Union Electric

One Ameren Plaza
1901 Chouteau Avenue
PO Box 66149
St. Louis, MO 63166-6149
314.621.3222

May 19, 1999

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555-0001

Gentlemen:

ULNRC-4037
TAC No. MA 93443

AmerenUE

DOCKET NUMBER 50-483
CALLAWAY PLANT
UNION ELECTRIC COMPANY
NRC GENERIC LETTER 95-07
PRESSURE LOCKING AND THERMAL BINDING OF MOV GATE VALVES

References:
1) ULNRC-3277 dated October 10, 1995
2) ULNRC-3327 dated February 9, 1996
3) ULNRC-3333 dated February 15, 1996
4) ULNRC-3395 dated June 24, 1996
5) NRC Request for Additional Information dated March 15, 1999

References 1 through 4 provide previous Union Electric/AmerenUE correspondence to NRC concerning Generic Letter 95-07. This letter provides responses to request for additional information transmitted by Reference 5.

Although Reference 5 requested a response within 30 days of receipt, the Staff has agreed that a response with 60 days of receipt was acceptable. If you have additional questions please contact us.

Sincerely,

David Shafer
for Alan C. Passwater
Manager, Corporate Nuclear Services

A056

DS/jdg

Attachments

STATE OF MISSOURI)
)   S S
CITY OF ST. LOUIS)

David Shafer, of lawful age, being first duly sworn upon oath says that he is Supervising Engineer, Corporate Nuclear Services, Regulatory Operations for Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By David Shafer
David Shafer
Supervising Engineer,
Regulatory Operations,
Corporate Nuclear Services

SUBSCRIBED and sworn to before me this 19th day of May, 1999.

Thomas J. Bokern

THOMAS J. BOKERN
NOTARY SEAL
NOTARY PUBLIC
STATE OF MISSOURI

THOMAS J. BOKERN
NOTARY PUBLIC--STATE OF MISSOURI
ST LOUIS COUNTY
MY COMMISSION EXPIRES JULY 5, 2000

cc: M. H. Fletcher
Professional Nuclear Consulting, Inc.
19041 Raines Drive
Derwood, MD 20855-2432

Regional Administrator
U.S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive
Suite 400
Arlington, TX 76011-8064

Senior Resident Inspector
Callaway Resident Office
U.S. Nuclear Regulatory Commission
8201 NRC Road
Steedman, MO 65077

Mr. Mel Gray (2)
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
1 White Flint, North, Mail Stop 13E16
11555 Rockville Pike
Rockville, MD 20852-2738

Manager, Electric Department
Missouri Public Service Commission
P.O. Box 360
Jefferson City, MO 65102

Ron Kucera
Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102

Denny Buschbaum
TU Electric
P.O. Box 1002
Glen Rose, TX 76043

Pat Nugent
Pacific Gas & Electric
Regulatory Services
P.O. Box 56
Avila Beach, CA 93424

AMERENUE RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION CONCERNING GENERIC LETTER 95-07

NRC Question 1

The containment recirculation sump to residual heat removal (RHR) and containment spray pump suction valves, EJHV8811A/B and ENHV0001/7, were modified to eliminate the potential for the valves to pressure lock. Describe the modification and any calculations used to demonstrate that the valves are not susceptible to pressure locking. Explain why EJHV8811A/B are not susceptible to pressure locking following operation of RHR system in the shutdown cooling mode, RHR pump surveillance testing and RHR injection.

AmerenUE Response

Callaway modification 96-1025 installed an air expansion pipe to each of the four containment recirculation sump valves. An air volume of 2.3 gallons was attached to the bonnet of each valve. The presence of this free volume provides space for water expansion to address thermally induced pressure locking concerns. AmerenUE calculations EN-10 and EJ-27 evaluated the size of the expansion pipes, and determined the resultant maximum pressure increase in the valve bonnets. Considering the maximum pressure increase in the valve bonnets, AmerenUE calculation EJ-21 then determined the thrust required to open with the additional loads due to pressure in the valve bonnets. The four containment recirculation sump valves were verified to have sufficient capability to open considering the calculated thrust requirements.

Three scenarios for pressurizing the bonnet of valves EJHV8811A/B are listed. Two of the scenarios, RHR pump surveillance testing and RHR pump injection, have a negligible impact. These valves are located on the suction side of the RHR pumps, and are normally exposed to the static head of the Refueling Water Storage Tank (RWST). Surveillance testing or operation during the injection phase of an accident response does not change this. These valves receive an open signal at low RWST level. The only pressure reduction is a slow decrease from the changing elevation of the RWST level. Since the valves are continuously exposed to a slowly decreasing pressure, the valve bonnet would not pressure lock. Additionally, the magnitude of the pressure change (about 30 psi) is insignificant.

When the RHR system is aligned for shutdown cooling, the RHR pump suction is aligned to the Reactor Coolant System (RCS) hot leg. RCS pressure is procedurally limited to 440 psig in procedure OTG-ZZ-00001 in order to not challenge the RHR suction relief valves, set at 450 psig. With these valves exposed to the RHR pump suction pressure, the bonnets could be exposed to a pressure of 440 psig.

The scenario postulated is that the plant reaches Normal Operating Pressure (NOP) and Normal Operating Temperature (NOT) before the pressure in the valve bonnet is relieved. A design basis accident occurs such that the RHR system is required to be aligned for cold leg recirculation and valves EJHV8811A/B are required to open.

When terminating shutdown cooling, procedure OTG-ZZ-00001 requires the RHR system to be secured prior to the RCS temperature reaching 205 degrees F. Plant data from the 5 most recent plant startups indicates the time it takes to reach Mode 3 from this point as follows:

April, 1995	Refuel 7 Startup	41 hours, 21 minutes
May, 1995	Repair RCP Seal Leak	4 hours, 40 minutes
October, 1995	Excess Letdown Leak	9 hours, 25 minutes
November, 1996	Refuel 8 Startup	6 hours, 22 minutes
April, 1998	Refuel 9 Startup	38 hours, 18 minutes

Plant Mode 3 is entered at a RCS temperature of 350 degrees F. At the Technical Specification maximum heatup rate, it would take an additional 2 hours to reach normal operating temperature.

Based on the above plant data, a conservative estimate of the shortest time in which the plant could reach NOP/NOT after securing the RHR system from shutdown cooling is 6 hours. In this 6 hour period the pressure in the bonnet would be reduced significantly. Post LOCA, valves EJ-HV-8811A/B are not opened until the switch to cold leg recirculation, providing additional margin (time) to allow for a reduction in valve bonnet pressure.

The Westinghouse Owners Group (WOG) performed testing to determine depressurization rates for water trapped inside of valve bonnets. Based on these test results, conservative depressurization rates were developed for use by the WOG utilities. At bonnet pressures of less than 500 psig, a depressurization rate of 1 psi/min was provided for utility use. Therefore, over a 6 hour period, the valve bonnets can be predicted to depressurize by 360 psig.

AmerenUE calculation EJ-21, Rev. 0 Addenda 3 has been performed to calculate the required thrust to open valves EJ-HV-8811A/B assuming the valve bonnets are pressurized. Using the 1 psi/min. depressurization rate, the valve bonnet pressure would be reduced to approximately 80 psi when required to open. The calculation results show that valves EJHV8811A/B have excess thrust available when opening under this postulated scenario. Therefore, these valves remain capable of performing their required safety function under this scenario.

<u>NRC Question 2</u>

By letter dated June 24, 1996, Union Electric (UE) indicated that the boron injection tank outlet valves, EMHV8801A/B, are not susceptible to pressure locking because there is a large margin between actuator capability and the thrust required to overcome differential pressure, the valves are inservice tested, and the downstream piping is monitored to ensure that it is not pressurized from reactor coolant system leakage. The reasoning that a large margin exists between actuator capability and the thrust required to overcome differential pressure, and inservice testing demonstrate that these valves are not susceptible to pressure locking in these valves. In addition, explain how downstream piping is monitored and what actions are taken if the header becomes pressurized. Either clarify your basis or provide appropriate actions to ensure that pressure locking is not a concern for these valves.

<u>AmerenUE Response</u>

As noted in AmerenUE's previous discussion for EMHV8801A/B, these valves have excess capacity when opening against their design differential pressure of 2713 psid, which is 478 psi greater than normal RCS pressure.

Valves EMHV8801A/B receive a signal to open at the same time as the start signal for their respective CCP. Therefore, if the valve bonnet is pressurized and the CCP is not running or a loss of off-site power has occurred, the valve may attempt to operate for a short period of time under a locked rotor condition until the CCP develops sufficient discharge pressure. Once sufficient pump discharge pressure is developed against one side of the valve, any pressure in the valve bonnet will not have a significant impact on the required opening forces.

To determine the time period for which a locked rotor condition could exist, the Inservice Testing (IST) results for the CCPs over the last 8 years were reviewed. From these test results the maximum measured pump spin-up (to full speed) for the CCPs was found to be 1.50 seconds. As shown in the following discussion, the subject valves would remain capable of operating after experiencing locked rotor conditions for this short period of time (<1.5 seconds).

If normal (rated) voltage is present, these valves have sufficient available thrust to open. Only when a degraded voltage situation is present could the valves attempt to operate under a locked rotor condition.

The ability of the valve(s) to remain operable after experiencing a locked rotor condition is dependent on the MOV motor(s) not reaching a thermal limit, which would cause the motor to fail. In order to remain operable, the MOV motor must be able to withstand the heating caused by the electric current seen during the time spent at the locked rotor condition. It is a normal function of the motor design to be able to withstand the locked rotor current and running current without causing damage or failure of the motor. The MOV(s) may be under a locked rotor condition until the CCP develops sufficient discharge head to reduce the pressure locking forces.

The ability of the MOV motors to withstand a locked rotor current is shown on Reliance A-C Motor Performance curves. The curve applicable to the motors on EM-HV-8801A/B and EM-HV-8803A/B is provided as an attachment to RFR 16843C. The curve shows that the motors will see a heat rise of 90 degrees C when attempting to operate with a locked rotor current of 26 amps (460Vac) for 10 seconds. The end of the curve is taken as a maximum limit. The thermal capacity of the motor is a function of the locked rotor current (which varies with motor terminal voltage) and time (Ref. IEEE Std. 741-1990 Appendix B). Therefore, the ten second limit will vary with the locked rotor current. At a low voltage, such as degraded voltage conditions, the locked rotor current will be lower and, as a result, the locked rotor safe time longer than ten seconds.

Using the WOG/ComEd method, pressure locking calculation EM-21, Rev. 0 was performed to determine what upstream pressure was required for valves EMHV8801A/B to open using the required degraded voltage for input. Assuming the bonnets are pressurized to 2235 psig, EMHV8801A will open when upstream pressure reaches 1350 psig, and EMHV8801B will open when upstream pressure reaches 1600 psig. IST test results from the last 4 years indicate that these valves stroke in 10 seconds or less. The maximum allowed stroke time is 15 seconds. Therefore, in the event that these valves cannot operate for a short period of time (< 1.5 seconds) due to a locked rotor condition, they are still capable of performing their safety function within the required time frame.

NRC Question 3

By letter dated June 24, 1996, UE indicated that the boron injection tank inlet valves, EMHV8803A/B, are not susceptible to pressure locking because the charging pump is operating when the valves are required to open. With a loss of off-site power, do the valves open when the charging pumps are not operating or are the valves sequenced to open after a charging pump has started and developed full discharge pressure? Are there any pressure locking scenarios where the valves will operate at locked rotor conditions until the charging pump develops full discharge pressure?

AmerenUE Response

Valves EMHV8803A/B are similar to valves EMHV8801A/B in that they also receive a signal to open at the same time as the start signal for their respective CCP. Therefore, if the valve bonnet is pressurized and the CCP is not running or a loss of off-site power has occurred, the valve may attempt to operate for a short period of time under a locked rotor condition until the CCP develops sufficient discharge pressure. Once sufficient pump discharge pressure is developed against one side of the valve, any pressure in the valve bonnet will not have a significant impact on the required opening forces.

To determine the time period for which a locked rotor condition could exist, the Inservice Testing (IST) results for the CCPs over the last 8 years were reviewed. From these test results the maximum measured pump spin-up (to full speed) for the CCPs was found to be 1.50 seconds. As shown in the following discussion, the subject valves would remain capable of operating after experiencing locked rotor conditions for this short period of time (<1.5 seconds).

If normal (rated) voltage is present, these valves have sufficient available thrust to open. Only when a degraded voltage situation is present could the valves attempt to operate under a locked rotor condition.

The ability of the valve(s) to remain operable after experiencing a locked rotor condition is dependent on the MOV motor(s) not reaching a thermal limit, which would cause the motor to fail. In order to remain operable, the MOV motor must be able to withstand the heating caused by the electric current seen during the time spent at the locked rotor condition. It is a normal function of the motor design to be able to withstand the locked rotor current and running current without causing damage or failure of the motor. The MOV(s) may be under a locked rotor condition until the CCP develops sufficient discharge head to reduce the pressure locking forces.

The ability of the MOV motors to withstand a locked rotor current is shown on Reliance A-C Motor Performance curves. The curve applicable to the motors on EM-HV-8801A/B and EM-HV-8803A/B is provided as an attachment to RFR 16843C. The curve shows that the motors will see a heat rise of 90 degrees C when attempting to operate with a locked rotor current of 26 amps (460Vac) for 10 seconds. The end of the curve is taken as a maximum limit. The thermal capacity of the motor is a function of the locked rotor current (which varies with motor terminal voltage) and time (Ref. IEEE Std. 741-1990 Appendix B). Therefore, the ten second limit will vary with the locked rotor current. At a low voltage, such as degraded voltage conditions, the locked rotor current will be lower and, as a result, the locked rotor safe time longer than ten seconds.

Using the WOG/ComEd method, pressure locking calculation EM-20, Rev. 0 was performed to determine what upstream pressure was required for valves EMHV8803A/B to open. Assuming the bonnets are pressurized to 2235 psig, EMHV8803A will open when upstream pressure reaches 500 psig, and EMHV8803B will open when upstream pressure reaches 1300 psig. IST test results from the last 4 years indicate that these valves stroke in 10 seconds or less. The maximum allowed stroke time is 15 seconds. Therefore, in the event that these valves cannot operate for a short period of time (< 1.5 seconds) due to a locked rotor condition, they are still capable of performing their safety function within the required time frame.

NRC Question 4

By letter dated June 24, 1996, UE indicated that the pressurizer power operated relief valve (PORV) block valves, BBHV8000A/B, are not a pressure locking concern. These valves are a pressure locking concern at other Westinghouse plants for steam generator tube rupture events. The pressure locking evaluations assume 2235 psig in the bonnet of the valves (parallel disk or flexible wedges and steam or water in the valve bonnet) and a reactor coolant system pressure of approximately 1400-1500 psig. Typically, these valves are modified or a calculation is used to demonstrate that the valves will operate during this pressure locking scenario. Explain why pressure locking is not a concern for the Callaway pressurizer PORV block valves.

AmerenUE Response

At Callaway, the PORV block valves are normally open. However, one or both may be closed to isolate excessive seat leakage past a PORV. Following a Steam Generator Tube Rupture (SGTR) accident, one PORV and block valve are assumed to open in order to reduce RCS pressure.

In operating under this scenario, the RCS will typically have partially depressurized due to cooldown. Pressure locking scenarios have been typically characterized by a more rapid depressurization of the pressure source. Therefore, this condition was not addressed in detail in AmerenUE's prior reviews.

However, assuming pressure in the valve bonnet remains at normal RCS pressure, and a subsequent RCS depressurization to 1400 psig, the PORV block valves have sufficient capacity to open. AmerenUE calculation BB-143, Revision 0 has been performed evaluating operation of these valves. Valves BB-HV-8000A/B have sufficient thrust capability to open under the assumed post SGTR conditions.

NRC Question 5

Explain why the RHR to charging pump suction valves, EJHV8804A/B, and RHR to safety injection pump suction valves, EMHV8807A/B, are not susceptible to pressure locking. Discuss if the bonnets of these valves could be pressurized during shutdown cooling, RHR pump surveillance testing, and RHR pump injection, and if these valves would be required to open later at a lower RHR pump discharge pressure.

AmerenUE Response

Valves EMHV8807A & B are not exposed to RHR pump discharge pressure under the operating conditions presented in this question. Valves EJHV8804A/B are normally closed, preventing RHR pump discharge pressure from reaching EMHV8807A & B. Therefore, a pressure locking concern as described above does not exist for valves EMHV8807A & B.

Three scenarios for pressurizing the bonnet of valves EJ-HV-8804A/B are listed. Two of the scenarios, RHR pump surveillance testing and RHR pump injection, have negligible impact. In these two cases, the RHR suction source is the RWST. In post accident operation. These valves would continually be exposed to the discharge head of their respective RHR pump.

These valves receive an open signal at low RWST level. Since the valves are continuously exposed to a slowly decreasing pressure, the valve bonnet would not pressure lock, but decrease in pressure following the discharge pressure of the pump.

The difference in pressure is attributed to lowering RWST level by about 28 feet (12 psi) and RHR pump increased flow (45 psi max.). This relatively small difference, occurring while the pump is continually running, does not meet the requirements for pressure locking conditions.

When the RHR system is aligned for shutdown cooling, suction is from the Reactor Coolant System (RCS) hot leg. RCS pressure is procedurally limited to 440 psig in OTG-ZZ-00001 in order to not challenge the RHR suction relief valves, set at 450 psig. With a maximum differential pump pressure of 200 psig, the bonnets of these valves could be exposed to a pressure of 640 psig.

The scenario postulated is that the plant reaches Normal Operating Pressure (NOP) and Normal Operating Temperature (NOT) before the pressure in the valve bonnet is relieved. A design basis accident occurs such that the RHR system is required to be aligned for cold leg recirculation and valves EJHV8804A/B are required to open.

April, 1995	Refuel 7 Startup	41 hours, 21 minutes
May, 1995	Repair RCP Seal Leak	4 hours, 40 minutes
October, 1995	Excess Letdown Leak	9 hours, 25 minutes
November, 1996	Refuel 8 Startup	6 hours, 22 minutes
April, 1998	Refuel 9 Startup	38 hours, 18 minutes

Plant Mode 3 is entered at a RCS temperature of 350 degrees F. At the Technical Specification maximum heatup rate, it would take an additional 2 hours to reach normal operating temperature.

Based on the above plant data, a conservative estimate of the shortest time in which the plant could reach NOP/NOT after securing the RHR system from shutdown cooling is 6 hours. In this 6 hour period the pressure in the bonnet would be reduced significantly. Post LOCA, valves EJ-HV-8804A/B are not opened until the switch to cold leg recirculation, providing additional margin (time) to allow for a reduction in valve bonnet pressure.

The Westinghouse Owners Group performed testing to determine depressurization rates for water trapped inside of valve bonnets. As a result of these tests, conservative depressurization rates were developed for use by the WOG utilities. At bonnet pressures between 500 and 1000 psig, a depressurization rate of 2.5 psi/min was provided. At bonnet pressures from 0 to 500 psig, a depressurization rate of 1 psi/minute was provided. Therefore, over a 6 hour period, the valve bonnets are predicted to depressurize by approximately 440 psig. Using these depressurization rates, the valve bonnet pressure at the time when it is required to operate would be 200 psig. At this time, the RHR pump discharge pressure is approximately 180 psi (10 psig RWST suction & 170 psi pump DP). Note: It is assumed that the RHR pump flow rate is higher post LOCA than during shutdown cooling, therefore its DP is lower.

AmerenUE calculation EJ-30, Revision 0 has been performed to calculate the required thrust to open valves EJ-HV-8804A/B assuming the valve bonnets are pressurized. The calculation results show that valves EJHV8804A/B have excess thrust available when opening under this postulated scenario. Therefore, these valves remain capable of performing their required safety function under this scenario.

NRC Question 6

Explain why containment spray pump discharge valves, ENHV0006 and ENHV0012, are not susceptible to pressure locking following operation of the containment spray pumps with the discharge valves shut. Are there any pressure locking scenarios where the valves will operate at locked rotor conditions until the containment spray pump develops full discharge pressure?

AmerenUE Response

Historically, the quarterly Inservice Testing of the containment spray pump and its associated discharge valve has been performed on the same day. To address the potential pressure locking scenario identified by the NRC, the Callaway Plant surveillance procedure task sheets will be revised to sequence the valve stroke test to be performed after the pump run has been completed. If the bonnet were pressurized, the pressure will be relieved when the valve is opened.

With this sequencing of the Inservice Testing activities, there is not any scenarios where these valves will attempt to operate under locked rotor conditions.