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"

SEABROOK STATION, UNIT 1

DOCKET NO. 50-443

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* Part 50 (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 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. 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 dated February 13, 1996, North Atlantic Energy Service Corporation submitted its 180-day response to GL 95-07 for Seabrook Station, Unit 1. The NRC staff reviewed the licensee's submittal and requested additional information in a letter dated July 17, 1996. In a letter dated August 15, 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. 50-443/98-08. On August 11 and November 8, 1999, the licensee provided responses to the NRC staff's second request for information that was forwarded to the licensee on June 30, 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 North Atlantic Energy Service Corporation letters of February 13 and August 15, 1996, and August 11 and November 8, 1999, and NRC Inspection Report No. 50-443/98-08 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 to be 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 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:

CBS-V-8	Containment Recirculation Sump Isolation
CBS-V-14	Containment Recirculation Sump Isolation
RC-V-22	Residual Heat Removal (RHR) Pump Hot Leg Suction
RC-V-23	RHR Pump Hot Leg Suction
RC-V-87	RHR Pump Hot Leg Suction
RC-V-88	RHR Pump Hot Leg Suction
RH-V-32	RHR Hot Leg Recirculation Supply
RH-V-70	RHR Hot Leg Recirculation Supply
SI-V-77	Safety Injection (SI) to Hot Legs
SI-V-102	SI to Hot Legs

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 operating during pressure-locking conditions:

RC-V-122	Pressurizer Power Operated Relief Valve (PORV) Block
RC-V-124	Pressurizer PORV Block
SI-V-138	Charging Pump Supply to Cold Legs
SI-V-139	Charging Pump Supply to Cold Legs

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 provided the methodology limitations are incorporated into the pressure-locking calculations. In its letter dated November 8, 1999, the licensee stated that it applied a 15% margin to account for ComEd methodology uncertainty and variations in the static unseating load,

a 5% margin for diagnostic test equipment uncertainty repeatability, and a 5% uncertainty for control switch repeatability. These uncertainties are based on the licensee's evaluation of the ComEd test data and are combined using the square root sum of the squares method to determine an acceptable margin. The NRC considers the use of the ComEd pressure-locking methodology acceptable provided this margin is incorporated into the pressure-locking calculations for rigid valves only. ComEd pressure-locking test results indicate that a higher margin is needed for flexible valves. 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 ensuring that valves susceptible to pressure locking are capable of performing their intended safety-related function.

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

CBS-V-11	Containment Spray Header A Isolation
CBS-V-17	Containment Spray Header B Isolation
RH-V-35	RHR Pump Discharge to SI/Charging Pumps
RH-V-36	RHR Pump Discharge to SI/Charging Pumps

In its letter dated November 8, 1999, the licensee clarified that valves RH-V-35 and RH-V-36 will only be cycled if the time from RHR shutdown to entering Mode 3 is less than 12 hours. Since the temperature of the valves does not significantly increase during the 12-hour period, it is acceptable to assume that pressure in the bonnets will decay after 12 hours. 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 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 the RHR pump hot leg suction valves, RC-V-22, RC-V-23, RC-V-87 and RC-V-88, exceed these temperature limitations; however, operational history demonstrates that the valves are not susceptible to thermal binding. Operating conditions for the PORV Block Valves, RC-V-122 and RC-V-124, exceed these temperature limitations. The actuators for these valves are equipped with spring compensators and are position seated which reduces the potential for the valves to thermally bind. Operational history verified that these 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 the Seabrook Station, 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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