Public Service
Electric and Gas
Company

E. C. Simpson
Senior Vice President - Nuclear Engineering

Public Service Electric and Gas Company P.O. Box 236, Hancocks Bridge, NJ 08038 609-339-1700

FEB 13 1996

LR-N96034

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
HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NO. NPF-57
DOCKET NO. 50-354**

The Nuclear Regulatory Commission (NRC) 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 Hope Creek Generating Station 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 including test configurations.

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 is summary listing of those safety related power operated gate valves that were determined to be susceptible to pressure locking or thermal binding based on the screening criteria contained in Attachment 1. Attachment 2 also provides a summary of the disposition of each of these valves and corrective actions completed or planned along with the schedule for completion.

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

Sincerely,

E C Simpson

Enclosure w/ Attachments (2)
Affidavit

C Mr. T. T. Martin, Administrator - Region 1
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. D. Jaffe, Licensing Project Manager - Hope Creek
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Mail Stop 14E21
Rockville, MD 20852

Mr. R. Summers (X24)
USNRC Senior Resident Inspector

Mr. Kent Tosch, Manager, IV
Bureau of Nuclear Engineering
33 Arctic Parkway
CN 415
Trenton, NJ 08625

REF: LR-N96034

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 Hope Creek Generating Station, 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 Shimp
Notary Public of New Jersey

My Commission expires on _____

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

LR-N96034

ENCLOSURE

SUMMARY DESCRIPTION

**RESPONSE TO NRC GENERIC LETTER 95-07,
PRESSURE LOCKING AND THERMAL BINDING OF
SAFETY RELATED POWER OPERATED GATE VALVES
HOPE CREEK GENERATING STATION
DOCKET NO. 50-354**

This report provides information to satisfy the 180 day reporting requirements of Generic Letter 95-07 (Ref. 1). The scope of the review for Hope Creek Generating Station includes all power operated gate valves (air, hydraulic and motor operated) for their susceptibility to pressure locking or thermal binding 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 Hope Creek response is based on a series of reviews (Refs. 7 through 10) performed since the issuance of the Reference 4 AEOD Study. The review process identified safety related power operated gate valves that have an open function. No hydraulically operated valves were determined to have a safety related open function. The identified valves were then screened for susceptibility to pressure locking or thermal binding 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 a listing of those valves considered susceptible based on the screening criteria in Attachment 1. No air operated valves passed beyond this screening review.

Additional evaluations (Ref. 8) were performed including detailed

ENCLOSURE

SUMMARY DESCRIPTION

operability analyses (Refs. 8 & 9), as required, of the valves listed in Attachment 2. Operability for the ten valves listed below was demonstrated based on detailed Motor Operated Valve (MOV) capability analyses. The concern for the 10 valves listed below was a susceptibility to pressure locking. The results and bases for the conclusions were reviewed with NRR and Region I representatives on October 16, 1995.

Valves Analyzed for Operability

1BCHV-F017A,B,C&D	LPCI Injection Isolation
1BDHV-F013	RCIC Injection Isolation
1BEHV-F005A&B	Core Spray Injection isolation
1BJHV-F006	HPCI Discharge to Core Spray Isolation
1BJHV-F042	HPCI Pump Suction, Suppression Pool Isolation
1BJHV-8278	HPCI Discharge to Feedwater Isolation

The valves analyzed within Reference 9 have been scheduled for modification during the current refueling outage under the Reference 11 design change with one exception (1BJHV-F042) which has been scheduled for modification at the next refueling outage (RF07). Deferral of the modification for 1BJHV-F042 (HPCI Pump Suction, Suppression Pool Isolation) was determined to represent a prudent course of action. This would allow an appropriate design evolution which would enable resolution of issues associated with its isolation from the torus. Additionally, this would allow the most suitable type modification from a systems interface standpoint to be implemented. Safety of the public will not be compromised on the basis that the valve has appreciable margin of capability to perform its open safety function should pressure locking occur. Best estimate margin of capability is +71% with a sensitivity analysis of bounding analysis factors yielding a single worst case of +15% margin. Prior to completion of the modification, the valve will be maintained so as not to adversely affect the current analyzed capability margin.

ENCLOSURE

SUMMARY DESCRIPTION

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. INPO Significant Operating Experience Report (SOER) 84-07, dated December 14, 1984

4. NRC AEOD Study S/92-07, dated December, 1992

5. NRC Information Notice 92-26, dated April 2, 1992

6. NRC Generic Letter 89-10, Supplement 6, dated March 8, 1994

7. Stone & Webster Study Project No. G-0508, "Thermal Binding and Hydraulic Locking of Gate Valves for Hope Creek Generating Station", dated July 27, 1993 (Susceptibility Screening)

8. PSE&G Engineering Evaluation No. H-1-ZZ-MEE-0864, "Motor Operated Gate Valve Pressure Locking/Thermal Binding Review", dated March 22, 1995

9. MPR Associates, Inc. letter and enclosure, "Hope Creek Gate Valve Pressure Locking Evaluation", dated September 27, 1995

10. MPR Associates, Inc. letter and enclosure, "Hope Creek HOVs Potentially Susceptibile to Pressure Locking and Thermal Binding", dated November 14, 1995

11. Design Change Package 4EC-3579

12. Memorandum HCT-92-100 dated May 12, 1992

ATTACHMENT 1

SUSCEPTIBILITY SCREENING METHODOLOGY

INITIAL SCREENING BASED ON VALVE TYPE/FUNCTION

An initial screen is performed for both pressure locking and thermal binding (PL/TB) 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 are 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 DISK TYPE

Hope Creek valves subject to the concerns of the Generic Letter are all flex wedge gate valves based on the initial screen above for valve type/function. Therefore, no specific disc type screening was required.

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 bonne 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

ATTACHMENT 1

SUSCEPTIBILITY SCREENING METHODOLOGY

of leakage. Experience indicates that normal 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 (CBDS) 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 sides of the check valve.

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.

ATTACHMENT 2
EVALUATION OF SUSCEPTIBLE VALVES

VALVE ACTUATOR ID.	VALVE FUNCTION	SUSCEPT-IBILITY	DISPOSITION NOTE
1BCHV-F004A & B	RHR PUMP A&B TO SUPPRESSION POOL SUCTION	B	NOTE 1
1BCHV-F007A-D	RHR PUMP A-D MINI-FLOW	H	NOTE 2
1BCHV-F008	RHR SHUTDOWN COOLING OUTBOARD SUCTION ISOLATION	H	NOTE 3
1BCHV-F009	RHR SHUTDOWN COOLING INBOARD SUCTION ISOLATION	B	NOTE 3
1BCHV-F016A & B	RHR LOOP A&B CONTAINMENT SPRAY OUTBOARD ISOLATION	H	NOTE 4
1BCHV-F017A-D	RHR LPCI INJECTION ISOLATION	H	NOTE 5
1BCHV-F021A & B	RHR LOOPS A&B CONTAINMENT SPRAY INBOARD ISOLATION	H	NOTE 4
1BDHV-F013	RCIC INJECTION	H	NOTE 5
1BDHV-F031	RCIC PUMP SUCTION FROM SUPPRESSION POOL	H	NOTE 6
1BEHV-F005A & B	CORE SPRAY LOOPS A&B INBOARD INJECTION	H	NOTE 5
1BJHV-F006	HPCI DISCHARGE TO CORE SPRAY ISOLATION	H	NOTE 5
1BJHV-F042	HPCI PUMP SUCTION FROM SUPPRESSION POOL ISOLATION	H	NOTE 5
1BJHV-8278	HPCI DISCHARGE TO FEEDWATER ISOLATION	H	NOTE 5
1FDHV-F001	HPCI TURBINE STEAM ADMISSION	B	NOTE 7

T - THERMAL BINDING
H - HYDRAULIC LOCKING
B - BOTH

ATTACHMENT 2
EVALUATION OF SUSCEPTIBLE VALVES

Note 1: A potential concern exists should the second loop of Shutdown Cooling (SDC) be aligned when the first loop is operating at a high temperature. During the subsequent open stroke of the valve in the off going loop, thermal binding may occur. Pressure locking is also a potential concern in the standby SDC loop, should water in the bonnet heatup due to the potential physical proximity to an operating SDC flowpath. This is the liquid entrapment type pressure locking scenario.

At Hope Creek, a normal shutdown closes the RHR Torus Suction Valves 1BCHV-F004A or B with torus fluid temperatures low, then opens F006A or B for RHR Shutdown Cooling alignment. For normal shutdown cooling, thermal input to F004A & B occurs after the valves are already closed and does not represent a safety concern should thermal binding occur. In a post accident situation, F004A or B is closed with torus flow as hot as 271°F. With the alignment to RHR and subsequent cooldown, the F004 valves may experience some thermal binding. Since the F004 valves do not have any design basis requirement to be opened, this is not a safety concern. Also, when either loop is in Shutdown Cooling, the loop is considered Inoperable for LPCI, Torus Cooling, and Containment Spray. These other modes of RHR require the respective suction valve to be open. This is not a safety concern.

Pressure locking occurrences caused by liquid entrapment have occurred in the industry due to relatively rapid fluid temperature increases (Refs. 3 & 4). Liquid entrapment and pressurization of the bonnet cavity can potentially occur should the valve disk and the valve packing provide a 100% seal. This is not credible given a slow ambient temperature increase. The maximum ambient temperature analyzed for pressure locking is 148°F (65°C). This does not relate to a rapid temperature increase associated with liquid entrapment and bonnet cavity pressurization of the F004A & B valves. Temperatures above 148°F occur in the Reactor Building only under High Energy Line Break (HELB) conditions. These valves are not required to stroke to mitigate the consequences of a HELB in the Reactor Building based on Hope Creek Environmental Design Criteria and UFSAR Sections 3.6.1 and 3.6.3.

The "A" and "B" loop RHR torus suction valves (1BCHV-F004A & B) have over 38 feet of 24" diameter horizontal piping from the Shutdown Cooling flowpath based on RHR isometric drawings. These valves are also considered Inoperable for LPCI, Torus Cooling, or Containment Spray when closed during Shutdown Cooling operation. They must be successfully opened prior to being considered

operable for the alternate modes.

On the basis of the preceding discussion, liquid entrapment does not present a concern for these valves at Hope Creek.

Note 2: The RHR minimum flow valves are located in the Torus Room. A High Energy Line Break (HELB) could increase the ambient temperature in the room. The HELB to heat Room 4102 is caused by a HPCI Steam Line Break (UFSAR, TABLE 3.6-5). Operation of RHR is not required to mitigate the consequences of a HPCI steam line break external to primary containment (UFSAR, Sections 3.6.1 and 3.6.3).

Note 3: The thermal binding issue suggested by the Reference 4 AEOD Study was caused by hand torquing the valve closed. At Hope Creek, a hand torqued closed MOV is considered inoperable/ incapable of performing a remote open stroke. The safety design bases for the RHR Shutdown Cooling Suction (1BCHV-F008 & F009) valves is to be opened manually at the valve (UFSAR SECTION 5.4.7.1.5). Since this flow path is not single failure proof, the alternate shutdown cooling flow path is available as discussed by UFSAR section 15.2.9. Therefore, remote operation of these valves is not a design basis requirement.

Note 4: The RHR drywell spray valves are located in different pipe chases. A significant distance of separation exists between the different divisions of these valves. A High Energy Line Break (HELB) (UFSAR Pg. 6.3-5) would not affect more than one division. Opening of more than one division is not allowed by the Emergency Operating Procedures (EOPs). When one set of these valves are operated in accordance with the EOPS, upstream pressure is near shutoff head of the corresponding RHR pump and not at keep fill pressure. Also, drywell spray is not required to mitigate the consequences for a break external to primary containment.

Note 5: This valve was determined to require additional analysis to demonstrate operability based on detailed MOV capability analyses. Although demonstrated to be operable, these valves were determined to require a design change to enable relief of bonnet cavity pressure. A relief path will be provided by installation of a 1/8" weephole in the high pressure side of the valve disc. The valve internals will be refurbished as required to assure proper performance. These modifications will be completed during the current RF06 outage with the exception of 1BJHV-F042. This valve will be modified during RF07. The justification for deferring completion of the modification to

this valve until RF07 is provided in the enclosed Summary Description.

Note 6: The RCIC torus suction valve strokes open, based on flowrate and inventory, at least 3 hours after an isolation event. Pressure locking would require a High Energy Line Break to increase the local ambient temperature. Automatic Isolation Systems monitor area temperatures and differential temperatures in the areas where high energy systems are located. RCIC system operation is not required for a HELB in the torus room (UFSAR Pg 3.6-27 and Table 3.6-5).

Note 7: The HPCI Steam Admission Valve (1FDHV-F001) physically drains to a large unlagged drain pot which continuously rejects condensate via a steam trap. This maintains the valve hot at near steam temperature. There is approximately a 160 degree difference between the valve temperature when the valve could be closed during surveillance testing and the lower temperature when it may be required to automatically open. HPCI is required to pass both a high pressure (high saturated temperature) and a low pressure (low saturated temperature) full flow test by Technical Specifications 4.5.1.b.3 & 4.5.1.c.2.a. When stroking during the low pressure test, 1FDHV-F001 demonstrates that a 160°F temperature decrease does not thermally bind the valve. When the HPCI system is secured during a normal cooldown, the HPCI Steam Supply Isolation Valves (1FDHV-F002 & F003) are closed at approximately 350°F. These isolation valves are cycled for surveillance testing purposes during cold shutdown. No thermal binding of these valves has been indicated over a broader temperature decrease than applicable to F001. Since these three valves are essentially the same, the ability of the F002 & F003 to open demonstrates the capability of the F001 to perform its safety function.

The pressure locking event identified in the AEOD study was caused by improper system draining and warmup. Should the valve be used as a pressure blocking point during a steam system hydro, any water inventory should be removed post hydro by opening (cracking) the valve prior to returning the system to service.