March 8, 2000

Mr. James Scarola, Vice President
Shearon Harris Nuclear Power Plant
Carolina Power & Light Company
Post Office Box 165, Mail Code: Zone 1
New Hill, North Carolina 27562-0165

SUBJECT: SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1 - EVALUATION OF GENERIC LETTER 95-07 RESPONSE (TAC NO. M93469)

Dear Mr. Scarola:

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 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.

By letters dated February 13 and August 19, 1996, May 26, 1997, and September 29 and December 30, 1999, Carolina Power & Light Company (CP&L) provided its responses to GL 95-07, and to NRC requests for additional information regarding the responses, for the Shearon Harris Nuclear Power Plant (HNP). As discussed in the enclosed Safety Evaluation, the NRC staff has reviewed the submittals and finds that CP&L has adequately addressed the actions requested in GL 95-07 for HNP.

Sincerely,

/RA/

Richard J. Laufer, Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-400

Enclosure: Safety Evaluation

cc w/encl: See next page

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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 MOTOR-OPERATED GATE VALVES,”

SHEARON HARRIS NUCLEAR POWER PLANT

DOCKET NUMBER 50-400

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* (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 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 GL: (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 GL, 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, Carolina Power & Light Company (CP&L) submitted its 180-day response to GL 95-07 for the Shearon Harris Nuclear Plant (HNP). The NRC staff reviewed the licensee's submittal and requested additional information in a letter dated July 2, 1996. In a letter of August 19, 1996, the licensee provided the additional information. In a letter of May 26, 1997, the licensee updated several GL 95-07 commitments. On September 29 and December 30, 1999, the licensee provided responses to a request for additional information regarding GL 95-07 forwarded by the NRC staff on April 14, 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 CP&L letters of February 13 and August 19, 1996, May 26, 1997, and September 29 and December 30, 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 low head safety injection (SI) to reactor coolant system (RCS) hot leg valve 1SI-359, and the residual heat removal (RHR) cross-tie valves 1SI-326 and 1SI-327, are not included in the scope of GL 95-07 because the HNP licensing basis credits redundant charging SI pump hot leg recirculation/injection paths for providing flow to the RCS hot legs. 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 it used a thrust-prediction methodology developed by Commonwealth Edison Company (ComEd) (for the industry to use) to demonstrate that the following valves are capable of opening during pressure-locking conditions:

1SI-3 Boron Injection Tank Outlet
1SI-4 Boron Injection Tank Outlet

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. The NRC considers the use of the ComEd pressure-locking methodology acceptable provided these margins, diagnostic equipment accuracy requirements and methodology limitations are incorporated into the pressure-locking calculations. The CP&L letter of December 30, 1999, describes the licensee's method for determining minimum margins. The licensee accounts for accuracies associated with its test equipment and variances in static unwedging force. The NRC 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.

b. The licensee stated that it used the ComEd thrust-prediction methodology to demonstrate that the following valves are capable of operating during pressure-locking conditions:

1SI-86	Normal High Head SI to RCS Hot Leg
1SI-107	Alternate High Head SI to RCS Hot Leg

The margin between actuator capability and the thrust required for the valves to open during pressure-locking conditions is positive but less than that required for long-term corrective action. The licensee also credited seat leakage over a 6.5-hour period as short-term corrective action to justify the reduction of the pressure in the bonnets of the valves. The leakage rate was based on test data obtained from similar valves.

As a long-term corrective action, the actuators are scheduled to be modified to increase thrust and margin during the refueling outage scheduled for the spring of 2000. The NRC staff finds that the licensee's short-term and long-term actions provide reasonable assurance that the valves are capable of operating during pressure-locking conditions, and are thus acceptable.

c. The licensee stated that it used the ComEd thrust-prediction methodology to demonstrate that the following valves are capable of operating during pressure-locking conditions:

1SI-52	High Head SI to RCS Cold Leg
1RC-113	Pressurizer Power Operated Relief Valve (PORV) Block
1RC-115	Pressurizer PORV Block
1RC-117	Pressurizer PORV Block

In its letter to the NRC dated May 29, 1999, ComEd stated that its pressure-locking methodology was developed and validated for balanced and near balanced pressure-locking conditions (the difference between upstream and downstream pressure is not significant when compared to the difference between the bonnet pressure and upstream (downstream) pressure). In its letter dated December 30, 1999, CP&L stated that pressure-locking conditions for valves 1RC-113, 1RC-115, 1RC-117, and 1SI-52 do not meet the ComEd pressure-locking methodology balanced conditions. As a short-term corrective action, a maximum prediction error based on dynamic test results was used to compensate for the unbalanced conditions. As long-term corrective actions, the actuators are scheduled to be modified to increase thrust output during the refueling outage scheduled for the spring of 2000. The margins between calculated pressure-locking thrust and actuator capability will exceed 100% following the completion of the modifications. The NRC staff finds that the licensee's short-term and long-term actions provide reasonable assurance that the valves are capable of operating during pressure-locking conditions, and are thus acceptable.

d. The licensee also stated that the boron injection tank inlet valves 1SI-1 and 1SI-2 are susceptible to pressure locking and will operate for up to 1.5 seconds at locked-rotor conditions following a loss-of-offsite power concurrent with emergency core cooling system automatic initiation. It takes a maximum of 1.5 seconds for a charging SI pump to develop full discharge pressure and equalize pressure across the upstream disk of each valve. Pressure-locking conditions do not exist once the pressure across the upstream disk is equalized.

The NRC staff accepts operation of ac-powered motor actuators for short periods at locked-rotor conditions (approximately 1 second) because testing performed by Idaho National Engineering and Environmental Laboratory (NUREG/CR-6478) demonstrates that the capability of the actuator does not significantly degrade.

e. The licensee stated that procedures require that: (1) the piping between the RHR pump sump suction valves, 1SI-300 and 1SI-301, and the containment sump; and (2) the piping between the containment spray pump suction valves 1CT-102 and 1CT-105, and the containment sump, be filled with water to a level that maintains approximately 24 feet of filled vertical piping between the valves and the containment sump to insulate the valves from the hot, post-accident sump fluid. The staff finds that the licensee's procedural change to fill the piping between 1SI-300, 1SI-301, 1CT-102, and 1CT-105 and the containment sump provide assurance that thermal pressure-locking conditions are eliminated, and is an acceptable corrective action.

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

1CT-50	Containment Spray Pump Discharge
1CT-88	Containment Spray Pump Discharge
1RH-25	RHR Pump to Charging/SI Pump Suction
1RH-63	RHR Pump to Charging/SI Pump Suction
1SI-300	Containment Sump to RHR Pump
1SI-301	Containment Sump to RHR Pump
1SI-310	Containment Sump to RHR Pump
1SI-311	Containment Sump to RHR Pump

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.

c. The licensee stated that the following valves will be modified to eliminate the potential for pressure locking during the refueling outage scheduled for the fall of 2001:

1SI-322	RHR Pump Suction From Refueling Water Storage Tank (RWST)
1SI-323	RHR Pump Suction From RWST

For the short-term, operational experience representative of pressure-locking conditions was used to demonstrate operability of the valves. The staff finds that operational experience provides reasonable assurance that the valves will be operable until the planned modifications to prevent pressure locking are completed as scheduled. The staff finds that physical modification to valves susceptible to pressure locking is an appropriate long-term corrective action to ensure operability of the valves, and is thus acceptable.

h. The licensee stated that the RHR pump suction valves 1RH-1, 1RH-2, 1RH-39, and 1RH-40 are susceptible to pressure locking. The licensee stated that these valves are periodically opened during pressure-locking conditions and that operational history demonstrates that these valves have not failed to open due to pressure locking. These valves are not required to open to mitigate any of the accidents analyzed in Chapter 15 of the Final Safety Analysis Report. These valves are normally opened during plant

cooldown when full design voltage is available to the actuators. Also, there are two redundant RCS hot leg flow paths available to accomplish this function. The NRC staff finds that the analysis and operational history results provide an acceptable approach for resolving 1RH-1, 1RH-2, 1RH-39, and 1RH-40 pressure-locking concerns.

i. 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 pressurizer PORV block valves 1RC-113, 1RC-115, and 1RC-117, and the RCS to RHR pump suction valves 1RH-2 and 1RH-40, exceeded the temperature thresholds. The licensee stated that procedures require that valves 1RC-113, 1RC-115, and 1RC-117 be opened prior to cooling the plant to prevent the valves from thermal binding and that operating experience demonstrated that valves 1RH-2 and 1RH-40 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 HNP 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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Date: March 8, 2000

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