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A Edward Scherer
Manager of Nuclear
Oversight and Regulatory Affairs

February 28, 2001

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

Gentlemen:

Subject: **Docket Nos. 50-361 and 50-362**
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
(TAC Nos. M93515 and M93516)

References:
1. June 6, 2000 letter from A. E. Scherer (SCE) to Document Control Desk (NRC), Subject: Completion of Commitments for 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
2. July 21, 1999 letter from J. L. Rainsberry (SCE) to Document Control Desk (NRC), Subject: Response to Request for Additional Information Regarding 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 provides additional information regarding Generic Letter 95-07, Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves at San Onofre Units 2 and 3. The additional information, enclosed, includes an evaluation which demonstrates that the actual valve leakage past the gate seat of WKM shutdown cooling containment isolation valves is sufficient to dissipate the entire bonnet pressure, thus eliminating the potential for pressure locking. Therefore, Southern California Edison has demonstrated that pressure locking will not affect the operation of WKM shutdown cooling containment isolation valves based on the enclosure and references 1 and 2, which are summarized as follows:

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A056

1. Evaluation which demonstrates that valve leakage is sufficient to dissipate the entire bonnet pressure (enclosed)

2. The analysis and testing evaluation which concluded that the valve actuator has the capability to overcome any potential pressure locking condition (described in reference 1), and

3. The Marotta poppet valve will be removed permanently if and when any of these WKM valves is disassembled for maintenance (commitment made in reference 2).

If you have any questions or would like additional information, please let me or Mr. Jack Rainsberry (949)368-7420 know.

Sincerely,

Enclosure

cc: E. W. Merschoff, Regional Administrator, NRC Region IV
J. A. Sloan, NRC Senior Resident Inspector, San Onofre Units 2 & 3
L. Raghavan, NRC Project Manager, San Onofre Units 2 and 3

ADDITIONAL INFORMATION
GENERIC LETTER 95-07, PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES
SAN ONOFRE UNITS 2 AND 3

I. PURPOSE

The purpose of this evaluation is to demonstrate that pressure locking (PL) will not affect operation of the shutdown cooling (SDC) valves listed in Table 1 below.

Table 1
Subject SDC Isolation Valves Inside Containment

Valve ID	Valve Size (inch)	Description
2(3)HV9339	16	SDC suction containment isolation valve
2(3)HV9337	16	SDC suction containment isolation valve
2(3)HV9378	10x8x10	SDC suction containment isolation valve
2(3)HV9377	10x8x10	SDC suction containment isolation valve

II. SUMMARY/CONCLUSIONS

This PL evaluation and conclusions are the following:

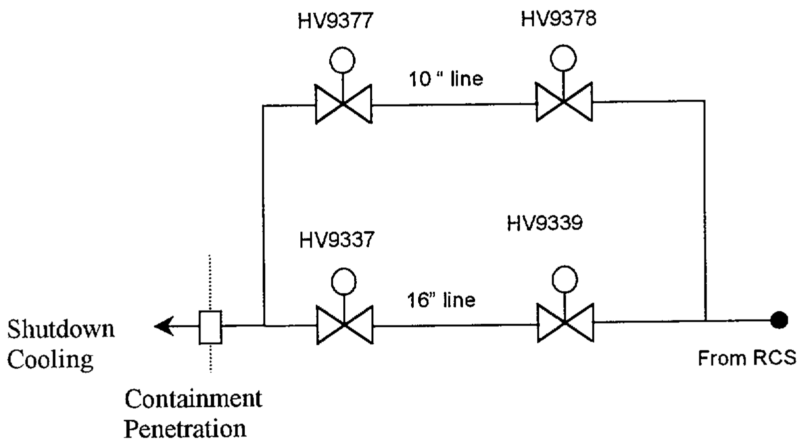
1. The stem thrust prediction methodology used by Southern California Edison (SCE) to evaluate PL on the subject valves relied on test results of a typical WKM valve (Reference 1). Test results confirmed the validity and accuracy of the PL stem thrust prediction evaluation methodology used by SCE. Results also showed that the actuator output capability thrust of the tested valve exceeded the predicted (by calculation) required thrust. Based on these results, it is concluded that the valve actuator has the capability to overcome any potential PL condition.

2. Credit for leakage past the valve seat (gate side) was evaluated. It was shown that the actual leakage past the gate seat measured by inservice testing of all impacted valves is sufficient to dissipate the entire bonnet pressure, thus eliminating the potential for pressure locking.

3. Degraded voltage is not a concern for valve operations in a pressure locking situation.

III. BACKGROUND

The subject WKM valves provide isolation between the reactor coolant system (RCS) and the shutdown cooling (SDC) system as shown schematically below. See Figure 1 for a drawing of a typical WKM valve.



These valves are Category A active motor operated valves (MOVs) subject to periodic testing in accordance with the inservice testing (IST) program at the San Onofre Nuclear Generating Station (SONGS). They are double disc gate valves, with an upstream segment and a downstream gate, manufactured by WKM. These valves are normally closed to provide isolation for the RCS. They are opened for shutdown cooling operation. Also, the SDC system may be activated following a design basis accident, which requires opening the subject valves. These valves were identified to be potentially impacted by PL. The potential for PL in the valves exists as a result of

1. Leakage past the upstream segment would pressurize the bonnet to the RCS pressure (normal operating pressure is 2,250 psi). SDC is initiated only after the RCS pressure has been reduced to about 400 psi. PL will occur if the water trapped in the bonnet should remain at a higher pressure, which can impact the opening function of the valve.

2. Thermally induced PL can occur due to thermal expansion of the water trapped in the bonnet. The increase in the trapped water temperature can be due to a rise in containment temperature following an accident.

Under PL conditions, the bonnet pressure is limited to the upstream pressure plus the maximum lift-off pressure of the pressure relief devices installed in the segments of the subject valves. These relief devices are spring-loaded poppet relief valves manufactured by Marotta Scientific Controls. Their function is to limit the pressure in the bonnet by providing a relief path from the bonnet to the upstream side. The relief path is established when the bonnet pressure exceeds the upstream pressure by the poppet valve's nominal lift-off pressure of 250 psi±50 psi.

A relief request (Reference 2) was approved by the NRC (Reference 3) which exempts the Marotta poppet valves from individual testing under the IST program based on their high reliability, their operating history which indicates that there has been no failure to open any of these valves since the startup of both units (Unit 2 in 1982 and Unit 3 in1983) which could be attributed to PL, and their ability to provide a relief path under all anticipated operating conditions. Reference 2 also provides a more detailed discussion of the function and reliability of the Marotta poppet valves.

In addition, per Reference 2, SCE will remove the Marotta poppet valve if disassembly of a subject WKM valve is required for other maintenance or performance issues. Removing the Marotta poppet valve provides an open flow path between the bonnet and the upstream side to eliminate the potential for PL.

IV. EVALUATION

IV.1. Test Results under PL Conditions

SCE preformed PL tests on a WKM valve to validate the thrust prediction methodology used by SCE in the Generic Letter (GL) 95-07 PL evaluation (Reference 1). The tests were performed utilizing an 8 inch 1500 LB WKM valve similar to the subject valves listed in Table 1 (Refer to SCE letter dated June 6, 2000 for a detailed description of the tests). The test valve is considered representative of the subject valves based on

1. The test valve is a class 1500 valve manufactured to WKM's POW-R-SEAL design, which is identical to the subject valves.

2. Based on the similarity in design, the opening stroke sequence of the test valve is similar to the opening stroke sequence for the subject valves, including key stroke positions such as unwedging, single disc drag, and double disc drag. The opening stroke sequence positions provide the required data to calculate the friction coefficient for sliding surfaces (flat stellite on stellite) and the maximum required force to open the valve under PL conditions.

3. The test valve internals, including the gate, the segment and their corresponding seats, are made of the same materials as the subject valves. Accordingly, the friction coefficient for stellite on stellite calculated based on the test results is considered representative of the subject valves.

4. Testing was performed using bonnet and upstream pressures similar to the bonnet and upstream pressures that could exist in the subject valves assuming PL conditions.

Testing consisted of a series of static tests (ST) and pressure-locked tests in which the bonnet was pressurized. Specifically, the valve opening stroke sequence under PL conditions is described as follows:

1. Starting position: the valve is initially fully closed with the gate and segment wedged. Under PL conditions, the maximum bonnet pressure, P_b, is given by

$$P_b = P_u + \text{maximum Marotta poppet valve lift off pressure}$$

where

P_u = upstream pressure, psi

the maximum Marotta poppet valve lift off pressure = 300 psi

2. Stem decompression followed by stem-stem nut transition and take-up of the T-slot clearance.

3. Unwedging – Tensile load develops in the stem to overcome wedging load on the gate. Wedging loads exist due to contact on both sides of the gate.

4. After unwedging, single disc drag exists due to gate motion only.

5. Gate motion continues until the lever lock arm engages the segment, causing it to move.

6. A flow path is established past the segment, which equalizes the bonnet pressure and the upstream pressure. At this point, a single disc drag is re-established.

7. A flow path is established past the gate. Motion continues until the valve is fully open.

Table 2 below shows a comparison between the measured and the predicted stem thrust using the SONGS methodology. The results in the table reflect different tests with different values of bonnet pressure and upstream pressure. Results in Table 2 show that the predicted thrust always exceeded the measured thrust by a margin varying between 11% and 28%.

Table 2

Measured and Predicted Stem Thrust

Thrust (lbs)		Margin (%)	Thrust (lbs)		Margin (%)
Test	Predicted		Test	Predicted	
5,207	6,149	18	10,505	11,907	13
4,836	6,190	28	9,141	10,170	11
5,958	7,636	28	11,871	14,411	21
6,932	8,066	16	11,086	12,715	15
6,236	7,815	25	10,021	11,286	13
8,170	9,549	17	13,224	15,953	21
8,018	9,646	20	10,990	13,166	20
8,666	10,463	21	13,651	16,547	21
8,759	10,083	15	15,275	17,410	14
11,199	13,979	25	15,265	17,683	16
9,013	10,425	16	21,731	25,839	19
10,448	12,731	22			

IV.2. PL Evaluation Based on Measured Leak Rate

An evaluation was performed to determine the minimum amount of leakage from the bonnet past the valve seats required to eliminate the potential for PL in the subject valves that could affect SDC operation. The evaluation was based on a comparison between

1. The actual downstream leakage rate past the gate. The leakage rate was measured by testing under the IST program at SONGS, and
2. The minimum required rate to remove the excess volume, ΔV, of water in the bonnet that could result in a PL condition. The excess volume was conservatively calculated based on dissipating the entire maximum bonnet pressure, P, and the compressibility of water, K.

$$\Delta V = V \ \Delta P/K$$

where

- V = the total volume of water trapped in the bonnet, in^3
- ΔP = conservatively taken equal to the entire maximum bonnet pressure of 700 psi under PL conditions
- K = bulk modulus of water (a typical value of 300,000 psi was used)

The rate was conservatively based on removing ΔV from the bonnet through leakage within the minimum time of one hour to activate SDC. Results of the evaluation are summarized in Table 3.

The minimum time of one hour to place the SDC system in operation was conservatively based on the maximum pressurizer cooldown rate of 200°F/hr to reduce RCS pressure from the normal pressure of 2,250 psi to less than 400 psi (SDC entry conditions are hot leg temperature < 400 °F and pressurizer pressure < 400 psi). During normal operation, the SDC system is placed in operation approximately 3.5 to 4 hours after the reactor trip. Furthermore, per the SONGS long term cooling analysis following an accident, the decision to place the SDC system in operation is made 6 hours after the start of the event. Therefore, using a one-hour period for the SDC entry time as basis for the leak rate calculation is conservative.

Based on the results summarized in Table 3, the actual leak rate measured by testing is greater than the minimum required leakage rate to dissipate the bonnet pressure, thus eliminating any potential PL condition that could affect SDC operation. Therefore, it is concluded that the subject valves are not susceptible to pressure locking. Conservatively, the evaluation was based on the maximum Marotta poppet valve lift off pressure of 300 psi, and no credit was taken for leakage past the segment to the upstream side.

Some leak rate test results obtained prior to 1998 were recorded as zero leakage for the subject valves. At that time, a zero gpm was recorded if the leakage was "not measurable." The method for determining leakage was based on being able to quantify 1 gpm, i.e., a discernable level change in a 5 to15 gallon bottle - usually a 5 gallon bottle. As such, the leakage measurement was rather coarse and could have resulted in minimal leakage being recorded as zero in some cases.

Table 3
IST Leak Rate Limit and Minimum Required Leak Rate

	Valve ID	size (inch)	Dates of the most Recent tests	Leak rate test results (gpm)	required leak rate (gpm)
Unit 2 Valves	2HV9339	16	11/13/00	0.26	0.006
			02/20/99	0.59	
			02/20/98	0.40	
	2HV9337	16	11/13/00	0.49	0.006
			02/20/99	0.10	
			02/20/98	1.00	
	2HV9378	10x8x10	11/13/00	0.2	0.001
			02/20/99	0.30	
			02/20/98	0.40	
	2HV9377	10x8x10	11/13/00	0.89	0.001
			02/20/99	0.05	
			02/20/98	0.40	
Unit 3 Valves	3HV9339	16	05/05/99	0.80	0.006
			03/24/98	0.99	
	3HV9337	16	05/06/99	0.30	0.006
			03/24/98	1.77	
	3HV9378	10x8x10	05/05/99	0.36	0.001
			03/24/98	0.39	
	3HV9377	10x8x10	05/06/99	0.12	0.001
			03/24/98	0.99	

IV.3. Operational History

All the subject valves are routinely opened during outages to start SDC. There has been no failure to open any of these valves since the startup of both units (Unit 2 in 1982 and Unit 3 in1983) which could be attributed to PL. One valve, 2HV9378, failed to open electrically due to a switch problem, and valve 3HV9339 failed to open completely (75% open) due to a sheared gate rail. Clearly, PL was not the root cause for failure to open the valve properly in both cases.

IV.4. Voltage at the Motor Terminals

Under normal conditions, no degraded voltage conditions exist. However, under the most limiting worst case accident conditions without loss of offsite power combined with maximum bus loading and a minimum switchyard voltage of 218 KV instead of the normal 230 KV, the calculated degraded voltage factors (DVF) are listed in Table 4.

Per Limitorque Technical Update 98-01 (Reference 4), the actuator motor output torque is not degraded for values of DVF ≥ 0.9. Therefore, including the effect of voltage degradation is not required for valves 2HV9377, 2HV9378, 3HV9377, and 3HV9378. For valves 2HV9337, 2HV9339, 3HV9337, and 3HV9339, conservative values of DVF (less than Table 4 values by about 5%) were included in the calculation of the available motor torque in the PL evaluation.

Table 4
Degraded Voltage Factors (DVF)

Valve ID	Degraded Voltage Factor (DVF)	Valve ID	Degraded Voltage Factor (DVF)
2HV9377	0.94	3HV9377	0.94
2HV9378	0.94	3HV9378	0.94
2HV9337	0.90	3HV9337	0.89
2HV9339	0.84	3HV9339	0.84

It should be noted that the values of DVF listed in Table 4 represent the most limiting worst case conditions since the switchyard voltage is expected to be restored to the normal value of 230 KV within one hour by adjusting the system load flow. This results in improving the values of DVF in Table 4 by about 5%. Also, accident conditions with the loss of offsite power are less severe since the diesels provide basically the nominal voltage.

V. REFERENCES

1. SCE Calculation No. A-96-NM-MOV-PL/TB-003, Revision 1,"GL 95-07 Pressure Locking and Thermal Binding Performance Evaluation."

2. Letter from D. E. Nunn (SCE) to the Document Control Desk (NRC), dated January28, 2000, Subject: Docket Nos. 50-361 and 50-362, Request for Proposed Alternative Testing for Check Valves Which are Internally Mounted in Motor Operated Valves, in Accordance with 10 CFR 50.55a(a)(3), San Onofre Nuclear Generating Station, Units 2 and 3 (TAC Nos. M93515 and M93516).

3. Letter from Mr. S. Dembek (NRC) to Mr. H. B. Ray (SCE), dated March 16, 2000, Subject: San Onofre Nuclear Generating Station, Units 2 and 3 – Related to the Inservice Testing (IST) Program – Relief Request for Alternative Testing for Certain Check Valves (TAC Nos. MA8146 and MA8147).

4. Limitorque Technical Update 98-01, Subject: Actuator Output Torque Calculation.

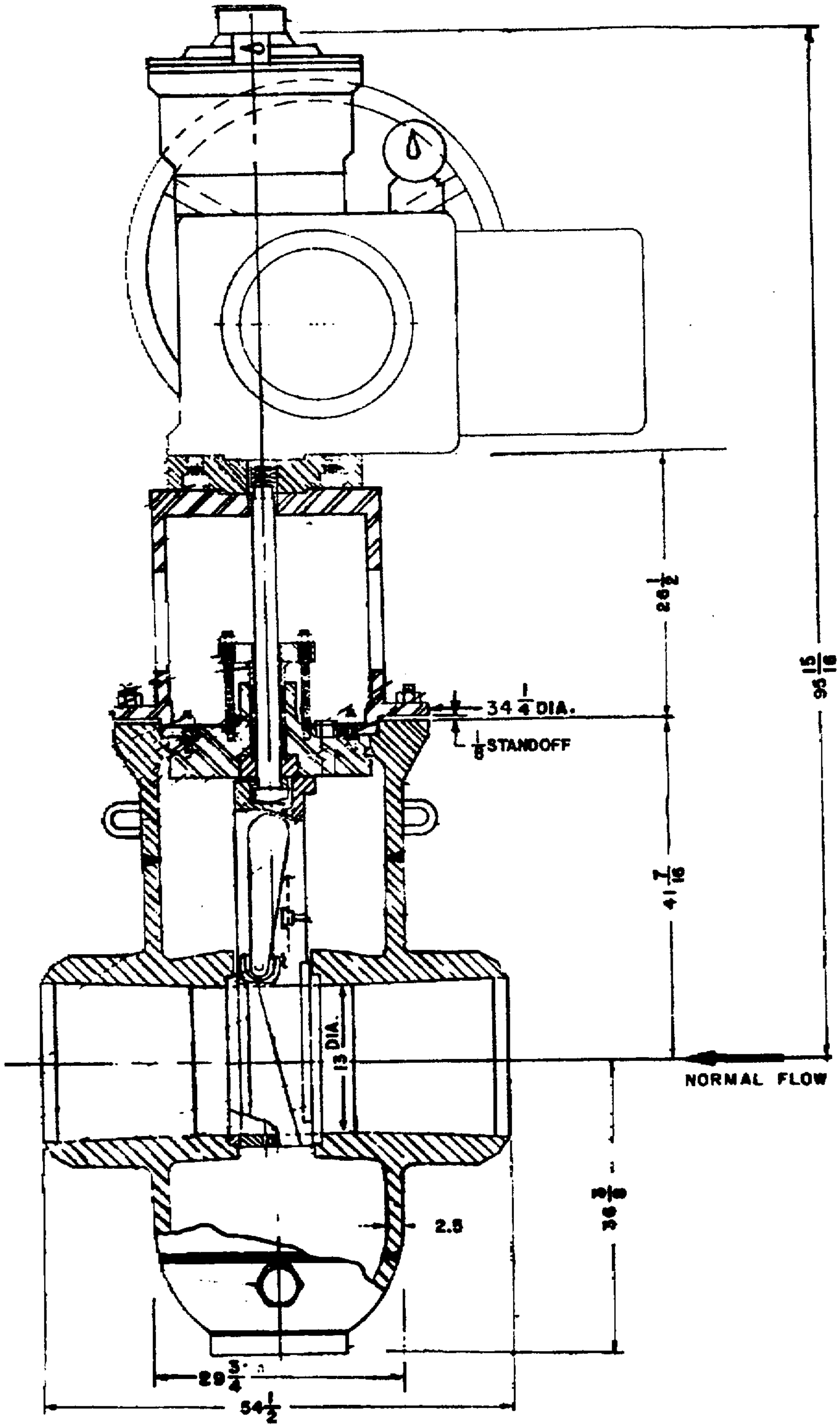


Figure A-1 16" Class 1500 Model D-2 OPG POW-R-SEAL WKM Valve
Based on Drawing No. SO23-507-5-1-37, Rev. 12