North Atlantic

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The Northeast Utilities System

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U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555-0001

Seabrook Station
Response to Second Request for Additional Information
Regarding Generic Letter 95-07,
"Pressure Locking and Thermal Binding
of Safety-Related Power-Operated Gate Valves"

North Atlantic Energy Service Corporation (North Atlantic) has enclosed a response to the second request for additional information regarding Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," that was requested via a June 30, 1999 letter.

Should you have any questions regarding this information, please contact James M. Peschel, Regulatory Compliance Manager, at (603) 773-7194.

Very truly yours,

NORTH ATLANTIC ENERGY SERVICE CORP.

Ted C. Feigenbaum
Executive Vice President and
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cc:
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ENCLOSURE 1 TO NYN-99075

Response to Second Request for Additional Information Regarding Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"

Request No. 1:

Your August 15, 1996, submittal states that the charging pump discharge to the cold leg valves, SI-V138 and SI-V139, are not susceptible to pressure locking because a charging pump is operating when the valves receive a signal to open. The staff requests that North Atlantic Energy Service Corporation reevaluate the potential for valves SI-V138 and SI-V139 to pressure lock in the event that a charging pump is not operating when the valves receive a signal to open and discuss the results of the evaluation. The evaluation should explain (1) when the valves are sequenced to automatically open in relationship to the automatic restart of a charging pump on a loss of off-site power concurrent with a loss of coolant accident, (2) if there are any pressure locking scenarios where the valves will operate at locked rotor conditions until a charging pump develops full discharge pressure, and (3) if applicable, long-term corrective action, and any short-term corrective action to ensure operability, if long-term corrective action is not complete.

The NRC has approved the operation of motor-operated valve motor actuators for approximately 1 second at locked rotor conditions as acceptable corrective action for Generic Letter (GL) 95-07 because testing performed by Idaho National Engineering & Environmental Laboratory (NUREG/CR-6478) demonstrated that the capability of the actuator does not degrade for that period of time. If applicable, explain how long valves SI-V138 and SI-V139 would operate at locked rotor conditions. If greater than approximately 1 second, then explain how any reduction in actuator capability due to operation at locked rotor was accounted for or describe any testing that demonstrates that actuator capability will or will not degrade after operating at locked rotor for greater than approximately 1 second.

During a telephone conversation conducted on May 20, 1999, you stated that you were considering the use of the Commonwealth Edison (ComEd) pressure locking thrust prediction methodology to demonstrate that the valves would operate during pressure locking conditions. ComEd recommends that, when using its pressure locking thrust prediction 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 an acceptable long-term corrective action provided these margins, diagnostic equipment accuracy requirements and methodology limitations are incorporated into the pressure locking calculations. If applicable, discuss how you implemented the ComEd pressure locking thrust prediction methodology guidelines discussed in the May 29, 1998, letter.

Response to Request No. 1:

On a loss of offsite power coincident with a safety injection signal, SI-V138 and SI-V139 receive a signal to open at the same time that the charging pumps receive a signal to start. This occurs at the first step of the diesel generator sequencer.

The bonnets of SI-V138 and SI-V139 are susceptible to becoming pressurized. These valves are normally in the close position during operation. The upstream side of the valve is pressurized to the discharge pressure of the operating charging pump (~2400 psig). The downstream side of the valve is pressurized to reactor coolant pressure. If one postulates a large break LOCA coincident with a Loss of Offsite Power, the upstream and downstream pressure could be reduced to approximately 50 psig. North Atlantic's original response credited the upstream pressure recovering to the discharge pressure of the charging pump during the valve opening sequence. This was based on the fact that both of these components receive signals to start at diesel generator sequencer step 1.

Subsequently, the actuators for SI-V138 and SI-V139 were replaced with larger actuators (DCR 98-009). The larger size actuators have additional capability to unseat these valves against a differential pressure, pressure locking scenario. The Commonwealth Edison Pressure Locking Methodology was used to assure that adequate actuator capability exists to unseat a pressure locked valve. Based on this methodology, the calculated thrust to unseat a pressure locked valve under the assumed conditions (2400 psig in the bonnet and 50 psig upstream and downstream) is 17,419 lbf for SI-V138 and 16,445 lbf for SI-V139. These thrust values have compensated for the uncertainty in the peak unseating thrust value. Additionally, inaccuracy allowances for instrument uncertainty and limit switch repeatability (valves close on limit switch control) were applied to the static peak unseating value.

The Commonwealth Edison methodology adequately predicts the pressure locking forces of valves provided the evaluation considers the usual uncertainties (equipment accuracy, etc.) associated with thrust calculations. The development of this methodology was partially funded by the Westinghouse Owners Group (WOG). The WOG has initiated a project to revisit the Commonwealth Edison pressure locking methodology to assess the appropriate margins/uncertainties to be considered. North Atlantic does not expect the WOG assessment to change the results for the Westinghouse valves, since these valves are forged valves and rigidly designed. One Westinghouse valve was tested in the development of the methodology. The pressure locking methodology accurately predicts pressure locking forces for rigid valves.

Presently, North Atlantic does not add a minimum margin value between the predicted pressure locking unseating thrust and the actuator capability. However, as stated above, the peak unseating thrusts have been adjusted for diagnostic test equipment uncertainty and limit switch repeatability.

North Atlantic retained MPR Associates to review friction data at valve unwedging to determine the mean friction coefficient, standard deviation and a recommended maximum coefficient of friction. At valve unwedging, the recommended maximum friction coefficient based on static test results was 0.120. Based on dynamic test results the maximum recommended coefficient of friction was 0.117. Therefore, the 0.12 friction coefficient at valve unwedging is an appropriate value to use to determine the actuator derated capability for this condition.

Based on the static test results, the actual measured coefficient of friction at peak unseating for SI-V138 was 0.076 and 0.111 for SI-V139. The actuator derated thrust capability based on a 0.12 friction coefficient is:

- 23,845 lbf for SI-V138 and
- 26,196 lbf for SI-V139.

The resulting margins for SI-V138 and SI-V139 are as follows:

Margin for SI-V138 is (23,845 lbf - 17,419 lbf)/ (17,419 lbf) or 36.9%.
Margin for SI-V139 is (26,196 lbf - 16,445 lbf)/ (16,445 lbf) or 59.3%.

In conclusion, SI-V138 and SI-V139 have adequate derated actuator capability to open under the postulated pressure locking conditions.

Request No. 2:

Your GL 95-07 submittals do not address if the residual heat removal (RHR) to safety injection and charging pump suction valves, RH-V35 and RH-V36, are susceptible to pressure locking. The NRC staff requests that North Atlantic Energy Service Corporation discuss the potential for valves RH-V35 and RH-V36 to pressure lock in the event that (1) the bonnets of these valves become pressurized during shutdown cooling or RHR pump surveillance evolutions, and then required to open later at a lower RHR pump discharge pressure, (2) if the temperature of these valves increases when operating the RHR system during a plant heatup, and (3) if applicable, long-term corrective action, and any short-term corrective action to ensure operability if long-term corrective action is not complete.

During a telephone conversation conducted on May 20, 1999, you stated that you were considering the use of the ComEd pressure locking thrust prediction methodology to demonstrate that the valves would operate during pressure-locking conditions. If applicable and not previously addressed, discuss how you implemented the ComEd pressure locking thrust prediction methodology guidelines discussed in the May 29, 1998, letter.

Response to Request No. 2:

RH-V35 and RH-V36 are the RHR cross connect valves to the charging and safety injection pump suctions. The bonnets of these valves could potentially become pressurized during shutdown cooling operations. However, during shutdown cooling operation, one Train of RHR is aligned for shutdown cooling and the other Train is aligned for Emergency Core Cooling System (ECCS) injection. Therefore, a maximum of one of the bonnets of these valves could be potentially pressurized during shutdown cooling/plant heat up operation. During shutdown cooling/plant heat up operation the RHR suction pressure could be as high as 365 psig. These valves are not required to open following shutdown cooling operation. Likewise, during RHR pump surveillance testing, the bonnet pressures of these valves could increase. However, during surveillance testing the RHR discharge pressure is significantly less than suction pressure during shutdown cooling or heat up operation. During Modes 1 through 4, surveillance testing is performed with the suction aligned to the Refueling Water Storage Tank (RWST) and the RHR pump is operated on minimum flow recirculation. As a result, the bonnet pressure could increase to the RHR pump discharge pressure (approximately 250 psig). Additionally, the valve bonnets have the potential for being pressurized if the RHR to Reactor Coolant System (RCS) check valves leak during normal power operation.

As part of the transition to ECCS Cold Leg Recirculation, these valves are opened early in the switchover process. Both the environment temperature and the bonnet temperature would not have time to heat up appreciably during this relatively short period of time and the bonnet temperature would be at approximately ambient temperature. Therefore, these valves are not susceptible to temperature induced pressure locking. Prior to the cross connect valves opening, one of the RHR cold leg injection isolation valves, RH-V14 or RH-V26, is closed. This action prevents run out of the RHR pumps. The pump discharge pressure during valve opening would be approximately the same as during ECCS injection. This condition is not susceptible to pressure locking.

In Hot Shutdown operation, Mode 4, one Train of RHR is in operation to support plant heatup or cooldown. During this operational alignment, the redundant RHR Train is in its ECCS injection alignment. RH-V35 and RH-V36 are closed in both alignments. The bonnet temperature of the valve in the RHR Train that is used for shutdown cooling would not increase appreciably. RH-V35 is located approximately 17.5 feet from the RHR discharge header. RH-V36 is approximately 42 feet from the RHR discharge header. The maximum temperature in the RCS (T_{AVE}) when the RHR System is used for cooling is 350°F. The branch connection off the RHR discharge header is just downstream of the applicable RHR heat exchanger. The process temperature is much less than the RCS temperature at this branch connection. Therefore, it is reasonable to conclude that these valves are not susceptible to temperature induced pressure locking under these conditions. However, as stated above, the redundant RHR Train would be in its ECCS Cold Leg Injection alignment. During Hot Shutdown operation, the valve bonnet of the valve in the operating train could be pressurized to a maximum of approximately 565 psig (365 psig from RCS and approximately 200 psig from RHR pump head).

If the RHR check valves to the RCS leaked, RHR pressure could increase to a maximum pressure of approximately 600 psig. This is the set pressure of the RHR relief valves. This condition should only be temporary, since Operators would attempt to seat the leaking check valves. Seating of the leaking check valves, if this condition existed, should occur at a pressure much less than 600 psig (probably 100 - 200 psig). At this time, Seabrook Station has not experienced leaking RHR check valves that result in significant pressure increase of the RHR discharge header. If this condition exists, the valve bonnet has the potential of being pressurized to a maximum pressure of 600 psig. Upstream pressure when the valve is required to open is approximately 200 psig, the RHR pump discharge pressure. Downstream pressure would be RWST pressure, which is assumed to be 30 psig.

The Commonwealth Edison Pressure Locking Methodology was used to assure that adequate actuator capability exists to unseat a pressure locked valve for the worst case described above. Based on this methodology, the required thrust to unseat a pressure locked valve under the assumed conditions (600 psig in the bonnet and 200 psig upstream and 30 downstream) is 17,890 lbf for RH-V35 and 17,129 lbf for RH-V36.

Both of these valves have been dynamically and statically tested. The open dynamic/static friction coefficients at peak unseating are:

- 0.036/0.086 for RH-V35
- 0.02/0.012 for RH-V36

Using a 0.12 friction coefficient at peak unseating results in a degraded capability of :

- 18,939 lbf for RH-V35, and
- 19,128 lbf for RH-V36.

See the response to Request No. 1 for justification for using a 0.12 coefficient of friction at valve unwedging. It should be noted that the degraded actuator capability is based on the minimum reduced voltage of 428 volts for RH-V35 and 430 volts for RH-V36.

As stated above, North Atlantic does not add a minimum margin value between the predicted pressure locking unseating thrust and the actuator capability. However, the peak unseating thrusts have been adjusted for diagnostic test equipment uncertainty and torque switch repeatability.

The resulting margins for RH-V35 and RH-V36 are as follows:

Margin for RH-V35 is (18,939 lbf - 17,890 lbf)/ (17,890 lbf) or 5.9 %.
Margin for RH-V36 is (19,128 lbf -17,129 lbf)/ (17,129 lbf) or 11.7 %.

Based on the available margin, RH-V35 and RH-V36 have adequate capability to open under the postulated pressure locking conditions.