SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT ☐ 6201 S Street, Box 15830, Sacramento, California 95813; (916) 452-3211

April 20, 1981

DIRECTOR OF NUCLEAR REACTOR REGULATION
ATTENTION JOHN F STOLZ CHIEF
OPERATING REACTORS BRANCH 4
US NUCLEAR REGULATORY COMMISSION
WASHINGTON DC 20555

DOCKET 50-312
RANCHO SECO NUCLEAR GENERATING
STATION, UNIT NO. 1
REACTOR BUILDING PURGE VALVES
TMI ACTION PLAN ITEM II.E.4.2.6

Your letter of October 23, 1979 requested the Sacramento Municipal Utility District to commit to operate the reactor building purge system in accordance with your interim position on operation of this system. This matter is also the subject of item II.E.4.2.6 in NUREG-0737. In letters dated December 13, 1979 and January 18, 1980 the District committed to limit purging to times the reactor is at cold shutdown or refueling shutdown, pending resolution of purge valve operability qualification.

The District has performed an analysis which provides assurance that purge valves will operate when positioned at or less than 80% of full stroke for the motor operated valves inside the containment, and 60% of full stroke for the air operated valves outside the containment. With this assurance, we are confident that the FSAR analysis for a loss of coolant accident during a purge is valid and that operation of the purge system during reactor operation does not involve an unreviewed safety question. The safety analysis is attached for your information.

In addition to the above concern, it has been determined that the failure mode of the solenoid operated valves, providing air to the air operated purge and pressure equalizing valves, is in the open direction, resulting in these valves opening, should a loss of DC power occur. Although this power is not the motive power to the valve, the District has committed by letter dated November 19, 1980 to operate with the purge valves closed, and air isolated, until the failure mode can be reversed. The refueling outage we are now completing, occurred earlier

A046
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than scheduled due to inspection requirements on the main turbine, and parts were unavailable to make this modification. For that reason, we commit to continue plant operation with the purge valves closed, and air isolated, until these modifications can be made. Once these modifications are made, the District does intend to resume purging during plant operation.

John J. Mattimoe

John J. Mattimoe
Assistant General Manager
and Chief Engineer

Enclosure

REVIEW O. PROPOSED 50.59 FACILITY CH..NGE Log No. 189 & 190

1. DESCRIPTION:

This modification limits the position of the reactor building purge valves such, that allowable stresses will not be exceeded and adequate closure torques will be available.

NCR S1911 & S1912 ECN A-3430 ff 3/23/81

2. SAFETY ANALYSIS: In response to an NRC letter, dated October 23, 1979, the District committed in letters, dated December 13, 1979 and January 18, 1980, to limit the purging to times the reactor is at cold shutdown or refueling shutdown, pending resolution of purge valve operability qualification. The attached design basis report provides assurance that the purge valves will operate when positioned at or less than the specified opening. With this assurance, the FSAR analysis for a loss of coolant accident during a purge is valid, and this modification does not involve an unreviewed safety question. As discussed in the minutes to PRC meeting No. 816, dated September 30, 1980, Generation Engineering will prepare an informational letter to the NRC, based on the findings from the review of this safety analysis.

Licensing Engineer — Date 10/30/80

Manager Generation Engineering — Date 11/4/80

3. PRC RECOMMENDATION: 50.59(a) Yes ☐ No ☒ 50.59(b) Yes ☒ No ☐

DISPOSITION OF PRC:

a. Unanimously recommends proposal ☒
b. Send to MSRC for concurrence ☒
c. Recommends not to proceed ☐
d. Safety analysis inadequate ☐
e. MSRC review prior to implementing ☐
f. Test of system required ☒

PRC Chairman — Date 11-7-80

4. ANALYSIS: 50.59(a) Yes ☐ No ☒ 50.59(b) Yes ☒ No ☐

Recommend to Proceed Yes ☐ No ☒
Refer to MSRC ☒
Test of system required ☒

Plant Superintendent — Date 11-10-80

5. MSRC FINDINGS: 50.59(a) Yes ☐ No ☒ 50.59(b) Yes ☒ No ☐

DISPOSITION OF MSRC:

a. Recommends proposal ☒
b. Send to NRC for approval ☐
c. Recommends not to proceed ☐
d. Safety analysis inadequate ☐

MSRC Chairman — Date 12/19/80

6. COMMISSION APPROVAL OBTAINED

Date — MSRC Chairman

7. RETEST COMPLETE AND ACCEPTABLE: Test results approved

Supervisor Engineering and Quality Control

8. OVERALL REVIEW: Plant modification change complete.

Manager Nuclear Operations — Date

9. DOCUMENTATION COMPLETE:

Quality Assurance Director — Date

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Log No. 189 & 190

SAFETY ANALYSIS FORMAT

RANCHO SECO NUCLEAR GENERATING STATION UNIT NO. 1

ECN _____ NCR S1911 & S1912 Work Request _____

DESCRIPTION:

This modification limits the position of the reactor building purge valves such, that allowable stresses will not be exceeded and adequate closure torques will be available.

REASON FOR CHANGE:

This modification will allow the reactor building purge valves to be partially opened during plant operation.

EVALUATION AND BASIS FOR THE SAFETY FINDINGS:

In response to an NRC letter, dated October 23, 1979, the District committed in letters, dated December 13, 1979 and January 18, 1980, to limit the purging to times the reactor is at cold shutdown or refueling shutdown, pending resolution of purge valve operability qualification. The attached design basis report provides assurance that the purge valves will operate when positioned at or less than the specified opening. With this assurance, the FSAR analysis for a loss of coolant accident during a purge is valid, and this modification does not involve an unreviewed safety question. As discussed in the minutes to PRC meeting No. 816, dated September 30, 1980, Generation Engineering will prepare an informational letter to the NRC, based on the findings from the review of this safety analysis.

☒ The proposed change will not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the FSAR or create the possibility for an accident or malfunction of a different type than any evaluated previously in the FSAR or reduce the margin of safety as defined in the basis for any Technical Specification.

SAFETY FINDING:

☒ The proposed change does not involve a change in the Technical Specifications or an unresolved safety question.

Licensing Engineer R. A. Dieterich Date 10/30/80

Review Engineer Ral Arnold Date 10/31/80

DESIGN BASIS REPORT

NCR S-1911 and S-1912

I. PURPOSE OF DESIGN CHANGE:

Limit the position of the reactor building purge valves such that allowable stress will not be exceeded and adequate closure torque is available.

SFV 53504	$\leq 80°$
SFV 53605	$\leq 80°$
SFV 53503	$\leq 60°$
SFV 53604	$\leq 60°$

II. DESIGN CRITERIA USED:

1) Reactor Building Pressure for 14.1 Ft.^{2} LOCA.
2) Allis-Chalmers Report A-C, VER 0209, dated 12/17/79. Test Report on an Allis-Chalmers 6" STREAMSEAL Butterfly Valve.
3) Valves close within 3.5 seconds (Air/Spring and 5 seconds (Motor Operated).
4) Initial delay time of 0.5 seconds.
5) Maximum allowable shaft torque 13,300 ft. lbs. (AWWA).
6) Maximum allowable operator torque 41,600 ft. lbs. (motor operated valve).

Allis-Chalmers Letters:

7) Theodore Kopey to L. Smith, January 9, 1980.
8) Theodore Kopey to D. Blachly, February 6, 1980.
9) Theodore Kopey to D. Blachly, March 20, 1980.
10) P.R. Schwartz to Atten. D. Blachly, April 14, 1980.

SMUD Letters:

11) R. J. Rodriguez to Mr. LaSage, December 28, 1979.
12) D. C. Blachly to Theodore Kopey, March 13, 1980.

III. CALCULATIONS AND DESIGN INFORMATION

Allis-Chalmers test report (reference 2) concluded that accurate calculation of torque may be made using the data, and formulas given within the test report.

The total shaft torque is calculated by algebraic addition of disc dynamic torque and bearing torque. The dynamic torque is given by:

$$T_d = G_T \times D^3 \times \Delta P$$

T_d = Dynamic Torque.

G_T = Experimentally determined torque coefficient.

D = Diameter of valve disc.

ΔP = Experimentally determined pressure differential across the valve.

The bearing torque is given by:

$$T_b = 4.71 \times D^2 \times d \times f \times \Delta P$$

T_b = Bearing Torque

D^2 = Diameter of valve disc (ft)

d = Shaft diameter (in)

f = Friction Coefficient (.12)

ΔP = Experimentally determined pressure drop across the valve.

Test report VER 0209 contains the data for torque coefficient and pressure drop for various opening positions and inlet pressures of given disc thickness ratios and inlet configuration Linear interpolation between pressures is assumed.

The inlet configuration for SFV 53504 is with an elbow at 90° to the valve shaft and the curved face of the disc upstream. This is considered most limiting configuration (test #27). The inlet configuration for SFV 53605 is with an elbow inline with the valve shaft (test #26). The configuration of SFV 53604 and SFV 53503 is flat face upstream (test #28). Closure initiation is assumed at 0.5 seconds from rupture. Reactor Building pressure is a maximum of 7 psig. This is conservative since initiation actually occurs at a building pressure of 4 psig.

Reactor Building pressure vs. time is shown in my March 13, 1980 letter to Theodore Kopey in tabular form in Table Two (2), and graphically as an attachment. The limiting reactor building pressure is the maximum pressure ramp curve shown in figure 14.4-5 of the FSAR. This curve was based on the spectrum curves referenced above. Motor operated valve closure is assumed to vary linearly with respect to time (θ°/sec) during the LOCA condition. Air/Spring operated valves is assumed to vary linearly with respect to crosshead travel ("/sec) from the full closure times are based on experimental data open position with no differential pressure across the valve. Maintaining greater than the required torque will not significantly change these times under the dynamic conditions.

IV. FAILURE MODE

The failure modes analyzed in the original FSAR are unchanged by this repair.

V. CONCLUSIONS

SFV535004 and SFV53605 - Motor Operated Valves:

By limiting the valves full open position to 80° open, the maximum calculated torque is 12009 ft-lbs. This is below the recommended 13300 ft-lbs. recommended by the AWWA. This corresponds to a combined stress of 10418 psi, well below the ASME VIII allowable of 16000. Available torque is 41,600 ft-lbs.

SFV53503 and SFV53604 - Air/Spring Operated Valves:

By limiting the valves full open position to 60° open, the maximum calculated torque is 7700 ft-lbs. The combined stress is 12261 psi, well below ASM VIII allowable of 16000 psi. The minimum difference between available and allowable torque is 4500 ft-lbs. Attachment

4 shows the required and allowable torques for the Air/Spring Operated Valves.

Attachments 1, 2 and 3 show the required torques for these valves.

Design Engineer Donald C. Blickley Date 8-12-80

Reviewer Engineer L. M. Amico Date 8/13/80

Attachment 1 SFV53605

TEST # 26 VALVE LIMITED TO 80° OPEN
OPERATOR MOTOR Pmax 42 psig

°OPEN	SEC	P_B psi	ΔP psi	C_T	T_D '#	T_B '#	T_T '#	T_o '#
80	0	7	3.33	20.14	11142	-256	10886	41,600
70	0.56	14	4.95	13.30	10946	-381	10566	
60	1.11	20.5	13.39	5.13	11421	-1030	10390	
50	1.67	25.5	20.63	2.03	6952	-1587	5365	
40	2.22	30	27.00	0.03	135	-2077	-1942	
30	2.78	34	30.94	-0.26	-1318	-2380	-3698	
20	3.34	37	33.49	-0.60	-3315	-2576	-5891	
10	3.89	40	38.00	-0.87	-5501	-2923	-8424	
0	4.45	42						

T_D = Valve dynamic torque
T_B = Valve Bearing torque
T_T = Resultant torque
T_o = AVAILABLE TORQUE

T_{SEAT} = -7686'#

NOTE: Above data is bounded by A-C calculation in 3-20-80 Letter pg 6

Attachment 2

SFV53504

TEST # 27 VALVE LIMITED TO 80° open
Operator motor
Pmax 42 psig

°OPEN	SEC	P_B	ΔP	C_T	T_D' #	T_b' #	T_T' #	OPER T #
80°	0	7.0	3.82	17.12	10867	-293	10573	41,600
70°	0.56	14.0	3.27	21.46	11664	-251	11482	
60°	1.11	20.5	13.83	4.88	11228	-1064	10164	
50°	1.67	25.5	19.83	2.28	7521	-1525	5996	
40°	2.22	30.0	26.00	0.60	2596	-2000	595	
30°	2.78	34.0	31.45	-0.08	-419	-2419	-2838	
20°	3.34	37.0	34.97	-0.70	-4072	-2690	-6762	
10°	3.89	40.0	38.50	-1.00	-6406	-2962	-9367	
0°	4.45	42.0						

T_{SEAT} = -7686 #

NOTE: Above data is bounded by A-C data in ~~FSS~~ 3-20-80 letter page (2)

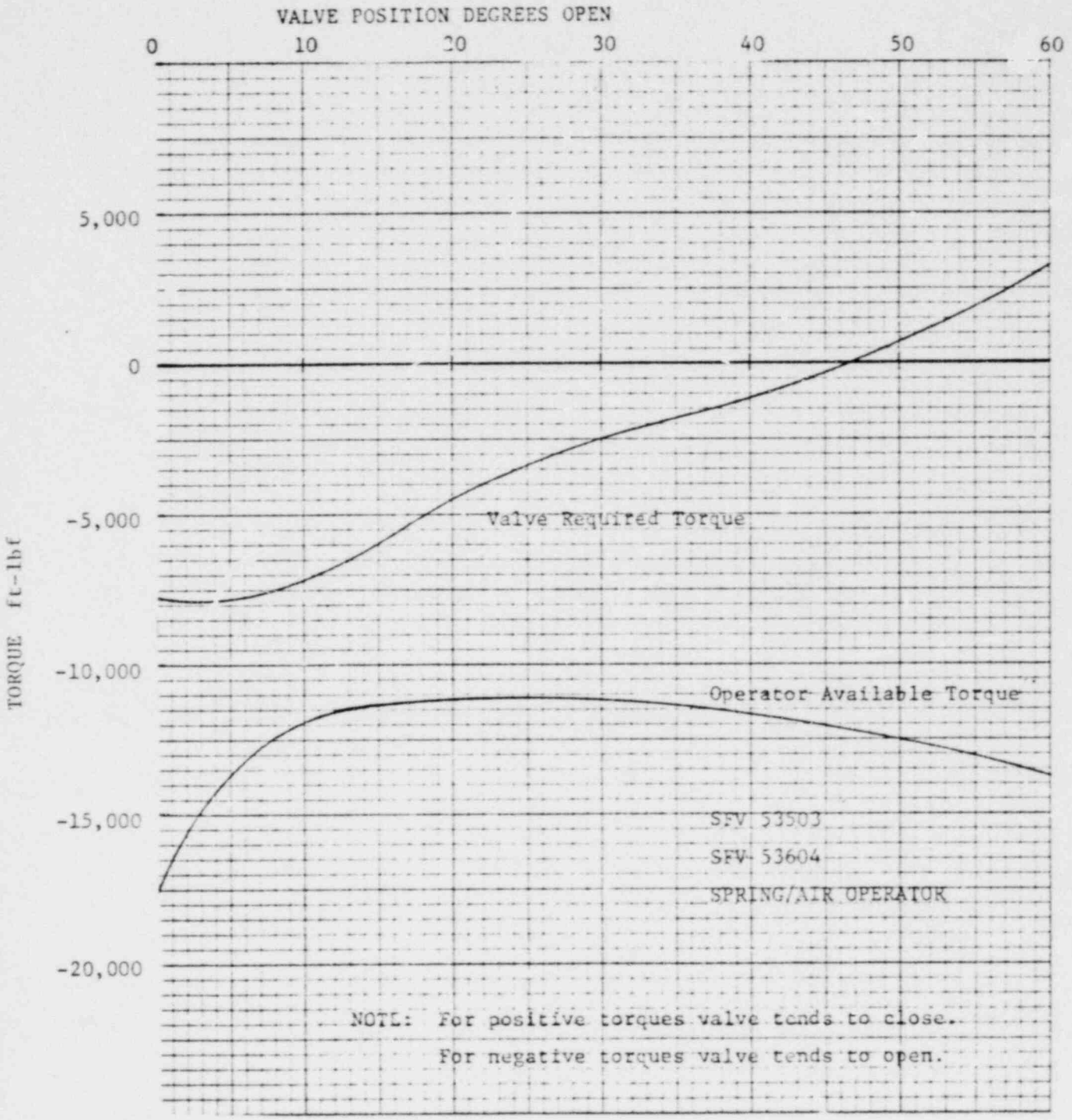
Attachment 3 SFV53503 and SFV53604

TEST # 28 VALVES LIMITED TO 60° open
OPERATOR AIR/SPRING Pmax 33. psig

°OPEN	SEC	P_B	ΔP	C_T	T_D '#	T_b '#	T_r '#	OPER T '#
60	0	7	5.29	3.98	3500	-407	3093	13,600
50	.27	10.5	8.23	1.02	1396	-633	763	12,500
40	.56	14.5	10.08	-.27	-453	-775	-1228	11,600
30	.87	18.0	15.03	-.44	-1100	-1156	-2256	11,200
20	1.20	21.5	19.81	-.86	-2834	-1524	-4358	11,200
10	1.62	25.5	23.47	-1.40	-5448	-1806	-7253	11,900
0	2.65	33.0						17,500

T_{SEAT} = -7686 '#

NOTE: Above data is bounded by A-C data summarized in 4-14-80 letter.


VALVE POSITION DEGREES OPEN
0
10
20
30
40
50
60
5,000
0
-5,000
-10,000
-15,000
-20,000
TORQUE ft-lbf
Valve Required Torque
Operator Available Torque
SFV 53503
SFV 53604
SPRING/AIR OPERATOR
NOTE: For positive torques valve tends to close.
For negative torques valve tends to open.

ATTACHMENT 5

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SUBJECT: SFV 53503 and SFV 53604

DATE

DEPT.

BY

REFERENCE

Closure time initial 3.5 seconds (from 90° open)

From A-C Engineering Report # VSR 0137 the angle of valve opening α and the operator spring travel x vary as follows:

$$\cos\theta = \frac{l - R_1 \sin\alpha}{l}$$

$$x = R_1(1 - \cos\alpha) + l\sin\theta$$

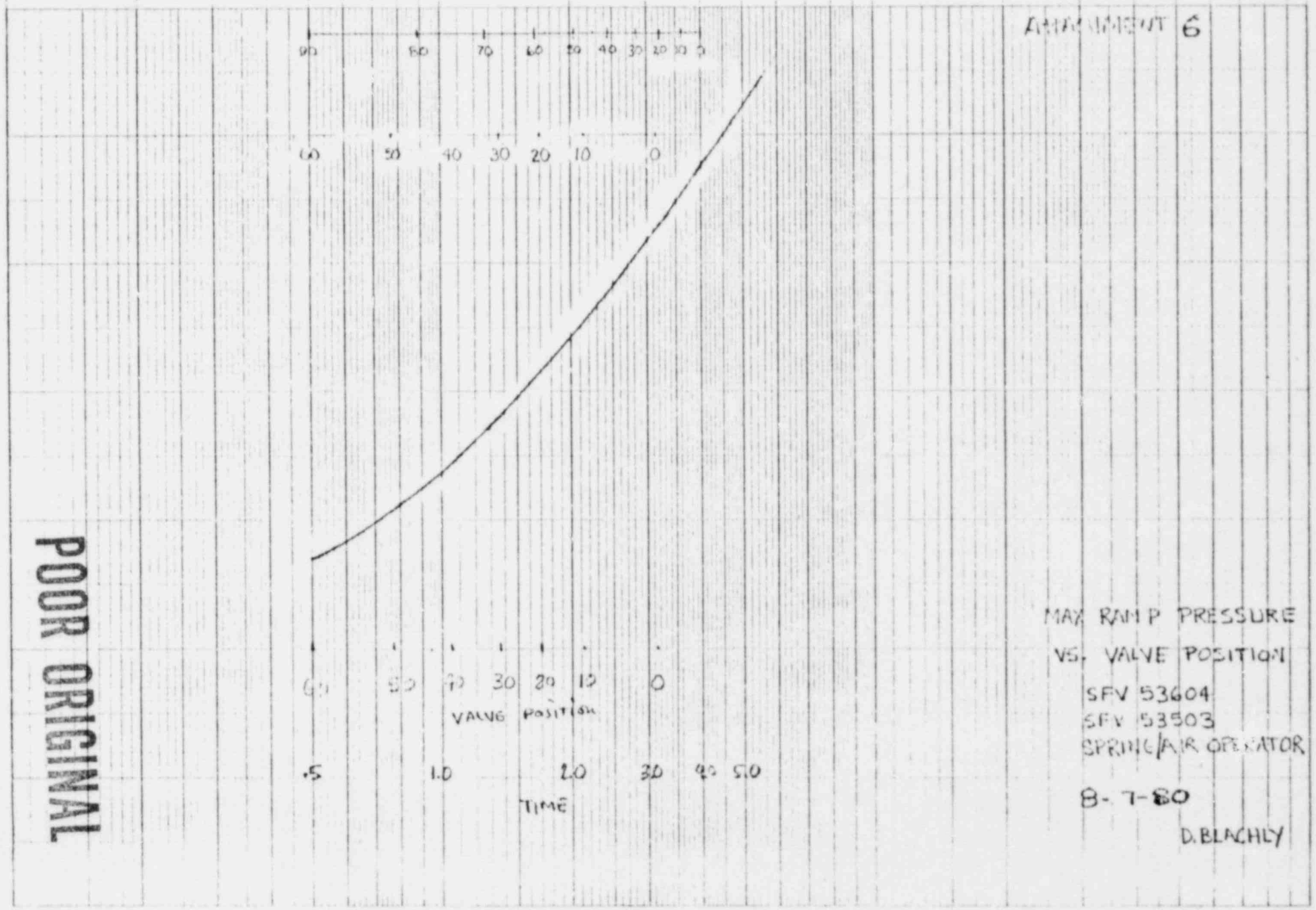
$l = 12''$
$R_1 = 10''$
θ = intermediate angle

α	θ	x	Time to Close
90	50.4	21.8"	3.5 sec

T_1 = elapse time to close from 60° position

α	θ	x	T_1	RxB. Press
60°	73.8°	16.5"	0.00 sec	7 psi
50°	68.8°	14.8"	0.27 sec	10.5 psi
40°	62.3°	13.0"	0.56 sec	14.5 psi
30°	54.3°	11.1"	0.87 sec	18.0 psi
20°	44.4°	9.0"	1.20 sec	21.5 psi
10°	31.2°	6.4"	1.62 sec	25.5 psi
0°	0.0°	0.0"	2.65 sec	33.0 psi

ATTACHMENT 6



MAX RAMP PRESSURE
VS. VALVE POSITION
SFV 53604
SFV 53503
SPRING/AIR OPERATOR

8-7-80

D. BLACHLY

Attachment 7

SMUD

SACRAMENTO MUNICIPAL UTILITY DISTRICT

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SUBJECT: SFV53503 and SFV53604

DATE:

DEPT.

BY:

REFERENCE: NCR 51912

Combined Shaft Stress

shaft dia = 4.5" $A_s = \pi/4 (4.5)^2 = 15.9 in^2$

dia valve = 66" $A_v = \pi/4 (66)^2 = 3422 in^2$

shear stress = $S_s = \frac{\Delta P \times A_v / 2}{A_s}$

Torsion stress = $S_T = \frac{T}{Z_p}$ $Z_p = \pi/16 \, D^3 = 17.89$

$S_c = S_s + S_T$

$= \frac{\Delta P \cdot 3422/2}{15.9} + \frac{T}{17.89} \times 12$

$= 107.6 \Delta P + T(.67)$

θ	S_s	S_T	S_c
60	569	2072	2641
50	886	511	1397
40	1013	922	1907
30	1017	152	3129
20	2132	2920	5052
10	2525	4860	7385
7700# lb @ 33psi?	3551	8710	12261

POOR ORIGINAL

Attachment 8

SMUD

SACRAMENTO MUNICIPAL UTILITY DISTRICT

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SUBJECT

SFV 53504 and SFV 53605

DATE

DEPT.

BY

REFERENCE

$S_c = S_s + S_T$

$S_c = 1076 \Delta P + .67 T$

	S_s	S_T	S_c
80	411	7084	7495
70	352	7646	7998
60	1482	6810	8292
50	2134	4817	6951
40	2798	3309	6107
30	3384	1901	5285
20	3766	831	4597
10	4143	6276	10418

MAX Wheel 10418 psi

POOR ORIGINAL