Public Service
Electric and Gas
Company

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LR-N96035

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

**RESPONSE TO NRC GENERIC LETTER 95-07 -
PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED
POWER-OPERATED GATE VALVES
SALEM GENERATING STATION UNIT NOS. 1 & 2
FACILITY OPERATING LICENSE NOS. DPR-70 & DPR-75
DOCKET NOS. 50-272 & 50-311**

The Nuclear Regulatory Commission issued Generic Letter (GL) 95-07, Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves, on August 17, 1995. In response to GL 95-07, Public Service Electric and Gas Company (PSE&G) has completed the Requested Actions for Salem Generating Station Units 1 & 2 in accordance with the 180 day schedule contained in the generic letter to ensure that safety-related power-operated gate valves susceptible to pressure locking or thermal binding will be capable of performing their intended safety functions under all modes of plant operation.

The Enclosure provides a summary description and results of the susceptibility evaluations. Attachment 1 contains the screening criteria used in determining which power operated safety related gate valves are or are not susceptible to pressure locking or thermal binding. Attachment 2 contains the listing of those valves that were determined to be susceptible to pressure locking and/or thermal binding, and a summary of the disposition of each of the valves based on the screening criteria contained in Attachment 1. Corrective actions completed or planned along with the schedule for completion are discussed in the Enclosure for those valves listed in Attachment 2 that remained susceptible to pressure locking or thermal binding.

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Should you have any questions on this submittal, please contact us.

Sincerely,

E. C. Simpson

Enclosure w/ Attachments (2)
Affidavit

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REF: LR-N96035

STATE OF NEW JERSEY)
) SS.
COUNTY OF SALEM)

E. C. Simpson, being duly sworn according to law deposes and says:

I am Senior Vice President - Nuclear Engineering of Public Service Electric and Gas Company, and as such, I find the matters set forth in the above referenced letter, concerning Salem Generating Station Unit Nos. 1 and 2, are true to the best of my knowledge, information and belief.

E C Simpson

Subscribed and Sworn to before me
this 13 day of February 1996

Ann L Shump
Notary Public of New Jersey

My Commission expires on

ANN L SHUMP
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires Oct. 13, 1997

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ENCLOSURE

SUMMARY DESCRIPTION

**RESPONSE TO NRC GENERIC LETTER 95-07,
PRESSURE LOCKING AND THERMAL BINDING OF
SAFETY RELATED POWER OPERATED GATE VALVES
SALEM GENERATING STATION UNITS 1 & 2
DOCKET NOS. 50-272 & 50-311**

This report provides information to satisfy the 180 day reporting requirements of Generic Letter 95-07 (Ref. 1). The scope of the review for Salem Generating Station Units 1 and 2 includes all power operated gate valves (air, hydraulic and motor operated) for their susceptibility to pressure locking or thermal binding (PL/TB) as follows:

- Within the requested 90 days of the issuance of the generic letter, perform a screening evaluation of all safety related power operated gate valves to identify valves potentially susceptible to pressure locking or thermal binding. Provide a basis for operability for those valves identified as susceptible as required or take appropriate actions in accordance with Technical Specifications.

- Within the requested 180 days of the issuance of the generic letter, evaluate operational configurations of those valves identified as susceptible and perform further analyses as appropriate. Take needed corrective actions (or justify longer schedules) to ensure valves are capable of performing their intended safety function.

The Salem response is based on a review process following the screening criteria contained in Attachment 1 to identify those safety related power operated gate valves that may be susceptible to pressure locking or thermal binding. This resulted in a list of valves that may be susceptible to pressure locking or thermal binding. A total of 60 valves were identified as potentially susceptible. No hydraulically or air operated valves were determined to have a safety related open function. The identified valves were further screened for susceptibility using the criteria in Attachment 1 based upon the design and operating conditions to which the valve may be exposed, including process and ambient conditions. Valve surveillance requirements were also considered. Attachment 2 contains the results of this screening which concluded that 14 valves are susceptible to pressure locking and 8 valves are susceptible to thermal binding. Evaluation of power operated gate valves that could be

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susceptible to pressure locking had previously been completed for Salem Units 1 and 2 during the plant design and construction phase. This evaluation resulted in design modifications to 24 valves that included 1) drilling a hole in one of the disk faces to vent the bonnet to the adjacent piping and 2) installation of a bypass line to vent the bonnet to the adjacent piping or another pressure sink as identified in Attachment 2.

Additional evaluations were performed including detailed operability analyses, as required, of the valves listed in Attachment 2. Operability for the valves listed below (identified with an *) could not be demonstrated using conservative design basis analysis methods. These deficiencies were reported to the NRC under 10CFR50.73(a)(2)(ii)(LER 272/96-002).

Valves Analyzed for Operability

11 & 12 CS2 21 & 22 CS2	Containment Spray Header Isolation Valves*
1 & 2 PR6 1 & 2 PR7	PORV Block Valves*
1 & 2 SJ1 1 & 2 SJ2	RWST Supply Isolation to Charging/Safety Injection*
2SJ12 2SJ13	BIT Outlet Isolation
11 & 12 SJ113 21 & 22 SJ113	RHR Discharge to SI Pump Suction Valves (SI Pump Cross-over Valves)*
11 & 12CC16 21 & 22CC16	RHR Heat Exchanger Component Cooling System Outlet Isolation

On the basis of these reviews, appropriate procedure changes and modifications have been initiated for completion prior to restart of Salem Units 1 and 2 from the current outage. The SJ1, SJ2, 2SJ12, 2SJ13 and SJ113 valves will be modified to preclude pressure locking by providing an appropriate bonnet cavity pressure relief path. Pressure locking of the CS2 valves will be addressed by a surveillance test procedure change to cycle the valves after the system has been depressurized. For thermal binding concerns, the PR6 and PR7 valves will be modified to

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provide primary control of the motor operator based on disc position instead of torque control, and a maximum thrust limit will be identified as a test procedure control to assure a positive margin of capability. The thermal binding concern for the CC16 valves does not require a change to the method of motor control. Similar to the PR6 & PR7 valves, a maximum thrust will be identified.

References:

1. NRC Generic Letter 95-07, dated August 17, 1995

2. PSE&G initial response to Generic Letter 95-07, LR-N95164, dated October 16, 1995

3. MPR Associates, Inc. Report No. MPR-1693, Evaluation of Salem Valves for Pressure Locking and Thermal Binding, Rev. 0 dated November 1995, and Rev. 1 dated January 1996

4. Design Change Packages 1EC-3540 & 2EC-3467

ATTACHMENT 1

SUSCEPTIBILITY SCREENING METHODOLOGY

INITIAL SCREENING BASED ON VALVE TYPE/FUNCTION

An initial screen was performed for both pressure locking and thermal binding based on the valve type and function. All safety related air-, hydraulic- and motor-operated valves were identified. The bill of materials (BOM) for each valve was reviewed to determine the valve type (e.g., gate, globe, butterfly, etc.). All non-gate valves were eliminated, resulting in a list of all safety-related, power-operated gate valves. The design basis requirements of each valve were then reviewed to determine if the valve has a safety function to open. Valves which are not required to open are not susceptible to PL/TB and were eliminated from further evaluation.

SCREENING BASED ON VALVE MODIFICATIONS

Some valves at Salem have been modified to address potential pressure locking concerns. Modifications include 1) drilling a hole in one of the disk faces to vent the bonnet to the adjacent piping and 2) installation of a bypass line to vent the bonnet to the adjacent piping or another pressure sink. These modifications prevent pressure locking of a valve since the bonnet is vented. The maintenance history in MMIS was used to identify valves which have been modified; these valves are not susceptible to pressure locking.

Valve modifications were not used as thermal binding screening criteria.

SCREENING BASED ON DISK TYPE

Solid wedge gate valves are less susceptible to pressure locking than flexible wedge or double disk gate valves because the solid disk design does not allow bonnet pressure to apply a direct load on each disk half in the pipe-axis direction. Solid wedge gate valves are typically being removed from consideration in pressure locking evaluations. Further, pressure locking experience documented in NUREG-1275, Vol. 9 indicates that instances of problems have occurred strictly with double disk and flexible wedge gate valves, and not with solid wedge gate valves.

One solid wedge gate valve application was identified to have a scenario where the bonnet pressure may exceed that in the adjacent piping. This application is the component cooling water outlet isolation valves from the RHR heat exchangers (Valves 11CC16, 12CC16, 21CC16 and 22CC16). Analyses confirmed that

bonnet pressure does not result in a required thrust which exceeds actuator capacity for these solid wedge gate valves. This conclusion is consistent with the approach used for solid wedge gate valves at other plants, and is consistent with experience which indicates that pressure locking problems do not occur with solid wedge gate valves. Accordingly, these solid wedge gate valves at Salem were determined to be acceptable as is, and the remaining efforts were focused on the other gate valve types (flexible wedge, double disk).

Copes-Vulcan parallel disk gate valves are not susceptible to thermal binding since these valves do not "wedge" at closure. These valves have a spring between the parallel disk halves which maintains contact between the disks and seats. Differential thermal expansion between internal components will be accommodated by compression or relaxation of the spring. Anchor/Darling double disk gate valves are not susceptible to thermal binding as documented in NUREG-1275, Vol. 9. The valve assembly drawings and References 3 and 4 were reviewed to determine the disk type for each valve.

SCREENING BASED ON GENERAL CONDITIONS

For each valve that was not screened out based on type/function, modifications or disk type, the general conditions under which the valve operates were reviewed to determine if it is susceptible to PL/TB. This screening is described below.

Pressure Locking

Pressure locking occurs when the fluid in the valve bonnet is at a higher pressure than the adjacent piping at the time of valve opening. The following two scenarios for elevated bonnet pressure were considered.

"Bonnet Heatup" -- entrapment of incompressible fluid in the bonnet during valve closure, followed by bonnet heat-up prior to valve opening. The bonnet heatup scenarios considered were:

- heatup due to an increase in the temperature of the environment during an accident. (Normal ambient temperature variation is not considered because it occurs over a long time period and pressure changes tend to be alleviated through extremely small amounts of leakage. Experience indicates that normal

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SUSCEPTIBILITY SCREENING METHODOLOGY

temperature variations are not a source of pressure locking events),

- heatup due to an increase in the temperature of the process fluid on either side of the valve.

"Pressure-Trapping" -- pressurization of the valve bonnet during normal system operation or system surveillance test conditions, followed by de-pressurization of the adjacent piping prior to valve opening. The following scenarios were considered:

- back-leakage past check valves, and

- system operating pressures (including surveillance test conditions) which are higher than the system pressure when the valve is required to open.

The normal and accident temperature envelopes from environmental design criteria for various plant locations were used to identify potential heatup of the environment. The applicable P&IDS, isometric drawings and Configuration Baseline Documents (CBD) were reviewed to determine process fluid temperatures and nearby heat sources. The CBDs were also used to determine the conditions when the valve is required to open to perform its design basis function and the conditions under which the valve is closed. Valves for which there were no plausible bonnet heatup or pressure-trapping scenarios are <u>not</u> susceptible to pressure locking.

The following assumptions were made in performing this screening evaluation.

1. For valves in water systems, the bonnet is completely filled with water upon valve closure.

2. There is no leakage from the bonnet either through the packing or through the bonnet-to-body seal.

3. The disk-to-seat seal allows leakage from the adjacent piping to the bonnet but not from the bonnet to the adjacent piping.

4. Check valves allow sufficient leakage such that the pressures are the same on both side of the check valve.

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Thermal Binding

Thermal binding occurs due to temperature changes of valve internal components. The following scenarios for thermal binding were considered.

The process fluid temperature is greater than the ambient temperature when the valve is closed, which can result in heat up and expansion of the stem after insertion (closure).

The valve temperature increases or decreases between the time the valve is closed and then opened under design basis conditions, which can result in:

- Differential expansion of the disk and body, and

- Differential expansion of the body and stem

The environment and process fluid temperatures during valve closure and subsequent opening under design basis conditions were determined as described above for pressure locking. Valves for which there were no plausible scenarios, as described above, were not susceptible to thermal binding.

SCREENING BASED ON SPECIFIC CONDITIONS

No pressure locking screening criteria based on specific conditions were used.

Thermal binding analysis criteria address uniform temperature conditions, i.e., they do not cover transient or steady-state temperature gradients in the valve body or disk. Based on the discussion of thermal binding events in NUREG-1275, Vol. 9, thermal binding tends to occur after temperature changes over long time periods, where the valve would be in thermal equilibrium.

The thermal binding analysis methods developed are intended to be conservative. For example, bounding values of valve stiffness were used based on data obtained in the EPRI MOV program. To ensure that the methods are bounding, they are validated against data. Specifically, six strokes (on five gate valves) were identified in the EPRI MOV Program data, where the valve temperature decreased significantly between closure and opening.

The screening criteria were based on the following inputs:

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- Valve body material,
- Valve disk material,
- Valve seat ring material,
- Valve stem material,

Process fluid temperature, ambient temperature, and valve steady state temperature when the valve is closed, and valve steady state temperature when the valve is opened under design basis conditions.

ATTACHMENT 2

RESULTS FROM SCREENING OF POTENTIALLY SUSCEPTIBLE SALEM VALVES

Valve ID(s)	Description	Pressure Locking[1]		Thermal Binding[1]	
		Susceptible?	Basis For No	Susceptible?	Basis For No
11CC16, 12CC16, 21CC16, 22CC16	RHR heat exchanger component cooling system outlet isolation valves	---	These solid wedge valves have a scenario with elevated bonnet pressure, but analyses indicate positive margin for operation under this condition	Yes	
11CS2, 12CS2, 21CS2, 22CS2	Containment spray header isolation valves	Yes		No	General Conditions screen (no heatup/cooldown)
1CS14, 2CS14	Spray additive tank isolation valves	No	General Conditions screen (no heatup/pressure-trapping)	No	General Conditions screen (no heatup/cooldown)
1CS16, 2CS16, 1CS17, 2CS17	Spray additive tank isolation valves	No	General Conditions screen (no heatup/pressure-trapping)	No	General Conditions screen (no heatup/cooldown)
11CS36, 12CS36	RHR to containment spray system isolation valves	No	Modifications screen (bypass line installed)	No	Disk Type screen (double disk)
21CS36, 22CS36	RHR to containment spray system isolation valves	No	Modifications screen (bypass line installed)	No	Specific Conditions screen $\Delta T = 0$
1PR6, 2PR6, 1PR7, 2PR7	PORV block valves	No	General Conditions screen (no heatup/pressure-trapping)	Yes	
1RH1, 1RH2, 2RH1, 2RH2	RCS hot leg suction isolation valves	No	Modifications screen (bypass line installed)	No	Disk Type screen (parallel disk)
11RH19, 12RH19	RHR heat exchanger discharge cross-connect	No	Modifications screen (bypass line installed)	No	Disk Type screen (double disk)
1SJ1, 1SJ2, 2SJ1, 2SJ2	RWST supply valves to the charging/safety injection pumps	Yes		No	General Conditions screen (no heatup/cooldown)
1SJ12, 1SJ13	Boron injection tank outlet isolation valves	No	Modifications screen (hole drilled in disk)	No	Disk Type screen (double disk)
2SJ12, 2SJ13	Boron injection tank outlet isolation valves	Yes		No	General Conditions screen (no heatup/cooldown)
11SJ40, 12SJ40, 21SJ40, 22SJ40	SI pump discharge valves to RCS hot legs	No	Modifications screen (hole drilled in disk)	No	Disk Type screen (double disk)
11SJ44, 12SJ44, 21SJ44, 22SJ44	Containment sump supply valves	No	Modifications screen (bypass line installed)	No	Disk Type screen (double disk)

ATTACHMENT 2

RESULTS FROM SCREENING OF POTENTIALLY SUSCEPTIBLE SALEM VALVES

Valve ID(s)	Description	Pressure Locking[1]		Thermal Binding [1]	
		Susceptible?	Basis For No	Susceptible?	Basis For No
11SJ45, 12SJ45	RHR heat exchanger supply valves to the SI and charging pump suction	No	Modifications screen (bypass line installed)	No	Disk Type screen (double disk)
21SJ45	RHR heat exchanger supply valves to the SI and charging pump suction	No	Modifications screen (bypass line installed)	No	General Conditions screen (no heatup/cooldown)
22SJ45	RHR heat exchanger supply valves to the SI and charging pump suction	No	Modifications screen (bypass line installed)	No	Specific Conditions screen $\Delta T = 0$
11SJ54, 12SJ54, 13SJ54, 14SJ54, 21SJ54, 22SJ54, 23SJ54, 24SJ54	Accumulator isolation valves to the RCS cold leg	No	General Conditions screen (no heatup/pressure-trapping)	No	General Conditions screen (no heatup/cooldown)
11SJ113, 12SJ113, 21SJ113, 22SJ113	RHR discharge to SI pump suction to charging/safety injection pump suction valves (SI pump cross-over valves)	Yes		No	Specific Conditions screen $\Delta T = 0$

Note 1: For valves identified as Susceptible, See enclosed Summary Description