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NLS960027
February 13, 1996

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

Subject: 180 - Day Response to Generic Letter 95-07
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

References:
1. NRC Generic Letter 95-07, dated August 17, 1995, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"
2. Letter from Horn, NPPD to US NRC, dated October 13, 1995, "60 - Day Response to Generic Letter 95-07"

The Nebraska Public Power District (District) has completed the evaluations and actions requested in Generic Letter (GL) 95-07 as stated in the District's October 13, 1995 response (Reference 2). This letter describes the evaluations performed and actions taken to respond to pressure locking/thermal binding of safety-related power-operated valves and fulfills the 180-day reporting requirements of GL 95-07.

The CNS Updated Safety Analysis Report does not specify repositioning of valves from their test positions to their normal standby positions as part of the safety design basis for the CNS Core Standby Cooling Systems. Therefore, it is the District's position that return of these valves to their standby condition following surveillance testing is not an active safety function and not within the scope of GL 95-07. However, the District did evaluate the susceptibility of essential power-operated gate valves during such operations as previously discussed in our November 16, 1995 teleconference with NRC staff members.

As a result of the requested evaluation of operational configurations of safety-related power-operated gate valves at CNS, the District initially determined fourteen valves to be susceptible to pressure locking. Further analysis was performed on eight of these valves that determined that they were not susceptible to pressure locking. Six valves had been determined to be susceptible to pressure locking and modifications for bonnet pressure relief implemented. No valves were found susceptible to thermal binding. The response to the specific information requested by Generic Letter 95-07 is provided in the attachment to this letter. As required in GL 95-07, the District is submitting this response under oath.

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Please contact me if you have any questions concerning this issue, or if you require any additional information.

Sincerely,

G. B. Horn
Vice President, Nuclear

cc: Regional Administrator
USNRC - Region IV

Senior Resident Inspector
USNRC - Cooper Nuclear Station

Senior Project Manager
USNRC - NRR Project Directorate IV-1

NPG Distribution

STATE OF NEBRASKA)
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PLATTE COUNTY)

G. R. Horn, being first duly sworn, deposes and says that he is an authorized representative of the Nebraska Public Power District, a public corporation and political subdivision of the State of Nebraska; that he is duly authorized to submit this response on behalf of Nebraska Public Power District; and that the statements contained herein are true to the best of his knowledge and belief.

G. R. Horn

Subscribed in my presence and sworn to before me this

13th day of February, 1996.

NOTARY PUBLIC

GENERAL NOTARY-State of Nebraska
RITA L. PFLASTERER
My Comm. Exp. Dec. 13, 1999

180 Day Response to Generic Letter 95-07
Pressure Locking and Thermal Binding of Safety Related Power Operated Valves

I. INTRODUCTION

Based on concerns regarding the potential for pressure locking and thermal binding (PL/TB) of safety-related power-operated gate valves, the NRC issued Generic Letter 95-07, requesting nuclear power plant licensees to evaluate the issue. Generic Letter 95-07 specifically requested that licensees perform or confirm that they previously performed: (1) evaluations of operational configurations of safety-related, power-operated (including motor-, air-, and hydraulically operated) gate valves for susceptibility to PL/TB and (2) further analyses and any needed corrective actions to ensure that safety-related power-operated gate valves that are susceptible to PL/TB are capable of performing the safety functions within the current licensing bases of the facility. The Nebraska Public Power District (District) has completed the requested actions for Cooper Nuclear Station (CNS), as committed in its October 13, 1995 letter to the NRC.[1]

II. DISCUSSION

The specific evaluations performed and corrective actions taken to address the PL/TB issue for CNS is provided below, in response to the Generic Letter 95-07 reporting requirements.

Requested Information

[Provide a summary description of] 1. The susceptibility evaluation of operational configurations performed in response to (or consistent with) 180-day Requested Action 1, and the further analyses performed in response to (or consistent) with 180-day Requested Action 2, including the bases or criteria for determining that valves are or are not susceptible to pressure locking or thermal binding.[2]

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1. Letter from G. R. Horn (NPPD) to NRC dated October 13, 1995, "60-Day Response to Generic Letter 95-07."

2. The requested actions were: "1. Perform a screening evaluation of the operational configurations of all safety-related power-operated (i.e., motor-operated, air-operated, and hydraulically operated) gate valves to identify those valves that are potentially susceptible to pressure locking or thermal binding; and 2. Document a basis for the operability of the potentially susceptible valves or, where operability cannot be supported, take action in accordance with individual plant Technical Specifications."

Response

The evaluation of the susceptibility of CNS essential power operated gate valves for PL/TB commenced with the identification of scope, by valve group. All essential power-operated valves (POVs) were identified and classified by valve and disc type. Since the PL/TB phenomenon is limited to gate valve designs, other valve designs such as globe and butterfly valves were screened out as not susceptible to PL/TB and the evaluation for these valve types closed.

The population of essential gate valves was classified by disc type. Pressure locking is limited to valve designs where fluid can become entrained between the disc surfaces. If the disc faces can move independently in the lateral direction, pressure buildup between the disc surfaces can force the discs against their seating surfaces resulting in increased seat forces. Thermal binding is limited to those gate valve designs that do not allow significant movement between the disc seating surfaces to overcome forces resulting from differential thermal contraction. Accordingly, depending on service conditions, parallel disc and flexible wedge gate valves can be susceptible to pressure locking and solid and flexible wedge gate valves can be susceptible to thermal binding. All wedge-type gate valves were conservatively assumed to contain flexible wedge type discs which can be susceptible to both pressure locking and thermal binding.

At the time of its initial response to Generic Letter 95-07, the District was preparing to shut down CNS to enter a refueling and maintenance outage. Therefore, those valves that had been specifically modified to preclude pressure locking, or were planned to be specifically modified during the upcoming outage to preclude pressure locking, were excluded from further evaluation of that issue.

Since the PL/TB phenomenon affects only the potential for valves to fail to open from a closed position, the safety significance of the opening function for the population of gate valves was evaluated. This evaluation included an assessment of whether the valves had an active safety function to open. The District also evaluated other operational modes which have the potential to create conditions conducive to pressure-locking, but represent functions beyond the current licensing basis for CNS. These operational modes included return to a standby condition following various system\valve operations and surveillance testing.

This evaluation also included an assessment of the risk significance of the valve opening based on the CNS-specific probabilistic safety assessment model. The results of this evaluation were reviewed by an expert panel consisting of representatives from CNS operations, design engineering, system engineering, maintenance engineering, and reliability engineering. The results of this evaluation did not indicate the need for any further valve modifications or procedural enhancements to address a pressure locking or thermal binding issue.

Different service conditions may lead to pressure locking or thermal binding. The "boiler effect" type of pressure locking is caused by bonnet pressurization due to heat-up (resulting from increased ambient or process temperatures) with the bonnet cavity completely filled with liquid (i.e., "water solid"). The "hydraulic locking" type of pressure locking is caused by bonnet pressurization due to seat leakage from high line pressure with a subsequent depressurization of the line pressure. A valve may be susceptible to either the boiler effect or hydraulic locking or, in some instances, both types of pressure locking. Valve cooling after seating can lead to thermal binding due to differential thermal contraction between the valve body and disc. Therefore, the final step in the screening evaluation was a determination of the specific service conditions for each POV not previously screened out.

The pressure locking service condition evaluation compared process and ambient temperature and pressure conditions for the open function scenario to the conditions when the valve is initially closed. If the bonnet cavity can be completely filled with liquid and the process or ambient temperature conditions for the open function scenario are higher than the conditions when the valve is initially closed, the valve was initially classified as "susceptible" to the boiler effect. Conversely, if the bonnet cavity cannot be completely filled with liquid or the process and ambient temperature conditions during the open function are the same as or lower than the conditions when the valve was initially closed, the valve is classified as "not susceptible" to the boiler effect type of pressure locking. Ambient temperature variations below 95°F were considered insufficient to result in boiler effect pressure locking.

For hydraulic locking, the service condition evaluation considered possible bonnet pressurization due to high pressure seat leakage prior to the opening scenario. If the potential exists for bonnet pressurization due to high pressure seat leakage prior to the opening scenario, and the upstream or downstream pressure during the opening scenario is significantly reduced from that in the bonnet, the valve was initially classified as "susceptible" to hydraulic locking. If the potential for bonnet pressurization due to high pressure seat leakage prior to the open function does not exist, the valve was classified as "not susceptible" to hydraulic locking. Additionally, if the upstream or downstream pressure is greater than or equal to the bonnet pressure (thereby offsetting the increased seating forces caused by the entrained fluid between the disc surfaces), the valve was classified as "not susceptible" to hydraulic locking.

The thermal binding service condition evaluation compared process and ambient temperature conditions for the open scenario to the conditions when the valve is initially closed. If the process and ambient temperature conditions for the open scenario are lower than the conditions when the valve is initially closed, the valve was classified as "susceptible" to thermal binding. If the process and ambient temperature conditions for the open scenario are the same as or higher than the conditions when the valve is initially closed, the valve was classified as "not susceptible" to thermal binding.

For POVs not screened out with this process, further evaluation and analysis was performed as necessary to determine susceptibility. The specific evaluations and analyses performed are discussed below.

Requested Information

[Provide a summary description of] 2. The results of the susceptibility evaluation and the further analyses referred to in 1 above, including a listing of the susceptible valves identified.

Response

Eight (8) additional valves in four (4) valve groups were initially considered susceptible to pressure locking but after further analysis were concluded to be not susceptible. These valves are discussed below by valve group.

HPCI Suppression Pool Suction Valve

The HPCI suppression pool suction valve, HPCI-MOV-MO58, was initially considered susceptible to pressure locking due to heat-up of the entrapped fluid or the boiler effect. The scenario resulting in this conclusion is as follows:

- HPCI-MOV-MO58 is closed prior to plant startup/heat up with the valve bonnet cavity filled with water.
- A design basis accident (DBA) occurs which requires HPCI to switch over to suppression pool suction on low ECST level. The suppression pool has reached maximum DBA temperature of 121°F prior to ECST depletion.
- The bonnet pressurizes due to heat transfer down the HPCI suppression pool suction line and elevated ambient temperature in the HPCI room.
- HPCI-MOV-MO58 becomes pressure locked.

A steady-state heat transfer calculation was performed for the suppression pool suction line from the torus to HPCI-MOV-MO58. The heat transfer analysis of the 65 ft. dead leg piping conservatively demonstrated that the heat dissipates rapidly in the suction line and no increase in valve temperature above ambient will occur.

To address bonnet pressurization due to room heating, a test was performed in-situ at CNS to evaluate potential PL effects. The results of this test indicated no abnormal unseating forces and demonstrated the valve is not susceptible to pressure locking due to elevated room temperature.

Therefore, based on conservative steady-state heat transfer analysis and in-situ testing, HPCI-MOV-MO58 was concluded to be not susceptible to pressure locking.

RCIC Suppression Pool Suction Valve

The RCIC suppression pool suction valve, RCIC-MOV-MO41, was initially considered susceptible to pressure locking due to heat-up of the entrapped fluid or the boiler effect. The scenario resulting in this conclusion is as follows:

- RCIC-MOV-MO41 is closed with the valve bonnet cavity filled with water.
- A DBA occurs which requires RCIC to switch over to suppression pool suction on low ECST level. The suppression pool has reached maximum DBA temperature of 121°F prior to ECST depletion.
- The valve bonnet pressurizes due to heat transfer down the RCIC suppression pool suction line and RCIC-MOV-MO41 becomes pressure locked.

A steady-state heat transfer calculation was performed for the suppression pool suction line from the torus to RCIC-MOV-MO41. The heat transfer analysis of the 49 ft dead leg piping conservatively demonstrated that the heat dissipates rapidly in the suction line and no increase in valve temperature above ambient will occur. Therefore, RCIC-MOV-MO41 was concluded to be not susceptible to pressure locking based on conservative steady-state heat transfer analysis.

RHR Suppression Pool Suction Valves

The RHR suppression pool suction valves, RHR-MOV-MO13A/B/C/D, were initially considered susceptible to pressure locking due to heat-up of the entrapped fluid or the boiler effect. The scenario resulting in this conclusion is as follows:

- The valves are closed to enter the shutdown cooling (SDC) mode of RHR. The valve bonnet is filled due to suppression pool submergence.
- After termination of shutdown cooling, the valves are required to open to establish LPCI standby alignment.
- The valves become pressure locked due to SDC process temperature transferred to the valves via the short dead leg piping connection to the SDC suction piping.

A pressure locking capability calculation was performed on these valves using valve factors and stem coefficients of friction based on CNS in-situ testing and a range of potential bonnet pressures. This capability calculation indicated that the torque and thrust capability of the MOV actuator, including the motor at 110% rated torque, would have been exceeded prior to valve damage. Therefore, failure to reopen for LPCI standby alignment would have been identified by motor actuator overload.

The operating scenario resulting in this potential for pressure locking is implemented every time SDC is secured and RHR is placed into LPCI standby mode. This has been performed after each refueling outage at CNS. A review of the maintenance history on these four valves identified one burned-out motor in 1988, which was not attributed to pressure locking. The corrective action history does not identify a history of repeated motor overload, motor stall, or other problems associated with opening these valves.

GL 95-07 Attachment 1 provides NRC guidance for addressing PL/TB of power-operated gate valves. In this guidance, one example of an unacceptable reason "as the sole basis" for eliminating valves from consideration of PL/TB is "lack of event occurrence at the specific plant." The primary basis for not allowing operating experience to be used for exclusion from consideration is that, for most valves, the scenarios resulting in PL/TB susceptibility are not normally and may never have been experienced at the plant.

As previously stated, the potential PL scenario for RHR-MOV-MO13A/B/C/D occurs every refueling cycle at CNS and no history of repeated valve failures exists. This is not a "similar" service condition scenario but rather the identical operating service condition. A history of successful performance of the identical scenario carries much more credibility than reliance on similar service conditions.

In summary, these valves were conservatively evaluated for susceptibility, determined to be potentially susceptible to pressure locking, and analyzed as such. The conservative susceptibility evaluation assumed that nearby process temperatures were sufficient to cause bonnet heating and pressure locking. The pressure locking capability analysis demonstrated that at elevated bonnet temperatures these valves would become pressure locked and the motors would stall attempting to open them. The fact that the failure to open due to pressure locking would have been observed was combined with successful operating history under the identical scenario to conclude that the scenario initially considered for pressure locking does not actually produce the bonnet pressurization required for pressure locking. Therefore, RHR-MOV-MO13A/B/C/D were determined to be not susceptible to pressure locking as operated at CNS.

RHR Suppression Pool Cooling Loop Isolation Valves

The RHR suppression pool cooling loop isolation valves, RHR-MOV-MO39A/B, were initially considered susceptible to pressure locking due to heat-up of the entrapped fluid or the boiler effect. The scenario resulting in this conclusion is as follows:

- The valves are closed after termination of suppression pool cooling during normal plant operation. The bonnet cavity is conservatively assumed to be filled with water.

- A DBA occurs requiring LPCI injection. The suppression pool and LPCI process fluid have reached maximum DBA temperature of 121°F.

- Reactor water level is restored and one division of RHR is placed into suppression pool cooling mode.

- The elevated LPCI process temperature is transferred down the suppression pool cooling branch line heating RHR-MOV-MO39A/B resulting in pressure locking.

A steady-state heat transfer calculation was performed for the suppression pool cooling branch line from the main LPCI flow line to RHR-MOV-MO39A/B. The heat transfer analysis of the 15 ft dead leg piping conservatively demonstrated that the heat dissipates rapidly in the branch line and no increase in valve temperature above ambient will occur.

Therefore, RHR-MOV-MO39A/B were concluded to be not susceptible to pressure locking based on conservative steady-state heat transfer analysis.

Requested Information

[Provide a summary description of] The corrective actions, or other dispositioning, for the valves identified as susceptible to pressure locking or thermal binding, including: (a) equipment or procedural modifications completed and planned (including the completion schedule for such actions); and (b) justification for any determination that particular safety-related power-operated gate valves susceptible to pressure locking or thermal binding are acceptable as is.

Response

The following discussion provides the description of valves screened out as not susceptible to PL/TB based on modifications performed to provide valve bonnet pressure relief. For valves initially determined susceptible for which no modifications were performed, the justification for acceptability is provided in the foregoing discussion which describes the additional analyses performed.

Core Spray Injection Valves

The Core Spray injection valves, CS-MOV-MO12A/B, were determined to be susceptible to pressure locking due to high pressure seat leakage. The scenario resulting in this conclusion is as follows:

- Reactor pressure leaks past inboard Core Spray check valve 11/12-CV thereby exposing the downstream disc face of CS-MOV-MO12A/B to reactor pressure.

- The downstream seats of CS-MOV-MO12A/B leak allowing the valve bonnets to become pressurized to reactor pressure.

- A DBA resulting in rapid reactor depressurization occurs relieving the downstream pressure on CS-MOV-MO12A/B. The 450 psig low pressure open permissive is satisfied prior to Core Spray pump acceleration.

- CS-MOV-MO12A/B become pressure locked due to insufficient pump pressure to counteract the pressure trapped in the bonnet.

The District had initially identified the potential for pressure locking of these valves during reviews performed under the scope of Generic Letter 89-10. Based on those reviews, the District performed a bonnet pressure decay analysis to provide an interim basis for operability for CS-MOV-MO12A/B until bonnet pressure relief modification of the valves could be implemented. The pressure decay analysis, which was the subject of discussions with the NRC in October, 1995, concluded that pressure locking of these valves would not occur due to depressurization of the bonnet cavity prior to required opening. These valves were modified during RE16 to provide a pressure relief path for the bonnet cavity. A hole was drilled in the downstream side of the disc to provide this pressure relief path.

High Pressure Coolant Injection System Injection Valve

The HPCI injection valve, HPCI-MOV-MO19, was initially considered susceptible to pressure locking due to high pressure seat leakage and/or the boiler effect.

During further evaluation, the District developed a basis for the determination that this valve is not susceptible to PL/TB. However, due to the high safety significance of a potential failure to open for this valve, the District modified the valve during RE16 to provide a pressure relief path for the bonnet cavity. A hole was drilled in the downstream side of the disc to provide this pressure relief path.

Reactor Core Isolation Cooling System Injection Valve

The RCIC injection valve, RCIC-MOV-MO21, was also initially considered susceptible to pressure locking due to high pressure seat leakage and/or the boiler effect.

During further evaluation, the District developed a basis for the determination that this valve is not susceptible to PL/TB. However, due to the high safety significance of failure to open for this valve, the District modified the valve during RE16 to provide a pressure relief path for the bonnet cavity. A hole was drilled in the downstream side of the disc to provide this pressure relief path.

Low Pressure Coolant Injection Valves

The RHR LPCI injection valves, RHR-MOV-MO25A/B, were initially determined to be susceptible to pressure locking due to high pressure seat leakage.

However, RHR-MOV-MO25A/B have body drains with piping and valves for pressure balancing during surveillance testing which can be used to provide pressure relief path for the bonnet cavity. The lineup for these body drain valves was modified during RE15 to provide this pressure relief path and eliminate pressure locking susceptibility during normal operations.

III. CONCLUSION

The District has completed its evaluation of the susceptibility of safety-related power-operated valves to PL/TB. The District's evaluation resulted initially in the identification of fourteen valves susceptible to pressure locking. Six of these valves have been modified to eliminate the potential for pressure locking. The remaining eight valves were evaluated further and determined not to be susceptible to pressure locking. No valves were found to be susceptible to thermal binding.

Correspondence No: NLS960027

The following table identifies those actions committed to by the District in this document. Any other actions discussed in the submittal represent intended or planned actions by the District. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Licensing Manager at Cooper Nuclear Station of any questions regarding this document or any associated regulatory commitments.

COMMITMENT	COMMITTED DATE OR OUTAGE
None	N/A