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Lusby, Maryland 20657
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BGE

February 13, 1996

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
180-Day Response to NRC Generic Letter 95-07: Pressure Locking and Thermal Binding of Safety-Related, Power-Operated Gate Valves

REFERENCE: (a) Letter from Mr. D. M. Crutchfield (NRC) to Mr. R. E. Denton (BGE), dated August 17, 1995, NRC Generic Letter 95-07: Pressure Locking and Thermal Binding of Safety-Related, Power-Operated Gate Valves

The purpose of this letter is to forward our 180-day response to NRC Generic Letter 95-07: Pressure Locking and Thermal Binding of Safety-Related, Power-Operated Gate Valves. Pressure locking or thermal binding can cause a power-operated valve to fail to open. The generic letter requests that we perform, or confirm we previously performed, evaluations of operational configurations of safety-related, power-operated gate valves for susceptibility to pressure locking and thermal binding. Power-operated valves include those valves that are motor-, air-, or hydraulically-operated. In addition, it requests that we perform further analyses, and any needed corrective actions, to ensure that the susceptible valves are capable of performing their safety functions as described in our current licensing basis.

Attachment (1) contains a summary description susceptibility evaluation of operational configurations, the results of this evaluation, and the corrective actions for the valves identified as susceptible to pressure locking or thermal binding.

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Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

Charles H. Cruse

STATE OF MARYLAND :
: **TO WIT:**
COUNTY OF CALVERT :

I hereby certify that on the 13 day of February, 1996 before me, the subscriber, a Notary Public of the State of Maryland in and for Calvert County, personally appeared Charles H. Cruse, being duly sworn, and states that he is Vice President of the Baltimore Gas and Electric Company, a corporation of the State of Maryland; that he provides the foregoing response for the purposes therein set forth; that the statements made are true and correct to the best of his knowledge, information, and belief; and that he was authorized to provide the response on behalf of said Corporation.

WITNESS my Hand and Notarial Seal: Denise D. Snuki
Notary Public

My Commission Expires: February 2, 1998
Date

CHC/DJM/dlm

Attachment: (1) Baltimore Gas & Electric Company's 180-Day Summary Response to GL 95-07: Pressure Locking and Thermal Binding of Safety-Related, Power-Operated Gate Valves

cc: D. A. Brune, Esquire
J. E. Silberg, Esquire
L. B. Marsh, NRC
D. G. McDonald, Jr., NRC
T. T. Martin, NRC
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ATTACHMENT (1)

BALTIMORE GAS & ELECTRIC COMPANY'S

180-DAY SUMMARY RESPONSE

TO

GENERIC LETTER 95-07:

PRESSURE LOCKING AND THERMAL BINDING

OF

SAFETY-RELATED, POWER-OPERATED GATE VALVES

ATTACHMENT (1)

BALTIMORE GAS & ELECTRIC COMPANY'S
180-DAY SUMMARY RESPONSE TO GENERIC LETTER 95-07:
PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED,
POWER-OPERATED GATE VALVES

Requested Actions

A. *Within 180 days of the date of this generic letter (GL), each addressee of this generic letter is requested to implement and complete the guidance provided in Attachment 1 to perform the following actions:*

1. *Evaluate the operational configurations of safety-related power-operated (i.e., motor-operated, air-operated, and hydraulically operated) gate valves in its plant to identify valves that are susceptible to pressure locking and thermal binding;*

2. *Perform further analyses as appropriate, and take needed corrective actions (or justify longer schedules), to ensure that the susceptible valves identified in 1 are capable of performing their intended safety function(s) under all modes of plant operation, including test configuration.*

Requested Information

All addressees, including those who have already satisfactorily addressed pressure locking and thermal binding for motor-operated valves (MOVs) by implementing the guidance in Supplement 6 to GL 89-10 (or equivalent industry methods), are requested to provide a summary description of the following:

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. *The results of the susceptibility evaluation and the further analyses referred to in 1 above, including a listing of the susceptible valves identified;*

3. *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.*

Baltimore Gas & Electric Company's 180-Day Summary Response to Generic Letter 95-07: Pressure Locking And Thermal Binding of Safety-Related, Power-Operated Gate Valves

Required Response

The GL requires Baltimore Gas and Electric Company to submit the following:

> *Within 180 days from the date of this GL, a written response to the information request above.*

Baltimore Gas & Electric Company's Response

Forty-one MOVs per unit were identified as within the scope of GL 95-07. No air-operated or hydraulically-operated valves were identified. The list of valves and their functions are generally identical for both units and will not be discussed on a unit basis unless there is a need to differentiate between Units 1 and 2.

The valves were initially screened to determine if they had a safety-related function to open or be opened after being closed. Seventeen valves per unit were determined to have a safety-related function to open. Seven of these valves were identified as being potentially susceptible to pressure locking and four valves were identified as being potentially susceptible to thermal binding. In addition to the 17 valves that have a safety-related function to open, the containment hydrogen purge isolation valves and the main feedwater isolation valves were also evaluated for susceptibility to pressure locking and thermal binding. The purge valves are mentioned in a Updated Final Safety Analysis Report Chapter 14 accident as being capable of venting hydrogen from containment in the event both safety-related hydrogen recombiners fail. The main feedwater isolation valves are used in many Emergency Operating Procedures (EOPs) to remove decay heat. Although these functions are not classified as safety-related, we consider these functions to be important and, therefore, included these valves in our evaluation.

All valves that were screened as being potentially susceptible to pressure locking and thermal binding were evaluated and verified to be operable by November 15, 1995, to meet the 90-day Requested Action of the GL. Although operability has been justified for all the valves and none of the subject valves have ever pressure locked or thermally bound, six of the valves screened out as requiring additional corrective action to justify long term acceptability. The corrective actions for these valves are contained in the Summary Description of the Susceptibility Evaluation of the Operational Configurations.

1. **Summary Description of the Susceptibility Evaluation of the Operational Configurations Performed in Response to Requested Action 1.**

Power-Operated Relief Valve (PORV) Block Valves MOVs-403 and 405

The isolation valves for the PORVs, MOVs-403 and 405, are normally open during plant operation. These valves are 2.5-inch solid wedge gate valves. Gate valves with solid wedges are not susceptible to pressure locking. These valves are normally open but can be closed during normal operation to isolate a leaking PORV or to isolate a stuck open PORV during a plant transient. If a block valve has been closed to isolate a leaking or stuck open PORV, it could be required to open for once-through core cooling or overpressure protection per Technical Specification 3/4.4.9. The valves are limit seated and are, therefore, not expected to thermally bind. Since analysis cannot predict susceptibility nor validate engineering judgment, the limits on the valves will be adjusted to reduce/prevent wedging to provide additional margin for preventing thermal binding.

The changes to the limits on the valves will be completed during the 1996 Unit 1 refueling outage and the 1997 Unit 2 Refueling Outage. Baltimore Gas and Electric Company is currently evaluating potential modifications to the PORV block valves. The evaluation will ensure that any changes or modifications address pressure locking and thermal binding susceptibility.

Volume Control Tank (VCT) Outlet Isolation Valve MOV-501

The VCT outlet isolation valve is normally open to provide a flow path from the VCT to the suction of the charging pumps. The valve will automatically close on low VCT level to allow charging pumps to automatically align to the Refueling Water Tank (RWT). The valve closes automatically on the receipt of a Safety Injection Actuation Signal (SIAS). The design basis function of this valve is to close following a low VCT level transient or SIAS. The valve can be reopened in various EOPs to align the charging pumps suction to the discharge of the VCT. This action is required to prevent excess boration and to prepare the plant for start-up, not to mitigate an accident. The valve has no safety-related function to reopen.

No further action required.

Charging Pump Suction Valve from the RWT MOV-504

This is the normally closed charging pump suction valve from the RWT. The valve will automatically open on a low VCT level signal to allow pump suction to switch from the VCT to the RWT. The valve is opened in numerous EOPs to align the charging pump suction to the RWT. In addition, this line-up can be credited as a boration flowpath in Modes 5 and 6 per Technical Specification 3/4.1.2.1, and in Modes 1, 2, 3, and 4 per Technical Specification 3/4.1.2.2. The fluid that flows through this valve is from the RWT which is at ambient temperatures and RWT head. The constant ambient temperatures of the borated water from the RWT prevents the valve from being susceptible to thermal binding. Normal operating pressure from the VCT of 35 psig could be trapped in the bonnet. The pressure at MOV-504 will change 16 psig from a full RWT to an empty RWT and is enveloped by normal operating pressures (35 psig). Thermally induced temperatures increases could add another 16.4 psig for a maximum bonnet pressure of 51.4 psig (The room temperatures before and after an accident will not exceed 121°F). Calculations verifying the actuator can overcome the minor pressure and temperature transients have been completed.

No further action required.

Boric Acid Storage Tank (BAST) Gravity Feed Valves MOVs-508 and 509

These valves provide borated water from the BASTs to the suction of the charging pumps. The valves are normally closed and are heat traced to ensure the valves, piping, and borated water stay at temperatures between 140°F and 160°F. The valves receive a SIAS to open and are subsequently closed by the operators after the required amount of borated water has been injected to the Reactor Coolant System (RCS) (EOPs). The valves are stroked quarterly under the In-Service Test program to verify operability. The pressure change from a full BAST to an empty BAST is approximately 6 psig. The maximum room temperature before or after an accident is 121°F, well below the maintained temperature of 140°F to 160°F. Since the local temperatures do not exceed normal system temperatures, the 20° temperature swings caused by heat tracing are insignificant, and the system pressure remains fairly constant, these valves are not susceptible to pressure locking or thermal binding. Results of quarterly valve testing under the inservice test program supports this conclusion.

No further action required.

Boric Acid Pumps Discharge Isolation Valve MOV-514

This valve provides the common discharge for the Boric Acid Pumps to the suction of the Charging Pumps. The valve is normally closed and is heat traced to ensure the valve, piping, and borated water stay at temperatures between 140°F and 160°F. The valve is stroked quarterly under the inservice test program to verify operability. The safety function of the valve is to open on a SIAS to align the Boric Acid Pump discharges to the suction of the Charging Pumps. Since the valve has a flex wedge, the maximum room temperature before and after an accident (121°F) is well below the maintained temperature range of 140° to 160°F, and the 20° temperature swings caused by heat tracing are insignificant, the valve will not be evaluated further for thermal binding.

This valve could be susceptible to pressure locking during the following scenario:

> The valve is in its normally closed position and the boric acid pumps are operated for BAST circulation or a surveillance test. The pump discharge pressure could lock in the bonnet after the pump is shut down. If a SIAS was initiated, there is a potential for the valve to start opening prior to a pump start. This would require the valve to open with 118.6 psig locked in the bonnet. The engineering analysis verified the actuator has the capability of opening the valve with pressure locked in the bonnet.

Satisfactory quarterly stroking under the inservice test program verifies the engineering analysis.

No further action required.

Safety Injection Tank (SIT) Outlet Valves MOVs-614, 624, 634, and 644

The SIT outlet MOVs are used to isolate the SITs in shutdown modes that the tanks are not required to be operable. The valves are administratively locked open in Modes 1, 2, and 3. If the MOVs were closed in Modes 1, 2, or 3, the tank(s) are considered inoperable and the appropriate Technical Specification entered. These valves will not be evaluated further for susceptibility to pressure locking or thermal binding. Their safety function is to remain open allowing SITs to dump to the RCS in case of a large-break loss-of-coolant accident. The valves are only shut in Mode 4 to prevent the water and pressure from adversely affecting the RCS during plant shutdown to Modes 5 and 6.

No further action required.

Shutdown Cooling (SDC) Return Isolation Valves MOVs-651 and 652

The SDC suction isolation valves are closed during Modes 1, 2, and 3. Interlocks prevent the valves from being opened with RCS pressure above 300 psig. The valves are opened in Mode 4 to initiate SDC and remove decay heat from the RCS. Calvert Cliffs is licensed as a hot standby plant for post-accident analyses. Valves MOV-651 and 652 are used in one of the core flush flow paths that prevent unacceptable precipitation of boric acid in the core following an accident. These valves are closed during plant startup and could have 2250 psig trapped in their bonnets after the RCS has been depressurized (accident or shutdown) and be required to open for core flush. Calculations have been performed to verify MOVs-651 and 652 have the capability to open with pressure trapped in the bonnet. Analysis concluded that the valves are not susceptible to pressure locking. However, since they have minimal margin and are difficult to test, we will take additional action to implement modification or provide additional justification to ensure 1/2-MOV-651 and 652 are not susceptible to pressure locking. Modifications will be completed during the 1998 Unit 1 Refueling Outage and the 1999 Unit 2 Refueling Outage.

These valves are closed during plant start up at RCS temperature around 200°F, and could be required to open 8 to 11 hours (core flush) following an accident. MOV-651 will be required to open for core flush at 80°F to 130°F and could, therefore, be susceptible to thermal binding. Valve MOV-652 will be required to open for core flush with the RCS temperature between 227°F to 328°F and a containment temperature of 150°F. Since MOV-652 is insulated and approximately six feet off the RCS hot leg, it can not be significantly below the initial closing temperature of 200°F. Since the temperature of MOV-652 will be close to or higher prior to initiating core flush service than when it was closed during plant heatup, it is not susceptible to thermal binding. MOVs-651 and 652 have flex wedges and are opened to go on SDC each outage. They have not experienced a failure attributed to pressure locking or thermal binding. Even though we have concluded that the valves will not thermally bind, we will test 1/2-MOV-651 and 652 for susceptibility to thermal binding if appropriate plant conditions can be established. The valves will be tested during the 1996 Unit 1 Refueling Outage and the 1997 Unit 2 Refueling Outage.

High Pressure Safety Injection (HPSI) Header Cross-Connect Valve MOV-653

Valve MOV-653 is a normally closed cross-connect valve between the Main and Auxiliary HPSI headers. The safety-related function for this valve is to remain closed to ensure the two trains of High Pressure Safety Injection remain independent. During normal operation, HPSI Pump Nos. 11(21) and 12(22) are aligned to the Auxiliary header and HPSI Pump No. 13(23) is aligned to the Main Header. MOV-653 can be opened to line HPSI Pump No. 12(22) to the Main Header as long as MOV-655 is closed. This will ensure independent trains. The valve can be opened in various EOPs to allow HPSI Pump Nos. 11 or 12 to be aligned to the Main Header if the Auxiliary Header were lost. This is not a design basis function. The safety-related function of this valve is to remain closed to ensure two independent trains of HPSI.

No further action required.

HPSI Main Header Isolation Valve MOV-654

The Main HPSI Header isolation valve is normally locked open during plant operation (Modes 1, 2, 3, and 4). If the valve is closed during the applicable modes, the Main HPSI Header is considered inoperable and the appropriate Technical Specification entered until the valve is reopened. This valve will not be evaluated further for susceptibility to pressure locking or thermal binding. The safety function of the valve is to remain open during power operation and remain open during initiation of a SIAS.

No further action required.

HPSI Cross-Connect Valve MOV-655

Valve MOV-655 is a normally open cross-connect valve between HPSI Pump Nos. 11(21) and 12(22). This valve allows HPSI Pump No. 12(22) to be lined up to the Auxiliary HPSI Header. Valve MOV-653 is the normally closed cross-connect valve between HPSI Pump Nos. 12(22) and 13(23). Valve MOV-655 would only be closed if MOV-653 were opened to align HPSI Pump No. 12(22) to the Main HPSI Header. Valve MOV-655 would not have to re-open to perform a design basis function. The safety-related function of MOV-655 is to remain open during an accident. It can be closed during EOP scenarios to maintain independent trains if MOV-653 were closed. This is not a safety-related function.

No further action required.

Auxiliary HPSI Header Isolation Valve MOV-656

This is the normally locked open Auxiliary HPSI header isolation valve. Its function is to remain open to ensure an operable HPSI flowpath. The valve can be shut to allow charging through the Auxiliary HPSI header per OI-2A or EOP-8. If closed in Modes 1, 2, 3, or 4, the Auxiliary HPSI train is considered inoperable and the applicable Technical Specification would be entered until the valve was reopened. Since the design basis function of this valve is to remain open and the header is declared inoperable when it is closed, the valve will not be evaluated for susceptibility to pressure locking or thermal binding.

No further action required.

SDC Heat Exchanger Low Pressure Safety Injection (LPSI) Supply Isolation Valve MOV-658

The SDC heat exchanger isolation valve from the LPSI pumps is normally closed when not on SDC in Modes 4, 5, and 6. This ensures that LPSI and Containment Spray will perform their design basis functions during an accident. The valve is closed after securing SDC at approximately 200°F. The valve is not required to be reopened until initiating SDC during the next outage or initiating long-term SDC after an accident. The valve has not experienced a failure to open indicating it is not susceptible to pressure locking nor thermal binding. Since Calvert Cliffs is licensed as a hot standby plant for safety-related design basis accident analyses, this valve does not have a safety-related design basis function to open. Therefore, it will not be evaluated further for pressure locking or thermal binding.

No further action required.

Safety Injection/Containment Spray Minimum Flow Isolation Valves MOVs-659 and 660

Valves MOV-659 and 660 are normally open to provide a minimum flow path to maintain the operability of the HPSI, LPSI, and Containment Spray pumps. These valves remain open during all modes of plant operation that the pumps are in standby, are closed after the initiation of the Recirculation Actuation Signal (RAS), and are not required to reopen. These valves will not be evaluated further for pressure locking or thermal binding. The design basis function is to remain open and close on a RAS.

No further action required.

HPSI Pump Suction Valves from SDC Heat Exchanger MOVs-662 and 663

These valves are normally closed during all modes of plant operation. The safety function of these valves is to remain closed during and after an accident to ensure Containment Spray flow is not diverted from containment. These valves can be opened to provide cooler water to the suction of the HPSI pumps after a RAS to prevent cavitation caused by inadequate net positive suction head. The actual net positive suction head following a RAS is greater than the required net positive suction head. The option to provide cooler water to the suction of the HPSI pumps is not a safety-related function, nor is it necessary to meet core cooling requirements. Therefore, these valves will not be evaluated further for pressure locking or thermal binding.

No further action required.

Instrument Air Containment Isolation Valve MOV-2080

This valve is the containment isolation air supply valve for all pneumatic valves located in containment. It is normally opened and closes on the receipt of a Containment Isolation Signal. The valve may be reopened following an accident that requires core flush. The normal and accident temperature will range from 80°F to 130°F. This valve is in the instrument air system and is not susceptible to pressure locking for the following reasons:

1. Assuming the air operated valves are available to support core flush, the pressure in the bonnet of the valve will be at system pressure, which is approximately 100 psig.

2. Since there will be air in the bonnet and air is compressible, MOV-2080 is not susceptible to the significant pressure increases that could cause pressure locking.

Calculations have been completed to ensure the valve is capable of operating with 120 psig in the bonnet. The pressure of 120 psig is based on an initial pressure of 100 psig and a thermally-induced pressure increase of 20 psig (50° temperature increase). The valve has a double (parallel) disk wedge design which is not susceptible to thermal binding. An additional reason it is not susceptible to thermal binding is that the valve will be closed under normal ambient temperatures and is not expected to cool down prior to opening for core flush.

No further action required.

Refueling Water Storage Tank Outlet Valves MOVs 4142 and 4143

These valves are normally open to provide a path from the RWT to the suction of the Safety Injection pumps. These valves are closed after the initiation of a RAS and are not required to reopen. These valves will not be evaluated further for pressure locking or thermal binding. Their design basis function is to remain open during normal operation and close after initiation of RAS.

No further action required.

Emergency Sump Recirculation Valves MOVs-4144 and 4145

The Emergency Sump Recirculation valves are normally closed during all modes of normal plant operation. The safety-related function of these valves is to automatically open upon receipt of a RAS. The valves are closed at Auxiliary Building ambient temperatures approximately 80°F to 100°F and Containment pressure approximately atmospheric. The valve bonnets could pressurize to 121 psi following an accident. The 121 psi assumes 57 psi from peak containment pressure plus the head of the sump and 64 psi caused by heat up of the valve from the hot water in the sump. Calculations that verify the actuator can overcome the bonnet pressure have been completed verifying the valve will not pressure lock. The valves are not susceptible to thermal binding because temperature following the accident are expected to be the same or higher than the initial closing temperatures.

To provide additional margin, plant startup procedures will be revised to fill the piping between MOVs-4144 and 4145 prior to plant startup. Filling the lines will provide a thermal barrier to prevent valve heat up after an accident and prior to a RAS and will provide additional margin to the analysis by reducing peak bonnet pressures by over 50%. The procedure revisions will be completed prior to startup from the 1996 Unit 1 Refueling Outage and the 1997 Unit 2 Refueling Outage.

Main Feedwater Isolation Valves MOVs-4516 and 4517

These are the main feedwater system isolation valves located upstream of the steam generators. The valves are open during normal plant operation and closed during outages that do not require the steam generators as a heat sink. The valves will close on a Steam Generator Isolation Signal or a Containment Spray Actuation Signal. The valves are opened during a plant start-up and can be opened in various EOPs, but these are not design basis safety-related requirements. The design basis safety-related function of these valves is to close, not open. Therefore, these valves are not required to be evaluated for susceptibility to pressure locking or thermal binding under the GL 95-07 scope.

No further action required.

Note: These valves are opened in the EOPs to provide decay heat removal via the steam generators. Although this is not a design basis safety-related function, it is an important function and calculations were performed to verify the valves could operate with 1165 psi trapped in the bonnet. The valves are insulated and would be required to open approximately 45 minutes following closure. The valves are not expected to cooldown significantly prior to opening and are, therefore, not susceptible to thermal binding.

Normal Containment Sump Drain Valves MOVs-5462 and 5463

These valves are the drains for the normal containment sump. They are normally closed during plant operation and are opened to drain the normal containment sump. These valves receive a SIAS close signal and remain shut during and after a design basis accident. These valves will not be evaluated further for pressure locking or thermal binding. Their design basis function is to close and remain closed after a SIAS.

No further action required.

Main Steam Line Drain Valves MOVs-6611, 6612, 6613, 6615, 6620, and 6621

These are Main Steam and Auxiliary Feedwater Steam line drains isolation valves. They are normally open in series with a flow orifice to drain condensation from the steam lines. Their safety-related function is to close following a design basis accident. The valves are opened in various EOPs to control steam generator pressure as an alternate to primary controls. These valves will not be evaluated further for pressure locking or thermal binding. Their design basis safety-related function is to close for pressure boundary purposes only.

No further action required.

Containment Hydrogen Purge Valves MOVs 6900, 6901 and 6903

These valves are part of the Containment Purge System that is designed to maintain hydrogen concentration inside containment below 4% (volume). During power operation, these valves are used to maintain containment pressure and activity levels within Technical Specification limits. These valves are normally closed and on receipt of a SIAS, Containment Radiation Signal, or high radiation signal, will automatically close. The isolation signals can be over-ridden after an accident if both hydrogen recombiners failed (Updated Final Safety Analysis Report Chapter 14.21). These valves could have a maximum containment pressure of 72 psig trapped in the bonnet. Calculations were completed to ensure the actuator is capable of opening the valve with pressure locked in the bonnet. These valves are not susceptible to thermal binding because they are closed under ambient conditions and would not be required to open for several days after an accident when temperatures will be about the same. The safety-related function of these valves is to close to maintain containment integrity, but an analysis is discussed in Updated Final Safety

Analysis Report Chapter 14 to vent containment following an accident where both safety-related recombiners fail.

No further action required.

Plant Heating to Containment Valve MOV-6579

This valve was designed to provide plant heating to containment during outages. The valve has been electrically disconnected. Unit 2 piping has been cut and capped. Unit 1 will be cut and capped during the 1996 refueling outage.

No further action required.

Summary Description of the Further Analyses Performed in Response to the 180-day Requested Action 2.

A calculation was developed to evaluate the capability of the potentially susceptible MOVs to overcome the pressure locking conditions and to document the operability of these valves in response to GL 95-07. Key assumptions made for this calculation include the valve disc to seat friction factor (0.40), Poisson's Ratio (0.3), and the assumed bonnet pressures. The general assumption for the bonnet pressure is that the bonnet pressure is the maximum pressure of the fluid on one side of the disc prior to depressurization, conservatively assuming no external leakage from the bonnet. However, certain valves have the potential for "heating up" due to operational or accident scenarios. In those cases, bonnet pressure was assumed to increase at a rate of 0.4 psig /°F, based upon testing performed at Northeast Utilities.

To determine whether or not there is sufficient margin in the design of the subject MOVs to open under pressure locking conditions, the following forces were calculated;

- Reaction force due to the bonnet pressure loads on both the downstream and upstream sides of the disc;

- The maximum additional seat reaction force due to the differential pressure loading on the hub; and

- The unwedging thrust required to open a closed valve

This methodology is consistent with methodology used by other plants and recommended by the NRC in NUREG/CP-0146, Workshop on Gate Valve Pressure Locking and Thermal Binding.

Once these forces were calculated, they were added together to obtain the minimum thrust needed to open the valves under maximum pressure locking conditions. The internal pressure for each valve was analyzed using Roark and Young's Formulas for Stress and Strain. This analysis provided the force exerted on the seat ring by the disc with the internal pressure.

Once the total force required to overcome the potential pressure locking force was calculated, it was compared to the Maximum Control Switch Trip (CST_{MAX}) value which was developed in the applicable thrust calculation for each valve. This comparison showed whether there is sufficient thrust margin available to open the valves under pressure locking conditions. In this first step, the standard evaluation, the calculation results indicated that the MOVs do not have the margin to overcome the pressure locking scenario. It should be noted that when calculating CST_{MAX}, the thrust calculations are extremely conservative in the interest of maximizing MOV reliability.

The next step of the calculation was to replace standard inputs and generic assumptions with MOV-specific data. Also some conservatism was justifiably removed based on actual MOV performance. Specifically, this evaluation used the following methodology in reduction of conservatism:

1/2-MOV-504 and 514 The standard evaluation assumed that the maximum closing force was the maximum thrust seen at closing during the last VOTES test. This value is based on the torque switch point plus inertia. This makes this value overly conservative for limit-controlled MOVs like 1/2-MOV-504 and 514. An equivalent maximum closing thrust based on the limit switch trip was derived for these valves. In addition, some of the applicable thrust calculations have a CST_{MAX}, based upon a spring pack limit. Since the "start of open torque" is the area of concern for pressure locking, the spring pack limit can be ignored (i.e., the MOVs' torque switch is bypassed). This method was used to raise the CST_{MAX} for 1/2-MOV-514. Once this was done, 1/2-MOV-514 showed sufficient margin. Valves 1/2-MOV-504 were shown to have sufficient capacity by ignoring the reduced starting voltages calculated in the thrust calculation, since these valves do not receive an actuation signal to open.

1/2-MOV-2080 These valves were shown to have sufficient margin by increasing CST_{MAX}. The value of CST_{MAX} calculated in the applicable thrust calculation was based upon the spring pack capability. Since the MOV's torque switch is bypassed in the opening direction, the spring pack limit can be ignored. Per the thrust calculation, the next limiting component is the motor at reduced starting voltage combined with the effects of temperature on the motor start torque. This value is greater than the calculated thrust needed to overcome pressure locking.

1/2-MOV-4144 and 4145 These valves were shown to have margin using the following methods. First, the same justification used on 1/2-MOV-504 and 514 was applied (i.e., maximum thrust values used for limit controlled valves). Once this was done, only 2-MOV-4144 had sufficient margin. Valves 1-MOV-4144 and 1/2-MOV-4145 were shown to have adequate margin by removing the maximum combined diagnostic inaccuracies and torque switch repeatability value and evaluating the valves in the opening direction.

1/2-MOV-4516 and 1/2-MOV-4517 These valves were shown to have margin by applying plant operational factors. The thrust calculations for 1/2-MOV-4516 and 1/2-MOV-4517 calculated CST_{MAX} based upon thrust at reduced starting voltages. These valves are not required to open on any accident signal. In fact, they are normally open and their safety function is to close on receipt of a Steam Generator Isolation Signal or Containment Spray Actuation Signal. Since the valves do not have to open on an Engineered Safety Features Actuation Signal, the under voltage condition will not be experienced in the open direction. For this intermediate evaluation, the reduced starting voltages were raised.

1/2-MOV-6900 and 6901 These valves were shown to have margin by using the same justification used on 1/2-MOV-504 and 514, maximum thrust values used for limit controlled valves. This, in combination with removing diagnostic inaccuracies, showed that all the valves had sufficient margin.

1/2-MOV-651 and 652 These valves could not demonstrate sufficient margin during the intermediate evaluation (reduced conservatism). Therefore, they were evaluated using an engineering evaluation approach. To show that these valves have capacity to overcome the effects of pressure locking, three components of the MOV were analyzed; operator, motor, and valve. It was determined that for these valves, the valve was the limiting component, specifically the valve stem. The one-time allowable of the valve stem is above the thrust required to overcome pressure locking, so the valves will perform their design function.

The calculation showed that the MOVs within the scope of this task are capable of operating under the maximum potential pressure locking conditions. Most of the valves were shown to have sufficient capability once some conservatism was justifiably removed from the applicable thrust calculations. Finally, four valves (1/2-MOV-651 and 652) were shown to have sufficient capability based upon valve material allowables.

2. Results of the Susceptibility Evaluation and the Analyses.

Valve #	Safety-Related Function To Open	Potentially Susceptible To Pressure Locking	Potentially Susceptible To Thermal Binding	Additional Evaluation/ Corrective Actions Required
MOV-403	**Yes**	No	**Yes**	**Yes**
MOV-405	**Yes**	No	**Yes**	**Yes**
MOV-501	No	—	—	
MOV-504	**Yes**	**Yes**	No	**Yes**
MOV-508	**Yes**	No	No	
MOV-509	**Yes**	No	No	
MOV-514	**Yes**	**Yes**	No	**Yes**
MOV-614	No	—	—	

ATTACHMENT (1)

BALTIMORE GAS & ELECTRIC COMPANY'S 180-DAY SUMMARY RESPONSE TO GENERIC LETTER 95-07: PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED, POWER-OPERATED GATE VALVES

Valve #	Safety-Related Function To Open	Potentially Susceptible To Pressure Locking	Potentially Susceptible To Thermal Binding	Additional Evaluation/ Corrective Actions Required
MOV-624	No	—	—	
MOV-634	No	—	—	
MOV-644	No	—	—	
MOV-651	Yes	Yes	Yes	Yes
MOV-652	Yes	Yes	Yes	Yes
MOV-653	No	—	—	
MOV-654	Yes	No	No	
MOV-655	No	—	—	
MOV-656	Yes	No	No	
MOV-658	No	—	—	
MOV-659	Yes	No	No	
MOV-660	Yes	No	No	
MOV-662	No	—	—	
MOV-663	No	—	—	
MOV-2080	Yes	Yes	No	Yes
MOV-4142	Yes	No	No	
MOV-4143	Yes	No	No	
MOV-4144	Yes	Yes	No	Yes
MOV-4145	Yes	Yes	No	Yes
MOV-4516	No	Yes***	—	Yes***
MOV-4517	No	Yes***	—	Yes***
MOV-5462	No	—	—	
MOV-5463	No	—	—	
MOV-6611	No	—	—	
MOV-6612	No	—	—	
MOV-6613	No	—	—	
MOV-6615	No	—	—	
MOV-6620	No	—	—	
MOV-6621	No	—	—	
MOV-6900	No	Yes***	—	Yes***
MOV-6901	No	Yes***	—	Yes***
MOV-6903	No	—	—	
MOV-6579	No	—	—	

*** Denotes important function that is not safety-related, but was evaluated under the scope of GL 95-07

3. Corrective Actions

The corrective actions and implementation schedules are contained in the Summary Description of the Susceptibility evaluation of Operation Configurations Performed to Respond to Requested Action 1.