50-237

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 28, 1997

Ms. Irene Johnson, Acting Manager
Nuclear Regulatory Services
Commonwealth Edison Company
Executive Towers West III
1400 Opus Place, Suite 500
Downers Grove, IL 60515

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR GENERIC LETTER 95-07 - RELATED TO BRAIDWOOD, UNITS 1 AND 2; BYRON, UNITS 1 AND 2; ZION, UNITS 1 AND 2; QUAD CITIES, UNITS 1 AND 2; DRESDEN, UNITS 2 AND 3; AND LASALLE, UNITS 1 AND 2 (TAC NOS. M93434, M93435, M93441, M93442, M93458, M93459, M93477, M93478, M93509, M93510, M93541 AND M93542)

Dear Ms. Johnson:

On August 17, 1995, the NRC issued Generic Letter (GL) 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves." The GL requested 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. The staff reviewed Commonwealth Edison Company's 180-day response dated February 13, 1996, to the GL for each of its six facilities. On April 2, 1996, and May 20, 1996, the staff issued requests for additional information (RAIs) to complete its review. The May 20, 1996, RAI was eventually superseded. On May 24, 1996, ComEd responded to the RAI of April 2, 1996. On June 5, 1996, a second RAI was issued. ComEd responded to the second RAI in letters dated July 5, 1996, August 15, 1996 (Zion only), and November 20, 1996 (Quad Cities only). The staff has reviewed ComEd's submittals and RAI responses and has determined that additional information, as discussed in the enclosure, is necessary to complete its review.

The information requested by this letter is within the scope of the overall burden estimated in Generic Letter 95-07, "Pressure Locking and Thermal

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Binding of Safety-Related Power-Operated Gate Valves," which was a maximum of 75 hours per response. This request is covered by Office of Management and Budget Clearance Number 3150-0011, which expires July 31, 1997.

Sincerely,

ORIGINAL SIGNED BY:

Clyde Y. Shiraki, Project Manager
Project Directorate III-2
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-454, STN 50-455,
STN 50-456, STN 50-457, 50-237,
50-249, 50-373, 50-374, 50-254,
50-265, 50-295 and 50-304

Enclosure: RAI

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REQUEST FOR ADDITIONAL INFORMATION

BRAIDWOOD, UNITS 1 AND 2; BYRON, UNITS 1 AND 2;

DRESDEN, UNITS 2 AND 3; LASALLE, UNITS 1 AND 2;

QUAD CITIES, UNITS 1 AND 2; AND ZION, UNITS 1 AND 2

RESPONSES TO GENERIC LETTER 95-07, "PRESSURE LOCKING AND THERMAL

BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES"

During a meeting on April 9, 1997, Commonwealth Edison Company (ComEd) discussed the development and use of its pressure locking thrust prediction methodology and the test data used to evaluate acceptability of its methodology. ComEd presented its pressure locking test results from a 4-inch (1500-pound) Westinghouse valve, a 10-inch (900-pound) Crane valve, and a 10-inch (300-pound) Borg-Warner valve in support of the methodology. ComEd also presented test results from Idaho National Engineering and Environmental Laboratory (INEEL) on a 6-inch (600-pound) Walworth valve and from the Electric Power Research Institute on a 6-inch Velan valve in support of its methodology. ComEd stated that a pressure locking load anomaly was identified when testing the Borg-Warner valve. Kalsi Engineering, Inc., presented enhancements being developed for the ComEd pressure locking methodology that will account for the anomaly identified when testing the Borg-Warner valve.

The following request is based on ComEd's presentation at the April 9, 1997, meeting:

1. In some instances, the ComEd pressure locking prediction methodology underestimated the amount of thrust required to open the Walworth valve under pressure locking conditions and consistently underestimated the amount of thrust required to open the Borg-Warner valve under pressure locking conditions. The staff understands that enhancements to the ComEd pressure locking thrust prediction methodology are being evaluated.

   a. Is the ComEd pressure locking thrust prediction methodology (current or enhanced version) applicable to all flexible wedge gate valves or is the methodology limited to specific flexible wedge gate valves?

   b. Discuss the criteria for determining the flexible wedge gate valves to which the ComEd pressure locking prediction methodology is applicable.

ENCLOSURE

2. The ComEd pressure locking prediction model does not account for differential pressure across the disk hub.

   Explain why this parameter does not need to be addressed.

3. When using its pressure locking prediction methodology, ComEd recommends a 20% or 40% margin between actuator capability and the calculated pressure locking thrust value.

   Explain the basis and application requirements for the individual elements of this margin.

4. Unwedging force is one of the parameters of the ComEd pressure locking prediction methodology. INEEL testing identified that the force required to unwedge a valve can significantly deviate as the valve is repeatedly stroked closed and then reopened.

   How is this variance in unwedging force accounted for in the ComEd pressure locking prediction methodology?

BRAIDWOOD, UNITS 1 AND 2; AND BYRON, UNITS 1 AND 2

The following request is based on ComEd's Braidwood and Byron GL 95-07 responses dated February 13, 1996, and July 5, 1996:

1. The February 13, 1996, submittal stated that valves 1(2)CC9412, component cooling water from residual heat removal (RHR) heat exchanger, are not susceptible to pressure locking. The Zion GL 95-07 submittal (same date) stated that these valves are susceptible to pressure locking.

   Explain why these valves are not susceptible to pressure locking at Braidwood and Byron.

2. The February 13, 1996, submittal stated that valves 1(2)CS009A, B, containment spray pump sump suction, are potentially susceptible to thermal induced pressure locking due to heating from the containment recirculation sump. The pressure locking analysis concluded that the valves were not susceptible because heat transfer would have to occur through approximately 9 feet of piping to heat these valves.

   a. Is this piping vertical or horizontal?

   b. If this piping is horizontal, provide the results of the heat transfer calculations.

3. The February 13, 1996, submittal stated that valves 1(2)CV8804, RHR to charging pump suction, are susceptible to heating during Mode 4 operation.

   a. Explain why thermal-induced pressure locking during Mode 4 would not overpressurize and damage the valves.

   b. Why are these valves not susceptible to thermal binding when the shutdown cooling system is secured and the valves cooled down?

   c. If applicable, provide the results of the heat transfer calculations.

4. The February 13, 1996, submittal, stated that some valves are susceptible to pressure locking, but are not in the scope of GL 95-07 because the valves are required to open during a Mode 4 loss-of-coolant accident (LOCA) which is outside the design basis of the plant.

   a. Explain why a Mode 4 LOCA is outside the plant design basis.

   b. Describe any Mode 4 emergency core cooling systems operability requirements.

5. The February 13, 1996, submittal stated that valves 1(2)RH610/611, RHR pump miniflow, are susceptible to pressure locking and thermal binding

and that operators could manually open the valves via the handwheels if the valves pressure lock or thermally bind.

Provide calculations that demonstrate that a pressure locked or thermally bound valve can be opened with the handwheel.

6. NUREG-1275, Volume 9, "Operating Experience Feedback Report - Pressure Locking and Thermal Binding of Gate Valves," discusses thermal binding and pressure locking events in which operators were unable to manually open the affected valves.

   a. Discuss whether radiation levels during the recirculation mode of operation would prohibit operators from entering the area where the valves are located when attempting to open the valves with the handwheel.

   b. Discuss whether the pumps would be damaged due to deadheading.

7. The February 13, 1996, submittal stated that valves 1(2)RH8701A, B/8702A, B, RHR from reactor coolant system suction, were not susceptible to thermal binding because the temperature differential experienced by these valves is not expected to be greater than 250 degrees Fahrenheit and that this temperature differential is not expected to cause thermal binding based on ComEd testing.

   a. Provide the test procedure/results that accomplished this testing and the information necessary for the staff to evaluate the similarity between these valves and the test valves.

   b. Provide calculations that demonstrate that the actuators can open 1(2)RH8701A, B/8702A, B following a cooldown.

8. In the February 13, 1996, submittal, it is not clear whether the valves (in 7. above) are susceptible to pressure locking. The staff considers that there could be reactor coolant system (RCS) normal operating pressure in the bonnets of the valves when opening the valves to place shutdown cooling in service. NUREG-1275 describes events at other nuclear power stations in which these valves would not open due to pressure locking.

   a. Clarify whether these valves are susceptible to pressure locking.

   b. If applicable, provide the basis for concluding that valve leakage is acceptable as a long-term corrective action for pressure locking.

9. The February 13, 1996, submittal stated that valves 1(2) SI8811A, B, containment sump suction, will be modified to prevent pressure locking.

a. Describe the modification.

b. If the modification increased actuator capability, provide pressure locking calculations and actuator capability calculations that demonstrate that the valves will open during pressure locking conditions.

10. The July 5, 1996, submittal stated that calculations demonstrated that valves 1(2)RY8000A, B, pressurizer power operated relief valve (PORV) isolation, would open during a pressure locking condition. The pressure locking calculation concluded that the margin between required pressure locking predicted thrust and actuator capability was 5.2 percent. The ComEd pressure locking prediction methodology recommends a minimum of 20 percent or 40 percent margin, depending on how actuator capability was determined.

Explain why a margin of 5.2 percent is acceptable as a long-term corrective action for pressure locking.

11. Calculations assume that a pressurizer PORV block valve is shut at 2235 psig and opened at 350 psig to mitigate a steam generator tube rupture or to place the low temperature overpressure protection system in service. Assuming saturated steam conditions, this represents a cooldown that exceeds 200 degrees Fahrenheit.

a. Explain why the pressurizer PORV block valves are not susceptible to thermal binding.

b. If testing is used to demonstrate that the valves are not susceptible to thermal binding, provide the test procedure/results and the information necessary to evaluate the similarity between the pressurizer PORV block valves and the test valves.

c. Provide the calculations that demonstrate that the actuators are capable of opening the pressurizer PORV block valves following a cooldown.

12. The July 5, 1996, submittal stated that valves 1(2)SI8801A, B, charging pump to RCS cold legs, might initially pressure lock when attempting to open, such that the actuators' motors would be incapable of unseating the valves and would undergo locked rotor conditions. However, the charging pumps would start and the discharge pressure applied to the upstream side of each valve would equalize bonnet pressure allowing the valves to open.

a. Provide actuator capability calculations that demonstrate that the actuators could develop adequate thrust following operation at locked rotor conditions.

b. Explain why the thermal overloads would not trip the motor during locked rotor conditions.

13. The July 5, 1996, submittal stated that bonnet leakage over an 8-hour period would reduce the amount of thrust required to overcome pressure locking for valves 1(2)SI8802A, B, safety injection pump to RCS hot legs, and 1(2)SI8840, RHR pump to RCS hot legs. Bonnet depressurization rates for gate valves tested by ComEd were used to determine bonnet depressurization rates for valves 1(2)SI8802A, B and 1(2)SI8840. The staff considers it difficult to demonstrate that valve leakage is an acceptable long term pressure locking corrective action. NUREG-1275 describes an event at another nuclear power station in which a valve remained pressure locked approximately 9 to 10 hours after the system was depressurized.

    a. Provide the test procedure/results used to determine the bonnet depressurization rates.

    b. Provide the information necessary to evaluate the similarity between valves 1(2)SI8802A,B and 1(2)SI8840 and the test valves.

    c. Discuss whether these valves are susceptible to thermal-induced pressure locking during cold leg recirculation.

    d. If applicable, provide the results of heat transfer calculations.

14. The July 5, 1996, submittal stated that the worst case pressure locking scenario for valves 1(2)SI8802A, B would occur during the transfer from cold to hot leg recirculation. The pressure locking calculation concluded that the margin between calculated pressure locking thrust and actuator capability was 1.7 percent. The ComEd pressure locking prediction methodology recommends a minimum of 20 percent or 40 percent margin depending on how actuator capability was determined.

    Explain why a margin of 1.7 percent is acceptable as long-term corrective action for pressure locking.

15. The February 13, 1996, submittal states that valves in systems that contain compressible gases are not susceptible to pressure locking except when steam can condense and accumulate in a valve bonnet.

    a. Explain why valve bonnets that contain compressible gases are not susceptible to hydraulic pressure locking.

    b. What valves were eliminated from the scope of GL 95-07 with this screening criterion?

DRESDEN, UNITS 2 AND 3

The following request is based on ComEd's Dresden GL 95-07 responses dated February 13, 1996, and July 5, 1996:

1. The February 13, 1996, submittal describes safety-related valves that were determined to be susceptible to pressure locking or thermal binding and corrective actions. However, the submittal did not describe safety-related gate valves that were not susceptible to pressure locking or thermal binding. For example, valves 2(3)-2301-36, high pressure core injection suppression pool suction, were not addressed in your February 13, 1996, submittal. In a request for additional information dated June 5, 1996, the staff asked why these valves were not susceptible to thermal induced pressure locking. ComEd's July 5, 1996, submittal, explained that they were solid wedge gate valves and, therefore, not susceptible to pressure locking.

   Describe any safety-related gate valves that were not addressed in either the February 13, 1996, or July 5, 1996, submittal and explain why the valves were determined not to be susceptible to pressure locking or thermal binding.

2. NRC Inspection Reports 50-237/96015 and 50-249/96015 identified a concern with the corrective action associated with valves 2(3)-1301-3, isolation condenser condensate return outboard isolation, in that there was a potential for creating a thermal binding condition during the performance of the 5-year isolation condenser test. In response to this concern, based on a cooldown curve, ComEd developed an action item to modify the existing procedures to include a cycling frequency for these valves.

   Discuss the long-term corrective action implemented to prevent thermal binding of these valves following performance of the 5-year isolation condenser test.

3. The February 13, 1996, submittal stated that Unit 3 valves, 3-1001-1A, B, shutdown cooling supply inboard isolation, would be modified to prevent pressure locking when maintenance is performed on the valves' internals. The staff has found that there could be RCS normal operating pressure in the bonnets of the valves when opening the valves to place shutdown cooling in service. NUREG-1275 describes events at other nuclear power stations in which these valves would not open due to pressure locking and thermal binding.

   a. Have these valves been modified?

   b. If they have not been modified, explain why pressure locking is not a concern when placing the shutdown cooling system in service.

   c. In addition, discuss the reasons these valves are not susceptible to thermal binding.

LASALLE, UNITS 1 AND 2

The following request is based on ComEd's LaSalle GL 95-07 responses dated February 13, 1996, and July 5, 1996:

1. The February 13, 1996, submittal, stated that valves 1(2)E12-F016A, B/F017A, B, drywell spray valves, are not required to be evaluated for pressure locking and thermal binding because no credit is taken for drywell spray in any design basis accident analysis. However, in NEDO-24782, the Boiling Water Reactor (BWR) Owners acknowledged the spray mode of the RHR system in BWRs as "essential." Drywell spray, while not credited for mitigation of a design basis LOCA, provides a potentially important means of reducing drywell pressure and temperature, and for reducing structural loads due to steam vent chugging phenomena (Reference: "Initiation of Wetwell Spray at the Suppression Chamber Spray Initiation Pressure," OEI Document 8390-4A Emergency Procedure Guideline). In addition, some licensees take credit for use of drywell spray cooling in the qualification of electrical equipment in containment.

   a. Include valves 1(2)E12-F016A, B/F017A, B in the scope of GL 95-07.

   b. Provide the information requested by GL 95-07 for valves susceptible to pressure locking or thermal binding for these valves.

2. The February 13, 1996, submittal stated that valves 1(2)E22-F012, high pressure core spray (HPCS) pump minimum flow, are susceptible to thermal-induced pressure locking. The submittal stated that this was not a significant concern because operator action is credited for securing a HPCS pump if deadheaded due to the failure of the valve to automatically open. The staff considers that these valves have a safety function to automatically open to support a HPCS pump restart and prevent pump damage due to deadheading. If operators did secure the pump due to the failure of the valve to open, the valve would have to be opened to restart the pump. If the valve is pressure locked, operators may not be able to open the valve with the handwheel. NUREG-1275 discusses pressure locking events in which operators were unable to manually open pressure locked valves with the handwheel.

   ComEd is requested to re-evaluate the pressure locking analysis for valves 1(2)E22-F012 and provide the results of the re-evaluation.

3. The February 13, 1996, submittal states that valves in systems that contain compressible gases are not susceptible to pressure locking except when steam can condense and accumulate in a valve bonnet.

   a. Explain why valve bonnets that contain compressible gases are not susceptible to hydraulic pressure locking.

   b. What valves were eliminated from the scope of GL 95-07 with this screening criterion?

QUAD CITIES, UNITS 1 AND 2

The following request is based on ComEd's Quad Cities GL 95-07 responses dated February 13, 1996, July 5, 1996, and November 20, 1996:

1. The February 13, 1996, submittal stated that valves 1(2)-1001-18A,B, RHR pump minimum flow valves, are not susceptible to thermal binding.

   Discuss why the valves are not susceptible to thermal binding following operation in shutdown cooling and during the injection and recirculation modes of operation.

2. The February 13, 1996, submittal stated that valves 1(2)-1001-43A, 43B, 43C, 43D, 47, 50, shutdown cooling suction, do not have a safety function to open.

   Discuss the safety-related systems that are used to cool down the units.

3. The February 13, 1996, submittal stated that valves 1(2)-1001-34A, 34B, suppression pool cooling isolation, are not susceptible to pressure locking.

   Discuss why these valves are not susceptible to pressure locking.

4. The February 13, 1996, submittal states that valves in systems that contain compressible gases are not susceptible to pressure locking except when steam can condense and accumulate in a valve bonnet.

   a. Explain why valve bonnets that contain compressible gases are not susceptible to hydraulic pressure locking.

   b. What valves were eliminated from the scope of GL 95-07 with this screening criterion?

ZION, UNITS 1 AND 2

The following request is based on ComEd's Zion GL 95-07 responses dated February 13, 1996, July 5, 1996, and August 15, 1996:

1. The February 13, 1996, and July 5, 1996, submittals stated that calculations were used to demonstrate that valves 1(2)SI9011A, B, safety injection pump discharge to RCS hot leg, are capable of opening under pressure locking conditions. A double disk gate valve pressure locking prediction methodology was used to calculate the thrust required to open the valves during pressure locking conditions.

   a. Provide the test procedure/results that validated this pressure locking prediction methodology and the information necessary to evaluate the similarity between valves 1(2)SI9011A, B and the test valves.

   b. Recent pressure locking testing sponsored by the NRC and performed by INEEL indicated that thrust requirements exceeded double disk pressure locking prediction calculation results. The results of this testing have been placed in the Public Document Room. Provide pressure locking calculations and actuator capability calculations that demonstrate that the valves will open during pressure locking conditions.

2. The pressure locking calculation for valves 1(2)SI9011A, B provided in the July 5, 1996, submittal stated that ambient temperature at the valves may increase to 126.5 degrees Fahrenheit during a design basis accident.

   Assuming that the valves' bonnets are pressurized to RCS normal operating pressure when a design basis accident occurs, discuss the highest expected bonnet pressure and if this pressure could damage the valves. NUREG-1275 describes an event at another nuclear power station in which a valve was damaged from the pressure increase caused by heatup of the water entrapped in the bonnet and between the disks and would not fully open.

3. The July 5, 1996, submittal stated that valves, 1(2)RC8000A, B, pressurizer PORV block valves, are not susceptible to thermal binding because RCS cooldown and subsequent pressurizer PORV openings are a common evolution and years of industry operating experiences have not shown problems with thermal binding.

   Discuss operating experience for the valves at Zion that support this conclusion. Include historical wedging and unwedging forces and modifications implemented that may have made the valves more susceptible to pressure locking. For example, increasing the closed torque switch setting causes the disk to wedge more tightly into the seat making the valve more susceptible to thermal binding.

4. The February 13, 1996, submittal stated that operation of the RHR pumps at shutoff head would heat up the component cooling water side of the RHR heat exchanger causing the temperature to increase at valves 1(2)CC9412A, B, RHR heat exchanger component cooling outlet. The submittal stated that a calculation concluded that the temperature rise is below the level of concern for thermally induced pressure locking. It was also assumed in the calculation that operators would secure the RHR pumps within 30 minutes if the pumps were operating at shutoff head.

   a. Provide the calculation that determined the temperature increase at valves 1(2)CC9412A, B when the RHR pumps are operating at shutoff head.

   b. Explain why thermal induced pressure locking is not a concern.

   c. Discuss the basis for the assumption that the operators would secure the RHR pumps within 30 minutes if they are operating at shutoff head.

5. The February 13, 1996, submittal stated that valves 0PRV-DG0039 and 1(2)PRV-DG0065/DG0066, emergency diesel generator lube oil, were not evaluated for pressure locking because small valves (less than or equal to 1.5 inches) are typically solid wedge design.

   How did ComEd verify that these valves are solid wedge?

6. The February 13, 1996, submittal stated that valves in systems that contain compressible gases are not susceptible to pressure locking except when steam can condense and accumulate in a valve bonnet.

   a. Explain why valve bonnets that contain compressible gases are not susceptible to hydraulic pressure locking.

   b. What valves were eliminated from the scope of GL 95-07 with this screening criterion?