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February 13, 1996

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

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
Response to Generic Letter 95-07: "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"
San Onofre Nuclear Generating Station Units 2 and 3

References: 1) Generic Letter 95-07: "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," dated August 17, 1995.

2) Letter from Walter C. Marsh to the NRC Document Control Desk dated September 29, 1995; Subject: Docket Nos. 50-361 and 50-362 Response to Generic Letter 95-07: "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," San Onofre Nuclear Generating Station Units 2 and 3.

This letter is to inform the NRC that Southern California Edison (Edison) has completed the actions requested in Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safey-Related Power-Operated Gate Valves" dated August 17, 1995, (Reference 1). Additionally, the information requested by the generic letter is provided in the Enclosure.

Edison committed to perform the requested actions and provide the requested information by letter from Walter C. Marsh to the NRC Document Control Desk dated September 19, 1995 (Reference 2).

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If you need any additional information, please let me know.

Very truly yours,

Walter C. Marsh

State of California
County of San Diego
On February 13, 1996 before me, Linda L. Rulon, Notary Public, personally appeared Walter C. Marsh, personally known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

Signature Linda L. Rulon

LINDA L. RULON
COMM. #[illegible]
Notary Public California
ORANGE COUNTY
My comm. expires MAR 04,1996

Enclosure

cc: L. J. Callan, Regional Administrator, NRC Region IV
J. E. Dyer, Director, Division of Reactor Projects, Region IV
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ENCLOSURE

NRC GENERIC LETTER 95-07 PROGRAM SUMMARY
PRESSURE LOCKING AND THERMAL BINDING OF GATE VALVES

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PART I: GL 95-07 PROGRAM EXECUTIVE SUMMARY

The Southern California Edison (Edison) pressure locking and thermal binding (PL/TB) program includes responses to the Generic Letter (GL) 95-07 90-Day and 180-Day Requested Actions. Provided below are summary descriptions of these requested actions, the results of these evaluations and further actions, and the corrective actions.

Initial Pressure Locking/Thermal Binding Valve Screening (90-Day Action)

Edison Calculation A-95-NM-MOV-PL/TB-002 provided the necessary screening evaluation to identify those valves considered potentially susceptible to pressure locking and/or thermal binding in accordance with the guidelines of GL 95-07. The screening evaluation concluded that of a total safety related, power operated, gate valve population of ninety valves (90), thirty two (32) valves were potentially susceptible to pressure locking and four (4) valves were potentially susceptible to thermal binding. A summary of the screening evaluation is included in Part II of this enclosure. Edison had previously completed an evaluation of the effects of pressure locking and thermal binding (PL/TB) in accordance with the guidance in Supplement 6 to GL 89-10. All of the valves identified by the GL 95-07 screening evaluation as potentially susceptible to PL/TB had been previously identified and evaluated by the Supplement 6 GL 89-10 evaluation. Issuing the screening evaluation calculation A-95-NM-MOV-PL/TB-002 completed the 90-day action request of GL 95-07.

Assessment of Pressure Locking (180-Day Action)

In response to the 180-day action request of GL 95-07, Edison issued Calculation A-96-NM-MOV-PL/TB-003, which provided further analyses of valves identified by the initial screening evaluation as being potentially susceptible to PL/TB. This calculation verified that all valves identified as potentially susceptible to pressure locking have adequate actuator output thrust margin to overcome the maximum anticipated pressure locking forces with the exception of two valves, 2HV9336 and 3HV9336. The PL/TB evaluation performed in response to Supplement 6 of GL 89-10 had previously identified 2(3)HV9336 as being potentially susceptible to pressure locking. The results of the Supplement 6 GL 89-10 pressure locking calculation, A-94-NM-MOV-PL/TB-001, had concluded that these valves had sufficient margin to operate. However, in response to GL 95-07 the methodology to determine the maximum required force to overcome pressure locking was revised to include additional NRC guidelines on pressure locking. Based on the updated GL 95-07 calculation methodology 2(3)HV9336 were determined to have negative capability margin available to overcome the effects of a worst case pressure locking condition. Upon identifying a possible negative operating margin condition, a non-conformance report (NCR) for 2(3)HV9336 was issued to provide the required operability assessment and corrective actions.

Valves 2(3)HV9336 were determined to be currently operable based on several factors including: 1) credit for completed quarterly in-service manual stroke testing (IST), 2) increased available motor torque based on actual available steady state motor supply voltage, 3) pressure and temperature reduction due to system cooling after valve closure, and 4) internal valve clearances not credited during PL/TB calculation assessment. In addition, an operational constraint limiting allowable system pressure at valve closure following shutdown cooling system operation was initiated until corrective actions can be implemented.

Permanent corrective actions for 2(3)HV9336 are still being developed. The corrective actions will be implemented by the end of the Cycle 9 refueling outages of each respective unit.

<u>Assessment of Thermal Binding</u> (180-Day Action)

Based on the results of the GL 95-07 valve screening evaluation, four valves were identified as potentially susceptible to the effects of thermal binding. During preparation of calculation A-96-NM-MOV-PL/TB-003 it was noted that the PL/TB evaluation performed in response to Supplement 6 of GL 89-10 had also identified these four valves as susceptible to thermal binding and requiring corrective actions. To ensure these four valves 2(3)HV8152, 2(3)HV8153 were capable of operating, procedural revisions preventing valve closure at high temperatures were implemented. In addition, modifications to increase the gear ratios of the valve motor operators were initiated. These corrective actions had been initiated as part of the response to Supplement 6 of GL 89-10. The modifications have been completed on two of the four valves (2HV8152 and 3HV8153). Modifications to the remaining valve operators is scheduled to be completed by the end of the Cycle 9 refueling outages of each respective unit. Based on review of GL 95-07 requirements, no further corrective actions are required for the four valves identified as susceptible to thermal binding.

<u>Summary</u>

The screening evaluation identified thirty two (32) valves as being potentially susceptible to pressure locking and four (4) valves as potentially susceptible to thermal binding. All valves were found to be capable of withstanding the effects of PL/TB with the exception of six (6) valves which were shown to need corrective actions to ensure PL/TB does not prohibit operation. Edison has performed operability assessments, implemented appropriate administrative controls, and initiated the necessary corrective actions for these six valves, 2(3)HV8152, 2(3) HV8153, and 2(3)HV9336. In addition, it has been concluded that no immediate operability concerns exist for these valves. Based on the current as-left configuration of these valves, assurance exists that they are fully operable and capable of performing their safety function if needed. All corrective actions will be implemented by the end of the Cycle 9 refueling outage for each unit. Both Units 2 and 3 are currently scheduled to complete their Cycle 9 refueling outages before mid 1997.

The summary descriptions of the 90-day Requested Action Screening Evaluation and the 180-day Requested Action Evaluation for all safety-related, power-operated gate valves are provided below. Flowcharts are provided to present the evaluation logic, and the evaluation results are provided in Sections II and III.

PART II: SUMMARY DESCRIPTION OF GL 95-07 SCREENING EVALUATION

1.0 PURPOSE

The purpose of calculation A-95-NM-MOV-PL/TB-002 is to provide a screening evaluation of the operational configurations of all safety related, power operated gate valves to determine if there was a potential susceptibility of the valve to become pressure locked or thermally bound. This document completes the 90-day action item of Generic Letter 95-07.

2.0 RESULTS AND CONCLUSIONS

Table IIA summarizes the results of the pressure locking and thermal binding screening evaluation performed on all safety related power operated gate valves in accordance with GL 95-07. Based on initial evaluation of the valves physical design and required safety function, it was concluded that of the total population of ninety (90) gate valves, thirty two (32) valves were potentially susceptible to pressure locking and four (4) valves were potentially susceptible to thermal binding. No valves were found to be incapable of performing their safety related function as a result of the effects of pressure locking and/or thermal binding based on existing operability assessments and/or as-left configuration.

TABLE IIA: PRESSURE LOCKING/THERMAL BINDING SCREENING SUMMARY

VALVE ID	VALVE MFR	DISC TYPE	POTENTIAL FUNCTIONAL IMPACT DUE TO PRESSURE LOCKING	POTENTIAL FUNCTIONAL IMPACT DUE TO THERMAL BINDING	PREVIOUS GL 89-10, SUPP 6 EVALUATION COMPLETED	EXISTING BASIS FOR OPERABILITY AVAILABLE
2(3)HV4048	WKM	SPLIT	NO	NO	NOT REQ	NOT REQ
2(3)HV4052	WKM	SPLIT	NO	NO	NOT REQ	NOT REQ
2(3)HV5686	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV5803	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV6366	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV6367	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV6368	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV6369	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV6370	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV6371	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV6372	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV6373	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV7258	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV7512	WKM	SPLIT	NO	NO	YES	NOT REQ
2(3)HV8152	ALOYCO	SOLID	NO	YES	YES	YES

TABLE IIA: PRESSURE LOCKING/THERMAL BINDING SCREENING SUMMARY

VALVE ID	VALVE MFR	DISC TYPE	POTENTIAL FUNCTIONAL IMPACT DUE TO PRESSURE LOCKING	POTENTIAL FUNCTIONAL IMPACT DUE TO THERMAL BINDING	PREVIOUS GL 89-10, SUPP 6 EVALUATION COMPLETED	EXISTING BASIS FOR OPERABILITY AVAILABLE
2(3)HV8153	ALOYCO	SOLID	NO	YES	YES	YES
2(3)HV8161	ALOYCO	SOLID	NO	NO	YES	NOT REQ
2(3)HV8162	W-HOUSE	FLEX	NO	NO	NOT REQ	NOT REQ
2(3)HV8163	W-HOUSE	FLEX	NO	NO	NOT REQ	NOT REQ
2(3)HV8204	WKM	SPLIT	NO	NO	NOT REQ	NOT REQ
2(3)HV8205	WKM	SPLIT	NO	NO	NOT REQ	NOT REQ
2(3)HV9235	T-ROCK	DOUBLE	YES	NO	YES	YES
2(3)HV9240	T-ROCK	DOUBLE	YES	NO	YES	YES
2(3)HV9247	T-ROCK	DOUBLE	YES	NO	YES	YES
2(3)HV9300	ALOYCO	SOLID	NO	NO	NOT REQ	NOT REQ
2(3)HV9301	ALOYCO	SOLID	NO	NO	NOT REQ	NOT REQ
2(3)HV9306	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9307	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9336	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9337	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9339	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9340	WKM	SPLIT	NO	NO	NOT REQ	NOT REQ
2(3)HV9347	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9348	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9350	WKM	SPLIT	NO	NO	NOT REQ	NOT REQ
2(3)HV9360	WKM	SPLIT	NO	NO	NOT REQ	NOT REQ
2(3)HV9367	T-ROCK	DOUBLE	YES	NO	YES	YES
2(3)HV9368	T-ROCK	DOUBLE	YES	NO	YES	YES
2(3)HV9370	WKM	SPLIT	NO	NO	NOT REQ	NOT REQ
2(3)HV9377	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9378	WKM	SPLIT	YES	NO	YES	YES
2(3)HV9379	WKM	SPLIT	YES	NO	YES	YES
2(3)LV0227B	T-ROCK	DOUBLE	NO	NO	YES	NOT REQ
2(3)LV0227C	T-ROCK	DOUBLE	YES	NO	YES	YES
2(3)TV9267	W-HOUSE	FLEX	NO	NO	YES	NOT REQ

3.0 ASSUMPTIONS

3.1 GL 95-07 indicated that solid wedge gate valves might not be susceptible to pressure locking. Based on this statement, it is assumed that solid wedge gate valves are exempt from pressure locking evaluations at this time. This exemption criteria will be re-evaluated if industry experience, plant specific experience, or the NRC indicate it is necessary.

3.2 GL 95-07 indicated that double disc gate valves are not likely to be susceptible to thermal binding. Based on this statement, it is assumed that double disc and split disc gate valves are exempt from thermal binding evaluations at this time. Only solid and flex wedge gate valves are considered susceptible to thermal binding at this time. This exemption criteria will be re-evaluated if industry experience, plant specific experience, or the NRC indicate it is necessary.

4.0 DESIGN INPUTS

4.1 The review scope specified by GL 95-07 is all safety related, power operated (including motor, air, and hydraulically operated) gate valves. To determine the applicable scope of GL 95-07 for SONGS, the available resources of the Nuclear Consolidated Database System (NCDB) were utilized. An ad-hoc search of all Quality Class I and Quality Class II power operated (pneumatic, hydraulic, and motor) valves from the available NCDB valve databases was performed. The database search did not include valve type (e.g., gate) because it was noted that within NCDB the contributing in-service testing (IST) database did not include this field. As a result, the ad-hoc search identified all safety related power operated valves regardless of disc type. Of the approximately 300 valves which were identified by the initial ad-hoc search, only ninety valves were confirmed to be safety related, power operated gate valves. This final population was identified by reviewing the vendor outline drawings for each of the valves identified in the initial ad-hoc search. Confirmation of the valves' normal position and active safety function were also verified from the NCDB system which includes the contributing IST database and the motor operated valve (MOV) database.

4.2 Review of the initial GL 95-07 valve scope reveals that 82 of the 90 valves are also part of the GL 89-10 program. Supplement 6 of GL 89-10 requested that licensees evaluate the potential for pressure locking/ thermal binding (PL/TB) of safety related motor operated valves identified in the scope of GL 89-10 and take action to ensure that these phenomena do not affect the capability of the MOVs to perform their safety-related functions. All of the MOVs within the GL 89-10 program, including the 82 identified within this screening evaluation, were evaluated for PL/TB in accordance with the requirements of Supplement 6. This evaluation is documented in calculation A-94-NM-MOV-PL/TB-001. Unless otherwise noted, the basis for operability of valves which are identified as potentially susceptible to PL/TB by this screening evaluation will be based on the justification provided by the MOV PL/TB calculation. This position is specifically noted by GL 95-07 as an acceptable approach to addressing potential PL/TB issues.

5.0 METHODOLOGY

The purpose of GL 95-07 is to "ensure that safety related power operated gate valves that are susceptible to PL/TB are capable of performing their intended safety function". The methodology of this evaluation identifies valves which are susceptible to PL/TB and which would possibly be unable of performing their safety function with either of these phenomenon present. Valves which are physically not susceptible to PL/TB will be excluded from further evaluation. In addition, valves which by design and system configurations may be susceptible to PL/TB but not affect the performance of their required safety function are also excluded from further evaluation.

Based on the initial valve population specified by the generic letter, an initial screening was performed to determine valves which may be exempted from further evaluation. Initial screening evaluation data sheets were prepared for each safety related, power operated gate valve identified as part of the GL 95-07 population. The methodology utilized for this initial screening is described below. Valves not excluded during the initial screening evaluation are considered susceptible to PL/TB (as noted) and require corrective actions or other dispositions as specified by GL 95-07 to assure that they are capable of performing their intended safety function.

Each of the power operated safety related gate valves identified within the scope of GL 95-07 is evaluated using the PL/TB screening evaluation checklist to determine if the valve is potentially susceptible to PL/TB. A total of 90 valves are within the GL 95-07 initial scope as determined by available plant database systems. As shown in Table IIB, a total of 32 valves are potentially susceptible to pressure locking and 4 valves are potentially susceptible to thermal binding. In addition to identifying potentially susceptible valves, a basis for operability is either provided or referenced in the screening evaluation.

5.1 Pressure Locking Screening Evaluation (See Figure 1- Screening Evaluation Flowchart)

For the purpose of complying with the guidelines of GL 95-07, all gate valves other than solid wedge type are considered potentially susceptible to pressure locking. Solid wedge gate valves are considered to be not susceptible to pressure locking based on discussions provided in NUREG 1275 and GL 95-07. In addition to exempting solid wedge gate valves from the scope of valves considered potentially susceptible to pressure locking, further exemptions are considered valid based on the operating requirements and the active safety function of the valve.

Pressure locking of a power operated gate valve can only occur with the valve in the closed position. If pressure locking occurs while the valve is closed, it may prevent the valve from successfully completing its open stroke. If a power operated gate valve identified in the initial scope did not have an active safety function to open, it was considered exempted from further evaluation since the effects of pressure locking would not prevent the valve from performing its safety related function. An active safety function is defined as a safety function which requires a change in valve position. Based on this definition, valves which

5.1 Pressure Locking Screening Evaluation (Continued)

are maintained in a normally open position and have a credited open safety function were also exempted from further evaluation if it could be shown that the valve was not required to open from an initially closed position.

Based on NRC responses to utility generated questions on the scope of GL 95-07, mispositioning of a valve is not required to be postulated during the evaluation of pressure locking or thermal binding.

The potential for pressure locking of a gate valve as a result of in-service inspection testing (ISI) or hydrotesting is recognized but is excluded from the scope of this initial screening evaluation. Based on the possible configurations of a given gate valve during the implementation of a hydro or ISI test, as discussed in the next paragraph, it is concluded that there is no need to evaluate test configurations when assessing the potential susceptibility of a valve to pressure locking.

Valves which have a normally closed position and are required to perform an active opening safety function will be considered susceptible to pressure locking regardless of the effects of testing. If a valve is normally open and has a closing function, testing would not impact the ability of this valve to complete its safety function and was therefore considered not susceptible to pressure locking. A third possible scenario in which testing could result in pressure locking would be if a normally open valve was closed to support testing and subjected to a significant pressure source. In this case, the valve could become pressure locked as a result of testing and possibly be incapable of returning to its designated normal position following the testing. If a safety related valve is being utilized to support ISI or hydrotesting, current work practices at San Onofre Nuclear Generating Station (SONGS) require that the component and/or complete system train be removed from service and designated as inoperable until testing is complete. The valve is not considered operable or relied upon to perform a safety function until the testing is completed and the valve can be returned to its normal operating position (i.e., open). Subsequently, if pressure locking were to occur under this test condition, it could not result in preventing the valve from performing its safety related function since the component would already be considered inoperable.

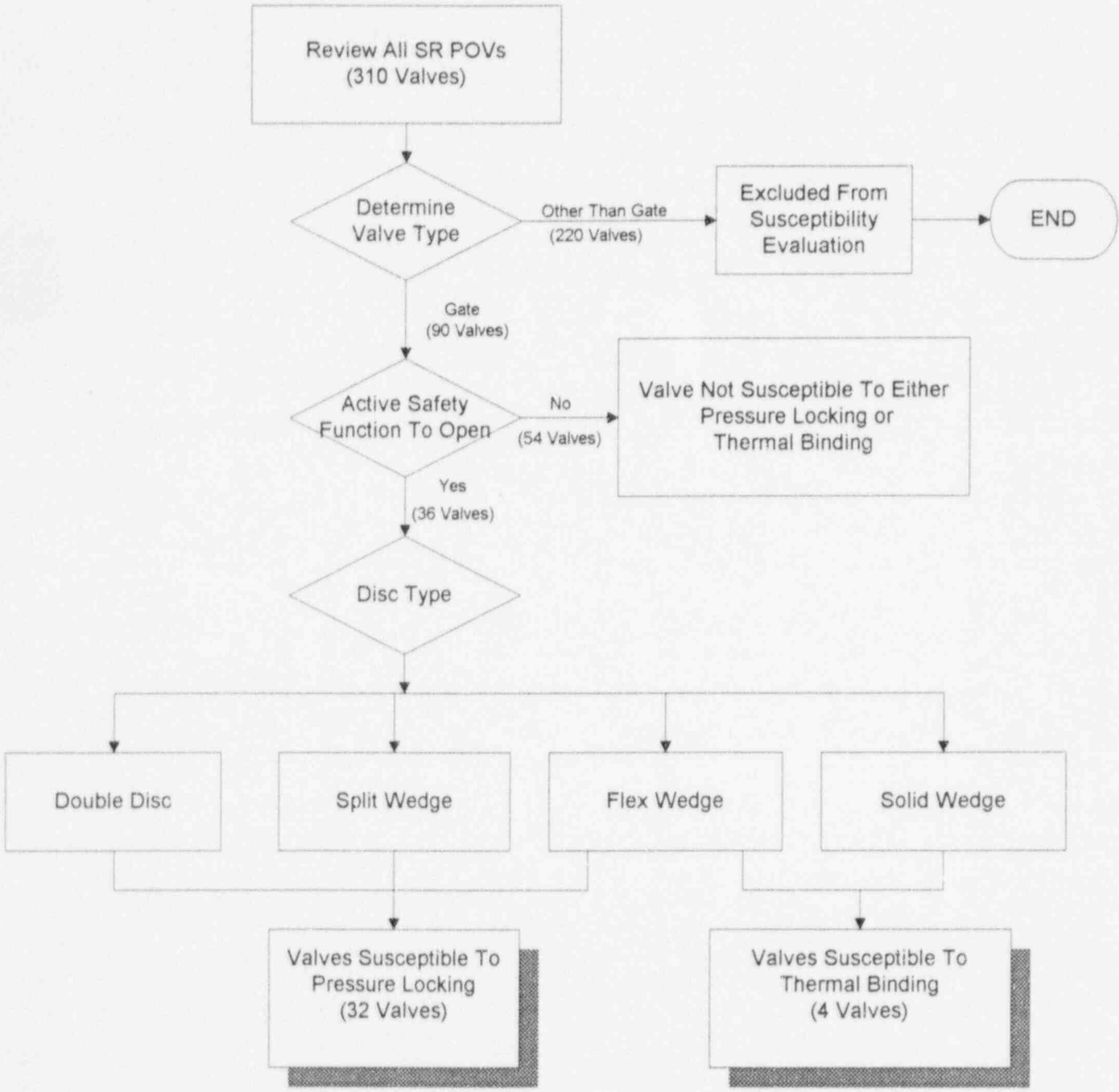
5.2 Thermal Binding Screening Evaluation

For the purpose of complying with the guidelines of GL 95-07, all gate valves other than double disc or the functionally equivalent split disc type are considered potentially susceptible to thermal binding. Double disc or split disc gate valves are considered to be not susceptible to thermal binding based on discussions provided in NUREG 1275 and GL 95-07. In addition to exempting a gate valve from further evaluation based on disc type, a gate valve may be excluded from further evaluation for thermal binding based on the safety function position exemption criteria outlined previously in the initial pressure locking screening evaluation.

FIGURE 1

PRESSURE LOCKING/THERMAL BINDING SCREENING EVALUATION FLOW CHART

Ref: Calculation A-95-NM-MOV-PL/TB-002



PART III: SUMMARY DESCRIPTION OF GL 95-07 EVALUATION

1.0 PURPOSE

Calculation A-96-NM-MOV-PL/TB-003 completes SCE's commitments to generic letter (GL) 95-07. This calculation provides a further evaluation of power operated gate valves previously identified as being potentially susceptible to the effects of pressure locking and/or thermal binding in the pressure locking/thermal binding (PL/TB) screening evaluation, A-95-NM-MOV-PL/TB-002. Calculation A-96-NM-MOV-PL/TB-003 provides the necessary analysis to verify that a valve considered susceptible to pressure locking and/or thermal binding is capable of performing its intended safety function. In addition, this calculation identifies any necessary corrective actions required to ensure valve operability.

Previously, calculation A-94-NM-MOV-PL/TB-001 was prepared in response to PL/TB issues identified in GL 89-10, Supplement 6. The scope of this previous calculation was limited to safety related motor operated gate valves included in the GL 89-10 MOV program. Calculation A-96-NM-MOV-PL/TB-003 incorporates requirements of GL 95-07 which requires that the potential effects of PL/TB be evaluated for all safety related power operated gate valves as identified in the GL 95-07 PL/TB screening evaluation. Calculation A-96-NM-MOV-PL/TB-003 supersedes calculation A-94-NM-MOV-PL/TB-001 in its entirety.

2.0 RESULTS AND CONCLUSIONS

2.1 Results

All of the valves identified as potentially susceptible to pressure locking and/or thermal binding by the screening evaluation were evaluated by calculation A-96-NM-MOV-PL/TB-003. This evaluation was performed to verify that the identified valves would be capable of successfully completing their required safety function if PL/TB were to occur. As shown in the Table IIIA, all valves identified as potentially susceptible to PL/TB have adequate margin to overcome the maximum anticipated PL or TB forces as determined by this calculation with the exception of 2(3)HV9336. Excluding 2(3)HV9336, no further actions are required for the identified population of gate valves. Based on the results of this calculation, NCR 960100390 was initiated for 2(3)HV9336. This NCR was initiated to provide further evaluation and corrective actions of the potential pressure locking concerns associated with these valves as well as provide the necessary operability assessment to assure that these valves will perform their safety function.

2.2 Conclusions

2.2.1 Effects of Pressure Locking on Gate Valves

The methodology utilized for determining the effects of pressure locking on the gate valves identified within the scope of this calculation is considered conservative. Specific areas of conservatism are identified within the body of calculation A-96-NM-MOV-PL/TB-003. For the WKM valves within the population, which includes 2(3)HV9336, a worst case bonnet pressure equal to the maximum upstream pressure at the time of valve opening (P1co) plus 300 psi was assumed to occur at all times. By design, WKM valves are less susceptible to pressure locking due to an internal relief valve installed in the disc of the valve. The maximum net bonnet pressure is limited by the setpoint of the relief valve. At SONGS, the majority of safety related gate valves installed in the systems considered most prone to pressure locking events are WKM gate valves.

All WKM valves identified within the pressure locking population of calculation A-96-NM-MOV-PL/TB-003 are capable of operating under a maximum pressure locking condition with the exception of 2(3)HV9336. NCR 960100390 was initiated to address the findings for 2(3)HV9336. This NCR provides the necessary operability assessment and also the required corrective actions. Valves 2(3)HV9336 are determined to be operable based on several factors including: 1) credit for completed quarterly IST manual stroke testing, 2) increased available motor torque based on actual available steady state motor supply voltage, 3) pressure and temperature reduction due to system cooling after valve closure, and 4) internal valve clearances not credited during PL/TB calculation assessment. In addition, an operational constraint limiting allowable system pressure at valve closure following shutdown cooling system operation was initiated until corrective actions can be implemented.

All remaining valves identified as susceptible to pressure locking are Target Rock double disc gate valves. All of these valves have positive capability margin under the worst case pressure locking conditions determined by calculation A-96-NM-MOV-PL/TB-003. Each of the Target Rock valves are located in relatively low pressure and temperature systems and are not exposed to high ambient temperatures associated with accident conditions. No further evaluation or corrective actions are required for these valves.

2.2.2 Effects of Thermal Binding on Gate Valves

Four valves, 2(3)HV8152 and 2(3)HV8153 are susceptible to thermal binding. The potential for thermal binding of these valves had been previously identified by calculation A-94-NM-MOV-PL/TB-001 in response to Supplement 6 of GL 89-10. Corrective actions, which included procedural revisions preventing valve closure at high temperatures and gear modifications to the valve actuator, have already been initiated for these valves to assure that these valves are capable of operating. These corrective actions are documented in the NCRs which were initiated following the GL 89-10 evaluation. Maintenance orders to replace the actuator gearing were also initiated. No further evaluation or corrective actions are required for these valves.

2.0 RESULTS AND CONCLUSIONS (continued)

TABLE IIIA: PRESSURE LOCKING AND THERMAL BINDING ANALYSIS RESULTS

VALVE ID	SUSCEPTIBLE TO PL	SUSCEPTIBLE TO TB	PL/TB CAPABILITY	NOTES
GROUP 1				
2(3)HV9306	YES	NO	Y	
2(3)HV9307	YES	NO	Y	
2(3)HV9336	YES	NO	N	1
2(3)HV9337	YES	NO	Y	
2(3)HV9339	YES	NO	Y	
2(3)HV9347	YES	NO	Y	
2(3)HV9348	YES	NO	Y	
2(3)HV9377	YES	NO	Y	
2(3)HV9378	YES	NO	Y	
2(3)HV9379	YES	NO	Y	
GROUP 2				
2(3)HV9367	YES	NO	Y	
2(3)HV9368	YES	NO	Y	
2(3)HV9235	YES	NO	Y	
2(3)HV9240	YES	NO	Y	
2(3)HV9247	YES	NO	Y	
2(3)LV0227C	YES	NO	Y	
GROUP 3				
2(3)HV8152	NO	YES	Y	2
2(3)HV8153	NO	YES	Y	2

NOTES:

1) NCR 960100390 was initiated to provide the necessary operability assessment and corrective action (as needed) to assure these valves are capable of withstanding the effects of pressure locking.

2) As part of the Supplement 6 GL 89-10 evaluation of PL/TB, NCR's were initiated to provide necessary corrective actions to assure successful valve operation. Maintenance orders were initiated to provide the physical modifications. No further evaluation is required.

3.0 ASSUMPTIONS

3.1 In order for pressure locking of a valve to occur, fluid must be present in the valve bonnet cavity. For the purpose of this evaluation, all gate valves which are considered potentially susceptible to pressure locking are conservatively assumed to have water solid bonnet cavities.

3.2 In accordance with NRC guidance, normal ambient temperature changes are assumed not to cause thermally induced pressure locking or thermal binding of a gate valve provided there are no potential significant heating or cooling sources near the valve. Maximum normal and post accident temperatures are identified in the Environmental Qualification Topical Report (DBD-SO23-TR-EQ).

3.3 For WKM gate valves the maximum bonnet pressure assumed to exist for the purpose of pressure locking evaluations is equal to the segment relief valve setpoint (including tolerances) plus the maximum upstream pressure at the time the opening stroke is initiated. The bonnet pressure cannot exceed this value since the relief valve would vent any net pressure differential between the bonnet and the upstream pressure greater than the relief valve set pressure.

3.4 For Target Rock gate valves the maximum bonnet pressure assumed to exist for the purpose of pressure locking evaluations is equal to the maximum system line pressure which could exist at any time as specified by the applicable operating basis calculation. Since the population of Target Rock valves are not subjected to thermal transients which could increase bonnet fluid temperature, the maximum bonnet pressure cannot exceed the maximum line pressure.

3.5 The Target Rock double disc gate valves identified within this calculation as susceptible to pressure locking do not utilize disc wedging force to provide sealing against system fluid flow. If these valves become pressure locked, it is assumed that they experience "double disc drag" due to the internal pressure acting on the valve discs. The required force to open under pressure locking does not include unwedging (cracking) forces since these valves do not wedge during closing.

3.6 The WKM valves identified within this calculation are double disc gate valves with a split wedge (gate and segment) design. If a WKM valve becomes pressure locked, it is assumed that the internal pressure between the gate and segment causes the gate and segment to maintain contact with their respective seat rings. The force required to overcome this pressure locking "double disc drag" is assumed to be more limiting than the normal design basis conditions of unwedging with single disc drag. The ability of each WKM valve within this calculation population to successfully operate under design basis conditions has been verified by the GL 89-10 program. If a WKM valve is pressure locked, the unwedging force will be relieved before double disc drag occurs since the contact between the valve gate and segment must transition from the upper to the lower gate/segment back angles before double disc drag can occur. Unwedging (cracking) forces will therefore be relieved prior to completion of this transition.

3.0 ASSUMPTIONS (continued)

3.7 When determining the maximum disc drag forces associated with a pressure locking and/or thermal binding condition, the NRC has endorsed the use of disc/seat coefficient of friction (COF) in lieu of valve factor. The disc to seat COF used in this calculation is defined as equal to 0.5 for stellite to stellite contact (disc to seat). The test results from EPRI for flat on flat, stellite to stellite testing is considered to be applicable for the purpose of this calculation. EPRI has concluded that for flat on flat, stellite to stellite sliding contact, a COF of 0.5 is representative of a median value based on testing at room temperature water and low stress conditions. EPRI also concluded that the COF will decrease with increasing temperature and contact stress which indicates that this design input is conservative.

3.8 Actuator available open torque (Tavo) is determined at design basis degraded voltage (DVF) as specified in the applicable GL 89-10 setpoint calculations. The setpoint calculation degraded voltage input is based on an alignment prior to the implementation of the plant modification to enhance available degraded voltage (minor modification package MMP 2060.00SE). Implementation of this MMP (completed during Cycle 8 refueling outage) provided an increase in available voltage and the available actuator output capability. The additional output capability due to the increase in voltage will be conservatively ignored unless specifically noted in the evaluation.

4.0 DESIGN INPUTS

The effect of pressure locking and thermal binding of safety related, power operated, gate valves is being evaluated in response to the NRC initiated Generic Letter 95-07. The methods in which pressure locking and thermal binding occur were determined utilizing guidelines provided by NUREG 1275, Volume 9, "Operating Experience Feedback Report - Pressure Locking and Thermal Binding of Gate Valves".

The scope of valves which were considered potentially susceptible to pressure locking and/or thermal binding was determined utilizing guidelines from GL 95-07 and was documented in the screening evaluation calculation. All of the valves identified as potentially susceptible to pressure locking and/or thermal binding are gate valves which are part of the GL 89-10 program. All of these gate valves had been previously evaluated in calculation A-94-NM-MOV-PL/TB-001 to assess the impact of PL/TB in accordance with the guidelines presented in Supplement 6 of GL 89-10. As noted in GL 95-07, if the evaluation of PL/TB had been previously evaluated as part of GL 89-10, then further evaluation is not required. Although all of the valves identified as potentially susceptible to pressure locking and/or thermal binding by the screening evaluation have been previously evaluated, Edison has chosen to re-evaluate the effects of PL/TB in accordance with the guidelines of GL 95-07.

Design inputs for the valves identified within the scope of this calculation, including maximum stem factor, seat and stem area, packing loads, disc weight, and available torque at degraded voltage are obtained from the applicable GL 89-10 MOV setpoint calculation. These design inputs have been validated by design basis testing and group performance analysis as documented in the GL 89-10 program.

5.0 METHODOLOGY

In response to GL 95-07, all safety related power operated gate valves identified as being potentially susceptible to pressure locking and/or thermal binding were evaluated to determine if thermal binding and/or pressure locking could result in any of these valves being incapable of performing its required safety function. In this calculation, A-96-NM-MOV-PL/TB-003, the methodology is being updated to comply with the guidelines of GL 95-07 for PL/TB. The determination of which valves are potentially susceptible to pressure locking and/or thermal binding are identified by calculation A-95-NM-MOV-PL/TB-002. This screening evaluation identified a total of 32 valves as potentially susceptible to pressure locking and 4 valves as potentially susceptible to thermal binding.

5.1 Evaluation of Pressure Locking (See Figure 2 - Pressure Locking Evaluation Flowchart)

The phenomenon of pressure locking in flexible wedge and double disc gate valves generally develops because of the nature of the valve design in combination with characteristics of the bonnet and specific local conditions at the valve. The essential feature to develop pressure locking is the presence of fluid in the bonnet cavity including the area between the discs. The fluid may enter the bonnet cavity during normal open and close valve cycling at whatever line pressure exists at the time. Also, fluid may enter the bonnet cavity of a closed valve which has a differential pressure across the disc. The pressure differential causes the disc to move slightly away from the seat creating a path so that the bonnet cavity becomes filled with high pressure fluid. Whether these situations lead to a valve pressure locking condition depends upon the fluid pressure when the bonnet cavity was filled and the local line pressure (upstream & downstream) compared with bonnet cavity pressure at the time the valve is required to operate. This type of pressure locking is referred to as " conventional" pressure locking.

A second type of pressure locking is referred to as "thermally induced". For thermally induced pressure locking the initial fluid entrapment and bonnet pressurization scenario is identical to conventional pressure locking. Thermally induced pressure locking refers specifically to increased bonnet pressure resulting from the thermal expansion of entrapped bonnet fluid. Thermally induced pressure locking cannot occur unless there is an increase in entrapped bonnet fluid temperature. The rate of pressure rise due to fluid temperature rise can be dramatic if a fully water solid bonnet with no leakage is assumed. There is no definitive pressure rise rate available at this time although estimates as high as 100 psi/F for large temperature changes have been considered suitable. For a valve to be susceptible to thermally induced pressure locking a specific heat source must be available which could increase the temperature of entrapped bonnet fluid prior to the initiation of the valve open stroke. Normal ambient temperature changes are not considered significant enough to result in a thermally induced pressure locking condition.

5.1 Evaluation of Pressure Locking (continued)

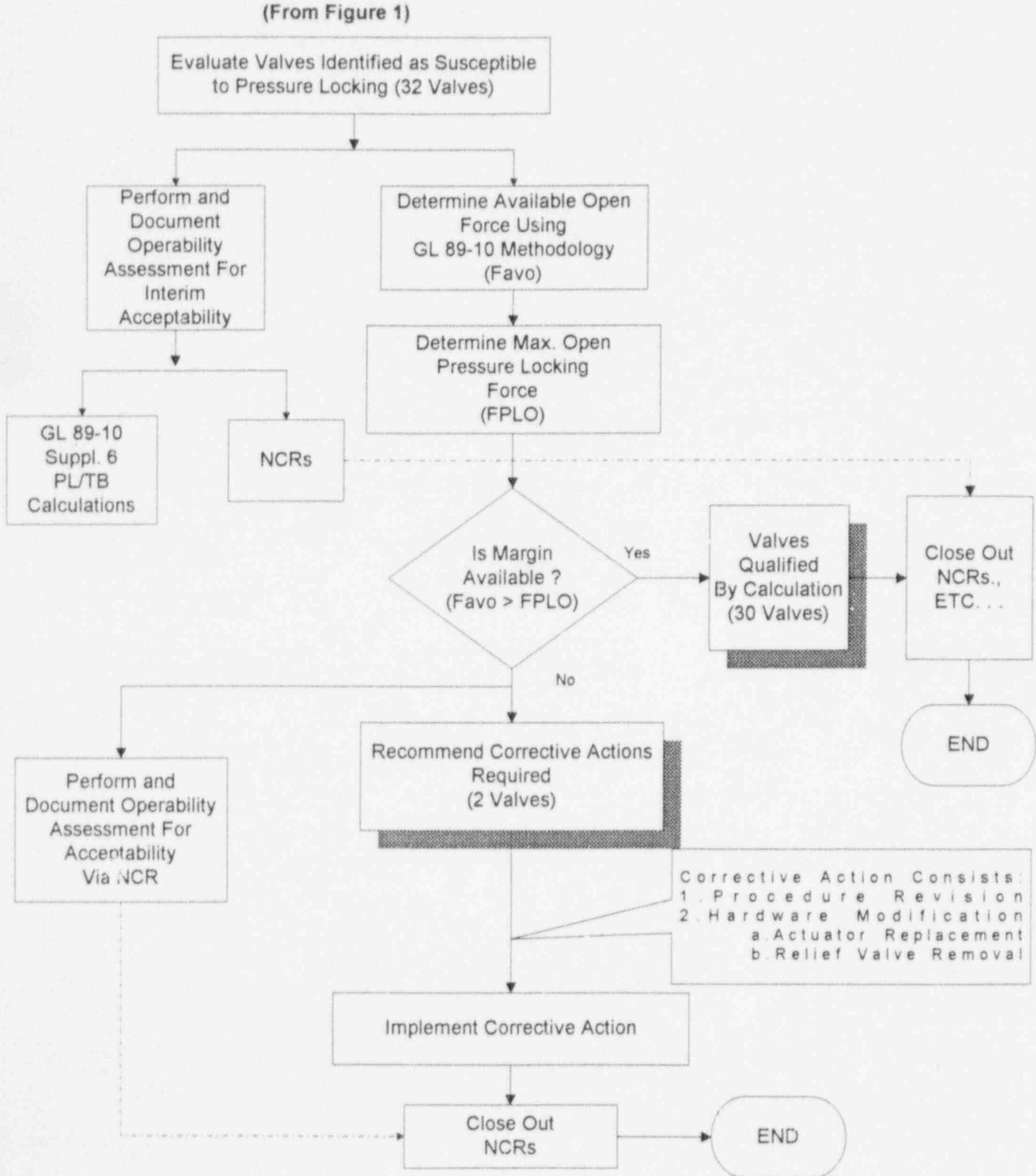
Based on the results of calculation A-95-NM-MOV-PL/TB-002, two valve designs (WKM & Target Rock) have been identified as potentially susceptible to pressure locking. The gate valves were identified by the screening criteria as potentially susceptible to pressure locking based solely on valve design and required safety function. To determine if the operating capability of a valve can be affected by pressure locking requires a more detailed evaluation into the specific system operating conditions of the valve, detailed operational function review, and determination of valve actuator output capability.

Initial margin capability assessments are provided for each gate valve identified as potentially susceptible to pressure locking. Although minor differences in the methodology exist for each different gate valve design, the basic capability assessment methodology is similar. Using a conservative bounding methodology, the capability assessment identifies the maximum required pullout force under the worst case pressure locking condition (FPLO) and compares it to the minimum available valve actuator opening thrust capability (Favo). If positive margin between the available thrust and the required pullout force exists, the valve is considered to have adequate capability to withstand the effects of pressure locking and no further evaluation of the valve was required. To limit the amount of detailed system analysis performed, the initial capability assessments for pressure locking include several conservative assumptions which may result in a valve being identified as having a negative margin. Negative margin does not indicate an immediate operability concern but does indicate that further analysis is required. When a valve was identified as having negative margin a NCR was initiated to provide further analysis and a required operability assessment.

FIGURE 2

PRESSURE LOCKING EVALUATION FLOW CHART

Ref: Calculation A-96-NM-MOV-PL/TB-003



5.1.1 WKM Valve Pressure Locking Margin Capability Assessment

WKM valves are split wedge valves which operate similar to a double disc design. WKM valves have an internal relief valve on the upstream disc (i.e., segment) which provides bonnet overpressure protection in the event that the valve is subjected to pressure locking (conventional or thermal induced). The manufacturer's drawing specifies the setpoint pressure of the relief valve as 250 psi ($\pm$ 50 psi). Therefore, the net pressure differential between the upstream segment and the valve bonnet cannot exceed 300 psi.

For the initial capability assessments of WKM valves the maximum required total pullout force under pressure locked conditions (FPLO) is calculated as the net sum of forces when the valve is in its worst case theoretical pressure locking condition. These forces include the disc drag forces due to pressure locking, packing load, stem/disc weight, and stem rejection forces. By conservatively assuming that all WKM valves are exposed to a worst case bonnet pressure, an evaluation of system configuration to determine if the cause of pressure locking of a WKM gate valve is conventional or thermally induced is not required. Each of the forces associated with calculating the total pressure locked pullout force are defined below:

Upstream Disc Drag Force (Fdd1)

The upstream disc drag force (Fdd1) is the force required to move the WKM valve segment across the upstream valve seat. The upstream disc drag force (Fdd1) is determined by the following equation:

Fdd1 = (COF x Ast x 300)

where:

COF	=	Disc to seat coefficient of friction equal to 0.5
Ast	=	Seating Area, (in2)
300	=	Internal relief valve setpoint pressure, (psi)

Note: The net pressure against the segment cannot be greater than 300 psi due to the internal relief valve. Seating area is identified by the applicable GL 89-10 MOV setpoint calculation.

5.1.1 WKM Valve Pressure Locking Margin Capability Assessment (continued)

Downstream Disc Drag Force (Fdd2)

The downstream disc drag force (Fdd2) is the force required to move the WKM valve gate across the downstream valve seat. When calculating this force the system upstream and downstream pressure at the time the valve is required to open must be considered. The maximum upstream pressure acting on the gate is conservatively defined to be equal to the upstream system pressure (P1co) plus the relative bonnet pressure associated with the relief valve setpoint (300 psi). Any downstream pressure (P2co) which exists at the time of valve opening would tend to decrease the contact force on the gate, therefore it is subtracted, which results in a net differential pressure force. The downstream disc drag force (Fdd2) is determined by the following equation:

$$Fdd2 = (COF \times Ast \times (300 + P1co - P2co))$$

where:

COF	=	Disc to seat coefficient of friction equal to 0.5
Ast	=	Seating Area, (in2)
300	=	Internal relief valve setpoint pressure, (psi)
P1co	=	Upstream system pressure at the time of valve opening (psi)
P2co	=	Downstream system pressure at the time of valve opening (psi)

Note: This calculation is conservative since it assumes that thermally induced pressure locking exists regardless of actual temperature transients. The actual pressure acting on the gate would only be equal to the net differential pressure (P1co - P2co) if there were no changes in the bonnet fluid temperature. Addition of the relief valve setpoint pressure conservatively assumes a maximum thermally induced pressure locking condition. Seating area is identified by the applicable GL 89-10 MOV setpoint calculation. System pressures are identified in the applicable Operating Basis Calculation (OBC) prepared for the GL 89-10 program.

The remaining forces which must be calculated prior to determining the maximum required total pullout force under pressure locked conditions (FPLO) include the stem rejection force (Fsr), the total disc/stem weight (Wg), and the valve packing load (Fpl). These forces are calculated or obtained from existing GL 89-10 setpoint calculations. A description of these forces follows.

5.1.1 WKM Valve Pressure Locking Margin Capability Assessment (continued)

Additional Loads

Stem Rejection Load (Fsr):

The stem rejection load is a negative force (assists valve opening) equal to the maximum bonnet pressure times the stem area (Asml) obtained from the applicable MOV setpoint calculation. For the purpose of this calculation, the maximum bonnet pressure is defined as P1co + 300 psi.

Disc/Stem Weight (Wg):

The weight of the disc and stem are a positive force which must be overcome in addition to the pressure locking force. The combined stem and disc weight can be obtained from the existing MOV setpoint calculation.

Packing Load (Fpl):

The packing load is a positive force which must be overcome in addition to the pressure locking force. The valve packing load can be obtained from the existing MOV setpoint calculation.

Maximum Total Pullout Force under Pressure Locked Conditions (FPLO):

Calculation of the maximum required total pullout force under pressure locked conditions (FPLO) is a sum of the forces previously defined. This calculation utilizes a bounding methodology which assumes worst case environmental and system conditions. If a valve is found to have negative margin when comparing the available output thrust to the maximum required pullout force under pressure locking conditions, further evaluation is required and an NCR will be initiated. The equation for determining a conservative value of pullout force required under pressure locked conditions is defined as:

$$FPLO = Fdd1 + Fdd2 + Wg - Fsr + Fpl$$

5.1.1 WKM Valve Pressure Locking Margin Capability Assessment (continued)

Actuator Available Open Force (Favo):

The available open thrust for an actuator is calculated utilizing the methodology of the existing GL 89-10 MOV setpoint calculation. The available opening output thrust (Favo) of the valve actuator is calculated using the available actuator output torque at the worst case degraded voltage (Tavo) and the maximum stem factor (SFmax). Both of these values are specified in the applicable GL 89-10 setpoint calculation. The open force available (Favo) to overcome a pressure locked condition is calculated as follows:

Favo = Tavo / SFmax

where:

Tavo = Available actuator torque at degraded voltage, (ft-lbs)
SFmax = Worst case valve stem/stemnut stem factor, (ft)

Available Capability Margin (MARGIN):

The available capability margin is defined as the amount of margin between the available open force (Favo) and the maximum open pressure locking force (FPLO). A valve which is shown to have positive margin will have adequate capability of opening when subjected to a worst case pressure locking condition. Margin is defined as:

MARGIN = ((Favo - FPLO) / FPLO) x 100

5.1.2 Target Rock Valve Margin Capability Assessment Methodology

Each of the Target Rock valves identified by the screening evaluation is a double disc gate valve. These Target Rock valves are limit seated and do not wedge upon closure. No internal relief valve or bonnet vent path is provided for these valves.

The population of Target Rock valves is only being evaluated for conventional pressure locking scenarios. Review of each operating basis calculation indicates that none of the Target Rock valves is subjected to a significant system thermal transient at the time of the opening safety related stroke. In addition, the normal and post-accident ambient environmental temperatures do not exceed 104 F for any of the valve locations. With the exception of 2(3)HV9367 and 2(3)HV9368, all of the Target Rock valves identified as potentially susceptible to pressure locking operate at a system temperature no greater than the maximum ambient temperature of 104 F. Valves 2(3)HV9367 and 2(3)HV9368 are the containment spray (CS) system isolation valves; these valves are identified by the line designation list as having a maximum system temperature as 350 F. However, at the time these valves are required to perform their safety related open function, the water supply source is the refueling water storage tank (RWST), which has a maximum temperature of 100 F. If the CS pumps are used to provide shutdown cooling (SDC), the branch line which connects the CS heat exchanger discharge to the low pressure safety injection (LPSI) inlet header is approximately 450 ft upstream from valves 2(3)HV9367 and 2(3)HV9368 based on review of applicable system isometric drawings and field walkdowns. The maximum system temperature when utilizing the CS system for SDC is 350 F. Valve bonnet fluid temperature increase (i.e., thermally induced pressure locking) due to the operation of SDC was not considered credible because of the dead headed length of piping between the heat source and the valve. The fluid system temperature associated with the operation of CS in the recirculation mode was not considered because the CS isolation valves would already be open due to the initial containment spray actuation signal (CSAS). As a result, no consideration for thermally induced pressure locking was considered necessary for the CS isolation valves.

For the initial margin capability assessments of Target Rock valves the maximum required total pullout force under conventional pressure locked conditions (FPLO) was calculated as the net sum of forces when the valve is in its worst case theoretical conventional pressure locked condition. These forces include the disc drag forces due to pressure locking, packing load, stem/disc weight, and stem rejection forces. Each of the applicable forces is defined below:

5.1.2 Target Rock Valve Margin Capability Assessment Methodology (continued)

Disc Drag Force (Fdd)

The disc drag forces for a Target Rock valve will be the highest when the maximum potential system line pressure is assumed to be entrapped in the valve bonnet and no credit for the actual upstream or downstream pressure at the time of valve opening is considered to relieve the disc to seat contact forces. Although this methodology for calculating disc drag forces is excessively conservative, it is anticipated that there is significant operating margin available for these valves. The disc drag force on each disc face is equal to the maximum valve bonnet pressure, times the seat area, times the disc to seat friction coefficient. The maximum valve bonnet pressure is defined as the maximum line pressure during system operation. The equation for the total disc drag force (Fdd) is identified below:

Fdd = 2 x (COF x MELP x Ast)

where:

COF = Disc to seat coefficient of friction equal to 0.5
Ast = Seating Area, (in2)
MELP = Maximum Expected Line Pressure, (psi)

Note: The calculation of disc drag force considers full double disc drag force to exist with no credit for upstream or downstream pressure available to reduce actual contact forces. Seating area is identified by the applicable GL 89-10 MOV setpoint calculation. Maximum expected line pressure (MELP) is identified in the applicable Operating Basis Calculation (OBC) prepared for the GL 89-10 program.

The remaining forces which must be calculated prior to determining the maximum required total pullout force under pressure locked conditions (FPLO) include the stem rejection force (Fsr), the total disc/stem weight (Wg), and the valve packing load (Fpl). These forces are calculated or obtained from existing GL 89-10 setpoint calculations. A description of these forces follows.

Additional Loads

Stem Rejection Load (Fsr):

The stem rejection load is a negative force (assists valve opening) equal to the maximum bonnet pressure times the stem area (Asml) obtained from the applicable MOV setpoint calculation. For the purpose of this calculation, the maximum bonnet pressure is defined as the maximum expected line pressure (MELP) as defined previously in the calculation of double disc drag forces.

5.1.2 Target Rock Valve Margin Capability Assessment Methodology (continued)

Disc/Stem Weight (Wg):

The weight of the disc and stem are a positive force which must be overcome in addition to the pressure locking force. The combined stem and disc weight can be obtained from the existing MOV setpoint calculation.

Packing Load (Fpl):

The packing load is a positive force which must be overcome in addition to the pressure locking force. The valve packing load can be obtained from the existing MOV setpoint calculation.

Maximum Total Pullout Force under Pressure Locked Conditions (FPLO)

Calculation of the maximum required total pullout force under pressure locked conditions (FPLO) is a sum of the forces previously defined. This calculation utilizes a bounding methodology which assumes worst case system conditions. If a valve is found to have negative margin when comparing the available output thrust to the maximum required pullout force under pressure locking conditions, further evaluation is required and an NCR will be initiated. The equation for determining a conservative value of pullout force required under pressure locked conditions is defined below:

$$FPLO = Fdd - Fsr + Wg + Fpl$$

Actuator Available Open Force (Favo):

The available open thrust for an actuator is calculated utilizing the methodology of the existing GL 89-10 MOV setpoint calculation. The available opening output thrust (Favo) of the valve actuator is calculated using the available actuator output torque at the worst case degraded voltage (Tavo) and the maximum stem factor (SFmax). Both of these values are specified in the applicable GL 89-10 setpoint calculation. The open force available (Favo) to overcome a pressure locked condition is calculated as follows:

$$Favo = Tavo / SFmax$$

where:

Tavo = Available actuator torque at degraded voltage, (ft-lbs)
SFmax = Worst case valve stem/stemnut stem factor, (ft)

5.1.2 Target Rock Valve Margin Capability Assessment Methodology (continued)

Available Capability Margin (MARGIN):

The available capability margin is defined as the amount of margin between the available open force (Favo) and the maximum open pressure locking force (FPLO). A valve which is shown to have positive margin will have adequate capability of opening when subjected to a worst case pressure locking condition. Margin is defined as:

$$\textbf{MARGIN} = ((\textbf{Favo} - \textbf{FPLO}) / \textbf{FPLO}) \times 100$$

5.2 Evaluation of Thermal Binding (See Figure 3 - Thermal Binding Evaluation Flowchart)

If a wedge type gate valve is closed while the system is hot, thermal binding may occur as the system cools. The valve body and discs mechanically interfere because of the different thermal expansion and contraction characteristics of the valve body and the disc. The difference in thermal contraction can cause the seats to bind the disc so tightly that reopening is either extremely difficult or impossible until the valve is reheated. Excessive closing force can contribute to thermal binding because excessive closing force causes the disc to be driven into the seat more tightly and, on cooling, the thermal binding effect is increased.

Four valves (2 per unit) were identified by the GL 95-07 screening evaluation as being potentially susceptible to thermal binding. These valves, 2(3)HV8152 and 2(3)HV8153, had been previously identified by the Supplement 6 GL 89-10 PL/TB evaluation as being susceptible to thermal binding. As a result of that calculation, NCR's for each of the susceptible valves were initiated. The disposition of these NCR's resulted in several corrective actions which ensured that these valves were capable of performing their safety related function. The corrective actions included valve testing to quantify the magnitude of the thermal binding effect, replacement of motor operator gearing to increase the overall output thrust capability of the actuator, and procedural revisions which limit the allowable temperature at which these valves can be closed. As a result of these corrective actions, these valves are now capable of successfully performing their intended safety function if thermal binding occurs. Each of these corrective actions is identified in Attachment 2 of GL 95-07 as a potential resolution option for valves susceptible to thermal binding. No further corrective actions are considered necessary for these valves at this time. A detailed description of the corrective actions is not provided here.

FIGURE 3

THERMAL BINDING EVALUATION FLOW CHART

Ref: Calculation A-96-NM-MOV-PL/TB-003