequently, the NRC staff requested additional information in a letter to the licensee dated June 10, 1997. By letters dated July 24 and August 22, 1997, and May 24, 1999, the licensee provided the additional information.

ENCLOSURE

2.0 EVALUATION

2.1 Background

Pressure locking and thermal binding of gate valves 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.

2.2 Scope of Licensee's Review

In GL 95-07, the NRC staff 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. In its letters of February 13, August 7 and 30, 1996, July 24 and August 22, 1997, and May 24, 1999, the licensee described the scope of valves evaluated in response to GL 95-07 at Salem. 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. The NRC 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."

2.2 Licensee Corrective Actions

In GL 95-07, the NRC requested that licensees 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:

11/12/21/22CS36	Residual Heat Removal (RHR) to Containment Spray
1/2RH1	Reactor Coolant System (RCS) Hot Leg Suction
1/2RH2	RCS Hot Leg Suction
11/12/21/22RH19	RHR Heat Exchanger Discharge Cross Connect
1/2SJ1	Refueling Water Storage Tank (RWST) to Charging and Safety Injection (SI) Pumps
1/2SJ2	RWST to Charging and SI Pumps
1/2SJ12	Boron Injection Tank Outlet
1/2SJ13	Boron Injection Tank Outlet
11/12/21/22SJ40	SI Pump Discharge to RCS Hot Legs
11/12/21/22SJ44	Containment Sump to RHR Pump Suction
11/12/21/22SJ45	RHR to SI and Charging Pumps Suction
11/12/21/22SJ113	RHR to SI and Charging Pumps Suction

The NRC 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. A flexible wedge pressure locking thrust prediction methodology was developed by the licensee and was used to calculate the thrust required to open the pressurizer power operated relief valve (PORV) block valves, 1/2PR6 and 1/2PR7, 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.

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." The 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.

c. The licensee stated that procedures were modified to cycle the containment spray header isolation valves, 11/12/21/22CS2, following evolutions that could potentially create a pressure-locking condition. The licensee stated that the boron injection tank inlet isolation valves, 1/2SJ4 and 1/2SJ5, were susceptible to pressure locking when closed for testing and that procedures were modified to maintain these valves open during surveillance testing. The staff finds that the licensee's procedural changes to require cycling the valves or maintaining the valves in the open position provide assurance that pressure-locking conditions are adequately identified and eliminated, and are thus acceptable.

d. The licensee stated that the RHR to RCS hot leg injection valves, 1/2RH26, are susceptible to pressure locking but are not opened until approximately 14 hours after the initiating event. These valves are not exposed to thermal induced pressure-locking conditions during the 14-hour period and seat leakage during the 14-hour period is credited to eliminate the potential for the valves to pressure lock. The staff finds the licensee's pressure locking analysis acceptable.

e. The licensee stated that flexible and solid wedge gate 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. A thermal binding thrust prediction methodology was developed by the licensee and was used to calculate the thrust required to open valves when operating conditions exceeded the temperature thresholds. The licensee used its thermal binding thrust prediction methodology to demonstrate that the RHR heat exchanger component cooling system outlet isolation valves, 11/12/21/22CC16, and that the pressurizer PORV block valves, 1/2PR6 and 1/2PR7, would operate during thermal-binding conditions. However, adequate test data are not available to the NRC staff to evaluate the licensee's thermal binding thrust prediction methodology.

During a telephone conversation conducted on May 12, 1999, the licensee clarified the operating conditions for 11/12/21/22CC16, 1/2PR6 and 1/2PR7. The licensee explained that the temperature of valves 11/12/21/22CC16 does not exceed 200°F and that cooldown of valves 1/2PR6 and 1/2PR7 would not exceed 100°F when the valves are required to open during a steam generator tube rupture accident. The NRC staff considers these operating conditions to be consistent with the thermal binding temperature thresholds developed by the industry in other GL 95-07 submittals.

Until more definitive industry criteria are developed, the NRC staff concludes that the temperature thresholds used to address thermal binding of gate valves are acceptable.

3.0 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 Salem Units 1 and 2 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.

Principal Contributor: S. Tingen

Date: June 23, 1999

If you have any questions regarding this matter, please contact me at (301) 415-1457.

Sincerely,

ORIGINAL SIGNED BY:

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Docket Nos. 50-272 and 50-311

Enclosure: Safety Evaluation

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