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J. Phillip Bayne
First Executive Vice President
Chief Operations Officer

May 3, 1985
JPN-85-40

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Mr. Domenic B. Vassallo, Chief
Operating Reactors Branch No. 2
Division of Licensing

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Containment Vent and Purge Valve Operability

References:
1. NRC letter, D.B. Vassallo to J.P. Bayne, dated January 13, 1984, same subject.
2. NYPA letter, J.P. Bayne to D.B. Vassallo (NRC), dated February 24, 1984 (JPN-84-14), same subject.
3. NYPA letter, J.P. Bayne to D.B. Vassallo (NRC), dated June 14, 1984 (JPN-84-35), same subject.
4. NRC letter, D.G. Eisenhut to J.P. Bayne, dated October 9, 1984, same subject.
5. NYPA letter, C.A. McNeill, Jr. to D.B. Vassallo, dated November 26, 1984 (JPN-84-74), same subject.

Dear Sir:

In Reference 1, the NRC requested information regarding the operability of the FitzPatrick plant containment vent and purge valves under design basis accident (DBA) conditions. The Authority provided this information in References 2 and 3.

In Reference 4, the NRC requested additional information to complete its review of the FitzPatrick vent and purge valves.

In response to this request, the Authority submitted results of detailed calculations for the subject valves (Reference 5). These results demonstrated that the valves and actuators are operable under DBA conditions, taking into account the effect of increased dynamic loads resulting from upstream elbows or other fittings.

A047
1/1

Enclosed with this letter are the complete detailed calculations (Attachment A).

These calculations have been revised to correct the data for spring torque versus valve opening angles as shown on pages 10, 11, 17 and 18 of Attachment A. The changes are based on discussions with the NRC staff in a meeting held on January 28, 1985 at Bethesda. These changes do not alter the conclusions stated above.

This submittal also includes a copy of the seismic analysis (Attachment B), which was performed by Fisher Controls Company, for these valves. This analysis demonstrates that the stresses, due to the combination of operating, seismic and dead weight loads, are below the allowable values for the valve assemblies including the mounting hardware. The results of this analysis are also valid in the circumstances where an upstream fitting causes an increase in the dynamic operating loads. In these cases, the valves have been modified to restrict the maximum angle of opening. This restriction reduces the dynamic operating loads and thereby compensates for increases in the loads caused by upstream fittings. As a result, the total dynamic operating load is less than the original design operating load; and the calculations (Attachment B) remain valid.

Based on this submittal, the Authority considers this issue closed for the FitzPatrick plant.

If you have any questions, please contact Mr. J. A. Gray, Jr. of my staff.

Very truly yours,

J. P. Bayne
First Executive Vice President
Chief Operations Officer

Enc.

cc: Office of the Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 136
Lycoming, New York 13093

ATTACHMENT A

JAMES A. FITZPATRICK
CALCULATION CONTROL SHEET

Mod. (I.D.) No. PES-001 Rev 1
Cal. Set. No. 28
Totl. No. Calc. Sheets 28

SYSTEM 20" & 24" CONTAINMENT PURGE/VENT VALVE QA CAT. 1

SUBJECT 20" & 24" CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

PROBLEM STATEMENT/OBJECTIVE/METHOD

TO PERFORM A CALCULATION TO CHECK THAT THE 20" & 24" CONTAINMENT PURGE VENT VALVE MEET THE NEW NUCLEAR REGULATORY COMMISSION REQUIREMENTS REGARDING THE ADDITIONAL LOAD AS A RESULT OF VALVE INSTALLATION CLOSE TO PIPE FITTINGS I.E., EFFECT OF UPSTREAM ELLBOW.
24" TAG NO AOV-111, AOV-112, AOV-113 & AOV-114
20" TAG NO AOV-115 & AOV-116

DETAILS OF ANALYSIS (DESIGN INPUTS, ASSUMPTIONS, COMPUTER TYPE - CODE - PROGRAM, ETC.

THE METHOD USED IN THIS ANALYSIS IS THE SAME METHOD USED BY THE VALVE MANUFACTURER I.E., FISHER CONTROL COMPANY AS SHOWN IN THE ATTACHMENT #1 TO THE CALCULATION REV 1, 3/19/1985 PAGE # 10, 11, 17 AND 18 SPRING TORQUE ACTUATOR VERSUS ANGLE(α°) VALVE OF OPENING WAS CORRECTED AS PER DISCUSSION DURING NRC/ NYPA MEETING ON JANUARY 28, 1985 I.E., SEE ATTACHMENT #1 PAGE 8 & 9, THE MAXIMUM SPRING TORQUE ACTUATOR CORRESPONDS TO MAXIMUM VALVE(α°) OF OPENING.

SUMMARY/CONCLUSIONS BASED ON THIS CALCULATION, THE 24" VALVE TAG # AOV-111, AOV-112 & AOV-113 WILL BE OPERABLE IN 0° TO 40° DEGREE RANGE. THE 24" VALVE TAG # AOV-114 IN 0° TO 50° RANGE.
THE 20" VALVE TAG # AOV-115 AND AOV-116 WILL BE OPERABLE IN THE RANGE OF 0° TO 50° DEGREE.

REFERENCES: FISHER CONTROL CONTROL COMPANY ATTACHED TO THE CALCULATION PACKAGE.
US-NRC LETTERS INCLUDED IN THE REFERENCE SHEET PAGE 28

Prepared/Date Jay Lester / 3/20/1985 Reviewer/Date [signature] / 3/20/85
Approval/Date [signature] / 3/20/1985 Method DESIGN REVIEW

POWER AUTHORITY OF THE STATE OF NEW YORK
JAMES A. FITZPATRICK NUCLEAR POWER PLANT

EDP-2

CALCULATION SHEET

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lefler 11/23/84	R. Salcedo 11/26/84	DESIGN REVIEW	[illegible] 11/27/84

SUMMARY

THIS CALCULATION WAS PERFORMED TO ADDRESS THE US-NRC CONCERN EXPRESSED IN THE REF # 1, 2, 3, & 4 PAGE 28

1. THE CALCULATION SHOWS THAT THE 24" CONTAINMENT PURGE/VENT VALVES TAG No. 27 AOV-111, 27 AOV-112 AND 27 AOV-113 CAN OPERATE AT 40° DEGREES OPENING DURING A DBA EVENT (SEE TABLE #1 PAGE 10 & 11).

2. THIS CALCULATION ALSO SHOWS THAT THE 24" CONTAINMENT PURGE/VALVE TAG NO. 27 AOV-114 CAN OPERATE AT 50° DEGREES OPENING DURING A DBA EVENT (SEE TABLE #2 PAGE 17 & 18)

3. THE CALCULATION FOR THE 20" CONTAINMENT PURGE/VALVE TAG NO 27 AOV-115 AND AOV-116 SHOWS THAT THESE VALVE CAN OPERATE AT 50° DEGREES OPENING DURING A DBA EVENT (SEE TABLE #3 PAGE 26 & 27)

REV 1 (3/19/85) PAGE #10, 11, 17 AND 18 SPRING TORQUE ACTUATOR VERSUS ANGLE(α°), VALVE OF OPENING WAS CORRECTED AS PER DISCUSSION DURING NRC/NYPA MEETING ON JANUARY 28, 1985 (I.E.) SEE ATTACHMENT #1 PAGE 8 & 9 THE MAXIMUM SPRING TORQUE ACTUATOR CORRESPONDS TO MAXIMUM VALVE ANGLE(α°) OF OPENING.

[illegible] 3/20/85

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CALCULATION SHEET

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Subject/Title: CONTAINMONT PURGE / VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lepka 11/14/84	[illegible] 11/21/84	DESIGN REVIEW	[illegible] 11/21/84

CALCULATIONS

THE CALCULATION FOR 24" VALVE TAG 27 AOV-111, 27 AOV-112 AND 27AOV-113 IS PERFORMED TO ADDRESS THE US-NRC CONCERNS WRITTEN IN THE US-NRC DOCKET No. 50-333 OF OCTOBER, 1984

THE CALCULATION IS PERFORMED USING THE SAME METHOD USED BY FISHER CONTROL INTERNATIONAL INC WITH THE EXCEPTION THAT A MULTIPLICATION FACTOR OF 3 IS USED FOR THE CLOSING TORQUE. THIS MULTIPLICATION FACTOR OF 3 IS USED BECAUSE THE SHAFT OF THESE VALVES LIE 90° OUT OF PLANE OF THE UPSTREAM ELBOW.

THESE 24" VALVES HAVE A 1 3/4 INCH SHAFT, BRONZE BUSHING, ADJUSTABLE SEALING AND PLATE DISC, SEE ATTACHMENT #1 PAGE 23 THRU 27.

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CALCULATION SHEET

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS.

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lefter 11/14/1984	R. Rhoades 11/21/84	Design Review	Jay Gaynor 11/21/84

CALCULATION FOR 24" BUTTERFLY CONTAINMENT ISOLATION VALVE TORQUE CAPABILITY USING "FISHER CONTROL INTERNATIONAL, INC. METHOD AS SHOWN IN THE ATTACHMENT #1 PAGE #1 THRU 6 & PAGE 19 THRU 27 VALVE TAG 27AOV-111, 27AOV-112 AND 27AOV-113.

$$\text{TORQUE @ } \alpha^\circ \text{ (In-Lb)} = A\Delta P_{ACT-\alpha^\circ} + B + C\left(\frac{\Delta P_{ACT-\alpha^\circ}}{\Delta P_{EFF-\alpha^\circ}} \text{ WHICHEVER IS SMALLER}\right) \quad \text{Eq \#1}$$

WHERE: A, B, C - TABULATED COEFFICIENTS

$\Delta P_{ACT-\alpha^\circ}$ - ACTUAL PRESSURE DROP AT ANGLE α°

$\Delta P_{EFF-\alpha^\circ}$ - EFFECTIVE PRESSURE DROP

"A" = 94.4 FROM ATTACHMENT 1 PAGE 3 FOR BRONZE BUSHING, TYPE 9200 class 2

"B" = 471 FROM ATTACHMENT 1 PAGE 3 FOR ADJUSTABLE SEALING, TYPE 9200 CLASS 2

"C" VALUE GIVEN IN TABLE #9 ATTACHMENT #1 PAGE #4 FOR PLATE DISC & 1 3/4" SHAFT

α°	0°	10°	20°	30°	40°	50°	60°	70°	80	90°
"C"	0	85	146	146	146	340	783	1910	2410	2410

ΔP_{EFF} = FROM ATTACHMENT 1 PAGE 5 FOR PLATE DISC & GAS FLOW

α°	0°	10°	20	30°	40°	50°	60°	70°	80	90
ΔP (psi)	145	145	88	56	26	14	8	4	2	2

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CALCULATION SHEET

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lefter 11/14/84	Joe Salvado 11/21/84	D.R.	[illegible] 11/21/84

ΔP - EFFECTIVE PRESSURE DROP IS GIVEN IN CF 40B-10 EFF ATTACHMENT #1 PAGE # 5

α°	0°	10	20°	30°	40°	50°	60°	70°	80-90°
GAS ΔP EFF	$\Delta P_{ACT-\alpha}$	0.260P,	0.35P,	⟶			0.25P,	0.18P,	0.11P,	0.09P,

WHERE P_1 = UPSTREAM PRESSURE PSIA AT INDICATED ANGLE OF OPENING α°

CALCULATION OF SHAFT TORQUE CAPABILITY FOR TORQUE DYNAMIC FACTOR = 1

TORQUE IN-LB $\alpha^\circ = 0$: $(T_{\alpha^\circ=0}) = 944 \times 145 + 471 + 0 \times [\ ] = \underline{14159}$ in-lb

$T_{\alpha^\circ=10^\circ} = 94.4 \times 145 + 471 + 85[0.260(145+14.7)] = 13688 + 471 + 3.529 = \underline{17688}$ in-lb

$T_{\alpha^\circ=20} = 94.4 \times 88 + 471 + 186[0.35(88+14.7)] = 8307.2 + 471 + 5248$

$T_{\alpha^\circ=20} = \underline{14,026}$ in-lb

$T_{\alpha^\circ=30} = 94.4 \times 56 + 471 + 146[0.35(56+14.7)] =$

$= 5286.4 + 471 + 3612.7 = \underline{9370}$ in-lb

$T_{\alpha^\circ=40^\circ} = 94.4 \times 26 + 471 + 146[0.35(26+14.7)] =$

$= 2454.4 + 471 + 2079.77 = \underline{5005.17}$ in-lb

$T_{\alpha^\circ=50} = 944 \times 14 + 471 + 340(0.250(14+14.7)] =$

$= 13216 + 471 + 2439.5 = \underline{4232}$ in-lb

$T_{\alpha^\circ=60^\circ} = 944 \times 8 + 471 + 783[0.18(8+14.7)] =$

$755.2 + 471 + 3199.33 = \underline{4425}$ in-lb

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CALCULATION SHEET

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jon Lepkie 11/14/1984	[illegible] 11/21/84	D.R.	[illegible] 11/21/84

CALCULATION OF MAXIMUM ΔP FOR SHAFT LOADING CARRYING CAPABILITY WHEN THE TORQUE DYNAMIC FACTOR OF 3 IS USED.

$T_{\alpha=0^\circ} = 14159 = 94.4\Delta P + 471 + 0 \times 3$

$\Delta P_{\alpha^\circ=0^\circ} = (14159 - 471)/94.4 = 145$ psi OK

$T_{\alpha^\circ=10} = 17688 = 94.4\Delta P + 471 + 85(0.260(\Delta P + 14.7)] \times 3$

$17,688 - 471 - 974.6 = 94.4\Delta P + 85 \times 0.261 \times 3 \times \Delta P$

$\Delta P_{\alpha^\circ=10} = 101$ psi

$T_{\alpha^\circ=20^\circ} = 14,026 = 94.4\Delta P + 471 + 146[0.35(\Delta P + 14.7)] \times 3$

$14,026 = 94.4\Delta P + 471 + 2253.51 + 153.3\Delta P$

$\Delta P_{\alpha=20^\circ} = 11301.49/247.7 = 45.62$ psi

$T_{\alpha^\circ=30} = 9370 = 94.4 \times \Delta P + 471 + 146[0.35(\Delta P + 14.7)] \times 3$

$9370 = 94.4\Delta P + 471 + 2253.51 + 153.3\Delta P$

$\Delta P_{\alpha^\circ=30^\circ} = 6645.49/247.7 = 26.82$ psi

$T_{\alpha^\circ=40^\circ} = 5005.17 = 94.4\Delta P + 471 + 146[0.35(\Delta P + 14.7)]3$

$T_{\alpha^\circ=40^\circ} = 5005.17 = 94.4\Delta P + 471 + 2253.51 + 153.3\Delta P$

$\Delta P_{\alpha=40^\circ} = 2280.64/247.7 = 9.20$ psi ✓

$T_{\alpha - 50^\circ} = 4232 = 94.4\,\Delta P + 471 + 340\left[.250\,(\Delta P + 14.7)\right] \times 3$

$4232 = 94.4\,\Delta P + 471 + 3748.5 + 255\,\Delta P$

$\Delta P_{\alpha^\circ = 50} = \dfrac{12.50}{349.4} = 0.0357 \text{ psi}$

α°	0°	10°	20°	30	40°	50°
TDF = 3 ΔP (SHAFT)(psi)	145	101.	45.62	26.82	9.20	0.0357

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

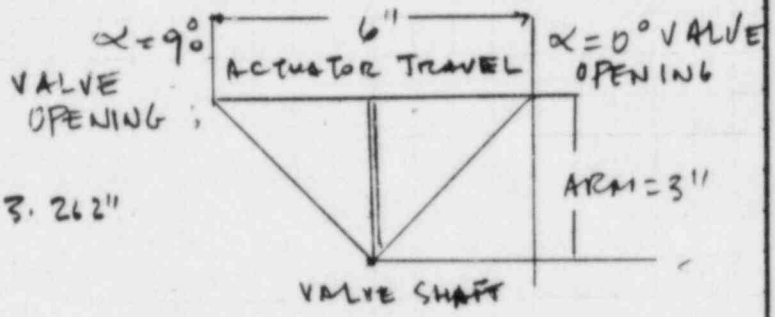
QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lefler 11/16/84	R. Laheda 11/21/84	DR.	Jerry Gugis 11/21/84

TOTAL BETTIS ACTUATOR STROKE = 6" @ 90° VALVE OPENING
ARM LENGTH = 3" @ 45° VALVE OPENING
FOR BOTH 733C SRB'S & 732C SRB DATA OBTAINED BY TELEPHONE CONVERSATION WITH MR Bob Kane 11/16/84 9:45 am Telephone # BETTIS (713) 463 5100 and 11/20/84, 10 am WITH MR BILL REED.

LENGTH OF ACTUATOR STROKE (L_{AS})

L_{AS} = 3"
α = 45°



$L_{AS}(\alpha = 50°) = 3" + 3 \tan 5° = 3.262"$

$L_{AS}(\alpha = 45°) = 3"$

$L_{AS}(\alpha = 40°) = 3" - 3" \tan 5° = 2.737"$ (See ATTACHMENT #1 PAGE 17)

$L_{AS}(\alpha = 30°) = 3" - 3" \tan 15 = 2.196"$

$L_{AS}(\alpha = 20°) = 3" - 3" \tan 25° = 1.601"$

$L_{AS}(\alpha = 10°) = 3" - \tan 35° = 0.899"$

$L_{AS}(\alpha = 0°) = 3" - \tan 45 = 0.0"$

THE TIME MEASURED TO CLOSE THE VALVE FROM 50° TO 0° DEGREES = 3.62 Sec. THE SAME TIME = 3.62 Sec will be used in the calculation to close the valve from 40° which IS CONSERVATIVE

$$V_{AS} = \frac{L_{AS}}{t} = \frac{2.737}{3.62} = 0.756 \text{ SEC.}$$

CALCULATE THE TIME FOR VALVE TO CLOSE FROM 40° TO 30°, 20, & 10°

$$t_{\alpha: 40 \text{ to } 30°} = \frac{2.737 - 2.196}{0.756} = 0.7156 \text{ SEC}$$

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Subject/Title: CONTAINMENT PURGE / VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lester 11/16/84	[illegible] 11/21/84	D.R.	[illegible] 11/21/84

ΔP = 19.23 PSI From Attachment #1 Page 15
$\{\alpha = 3.0°$
$\{t = 0.7156$ SEC
OK

The shaft capability @ 30° ΔP_{SHAFT} = 26.82 PSI

$T_{V\alpha=20°} = \frac{2.737'' - 1.601}{0.756} = 1.5026$ Sec

@ T_V = 1.5026 Sec, & α = 20° ΔP_{DBA} = 26.76 PSI
OK

The shaft capability @ α = 20°, ΔP_{SHAFT} = 45.62 PSI

$T_{V\alpha=10°} = \frac{2.737 - 0.899}{0.756} = 2.4312$ Sec

AT $T_{V\alpha=10°}$ = 2.4312, α = 10°, ΔP_{DBA} = 30.41 PSI
OK

THE shaft capability @ α = 10° → ΔP_{SHAFT} = 100.97 PSI

AT $T_{V\alpha=0°}$ = 3.62 Sec ΔP_{DBA} = 32.45 PSI
OK

THE SHAFT CAPABILITY @ α = 0° ΔP_{SHAFT} = 145 PSI

ΔP SHAFT CAPABILITY, DBA ΔP (ΔP_{SH}, ΔP_{DBA})

$\alpha°$	0	10°	20°	30°	40
ΔP_{SH} (PSI)	145	101.00	45.62	26.82	9.20
ΔP_{DBA} (PSI)	32.45	30.41	26.76	19.23	1.99

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CALCULATION SHEET

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lefter 11/16/84	[illegible] 11/21/84	D.R.	[illegible] 11/21/84

CALCULATION FOR TORQUE DEVELOPED BY CONTAINMENT PRESSURE RESPONSE TO A DBA EVENT FOR 27 AOV-111, 27 AOV-112 & 27 AOV-113.

$\alpha^\circ = 40^\circ$, $t = 0.02$ sec $\Delta P = 1.99$ PSI

$T_{DBA\ \alpha=40^\circ} = 94.4 \times 1.99 + 471 + 146 \times 3\,[0.35(1.99 + 14.7)]$

$5.84 > 1.99$ use 1.99

$T_{DBA\ \alpha=40^\circ} = 1531$ in-lb

$T_{DBA\ \alpha=30^\circ} = 94.4 \times 19.23 + 471 + 146 \times 3\,[0.35(19.23 + 14.7)] =$

$1815.312 + 471 +$

$= 7489$ in-lb

$T_{DBA\ \alpha=20^\circ} = 94.4 \times 26.76 + 471 + 146 \times 3\,(0.35\,(26.76 + 14.7)] =$

$2997.14 + 6355.82$

$= 9353$ in-lb

$T_{DBA\ \alpha=10^\circ} = 94.4 \times 30.41 + 471 + 85 \times 3\,[0.261\,(30.41 + 14.7)] =$

$2870.70 \quad 3473.29$

$= 6344$ in-lb

$T_{DBA\ \alpha=0^\circ} = 94.4 \times 32.45 + 471 + 0 = 3534$ in-lb

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Leffler 11/16/84	Alcaldo 11/21/84	D.R.	11/21/84

TABLE #1

LOADING CARRYING CAPACITY FOR 24" VALVES TAG # 27 AOV-111, 27 AOV-112 & 27 AOV-113, SHAFT LAYING 90° OUT OF PLANE, TORQUE MULTIPLICATION FACTOR = 3, AS REQUIRED BY NRC DOCKET No 50-333 / OCTOBER 9, 1984

α°	0°	10°	20°	30°	40°	
SPRING TORQUE ACTUATOR (in-lb)	12900	11480	10620	10260	10370	REV 1 PER NRC/NYPA MEETING JAN 28, 1985
SHAFT TORQUE CAPABILITY (in-lb)	14,159	17,688	14,026	9,370	5005	
TORQUE DEVELOPED BY DBA LOCA (in-lb)	3534	6344	9353	7489	1,531	✓
SHAFT ΔP CAPABILITY (PSI)	145.	101.	46.	27.	9.20	✓
SHAFT ΔP DEVELOPED BY DBA LOCA (PSI)	32.45	30.41	26.76	19.23	1.99	✓

REV 1 3/19/1985

JLeffler / Rad / 3/20/85

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lefter 11/16/84	[illegible] 11/21/84	D.R.	[illegible] 11/21/84

24" VALVE TAG # 27 AOV-111, 27 AOV-112, & 27 AOV-113

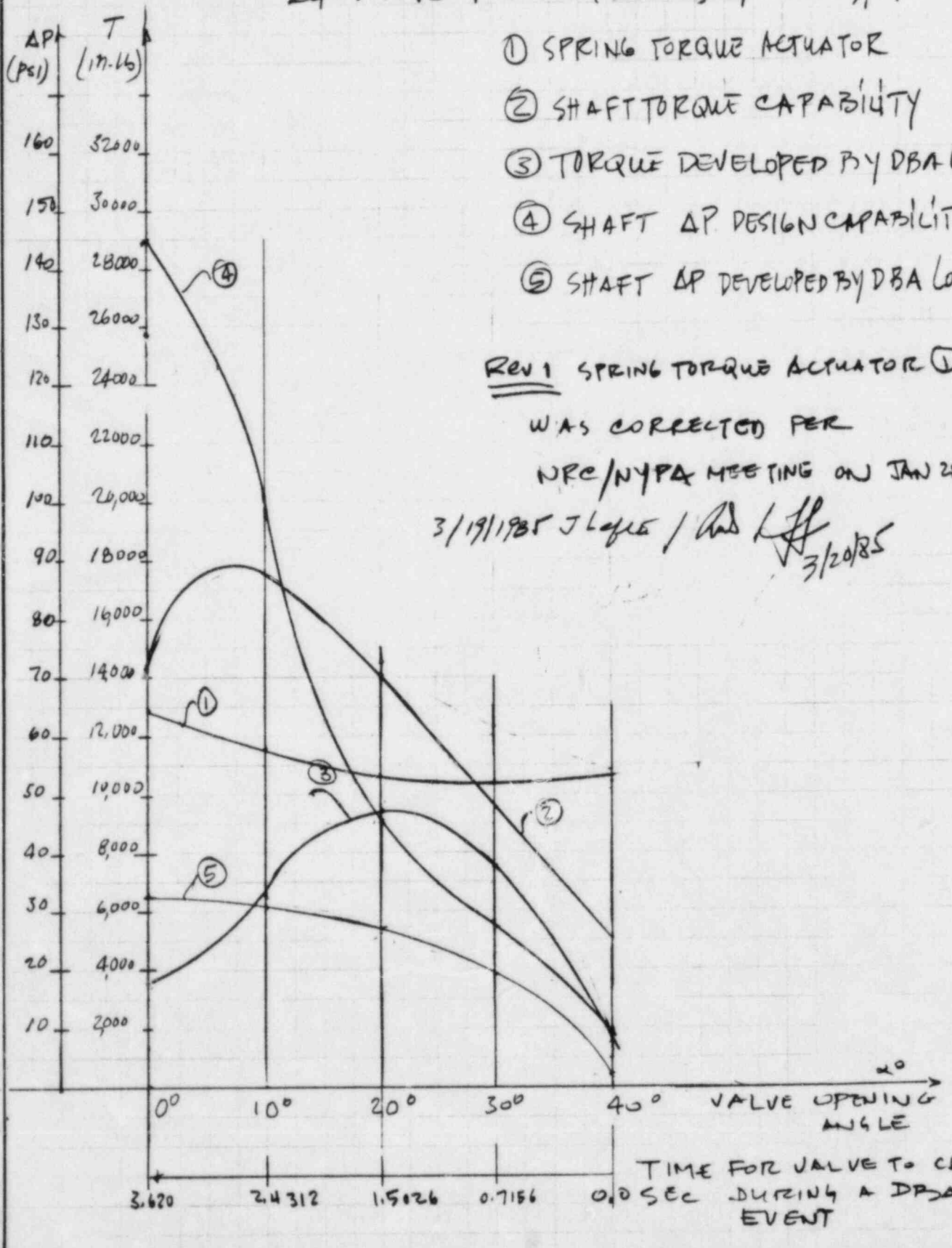
① SPRING TORQUE ACTUATOR

② SHAFT TORQUE CAPABILITY

③ TORQUE DEVELOPED BY DBA LOCA

④ SHAFT ΔP DESIGN CAPABILITY

⑤ SHAFT ΔP DEVELOPED BY DBA LOCA



REV 1 SPRING TORQUE ACTUATOR ① WAS CORRECTED PER NRC/NYPA MEETING ON JAN 28, 85

3/19/1985 J Lefter / [signature] 3/20/85

POWER AUTHORITY OF THE STATE OF NEW YORK
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CALCULATION SHEET

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Subject/Title: CONTAINMENT PURGE VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lester 11/19/84	M. Salvedo 11/21/84	D.R.	[signature] 11/28/84

CALCULATION FOR THE MAXIMUM ΔP FOR SHAFT LOADING CARRYING CAPABILITY WHEN THE TORQUE DYNAMIC FACTOR OF 1.5 IS USED FOR 24" VALVE TAG AOV-114, SHAFT LAYING IN THE PLANE OF THE UPSTREAM ELBOW - AS REQUIRED BY US-NRC DOCKET No. 50-333 / OCTOBER 9, 1984 Ref #1.

$T_{\alpha=0^\circ} = 14159 = 94.4\Delta P + 471 + 0. \times 1.5$

$\Delta P = 145$ psi

$\alpha^\circ = 0^\circ$

$T_{\alpha=100} = 17688 = 94.4\Delta P + 471 + 85[0.260(\Delta P + 14.7)] \times 1.5$

$17688 - 471 - 487.3 = \Delta P(94.4 + 85 \times 0.260 \times 1.5\Delta P)$

16430

$\Delta P_{SH\alpha=10^\circ} = 128.80$ psi

$T_{\alpha=20^\circ} = 14,026 = 94.4\Delta P + 471 + 146[0.35(\Delta P + 14.7)] \times 1.5$

$14,026 - 471 - 1126.75 = (94.4 + 76.65)\Delta P$

171.05

$\Delta P_{SH\alpha=20^\circ} = 72.65$ psi

$T_{\alpha=30^\circ} = 9370 = 94.4\Delta P + 471 + 146(0.35(\Delta P + 14.7)] \times 1.5$

$9370 - 471 - 1126.75 = \Delta P(94.4 + 76.65)$

171.05

$\Delta P_{SH\alpha=30^\circ} = 45.44$ psi

$T_{\alpha=40^\circ} = 5005.17 = 94.4\Delta P + 471 + 146(0.35(\Delta P + 14.7) \times 1.5$

$5005.17 - 471 - 1126.75 = (94.4 + 76.65)\Delta P$

$\Delta P_{SH\alpha=40^\circ} = 19.92$ psi

POWER AUTHORITY OF THE STATE OF NEW YORK
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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

QA Class: 1

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Jan Lefter 11/20/84	[illegible] 11/21/84	D.R.	[illegible] 11/21/84

$T_{\alpha=50°} = 4232 = 94.4\,\Delta P + 471 + 340 \left[.250(\Delta P + 14.7)\right] \times 1.5$

$4232 - 471 - 1874.25 = (94.4 + 127.5)\,\Delta P$

221.9

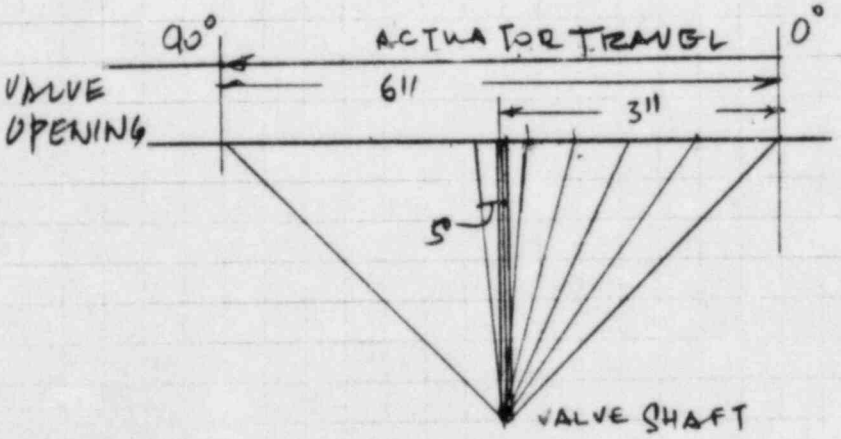
$\Delta P = 8.50$ PSI

$\alpha = 50°$

α	0°	10	20°	30°	40°	50
TDF = 1.5 ΔP (SHAFT, PSI)	145	128.8	72.65	45.44	19.92	8.50

TOTAL BETTIS ACTUATOR STROKE = 6" @ 90° VALVE OPENING.

ARM LENGTH = 3"



SEE ATTACHMENT #1 PAGE 17

$L_{AS} = 3" + 3 \tan 5° = 3.262"$

$\alpha = 50°$

$L_{AS} = 3"$

$\alpha = 45°$

$L_{AS} = 2 \times 3 \times \tan 5 = 0.5249$

α 50 TO 40°

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Jan Lefter 11/20/84	Mahaledo 11/21/84	D R.	

$LAS_{\alpha=50° \text{ TO } 30°} = 3 \tan 5° + 3 \tan 15° = 1.0663''$ (0.2624)

$LAS_{\alpha=50° \text{ TO } 20°} = 3 \tan 5° + 3 \tan 25° = 1.6613$

$LAS_{\alpha=10°} = 3 \tan 5° + 3'' \tan 35° = 2.363$

THE TIME MEASURED TO CLOSE THE VALVE FROM 50° TO 0° DEGREES = 3.625 sec.

$V_{AS} = \frac{LAS}{t} = \frac{3.262}{3.62} = 0.9011$ SEC

CALCULATE THE TIME FOR VALVE TO CLOSE FROM 50° TO 40, 30, 20, & 10°

$t_{\alpha=50° \text{ TO } 40°} = \frac{0.5249}{0.9011} = 0.58262$ sec

ΔP_{DBA} ($\alpha = 40°$, $t = 0.58262$ sec) = 17.45 PSI ✓

$t_{\alpha=50° \text{ TO } 30°} = \frac{1.0633}{0.9011} = 1.1800$

ΔP_{DBA} ($\alpha = 30°$, $t = 1.1800$) = 24.30

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Jan Lefler 11/20/84	Ila Salcedo 11/21/84	DR	[signature] 11/21/84

$t = 1.6613 / 0.9011 = 1.8436$ Sec

$\alpha = 20°$

$\Delta P_{DBA} = 28.39$ PSI ✓

$t = 1.8433$ Sec

$\alpha° = 20°$

$t = 2,363 / 0.9011 = 2.622$ Sec

$\alpha = 10°$

$\Delta P_{DBA} = 30.66$ ✓

$t = 2.622$ Sec

$\alpha = 10°$

$t = 3.62$ Sec

$\Delta P_{DBA} = 32.45$ PSI

$\alpha = 0°$

$t = 3.62$

$\alpha°$	0°	10	20	30	40	50°
ΔP_{SH} (PSI)	145	128.80	72.65	45.44	19.92	8.50
ΔP_{DBA}	32.45 ✓	30.66	28.39	24.30	17.45	1.99

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Jan Lester 11/20/84	M. Salcedo 11/21/84	D.R.	11/21/84

CALCULATION FOR TORQUE DEVELOPED BY CONTAINMENT PRESSURE TO A DBA EVENT FOR 27-11U

T_{DBA} $\alpha = 50°$ $= 94.4 \times 1.99 + 471 + 340 \lfloor 0.458(1.99 + 14.7) \times 1.5$ ⌋ $\llcorner$ 2544.98

$= 2734$ in-lb

T_{DBA} $\alpha = 40°$ $= 94.4 \times 17.45 + 471 + 146 \lfloor 0.35(17.45 + 14.7)] 1.5$ $\llcorner$ 2935.29

$= 4583$ in-lb

T_{DBA} $\alpha = 30°$ $= 94.4 \times 24.30 + 471 + 146 \lfloor 0.35(24.3 + 14.7)] 1.5$ $\llcorner$ 3460.35

$= 5754$ in-lb

T_{DBA} $\alpha = 20°$ $= 94.4 \times 28.39 + 471 + 146 \lfloor 0.35(28.39 + 14.7)] \times 1.5$ $\llcorner$ 3773.848

$= 6454$ in-lb

T_{DBA} $\alpha = 10$ $= 94.4 \times 30.66 + 471 + 85 \lfloor 0.260(30.66 + 14.7)) 1.5$ $\llcorner$ 1974.68

$= 4869$ in-lb

T_{DBA} $\alpha = 0°$ $= 94.4 \times 32.45 + 471 = 3534$ in-lb

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS | QA Class 1

Preparer/Date: Jan Lepter 11/20/1984 | Reviewer/Date: [illegible] 11/21/84 | Method: D.R | Approval/Date: [illegible] 11/21/84

TABLE #2

LOADING CARRYING CAPACITY FOR 24" VALVE TAG # 27 AOV-114, SHAFT LAYING IN THE PLANE OF THE UPSTREAM ELBOW, TORQUE DYNAMIC FACTOR = 1.5 AS REQUIRED BY NUS-NRC DOCKET NO 50-333 DATED OCTOBER 9, 1984

α°	0°	10	20	30	40°	50°	
SPRING TORQUE ACTUATOR in-Lb	12900	11480	10620	10260	10370	10990	Rev 1 ✓
SHAFT TORQUE CAPABILITY in-Lb	14159	17688	14026	9370	5005	4232	
TORQUE DEVELOPED BY DBA in-Lb	3534	4869	6454	5754	4583	2734	
SHAFT ΔP CAPABILITY (PSI)	145	128.80	72,65	45.44	19.92	8.50	
SHAFT ΔP DEVELOPED BY DBA (PSI)	32,45	30.66	28.39	24.30	17,45	1.99	

Rev 1 SPRING TORQUE ACTUATOR CORRECTED PER 3/19/1985 NRC / NYPA MEETING JAN 28, 1985

[illegible] 3/20/85

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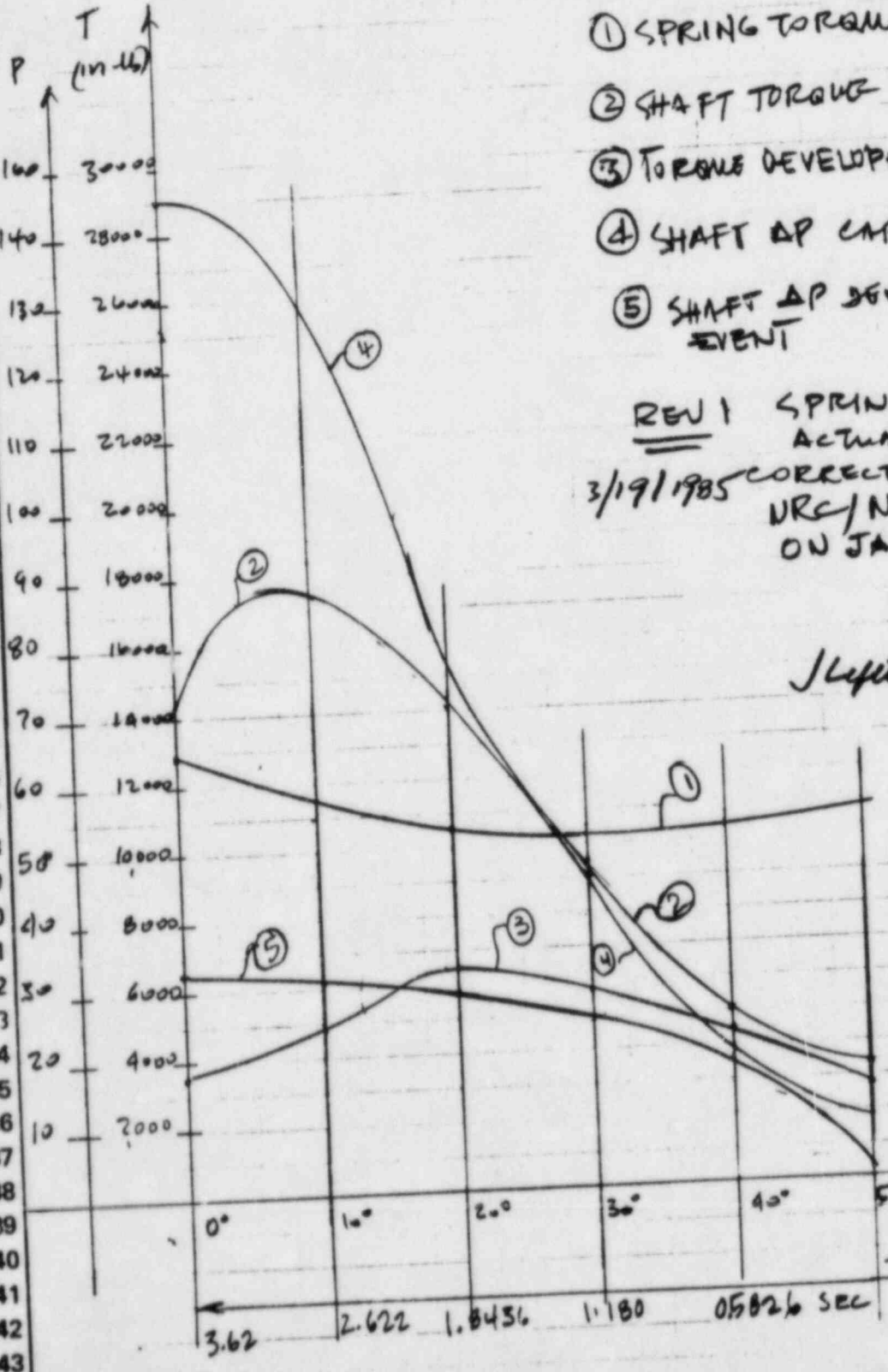
Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lepter 11/20/84	[illegible] 11/21/84	D.R.	[illegible] 11/26/84

24" VALVE TAG # 27 AOV-114



① SPRING TORQUE ACTUATOR

② SHAFT TORQUE CAPABILITY

③ TORQUE DEVELOPED BY DBA EVENT

④ SHAFT ΔP CAPABILITY

⑤ SHAFT ΔP DEVELOPED BY DBA EVENT

REV 1 SPRING TORQUE ACTUATOR ① CORRECTED PER NRC/NYPA MEETING ON JAN. 28, 1985
3/19/1985

J Lepter/Ans/ 3/20/85

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lefter 11/17/84	R Khaleda 11/21/84	D.R.	[illegible] 11/21/84

THE CALCULATION FOR 20" VALVE TAG # 27 AOV-115 AND 27 AOV-116 IS PERFORMED USING THE SAME METHOD USED BY FISHER CONTROL INTERNATIONAL, INC

THE 20" VALVE CONSTRUCTION HAS 1½" SHAFT, BRONZE BUSHING, ADJUSTABLE SEALING AND PLATE DISC SEE ATTACHMENT #1 PAGE 3 THRU 6 AND ATTACHMENT #2 PAGE 19 THRU 27.

THE MULTIPLICATION FOCTOR FOR THE CLOSING TORQUE FOR THIS CALCULATION IS 3.

THE 20" VALVE TAG 27 AOV-115 AND 27 AOV-116 HAVE THE SHAFT 60° OUT OF PLANE OF THE UPSTREAM ELBOW.

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Subject/Title CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS | QA Class 1

Preparer/Date Jan Lefler 11/7/84 | Reviewer/Date Holaleeko 11/21/84 | Method D.R | Approval/Date [illegible] 11/21/84

TYPE 9200 CLASS 2

A = 55 FROM ATTACHMENT 1 PAGE 3 FOR BRONZE BUSHING

B = 316 FROM ATTACHMENT 1 PAGE 3 FOR ADJUSTABLE SEALING

ΔP_{EFF} = FROM ATTACHMENT 1 PAGE 5, TABLE #2 PLATE DISC - GAS

C = FROM ATTACHMENT 1 PAGE 4 FOR PLATE DISC 1 1/2" VALVE SHAFT.

α°	0°	10	20°	30°	40°	50°	60°
C	0	48	82	82	82	191	438
ΔP_{EFF}	$\Delta P_{ACT-\alpha^\circ}$	0.26 P_1	0.35 P_1	0.35 P_1	0.35 P_1	0.250 P_1	0.180 P_1
ΔP_{SHAFT} TDF = 1	147	147	98	62	29	23	8

ΔP_{EFF}

ΔP_{SHAFT} @ TORQUE DYNAMIC FACTOR = 1 ATTACHMENT #1 PAGE #5

$$T_{\alpha^\circ} = A \cdot \Delta P + B + C \left(\begin{matrix} \Delta P_{ACT-\alpha^\circ} \\ \Delta P_{EFF-\alpha^\circ} \end{matrix} \begin{matrix} \text{WHICHEVER} \\ \text{IS} \\ \text{SMALLER} \end{matrix} \right)$$

$T_{\alpha^\circ=0} = 55 \times 147 + 316 + 0 \times [\ ] = 8401$ in-lb

TDF = 3

$T_{\alpha^\circ=10^\circ} = 55 \times 147 + 316 + 48 \times [0.26(147+147)] = 10,419$ in-lb

TDF = 3

$T_{\alpha^\circ=20^\circ} = 55 \times 98 + 316 + 82 [0.35(98+14.7)] = 8941$ in-lb

TDF = 3

$T_{\alpha^\circ=30^\circ} = 55 \times 62 + 316 + 82 [0.35(62+14.7)] = 5927$ in-lb

TDF = 3

$T_{\alpha=40^\circ} = 55 \times 29 + 316 + 82 [0.35(29+14.7)] = 3165$ in-lb

TDF = 3

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Subject/Title: CONTAINMENT PURGE/VENT VALVE LOAD CARRYING CAPACITY ANALYSIS

Preparer/Date: Jan Lefter 11/17/84 | Reviewer/Date: [illegible] 11/21/84 | Method: DR | Approval/Date: [illegible] 11/21/84

$T = 55 \times 23 + 316 + 191 \times [0.250 \times (23 + 14.7)] = 3381$ in-lb

$\alpha = 50$
TDF = 3

$T_{\alpha = 50°} = 3381$ in-lb
TDF = 3

CALCULATION MAXIMUM ΔP OF 17-4PH SHAFT DISC ANGLE OF OPENING AT TDF = 3

$8401 = 55\Delta P + 316$
$\alpha = 0°$

$\Delta P_{\alpha = 0°} = 147$ psi ✓

$10{,}419 = 55 \times \Delta P_{\alpha = 10°} + 316 + 48 \times 3 (0.26(\Delta P + 14.7)) =$

$10{,}419 - 316 - 48 \times 3 \times 0.26 \times 14.7 = \Delta P_{\alpha = 10°} (55 + 48 \times 3 \times 0.26)$

$9552.632 = 92.44 \Delta P_{\alpha = 10°}$

$\Delta P_{\alpha = 10°} = 103$ psi ✓

$15410 = 55 \times \Delta P_{\alpha = 20°} + 316 + 82 \times 3 (0.35(\Delta P + 14.7))$

$8941 - 316 - 1265.67 = \Delta P_{\alpha = 20} (55 + 86.1)$
$\Delta P_{\alpha = 20} = 52.16$ psi ✓ $\quad 141.1$

$5927 = 55 \Delta P_{\alpha = 30°} + 316 + 82 \times 3 [0.35 (\Delta P_{\alpha = 30°} + 14.7]$

$5927 - 316 - 1265.67 = \Delta P_{\alpha = 30°} (55 + 86.1)$
141.1

$\Delta P_{\alpha = 30°} = 30.80$ psi ✓

$3165 = 55 \Delta P_{\alpha = 40°} + 316 + 82 \times 3 (0.35 (\Delta P_{\alpha = 40} + 14.7))$

$3165 - 316 - 1265.67 = \Delta P_{\alpha = 40} (55 + 86.1)$ $\quad \Delta P_{\alpha = 40°} = 11.22$ psi

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Jan Lefter 11/17/84	Rafaluedo 11/21/84	D.R	11/21/84

$$3381 = 55 \times \Delta P_{\alpha=50^\circ} + 316 + 191 \times 3\left[0.25\left(\Delta P_{\alpha=50^\circ} + 14.7\right)\right]$$

$$3381 - 316 - 2105.78 = \Delta P_{\alpha=50^\circ}\,(55 + 143.25)$$

$$148.25$$

$$= 4.84 \text{ PSI}$$

$$\Delta P_{\alpha=50^\circ} = 4.84 \text{ psi}$$

α°	0°	10°	20°	30°	40°	50°
ΔP SHAFT TDF = 3 (#1)	147 ✓	103 ✓	52.16 ✓	30.80 ✓	71.22 ✓	4.84 ✓

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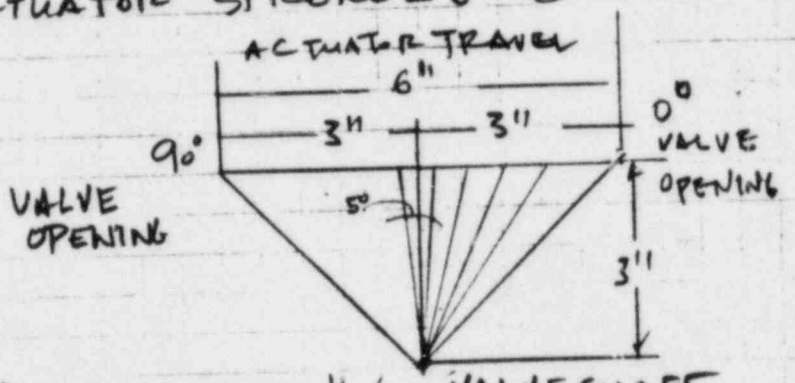
Jan Lefter 11/17/84	R. Salcedo 11/21/84	D.R	[illegible] 11/21/84

TOTAL BETTIS ACTUATOR STROKE = 6" @ 90° VALVE OPENING

ARM LENGTH = 3"



L_{AS} @ 49° = 3

L_{AS} $\alpha = 50°$ to $40°$ = $3 \tan 5° + 3 \tan 5° = 0.52493"$ ✓

SEE ATTACH #1 PAGE 18

L_{AS} $\alpha = 50°$ to $30° = 3 \tan 5° + 3 \tan 15 = 1.0663"$

L_{AS} $\alpha = 50°$ To $20 = 3 \tan 5° + 3 \tan 25° = 1.6613"$

L_{AS} $\alpha = 50°$ TO $10° = 3 \tan 5° + 3 \tan 35° = 2.3608"$

L_{AS} $\alpha = 50$ to $0° = 5° \tan 5° + 3" = 3.26246"$ ✓

TOTAL VALVE CLOSING TIME FROM PLANT TEST = 2.4 sec FROM 56° To 0° DEGREES

$$V_{AS} = \frac{L_{AS}}{t} = \frac{3.26246}{2.4} = 1.3593 \text{ INCH/sec}$$

$T_V = 0.0$ $\alpha = 56°$

$\Delta P_{DBA} = 0.15$ PSI ✓

$\alpha° = 58°$

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Jan Lepler 11/17/84	Ch Salvado 11/21/84	D.R	[illegible] 11/21/84

T_V α 50° to 40° $= \frac{0.52493}{1.3593} = 0.38617$ Sec

ΔP_{DBA} $= 2.550$ PSI
$t = 0.38617$ $\alpha = 40°$

T_V $\alpha = 50$ to $30° = \frac{1.0663}{1.3593} = 0.78444$ Sec

$\Delta P_{DBA\ \alpha = 30°} = 5.94$ PSI

T_V $\alpha = 50°$ TO $20 = \frac{1.6613}{1.3593} = 1.22215$ Sec

$\Delta P_{DBA\ \alpha = 20°} = 8.63$ PSI

T_V $\alpha = 50$ t $\alpha = 10° = \frac{2.3608}{1.3593} = 1.7367$ Sec

$\Delta P_{DBA\ \alpha = 10°} = 11.50$ PSI

T_V $\alpha = 0° = 2.45$ sec

ΔP_{DBA} $= 13.85$ PSI
$\alpha = 0°$

$\alpha°$	0°	10°	20°	30°	40°	50°
ΔP DBA (PSI)	13.85	11.50	8.63	5.94	2.55	0.15

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Jan Lefter 11/17/84	Tho Salcedo 11/21/84	D,R	Don Gray 11/21/84

CALCULATION FOR TORQUE DEVELOPED BY CONTAINMENT PRESSURE RESPONSE WETWELL USE EQ #1

USING A MULTIPLICATION FACTOR = 3 IS APPLICABLE FOR 90° OUT OF PLANE SHAFT INSTALLATION. THESE VALVES HAVE ONLY 60° OUT OF PLANE, i.e. THE ANALYSIS IS CONSERVATIVE

$T_{\alpha=50^\circ} = 55 \times 0.15 + 316 + 191\,[0.25(0.15 + 14.7)] \times 3$ ✓
(use 0.15)

$T_{\alpha=50^\circ} = 455$ in-lb

$T_{\alpha=40^\circ} = 55 \times 2.55 + 316 + 82\,[0.35(2.55 + 14.7)] \times 3$ ✓
(use 2.55)

$T_{\alpha=40^\circ} = 1084$ in-lb

$T_{\alpha=30^\circ} = 55 \times 5.94 + 316 + 82\,(035(5.94 + 14.7)] \times 3$
[use 5.94]

$T_{\alpha=30^\circ} = 2104$ in-lb ✓

$T_{\alpha=20^\circ} = 55 \times 8.63 + 316 + 82(0.35(8.63 + 14.7)] \times 3$

$T_{\alpha=20^\circ} = 2799$ in-lb

$T_{\alpha=10^\circ} = 55 \times 11.50 + 316 + 48(0.26(11.50 + 14.7)] \times 3$

$T_{\alpha=10^\circ} = 1929$ in-lb ✓

$T_{\alpha=0^\circ} = 55 \times 13.85 + 316 + 0 \times [\;] = 1078$

$T_{\alpha=0^\circ} = 1078$ in-lb ✓

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Jan Lester 11/17/84	[illegible] 11/21/84	D.R	[illegible] 11/21/84

TABLE #3
LOADING CARRYING CAPACITY FOR 20" VALVE TAG # 27AOV-115 AND 27AOV-116 SHAFT LAYING 60° OUT OF THE PLANE OF THE UPSTREAM ELBOW, TORQUE DYNAMIC FACTOR = 3.

α°	0°	10°	20°	30°	40°	50°
SPRING TORQUE ACTUATOR in-lb	10060	9,000	8420	8149	8200	8760
SHAFT TORQUE CAPABILITY in-lb	8,401	10,419	8,941	5928	3165	3381
TORQUE DEVELOPED BY LOCA DBA in-lb	1078	1929	2799	2104	1084	455
SHAT ΔP DESIGN CAPABILITY PSI	147.	103.	52.16	30.80	11.22	4.84
SHAFT ΔP DEVELOPED BY DBA LOCA (PSI)	13.85	11.50	8.63	5.94	2.55	0.15

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Jan Lepter 11/18/1984	M Faheda 11/21/84	D.R	[illegible] 11/21/84

20" VALVE TAG # 27 AOV-115 AND 27 AOV-116

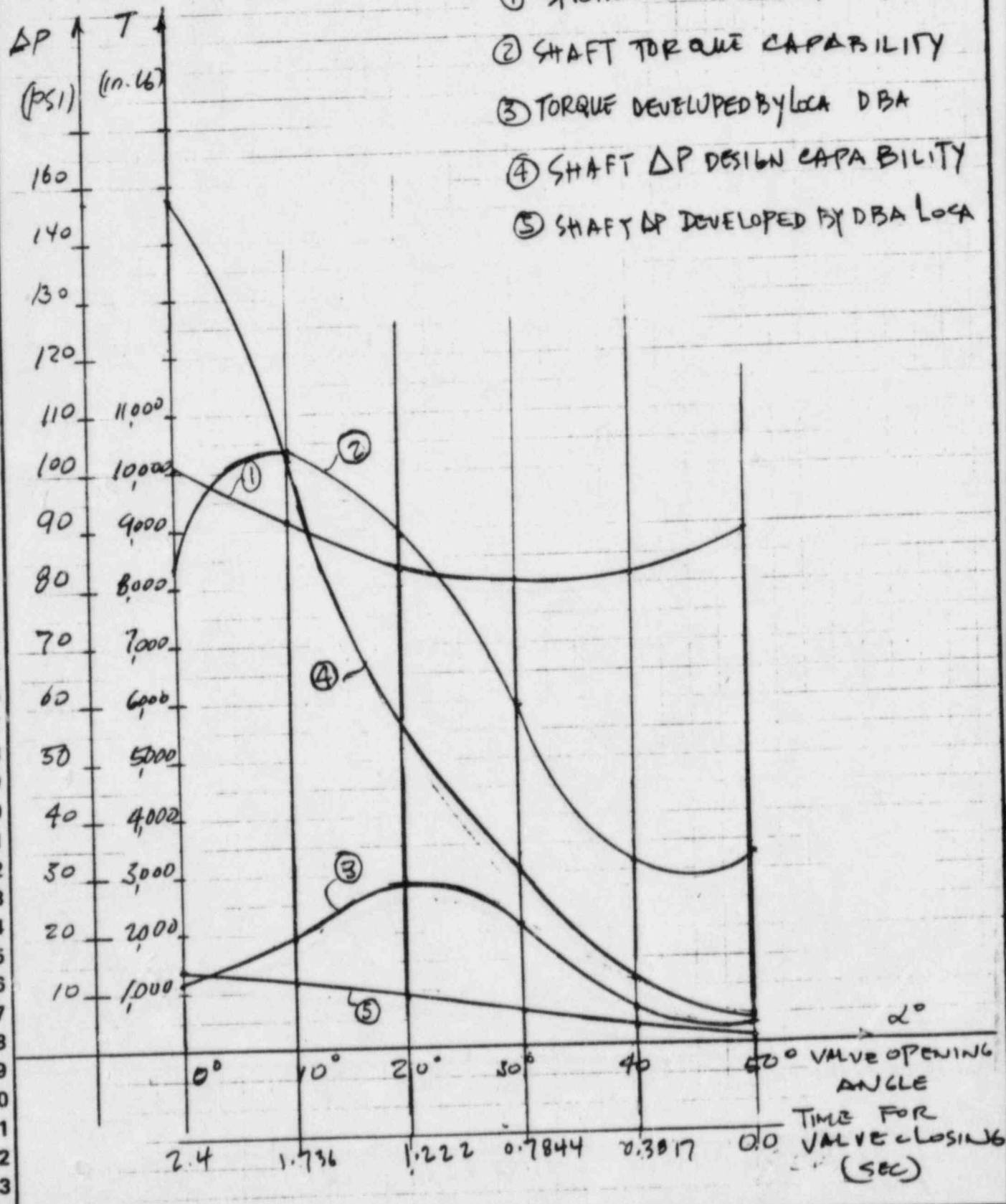
① SPRING TORQUE ACTUATOR

② SHAFT TORQUE CAPABILITY

③ TORQUE DEVELOPED BY LOCA DBA

④ SHAFT ΔP DESIGN CAPABILITY

⑤ SHAFT ΔP DEVELOPED BY DBA LOCA



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QA Class: 1

Preparer/Date	Reviewer/Date	Method	Approval/Date
Jan Lefler 11/21/84	Ma Salvido 11/21/84	D.R.	[illegible] 11/21/84

Docket No. 50-333

Containment Vent and Purge Valves Operability

References: 1. NRC letter, D. B. Vassallo to J. P. Bayne, dated January 13, 1984, "Containment Vent Valve Operability."

2. NYPA letter, J. P. Bayne to D. B. Vassallo (NRC), dated February 24, 1984 (JPN-84-14), "Containment Vent and Purge Valve Operability."

3. NYPA letter, J. P. Bayne to D. B. Vassallo (NRC), dated June 14, 1984 (JPN-84-35), "Containment Vent and Purge Valve Operability."

4. NRC letter, D. G. Eisenhut to J. P. Bayne, dated October 9, 1984, "Containment Purge/Vent Valve Operability."

APPENDIX

There are actually five torque components which add to produce the total torque in a butterfly valve. These are: friction torque (on shaft), packing torque (on shaft), unbalance torque (on offset discs), seating torque (on tight shutoff discs) and dynamic torque (on all discs).

Derivation of Formulas

The general formula for butterfly valve torque is:

$$T_t = T_f + T_p + T_u + T_s + T_d$$

where:

T_t = Total torque
T_f = Friction torque
T_p = Packing torque
T_u = Unbalance torque
T_s = Seating torque
T_d = Dynamic torque

Both friction torque and dynamic torque must be calculated. Friction torque is a function of the bushing coefficient of friction (friction torque factor), the shaft size (shaft diameter ratio - based on Type 7600 Class 2 shaft) and the actual pressure drop. Dynamic torque is a function of the valve size and disc opening (dynamic torque factor) and the actual or effective pressure drop whichever is smaller. From these factors the following equations are derived:

$$T_f = (FTF)\,(SDR)\,(\Delta P_{act\text{-}\alpha^\circ})$$

$$T_d = (DTF) \begin{pmatrix} \Delta P_{act\text{-}\alpha^\circ} & \text{whichever} \\ \text{or} & \text{is} \\ \Delta P_{eff\text{-}\alpha^\circ} & \text{smaller} \end{pmatrix}$$

where:

FTF = Friction Torque Factor
SDR = Shaft Diameter Ratio
$\Delta P_{act\text{-}\alpha^\circ}$ = Actual Pressure Drop at Angle α°
DTF = Dynamic Torque Factor
$\Delta P_{eff\text{-}\alpha^\circ}$ = Effective Pressure Drop at Angle α°

The general equation can now be written:

$$T_t = (FTF)(SDR)(\Delta P_{act\text{-}\alpha^\circ}) + T_p + T_u + T_s + (DTF) \begin{pmatrix} \Delta P_{act\text{-}\alpha^\circ} & \text{whichever} \\ \text{or} & \text{is} \\ \Delta P_{eff\text{-}\alpha^\circ} & \text{smaller} \end{pmatrix}$$

where:

$(FTF)\,(SDR) = A$

$DTF = C$

and for

Types 7500, 7600*, 7700 and 7800

$T_p = B;\quad T_u = T_s = 0$

Types 8200 and 8300

$T_p + T_u = B;\ T_s = 0$

Types 9100 and 9500

$T_p + T_s = B;\ T_u = 0$

Type 9200

$T_p + T_u + T_s = B$

thus, in each case

$$\text{TOTAL-TORQUE (IN-LBS)} = A\,(\Delta P_{act\text{-}\alpha^\circ}) + B + C \begin{pmatrix} \Delta P_{act\text{-}\alpha^\circ} & \text{whichever} \\ \text{or} & \text{is} \\ \Delta P_{eff\text{-}\alpha^\circ} & \text{smaller} \end{pmatrix}$$

* NOTE – The elastomer lined Type 7600 is ignored at this point since it is a special case and is treated as such in the tables. Were it to be included here, it would be simplified in the same manner as the Type 9100 and 9500 since it has a seating torque component at closed angles.

Additional Comments

Note that the tables give values for "B" at both 0° and open angles when seating torque is present. This is due to the fact that seating torque applies only when the disc is near the seat.

A value of zero is given for "C" for all valve types at 0° since dynamic torque is present only at angles of 10° or more.

9200 & 9280 BUTTERFLY VALVE TORQUE DETERMINATION

Introduction: Use the following procedure and tables to determine actuator torque required for 4-inch through 72-inch 9200 and 9280 series valves.

Warning: This procedure does not consider mechanically adjustable, non-inflatable Type 9200 with TFE seat 0°, see Table 33.

Butterfly valve torque is actually the sum of a number of torque components. To avoid confusion, a number of these have been combined and a number of calculations have been performed in advance. Thus, the following formulas are used in torque determination. The various torque components and the process of simplification are explained fully in the appendix.

Necessary Equations:

$$\text{Torque @ } 0^\circ \text{ (in-lbs)} = A\Delta P_{shutoff} + B + \overbrace{B_1 + B_2\,\Delta P_{shutoff}}^{T_S}$$

Where A, B, B_1, B_2, = tabulated coefficients

$\Delta P_{shutoff}$ = shutoff pressure drop

For inflatable seal, B_1 & B_2 = 0.

$$\text{Torque @ } \alpha^\circ \text{ (in-lbs)} = A\Delta P_{ACT\text{-}\alpha^\circ} + B + C\Delta P_{DYN\text{-}\alpha^\circ}$$

Where A, B, C = Tabulated coefficients

$\Delta P_{ACT\text{-}\alpha^\circ}$ = Actual pressure drop at angle α°

$\Delta P_{DYN\text{-}\alpha^\circ}$ = Dynamic pressure drop at angle α°

Procedure:

1. Determine shaft class.

   Using Table 1, determine the shaft class by valve size and shaft diameter.

TABLE 3 ATTACHMENT #1 PAGE #3

Body Size In.	A (Select One Bushing Mat'l) TFE Lined *	Graphite Filled Bronze	Bronze	None, Alloy 6	B (Select Sealing Type or Angle) Adjustable @ 0° B	B_1	B_2	Inflatable @ 0° (Select One) Other "Elastomers"	Viton	10°-90°
	0.299	0.800	1.00	1.60	52.2	79	1.6	212.2	372.2	52.2
5	0.357	1.25	1.56	2.50	54.0	138	1.9	254	454	54.0
6	0.500	1.75	2.19	3.50	54.8	197	2.2	294.8	534.8	54.8
8	1.07	3.75	4.69	7.50	76.0	313	2.5	396	716	76.0
10	2.24	7.85	9.81	15.7	116	469	3.2	516	916	116
12	3.29	11.5	14.4	23.0	123	665	4.1	603	1,083	123
14	5.14	18.0	22.5	36.0	185	889	5.0	715	1,245	185
16	6.71	23.5	29.4	47.0	198	1,212	6.6	808	1,418	198
18	10.3	36.0	45.0	72.0	260	1,603	8.1	940	1,620	260
20	12.6	44.0	55.0	88.0	316	2,188	11.3	1,076	1,836	316
24	21.6	75.5	94.4	151	471	3,634	24.1	1,391	2,311	471
30	38.7	136	169	271	782	5,860	62.3	1,942	3,102	782
36	54.9	192	240	384	995	8,110	101.3	2,395	3,795	995
42	94.3	330	413	660	2,040	10,360	140.3	3,680	5,320	2,040
48	124	434	543	868	2,200	12,610	179.3	4,080	5,960	2,200
54	189	662	828	1,320	2,420	14,860	218.3	4,540	6,660	2,420
60	234	820	1,020	1,840	4,520	17,110	257.3	6,880	9,240	4,520
66	332	1,160	1,450	2,320	5,760	19,360	296.3	8,360	10,960	5,760
72	396	1,390	1,730	2,770	6,860	21,610	335.3	9,700	12,540	6,860
84	619	2,170	2,710	4,330	9,150	26,110	413.3	12,470	15,790	9,150
96	911	3,190	3,990	6380	11,400	30,610	491.3	15,200	19,000	11,400

* TFE lined SST or TFE lined fiberglass.

TABLE 4 TYPE 9200-A/B TORQUE COEFFICIENTS - CLASS 3

Body Size In.	A (Select One Bushing Mat'l) TFE Lined *	Graphite Filled Bronze	Bronze	None, Alloy 6	B (Select Sealing Type or Angle) Adjustable @ 0° B	B_1	B_2	Inflatable @ 0° (Select One) Other "Elastomers"	Viton	10°-90°
4	0.274	0.960	1.20	1.92	67.2	79	1.6	227.2	387.2	67.2
5	0.429	1.50	1.88	3.00	69.0	138	1.9	269	469	69.0
6	0.600	2.10	2.63	4.20	69.8	197	2.2	309.8	549.8	69.8
8	1.43	4.99	6.23	9.98	111	313	2.5	431	751	111
10	2.80	9.81	12.3	19.6	156	469	3.2	556	956	156
12	4.11	14.4	18.0	28.8	163	665	4.1	643	1,123	163
14	6.17	21.6	27.0	43.2	229	889	5.0	759	1,289	229
16	8.06	28.2	35.3	56.4	242	1,212	6.6	852	1,462	242
18	12.0	42.1	52.7	84.2	308	1,603	8.1	988	1,668	308
20	14.7	51.5	64.4	103	364	2,188	11.3	1,124	1,884	364
24	24.6	86.1	108	172	521	3,634	24.1	1,441	2,361	521
30	48.4	169	212	339	896	5,860	62.3	2,056	3,216	896
36	68.6	240	300	480	1,110	8,110	101.3	2,510	3,910	1,110
42	113	396	495	792	2,160	10,360	140.3	3,800	5,440	2,160
48	149	521	651	1,040	2,320	12,610	179.3	4,200	6,080	2,320
54	221	775	969	1,550	3,560	14,860	218.3	5,680	7,800	3,560
	274	959	1,200	1,920	4,660	17,110	257.3	7,020	9,380	4,660
66	378	1,320	1,660	2,650	5,900	19,360	296.3	8,500	11,100	5,900
72	451	1,580	1,970	3,160	7,000	21,610	335.3	9,840	12,680	7,000
84	699	2,450	3,060	4,890	9,310	26,110	413.3	12,630	15,950	9,310
96	1,030	3,610	4,510	7,210	11,000	30,610	491.3	14,800	18,600	11,600

TABLE 3 ... TORQUE COEFFICIENTS

ATTACHMENT #1
PAGE # 4

Valve Size In.	Disc Type Flow Direction	Shaft Dia. [Shaft Class]	Torque Factor C (Select One Angle) 0°	10°	20°	30°	40°	50°	60°	70°	80°-90°
	Cast-Flat	All	0	10.3	21.0	33.0	72.0	129	245	495	763
	Cast-Hub	All	0	15.4	31.5	49.5	108	194	368	742	1140
		1 1/4 [2]	0	16.3	29.0	29.0	29.0	64.8	144	323	392
		1 1/2 [3]	0	16.2	27.8	27.8	27.8	65.0	139	276	313
14	Plate	1 3/4 [4]	0	16.3	29.0	29.0	29.0	64.8	134	239	280
		2 [5]	0	16.4	28.2	28.2	28.2	65.8	134	216	254
		2 1/2 [6]	0	16.5	28.2	28.2	28.2	65.8	113	151	177
		3 [7]	0	16.4	28.3	28.3	28.3	65.8	94.1	120	144
	Cast-Flat	All	0	15.0	31.0	51.0	108	195	370	750	1,160
	Cast-Hub	All	0	22.5	46.5	76.5	162	292	555	1,120	1,740
		1 1/4 [2]	0	24.7	42.3	42.3	42.3	99.0	224	515	627
		1 1/2 [3]	0	24.8	42.6	42.6	42.6	99.3	220	475	572
16	Plate	1 3/4 [4]	0	24.7	42.3	42.3	42.3	99.0	210	402	472
		2 [5]	0	25.1	42.9	42.9	42.9	100	207	365	426
		2 1/2 [6]	0	25.1	42.9	42.9	42.9	100	201	305	355
		3 [7]	0	25.1	42.9	42.9	42.9	100	154	201	236
	Cast-Flat	All	0	22.0	45.0	73.0	156	282	535	1,080	1,710
	Cast-Hub	All	0	33.0	67.5	110	234	423	802	1,620	2,560
		1 1/2 [2]	0	34.3	58.8	58.8	58.8	136	315	720	892
18		1 3/4 [3]	0	34.4	58.9	58.9	58.9	137	299	627	750
	Plate	2 [4]	0	34.3	58.8	58.8	58.8	136	290	535	630
		2 1/2 [5]	0	34.4	58.9	58.9	58.9	137	279	452	529
		3 [6]	0	34.4	58.8	58.8	58.8	138	260	373	442
		3 1/2 [7]	0	34.4	58.8	58.8	58.8	137	206	260	309
	Cast-Flat	All	0	32.0	61.0	99.0	210	381	720	1,460	2,310
	Cast-Hub	All	0	48.0	91.5	148	315	572	1,080	2,190	3,460
		1 1/2 [2]	0	48.0	82.0	82.0	82.0	191	438	1,030	1,280
		1 3/4 [3]	0	48.0	82.3	82.3	82.3	193	425	920	1,110
20	Plate	2 [4]	0	48.0	82.0	82.0	82.0	191	418	857	1,020
		2 1/2 [5]	0	47.9	82.3	82.3	82.3	192	398	688	803
		3 [6]	0	47.9	82.3	82.3	82.3	192	384	583	678
		3 1/2 [7]	0	47.9	82.3	82.3	82.3	192	329	453	534
	Cast-Flat	All	0	53.0	106	99.0 173 ~~210~~ 363 ~~311~~ 667 ~~720~~ 1260 ~~1,460~~ 2550 ~~3,310~~ 40					
	Cast-Hub	All	0	79.5	159	260	552	1,000	1,890	3,820	6,080
		1 3/4 [2]	0	85.0	146	146	146	340	783	1,910	2,410
		2 [3]	0	85.0	146	146	146	340	766	1,730	2,100
24	Plate	2 1/2 [4]	0	85.0	146	146	146	340	730	1,470	1,720
		3 [5]	0	85.2	146	146	146	341	706	1,300	1,540
		3 1/2 [6]	0	85.2	146	146	146	341	682	1,070	1,270
		4 [7]	0	85.2	146	146	146	341	621	876	1,040
	Cast-Flat	All	0	105	211	344	734	1,330	2,520	5,090	8,050
	Cast-Hub	All	0	158	316	516	1,100	2,000	3,780	7,640	12,100
		2 [2]	0	171	293	293	293	680	1,580	3,980	5,200
		2 1/2 [3]	0	171	293	293	293	682	1,480	3,510	4,320
30	Plate	3 [4]	0	171	293	293	293	680	1,510	3,240	3,720
		3 1/2 [5]	0	171	293	293	293	683	1,480	2,830	3,320
		4 [6]	0	171	293	293	293	683	1,390	2,270	2,680
		4 1/2 [7]	0	171	293	293	293	684	1,370	2,100	2,490

ATTACHMENT #1
PAGE #5

TABLE 1. SHAFT DIAMETERS (INCHES) FOR TYPE 9200

Valve Size In Shaft Class	2	3	4	5	6	7
4	5/8	3/4	1	1 1/4	-	-
5	5/8	3/4	1	1 1/4	-	-
6	5/8	3/4	1	1 1/4	1 1/2	-
8	3/4	1	1 1/4	1 1/2	1 3/4	-
10	1	1 1/4	1 1/2	1 3/4	2	2 1/2
12	1	1 1/4	1 1/2	1 3/4	2	2 1/2
14	1 1/4	1 1/2	1 3/4	2	2 1/2	3
16	1 1/4	1 1/2	1 3/4	2	2 1/2	3
18	1 1/2	1 3/4	2	2 1/2	3	3 1/2
20	1 1/2	1 3/4	2	2 1/2	3	3 1/2
24	1 3/4	2	2 1/2	3	3 1/2	4
30	2	2 1/2	3	3 1/2	4	4 1/2
36	2	2 1/2	3	3 1/2	4	4 1/2
42	2 1/2	3	3 1/2	4	4 1/2	5
48	2 1/2	3	3 1/2	4	4 1/2	5
54	3	3 1/2	4	4 1/2	5	5 1/2
60	3	3 1/2	4	4 1/2	5	5 1/2
66	3	3 1/2	4	4 1/2	5	5 1/2
72	3 1/2	4	4 1/2	5	5 1/2	6
84	4	4 1/2	5	5 1/2	6	6 1/2
96	4 1/2	5	5 1/2	6	6 1/2	7

TABLE 2 — EFFECTIVE PRESSURE DROP — TABLE 2

Type of Disc	Type of Fluid	Angle of Disc Opening 0°	10°	20°	30°	40°	50°	60°	70°	80° 90°
Cast	Liquid	$\Delta P_{act-0°}$	$0.570P_1$	$0.730P_1$	$0.500P_1$	$0.690P_1$	$0.650P_1$	$0.450P_1$	$0.390P_1$	$0.350P_1$
	Gas	$\Delta P_{act-0°}$	$\Delta P_{act-10°}$	$0.500P_1$	$0.250P_1$	$0.250P_1$	$0.200P_1$	$0.200P_1$	$0.140P_1$	$0.140P_1$
Plate	Liquid	$\Delta P_{act-0°}$	$0.700P_1$	$0.700P_1$	$0.700P_1$	$0.700P_1$	$0.670P_1$	$0.600P_1$	$0.500P_1$	$0.450P_1$
	Gas	$\Delta P_{act-0°}$	$0.260P_1$	$0.350P_1$	$0.350P_1$	$0.350P_1$	$0.250P_1$	$0.180P_1$	$0.110P_1$	$0.090P_1$

NOTE: P_1 = Upstream pressure (psia) at the indicated angle of opening ($\alpha°$).

Section 2A. Type 9200-Flow Against Hub Side of Disc (Continued)

T-Ring Material: Adjustable-All Except TFE(1)
Inflatible-All Except TFE(1) and Viton(2)

Size	Type - Class & Shaft Diameter	Maximum ΔP Valve Design (All Angles)	Bushing Type	Maximum Δ Bushing (All Angles)	Seal Type	Maximum ΔP C/S - Disc (All Angles)	Max ΔP Of 17-4PH Shaft Disc Angle Of Closure 0°	10°	20°	30°	40°	50°	60°	70°	80-90°
18"	9200 2 1-1/2"		TFE #1	197	ADJ	109	181	→	136	86	40	22	12	6	4
					INFLATE	109	234	→	136	86	40	22	12	6	4
			STELL. #3	197	ADJ	109	127	→	93	67	35	20	11	6	4
					INFLATE	109	167	133	93	67	35	20	11	6	4
	9200 3 1-3/4"		TFE #1	269	ADJ	153	258	→	213	136	63	35	19	9	6
					INFLATE	153	348	→	213	136	63	35	19	9	6
			STELL. #3	269	ADJ	153	180	→	140	102	54	32	18	9	6
					INFLATE	153	233	190	140	102	54	32	18	9	6
	9200 4 2"		TFE #1	351	ADJ	288	349	→	314	201	93	52	28	14	9
					INFLATE	288	427	→	314	201	93	52	28	14	9
			STELL. #3	351	ADJ	288	244	→	197	146	79	47	26	14	9
					INFLATE	288	311	257	197	146	79	47	26	14	9
20"	9200 2 1-1/2"		TFE #1	158	ADJ	124	147	→	98	62	29	23	8	4	3
					INFLATE	124	190	184	98	62	29	23	8	4	3
			STELL #3	158	ADJ	124	104	103	70	49	25	15	8	4	3
					INFLATE	124	135	103	70	49	25	15	8	4	3
	9200 3 1-3/4"		TFE #1	215	ADJ	161	210	→	154	98	45	25	13	7	4
					INFLATE	161	282	→	154	98	45	25	13	7	4
			STELL. #3	215	ADJ	161	147	→	105	75	40	23	13	7	4
					INFLATE	161	190	147	105	75	40	23	13	7	4
	9200 4 2"		TFE #1	281	ADJ	188	284	→	228	145	67	37	20	10	6
					INFLATE	188	353	→	228	145	67	37	20	10	6
			STELL. #3	281	ADJ	188	200	→	148	108	58	34	19	10	6
					INFLATE	188	253	200	148	108	58	34	19	10	6
→ 24"	9200 2 1-3/4"		TFE #1	147	ADJ	105	145	→	88	56	26	14	9	4	2
					INFLATE	105	193	165	88	56	26	14	8	4	2
			STELL #3	147	ADJ	105	101	95	63	44	23	13	7	4	2
					INFLATE	105	127	95	63	44	23	13	7	4	2
	9200 3 2"		TFE #1	192	ADJ	123	197	→	130	83	38	21	11	6	4
					INFLATE	123	243	242	130	83	38	21	11	6	4
			STELL #3	192	ADJ	123	136	129	90	64	34	20	11	6	3
					INFLATE	123	171	129	90	64	34	20	11	6	3
	9200 4 2-1/2"		TFE #1	300	ADJ	202	320	→	250	159	74	41	22	11	7
					INFLATE	202	403	→	250	159	74	41	22	11	7
			STELL #3	300	ADJ	202	223	215	161	118	63	38	21	11	7
					INFLATE	202	272	215	161	118	63	38	21	11	7
30"	9200 2 2"		TFE #1	120	ADJ	80	124	→	66	42	19	11	6	3	2
					INFLATE	80	157	125	66	42	19	11	6	3	2
			STELL #3	120	ADJ	80	85	74	48	34	17	10	5	3	2
					INFLATE	80	107	74	48	34	17	10	5	3	2

1. Consult factory. 2. See Section 2C.

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- _____ 10.00-1 Valve Actuator Selection Guide
- _____ 10.10-1 Valve Actuator Composite Bulletin
- _____ 10.30-1 Actuator Control Systems
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- _____ 15.10-1 GT-Series
- _____ 20.10-1 CR-Series Rack And Pinion Actuators
- _____ 30.10-1 Submersible Hydraulic Actuators
- _____ 90.10-1 Bettiswitch
- _____ 90.20-1 Hydraulic Manual Overrides
- _____ 90.30-1 Gas/Hydraulic Ordering Information
- _____ 90.40-1 T-Series Hydraulic (5000 PSI Rated)
- _____ 90.50-1 TR & TRQ Series Actuators

AD REPRINTS
- _____ Gas/Hydraulic Series
- _____ HD-Series
- _____ CB-Series

SERVICE INSTRUCTIONS
- _____ 30.00-2 HD-Service Instructions
- _____ 60.00-2 Gas/Hydraulic Installation Instructions
- _____ 10.00-2 Operation, Storage, & Maintenance Instructions For Rotary Valve Actuators
- _____ 20.00-2 Maintenance And Operating Instructions – Models CB, CBL, And CB-SR
- _____ 90.00-2 Bettiswitch Operating Instructions - Model 5R
- _____ 90.10-2 Bettiswitch Operating Instructions - Model 3R
- _____ 90.20-2 Hydraulic Control System - M4 And M4A-10
- _____ 90.60-2 PMV Service Inst

BINDERS & DIVIDERS
- _____ 1" General Sales (Binder, Only)
- _____ 1" Price Book (Binder Only)
- _____ Set of Product Dividers

SOUND/SLIDE PROGRAMS
- _____ Valve Actuation - Meeting The Challenge
- _____ CB-Series
- _____ Gas/Hydraulic
- _____ Heavy Duty Product Lines
- _____ GT-Series
- _____ Accessories & Service

OTHER _____

733C SR80

		SPRING	AIR @80PSI
OPEN	0	25,700 BREAK	11,700
	10	18,420	10,560
	20	14,500	9,850
	30	12,260	9,580
	40	10,990	9,740
	50	10,370	10,360
	60	10,260	11,600
	70	10,620	13,770
	80	11,480	10,560
CLOSED	90	12,900 END	24600

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733 SR 100

OPEN	0°	31,000 BREAK	15,500
	10	22,210	13,800
	20	17,480	12,780
	30	14,780	12,350
	40	13,250	12,490
	50	12,490	13250
	60	12,350	14780
	70	12,780	17480
	80	13,800	22,210
CLOSED	90	15,500 END	31,000

Gerry Hillis

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ATTACHMENT #1
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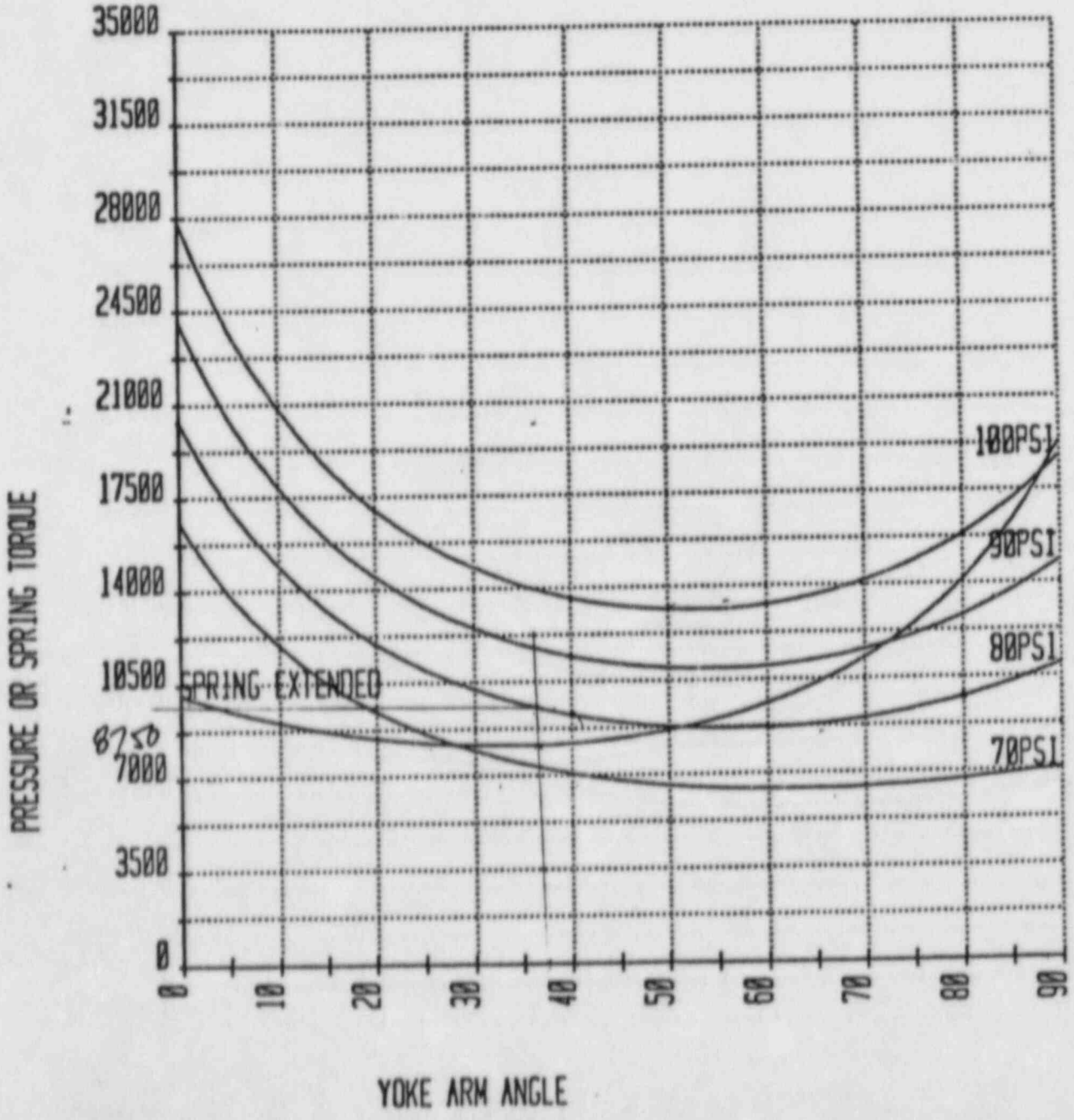
732 SR80

YOKE ARM ANGLE (degrees)	SPRING TORQUE (in lb)	PRESSURE TORQUE (70)psi	PRESSURE TORQUE (80)psi	PRESSURE TORQUE (90)psi	PRESSURE TORQUE (100)psi
0	10060	16541	20286	24031	27776
15	8687	10508	13222	15937	18651
30	8149	7933	10219	12504	14790
45	8412	6784	8955	11126	13297
60	9648	6417	8726	11036	13345
75	12544	6605	9381	12157	14933
90	19350	7138	11033	14928	18822



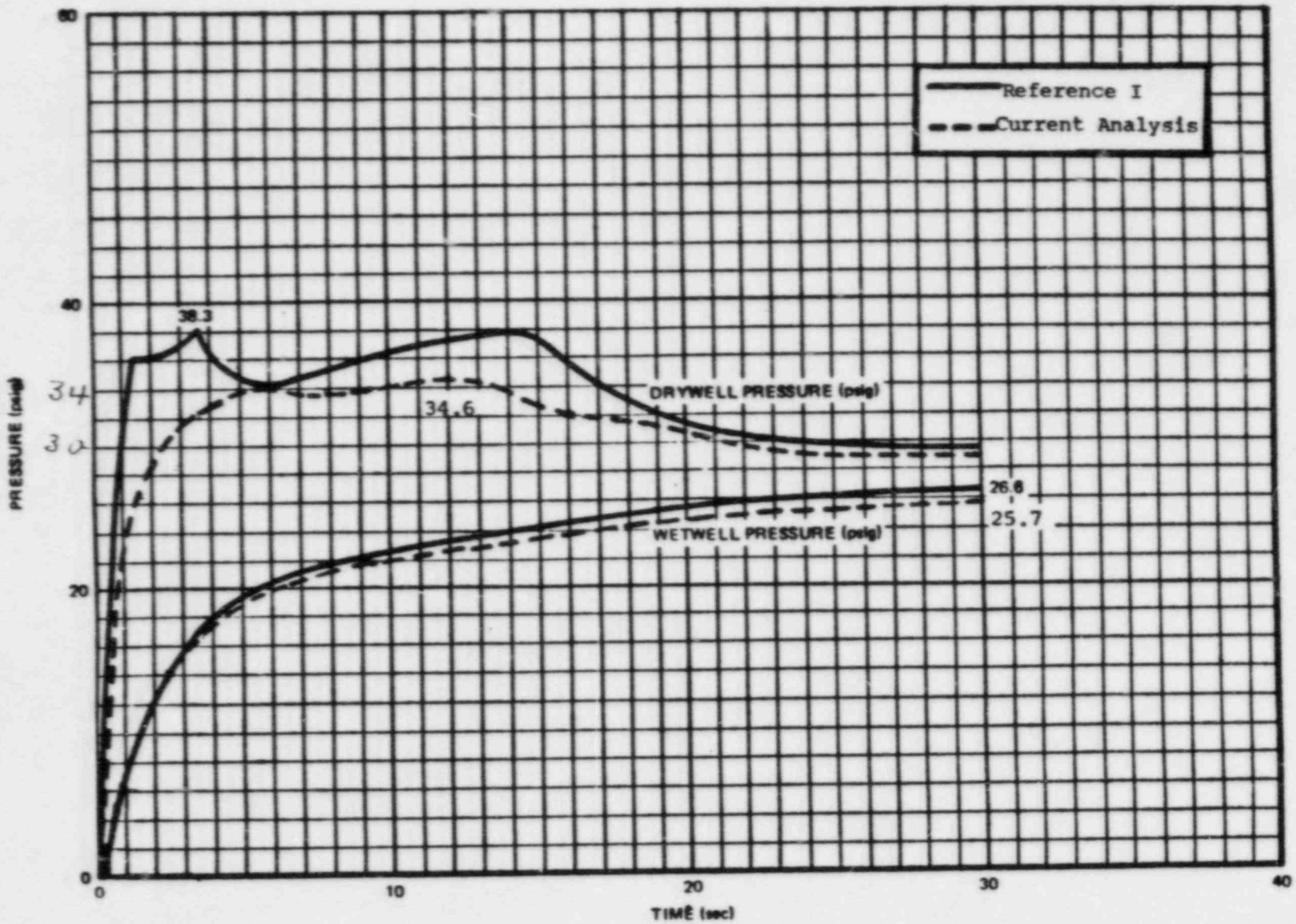


Figure 4: DBA Containment Pressure Response

7110T 01)LDRNUCO DBA LDR NOMINAL INITIAL CONT. CONDS. - SAFE BRK FLOW CASE # 1 082384 1206.6 PAGE 14

RUN NUMBER LDRNUCO 1

M3CIPT05 FITZPATRICK RECIRC BREAK SAFE HEM BRK FLOW - PEAK D.W. PRESSURE

TIME	LUMPED DW PRESS,PSIA	CONTAIN. RES. PSIA	P VESSEL PRESSURE PSIA	LUMPED DW TEMP F	CONTAIN. EMP. F	T TEMP. LIQ. VESSEL F	S.P. TEMP. F	VENT FLOW AIR LB/S	VENT FLOW VAPOR LB/S	VENT FLOW LIQ LB/S
0.	1.650E 01	1.485E 01	1.020E 03	1.350E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0019531	1.614E 01	1.485E 01	1.020E 03	1.161E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0039063	1.578E 01	1.485E 01	1.020E 03	9.775E 01	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0058594	1.582E 01	1.485E 01	1.020E 03	9.675E 01	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0078125	1.596E 01	1.485E 01	1.020E 03	9.922E 01	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0097656	1.609E 01	1.485E 01	1.020E 03	1.015E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0117188	1.621E 01	1.485E 01	1.020E 03	1.036E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0136719	1.633E 01	1.485E 01	1.020E 03	1.058E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0156250	1.645E 01	1.485E 01	1.020E 03	1.077E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0175781	1.657E 01	1.485E 01	1.020E 03	1.096E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0195313	1.669E 01	1.485E 01	1.020E 03	1.114E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0214844	1.680E 01	1.485E 01	1.020E 03	1.131E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0234375	1.691E 01	1.485E 01	1.020E 03	1.148E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0253906	1.702E 01	1.485E 01	1.020E 03	1.164E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0273438	1.714E 01	1.485E 01	1.020E 03	1.180E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0292969	1.725E 01	1.485E 01	1.020E 03	1.195E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****										
0.0312500	1.736E 01	1.485E 01	1.020E 03	1.209E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0332031	1.746E 01	1.485E 01	1.020E 03	1.223E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0351563	1.756E 01	1.485E 01	1.020E 03	1.237E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0371094	1.767E 01	1.485E 01	1.020E 03	1.250E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0390625	1.777E 01	1.485E 01	1.020E 03	1.263E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.

0.0429688	1.797E 01	1.485E 01	1.020E 03	1.287E 02	7.000E 01	5.470E 02	7.000E 01	0.	0	0.
0.0449219	1.807E 01	1.485E 01	1.020E 03	1.299E 02	7.000E 01	5.470E 02	7.000E 01	0.	0	0.
0.0468750	1.817E 01	1.485E 01	1.020E 03	1.311E 02	7.000E 01	5.470E 02	7.000E 01	0.	0	0.
0.0488281	1.827E 01	1.485E 01	1.020E 03	1.322E 02	7.000E 01	5.470E 02	7.000E 01	0.	0	0.
0.0507813	1.837E 01	1.485E 01	1.020E 03	1.333E 02	7.000E 01	5.470E 02	7.000E 01	0.	0	0.
0.0527344	1.847E 01	1.485E 01	1.020E 03	1.343E 02	7.000E 01	5.470E 02	7.000E 01	0.	0	0.
0.0546875	1.857E 01	1.485E 01	1.020E 03	1.354E 02	7.000E 01	5.470E 02	7.000E 01	0.	0	0.
0.0566406	1.867E 01	1.485E 01	1.020E 03	1.364E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0585938	1.876E 01	1.485E 01	1.020E 03	1.374E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0605469	1.886E 01	1.485E 01	1.020E 03	1.384E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0625000	1.895E 01	1.485E 01	1.020E 03	1.394E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0644531	1.905E 01	1.485E 01	1.020E 03	1.403E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0664063	1.914E 01	1.485E 01	1.020E 03	1.412E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0683594	1.924E 01	1.485E 01	1.020E 03	1.421E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0703125	1.933E 01	1.485E 01	1.020E 03	1.430E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0722656	1.942E 01	1.485E 01	1.020E 03	1.439E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0742188	1.951E 01	1.485E 01	1.020E 03	1.447E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0761719	1.961E 01	1.485E 01	1.020E 03	1.455E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0781250	1.970E 01	1.485E 01	1.020E 03	1.464E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0800781	1.979E 01	1.485E 01	1.020E 03	1.472E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0820313	1.988E 01	1.485E 01	1.020E 03	1.480E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0839844	1.997E 01	1.485E 01	1.020E 03	1.487E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0859375	2.006E 01	1.485E 01	1.020E 03	1.495E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0878906	2.015E 01	1.485E 01	1.020E 03	1.503E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0898438	2.024E 01	1.485E 01	1.020E 03	1.510E 02	7.000E 01	5.470E 02	7.000E 01	0.	0.	0.
0.0917969	2.033E 01	1.485E 01	1.020E 03	1.517E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.0937500	2.041E 01	1.485E 01	1.020E 03	1.524E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.0957031	2.050E 01	1.485E 01	1.020E 03	1.532E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.0976563	2.059E 01	1.485E 01	1.020E 03	1.538E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.

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13CIPT05 FITZPATRICK RECIRC BREAK SAFE HEM BRK FLOW - PEAK D.W. PRESSURE

TIME	LUMPED DW PRESS,PSIA	CONTAIN. P RES. PSIA	VESSEL PRE SSURE PSIA	LUMPED DW TEMP F	CONTAIN. T EMP. F	TEMP. LIQ. VESSEL F	S.P. TEMP. F	VENT FLOW AIR LB/S	VENT FLOW VAPOR LB/S	VENT FLOW LIQ LB/S
0.0996094	2.068E 01	1.485E 01	1.020E 03	1.545E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1015625	2.077E 01	1.485E 01	1.020E 03	1.552E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1035156	2.085E 01	1.485E 01	1.020E 03	1.559E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1054688	2.094E 01	1.485E 01	1.020E 03	1.565E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1074219	2.103E 01	1.485E 01	1.020E 03	1.572E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1093750	2.111E 01	1.485E 01	1.020E 03	1.578E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1113281	2.120E 01	1.485E 01	1.020E 03	1.585E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1132813	2.128E 01	1.485E 01	1.020E 03	1.591E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1152344	2.137E 01	1.485E 01	1.020E 03	1.597E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1171875	2.145E 01	1.485E 01	1.020E 03	1.603E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1191406	2.154E 01	1.485E 01	1.020E 03	1.609E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1210938	2.163E 01	1.485E 01	1.020E 03	1.615E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1230469	2.171E 01	1.485E 01	1.020E 03	1.621E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1250000	2.179E 01	1.485E 01	1.020E 03	1.627E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1269531	2.188E 01	1.485E 01	1.020E 03	1.633E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1289063	2.196E 01	1.485E 01	1.020E 03	1.638E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1308594	2.205E 01	1.485E 01	1.020E 03	1.644E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1328125	2.213E 01	1.485E 01	1.020E 03	1.649E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1347656	2.221E 01	1.485E 01	1.020E 03	1.655E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1367188	2.230E 01	1.485E 01	1.020E 03	1.660E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1386719	2.238E 01	1.485E 01	1.019E 03	1.666E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1406250	2.246E 01	1.485E 01	1.019E 03	1.671E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1425781	2.255E 01	1.485E 01	1.019E 03	1.676E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1445313	2.263E 01	1.485E 01	1.019E 03	1.681E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1464844	2.271E 01	1.485E 01	1.019E 03	1.686E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1484375	2.279E 01	1.485E 01	1.019E 03	1.692E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1503906	2.287E 01	1.485E 01	1.019E 03	1.697E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1523438	2.296E 01	1.485E 01	1.019E 03	1.702E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1542969	2.304E 01	1.485E 01	1.019E 03	1.706E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1562500	2.312E 01	1.485E 01	1.019E 03	1.711E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1582031	2.320E 01	1.485E 01	1.019E 03	1.716E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1601563	2.328E 01	1.485E 01	1.019E 03	1.721E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1621094	2.336E 01	1.485E 01	1.019E 03	1.726E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.
0.1640625	2.345E 01	1.485E 01	1.019E 03	1.731E 02	7.000E 01	5.469E 02	7.000E 01	0.	0.	0.

REGION 1 CLEARS AT 1.65039063E-01 SECONDS

***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****

0.1660156	2.354E 01	1.485E 01	1.019E 03	1.736E 02	7.000E 01	5.469E 02	7.000E 01	6.030E 03	1.450E 03	1.946E 03

TOP VENTS CLEAR AT 1.65527344E-01 SECONDS

***** REVERSE (UP) FLOW ENCOUNTERED IN WEIR. *****
***** DYNAMIC VENT CLEARING IS DONE. *****

0.1679688	2.359E 01	1.486E 01	1.019E 03	1.740E 02	7.000E 01	5.469E 02	7.000E 01	6.034E 03	1.465E 03	1.971E 03
0.1738281	2.375E 01	1.492E 01	1.019E 03	1.752E 02	7.000E 01	5.469E 02	7.000E 01	5.986E 03	1.510E 03	2.040E 03
0.1894531	2.416E 01	1.508E 01	1.019E 03	1.782E 02	7.001E 01	5.469E 02	7.001E 01	5.911E 03	1.621E 03	2.223E 03
0.2050781	2.456E 01	1.525E 01	1.019E 03	1.810E 02	7.001E 01	5.469E 02	7.001E 01	5.886E 03	1.723E 03	2.405E 03
0.2207031	2.495E 01	1.541E 01	1.019E 03	1.837E 02	7.002E 01	5.469E 02	7.002E 01	5.855E 03	1.823E 03	2.585E 03
0.2363281	2.533E 01	1.557E 01	1.019E 03	1.862E 02	7.002E 01	5.469E 02	7.002E 01	5.821E 03	1.921E 03	2.763E 03
0.2519531	2.571E 01	1.572E 01	1.019E 03	1.885E 02	7.003E 01	5.469E 02	7.003E 01	5.784E 03	2.016E 03	2.939E 03
0.2675781	2.607E 01	1.588E 01	1.019E 03	1.908E 02	7.003E 01	5.469E 02	7.003E 01	5.745E 03	2.110E 03	3.113E 03
0.2832031	2.642E 01	1.604E 01	1.019E 03	1.929E 02	7.004E 01	5.468E 02	7.004E 01	5.703E 03	2.201E 03	3.284E 03
0.2988281	2.676E 01	1.619E 01	1.019E 03	1.949E 02	7.004E 01	5.468E 02	7.004E 01	5.660E 03	2.291E 03	3.453E 03
0.3144531	2.710E 01	1.635E 01	1.019E 03	1.968E 02	7.005E 01	5.468E 02	7.005E 01	5.616E 03	2.378E 03	3.621E 03

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0.3457031	2.775E 01	1.665E 01	1.018E 03	2.004E 02	7.007E 01	5.468E 02	7.007E 01	5.462E 03	2.556E 03	3.943E 03
0.3769531	2.838E 01	1.695E 01	1.018E 03	2.037E 02	7.008E 01	5.468E 02	7.008E 01	5.374E 03	2.719E 03	4.264E 03
0.4082031	2.898E 01	1.725E 01	1.018E 03	2.068E 02	7.010E 01	5.467E 02	7.010E 01	5.284E 03	2.875E 03	4.576E 03
0.4394531	2.956E 01	1.754E 01	1.018E 03	2.096E 02	7.012E 01	5.467E 02	7.012E 01	5.193E 03	3.026E 03	4.881E 03
0.4707031	3.011E 01	1.782E 01	1.017E 03	2.123E 02	7.014E 01	5.467E 02	7.014E 01	5.101E 03	3.171E 03	5.177E 03
0.5019531	3.065E 01	1.810E 01	1.017E 03	2.147E 02	7.015E 01	5.466E 02	7.015E 01	5.010E 03	3.310E 03	5.466E 03
0.5332031	3.117E 01	1.838E 01	1.017E 03	2.170E 02	7.018E 01	5.466E 02	7.018E 01	4.919E 03	3.444E 03	5.748E 03

M3CIPT05 FITZPATRICK RECIRC BREAK SAFE HEM BRK FLOW - PEAK D.W. PRESSURE

TIME	LUMPED DW PRESS, PSIA	CONTAIN. P (vessel) RES. PSIA	VESSEL PRESSURE PSIA	LUMPED DW TEMP F	CONTAIN. TEMP. F	T VESSEL F	TEMP. LIQ. S.P. F	TEMP. F	VENT FLOW AIR LB/S	VENT FLOW VAPOR LB/S	VENT FLOW LIQ LB/S
0.5644531	3.167E 01	1.865E 01	1.016E 03	2.192E 02	7.020E 01	5.465E 02	7.020E 01		4.829E 03	3.573E 03	6.022E 03
0.5957031	3.215E 01	1.891E 01	1.016E 03	2.213E 02	7.022E 01	5.465E 02	7.022E 01		4.740E 03	3.698E 03	6.289E 03
0.6269531	3.262E 01	1.917E 01	1.016E 03	2.232E 02	7.024E 01	5.465E 02	7.024E 01		4.652E 03	3.818E 03	6.549E 03
0.6582031	3.307E 01	1.943E 01	1.015E 03	2.250E 02	7.027E 01	5.464E 02	7.027E 01		4.565E 03	3.934E 03	6.802E 03
0.6894531	3.351E 01	1.968E 01	1.015E 03	2.268E 02	7.029E 01	5.464E 02	7.029E 01		4.480E 03	4.046E 03	7.049E 03
0.7207031	3.393E 01	1.993E 01	1.014E 03	2.284E 02	7.032E 01	5.463E 02	7.032E 01		4.397E 03	4.154E 03	7.290E 03
0.7519531	3.434E 01	2.017E 01	1.014E 03	2.300E 02	7.035E 01	5.463E 02	7.035E 01		4.314E 03	4.258E 03	7.524E 03
0.7832031	3.474E 01	2.041E 01	1.014E 03	2.315E 02	7.037E 01	5.462E 02	7.037E 01		4.234E 03	4.358E 03	7.752E 03
0.8144531	3.512E 01	2.064E 01	1.013E 03	2.330E 02	7.040E 01	5.462E 02	7.040E 01		4.155E 03	4.455E 03	7.975E 03
0.8457031	3.550E 01	2.087E 01	1.013E 03	2.343E 02	7.043E 01	5.462E 02	7.043E 01		4.078E 03	4.549E 03	8.191E 03
0.8769531	3.586E 01	2.109E 01	1.013E 03	2.356E 02	7.046E 01	5.461E 02	7.046E 01		4.002E 03	4.640E 03	8.402E 03
0.9082031	3.621E 01	2.132E 01	1.012E 03	2.369E 02	7.049E 01	5.461E 02	7.049E 01		3.927E 03	4.728E 03	8.608E 03
0.9394531	3.655E 01	2.153E 01	1.012E 03	2.381E 02	7.052E 01	5.460E 02	7.052E 01		3.854E 03	4.812E 03	8.808E 03
0.9707031	3.688E 01	2.175E 01	1.011E 03	2.393E 02	7.055E 01	5.460E 02	7.055E 01		3.783E 03	4.894E 03	9.003E 03
1.0019531	3.720E 01	2.196E 01	1.011E 03	2.404E 02	7.059E 01	5.459E 02	7.059E 01		3.713E 03	4.974E 03	9.192E 03
1.0332031	3.752E 01	2.216E 01	1.011E 03	2.414E 02	7.062E 01	5.459E 02	7.062E 01		3.645E 03	5.050E 03	9.377E 03
1.0957031	3.812E 01	2.257E 01	1.010E 03	2.435E 02	7.070E 01	5.457E 02	7.070E 01		3.477E 03	5.198E 03	9.716E 03
1.1582031	3.869E 01	2.296E 01	1.009E 03	2.453E 02	7.077E 01	5.456E 02	7.077E 01		3.354E 03	5.335E 03	1.006E 04
1.2207031	3.922E 01	2.333E 01	1.008E 03	2.471E 02	7.084E 01	5.455E 02	7.084E 01		3.235E 03	5.463E 03	1.038E 04
1.2832031	3.972E 01	2.370E 01	1.007E 03	2.487E 02	7.091E 01	5.455E 02	7.091E 01		3.121E 03	5.583E 03	1.068E 04
1.3457031	4.020E 01	2.405E 01	1.006E 03	2.502E 02	7.099E 01	5.454E 02	7.099E 01		3.011E 03	5.695E 03	1.097E 04
1.4082031	4.064E 01	2.439E 01	1.006E 03	2.516E 02	7.107E 01	5.453E 02	7.107E 01		2.906E 03	5.799E 03	1.124E 04
1.4707031	4.106E 01	2.471E 01	1.005E 03	2.529E 02	7.115E 01	5.452E 02	7.115E 01		2.805E 03	5.897E 03	1.150E 04
1.5332031	4.146E 01	2.503E 01	1.004E 03	2.541E 02	7.123E 01	5.451E 02	7.123E 01		2.708E 03	5.988E 03	1.174E 04
1.5957031	4.183E 01	2.534E 01	1.004E 03	2.553E 02	7.131E 01	5.450E 02	7.131E 01		2.614E 03	6.072E 03	1.197E 04
1.6582031	4.218E 01	2.563E 01	1.003E 03	2.564E 02	7.140E 01	5.450E 02	7.140E 01		2.524E 03	6.150E 03	1.218E 04
1.7207031	4.250E 01	2.592E 01	1.003E 03	2.574E 02	7.148E 01	5.449E 02	7.148E 01		2.438E 03	6.223E 03	1.238E 04
1.7832031	4.281E 01	2.620E 01	1.002E 03	2.583E 02	7.157E 01	5.448E 02	7.157E 01		2.355E 03	6.291E 03	1.257E 04
1.8457031	4.309E 01	2.647E 01	1.001E 03	2.592E 02	7.166E 01	5.448E 02	7.166E 01		2.275E 03	6.353E 03	1.274E 04
1.9082031	4.336E 01	2.673E 01	1.001E 03	2.601E 02	7.175E 01	5.447E 02	7.175E 01		2.198E 03	6.410E 03	1.291E 04
1.9707031	4.361E 01	2.698E 01	1.000E 03	2.609E 02	7.184E 01	5.446E 02	7.184E 01		2.124E 03	6.463E 03	1.306E 04
2.0332031	4.384E 01	2.723E 01	1.000E 03	2.616E 02	7.193E 01	5.446E 02	7.193E 01		2.052E 03	6.511E 03	1.320E 04
2.0957031	4.406E 01	2.747E 01	9.996E 02	2.623E 02	7.202E 01	5.445E 02	7.202E 01		1.984E 03	6.555E 03	1.334E 04
2.1582031	4.426E 01	2.770E 01	9.992E 02	2.630E 02	7.211E 01	5.445E 02	7.211E 01		1.918E 03	6.595E 03	1.346E 04
2.2207031	4.444E 01	2.792E 01	9.988E 02	2.636E 02	7.221E 01	5.444E 02	7.221E 01		1.854E 03	6.631E 03	1.357E 04
2.2832031	4.461E 01	2.813E 01	9.985E 02	2.641E 02	7.230E 01	5.444E 02	7.230E 01		1.792E 03	6.663E 03	1.367E 04
2.3457031	4.477E 01	2.834E 01	9.982E 02	2.647E 02	7.239E 01	5.444E 02	7.239E 01		1.733E 03	6.692E 03	1.376E 04
2.4082031	4.491E 01	2.855E 01	9.980E 02	2.652E 02	7.249E 01	5.443E 02	7.249E 01		1.676E 03	6.717E 03	1.385E 04
2.5019531	4.511E 01	2.884E 01	9.976E 02	2.659E 02	7.266E 01	5.443E 02	7.266E 01		1.578E 03	6.751E 03	1.395E 04
2.6269531	4.536E 01	2.922E 01	9.974E 02	2.668E 02	7.285E 01	5.443E 02	7.285E 01		1.477E 03	6.791E 03	1.409E 04
2.7519531	4.562E 01	2.958E 01	9.973E 02	2.677E 02	7.304E 01	5.443E 02	7.304E 01		1.384E 03	6.830E 03	1.423E 04
2.8769531	4.586E 01	2.991E 01	9.974E 02	2.685E 02	7.324E 01	5.443E 02	7.324E 01		1.299E 03	6.867E 03	1.436E 04
3.0019531	4.610E 01	3.023E 01	9.976E 02	2.692E 02	7.343E 01	5.443E 02	7.343E 01		1.219E 03	6.903E 03	1.449E 04
3.1269531	4.633E 01	3.053E 01	9.980E 02	2.699E 02	7.363E 01	5.443E 02	7.363E 01		1.146E 03	6.937E 03	1.461E 04
3.2519531	4.655E 01	3.081E 01	9.986E 02	2.706E 02	7.383E 01	5.444E 02	7.383E 01		1.077E 03	6.970E 03	1.472E 04
3.3769531	4.676E 01	3.108E 01	9.993E 02	2.712E 02	7.403E 01	5.445E 02	7.403E 01		1.013E 03	7.001E 03	1.483E 04
3.5019531	4.696E 01	3.133E 01	1.000E 03	2.718E 02	7.423E 01	5.446E 02	7.423E 01		9.539E 02	7.031E 03	1.494E 04
3.6269531	4.715E 01	3.157E 01	1.001E 03	2.724E 02	7.443E 01	5.447E 02	7.443E 01		8.984E 02	7.058E 03	1.503E 04
3.7519531	4.734E 01	3.180E 01	1.002E 03	2.729E 02	7.464E 01	5.449E 02	7.464E 01		8.465E 02	7.084E 03	1.513E 04
3.8769531	4.751E 01	3.202E 01	1.003E 03	2.734E 02	7.484E 01	5.450E 02	7.484E 01		7.980E 02	7.108E 03	1.522E 04
4.0019531	4.768E 01	3.223E 01	1.004E 03	2.739E 02	7.505E 01	5.451E 02	7.505E 01		7.526E 02	7.130E 03	1.530E 04
4.1269531	4.784E 01	3.242E 01	1.005E 03	2.743E 02	7.525E 01	5.452E 02	7.525E 01		7.100E 02	7.151E 03	1.537E 04
4.3769531	4.813E 01	3.281E 01	1.006E 03	2.751E 02	7.571E 01	5.456E 02	7.571E 01		6.211E 02	7.182E 03	1.549E 04

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M3CIPT05 FITZPATRICK RECIRC BREAK SAFE HEM BRK FLOW - PEAK D.W. PRESSURE

TIME	LUMPED DW PRESS,PSIA	CONTAIN. P RES. PSIA	VESSEL PRE SSURE PSIA	LUMPED DW TEMP F	CONTAIN. T EMP. F	TEMP. LIQ. VESSEL F	S.P. TEMP. F	VENT FLOW AIR LB/S	VENT FLOW VAPOR LB/S	VENT FLOW LIQ LB/S
4.6269531	4.838E 01	3.315E 01	1.010E 03	2.758E 02	7.813E 01	5.458E 02	7.813E 01	5.545E 02	7.209E 03	1.561E 04
4.8769531	4.85GE 01	3.347E 01	1.013E 03	2.784E 02	7.654E 01	5.461E 02	7.654E 01	4.954E 02	7.221E 03	1.568E 04
5.1269531	4.869E 01	3.376E 01	1.015E 03	2.769E 02	7.696E 01	5.464E 02	7.696E 01	4.426E 02	7.218E 03	1.571E 04
5.3769531	4.877E 01	3.402E 01	1.018E 03	2.772E 02	7.738E 01	5.467E 02	7.738E 01	3.956E 02	7.204E 03	1.570E 04
5.6269531	4.880E 01	3.427E 01	1.020E 03	2.775E 02	7.779E 01	5.470E 02	7.779E 01	3.538E 02	7.179E 03	1.566E 04
5.8769531	4.880E 01	3.449E 01	1.023E 03	2.777E 02	7.821E 01	5.473E 02	7.821E 01	3.165E 02	7.144E 03	1.559E 04
6.1269531	4.876E 01	3.470E 01	1.026E 03	2.778E 02	7.862E 01	5.477E 02	7.862E 01	2.833E 02	7.102E 03	1.550E 04
6.3769531	4.870E 01	3.489E 01	1.028E 03	2.779E 02	7.903E 01	5.480E 02	7.903E 01	2.537E 02	7.052E 03	1.538E 04
6.6269531	4.861E 01	3.507E 01	1.031E 03	2.779E 02	7.943E 01	5.483E 02	7.943E 01	2.273E 02	6.995E 03	1.525E 04
6.8769531	4.851E 01	3.524E 01	1.034E 03	2.779E 02	7.983E 01	5.486E 02	7.983E 01	2.037E 02	6.933E 03	1.509E 04
7.1269531	4.843E 01	3.540E 01	1.037E 03	2.779E 02	8.023E 01	5.490E 02	8.023E 01	1.827E 02	6.876E 03	1.495E 04
7.3769531	4.840E 01	3.554E 01	1.039E 03	2.780E 02	8.062E 01	5.493E 02	8.062E 01	1.643E 02	6.833E 03	1.485E 04
7.6269531	4.840E 01	3.568E 01	1.042E 03	2.781E 02	8.101E 01	5.496E 02	8.101E 01	1.479E 02	6.801E 03	1.477E 04
8.1269531	4.845E 01	3.596E 01	1.049E 03	2.783E 02	8.188E 01	5.504E 02	8.188E 01	1.168E 02	6.750E 03	1.465E 04
8.6269531	4.855E 01	3.619E 01	1.055E 03	2.786E 02	8.264E 01	5.511E 02	8.264E 01	9.558E 01	6.726E 03	1.459E 04
9.1269531	4.867E 01	3.641E 01	1.061E 03	2.788E 02	8.340E 01	5.519E 02	8.340E 01	7.846E 01	6.714E 03	1.457E 04
9.6269531	4.880E 01	3.661E 01	1.068E 03	2.791E 02	8.415E 01	5.526E 02	8.415E 01	6.453E 01	6.704E 03	1.456E 04
10.376953	4.897E 01	3.692E 01	1.079E 03	2.794E 02	8.547E 01	5.539E 02	8.547E 01	4.450E 01	6.671E 03	1.451E 04
11.376953	4.925E 01	3.727E 01	1.092E 03	2.799E 02	8.696E 01	5.553E 02	8.696E 01	3.084E 01	6.663E 03	1.453E 04
11.626953	4.929E 01	3.730E 01	1.092E 03	2.799E 02	8.706E 01	5.554E 02	8.706E 01	3.078E 01	6.688E 03	1.462E 04
11.876953	4.931E 01	3.738E 01	1.095E 03	2.800E 02	8.743E 01	5.557E 02	8.743E 01	2.796E 01	6.669E 03	1.458E 04
12.126953	4.931E 01	3.746E 01	1.097E 03	2.800E 02	8.780E 01	5.560E 02	8.780E 01	2.542E 01	6.651E 03	1.451E 04
12.376953	4.929E 01	3.753E 01	1.099E 03	2.800E 02	8.817E 01	5.562E 02	8.817E 01	2.311E 01	6.632E 03	1.441E 04
12.626953	4.925E 01	3.761E 01	1.100E 03	2.799E 02	8.854E 01	5.563E 02	8.854E 01	2.101E 01	6.609E 03	1.428E 04
12.876953	4.919E 01	3.768E 01	1.101E 03	2.799E 02	8.890E 01	5.564E 02	8.890E 01	1.910E 01	6.582E 03	1.411E 04
13.001953	4.916E 01	3.771E 01	1.101E 03	2.798E 02	8.904E 01	5.563E 02	8.904E 01	1.845E 01	6.575E 03	1.399E 04
13.126953	4.914E 01	3.774E 01	1.099E 03	2.798E 02	8.922E 01	5.561E 02	8.922E 01	1.764E 01	6.569E 03	1.384E 04
13.251953	4.907E 01	3.778E 01	1.096E 03	2.797E 02	8.940E 01	5.559E 02	8.940E 01	1.688E 01	6.567E 03	1.364E 04
13.376953	4.898E 01	3.781E 01	1.093E 03	2.796E 02	8.957E 01	5.555E 02	8.957E 01	1.613E 01	6.555E 03	1.338E 04
13.501953	4.890E 01	3.785E 01	1.090E 03	2.795E 02	8.975E 01	5.551E 02	8.975E 01	1.543E 01	6.553E 03	1.311E 04
13.626953	4.883E 01	3.788E 01	1.085E 03	2.794E 02	8.993E 01	5.546E 02	8.993E 01	1.477E 01	6.560E 03	1.283E 04
13.751953	4.874E 01	3.792E 01	1.081E 03	2.793E 02	9.010E 01	5.541E 02	9.010E 01	1.412E 01	6.572E 03	1.255E 04
13.876953	4.864E 01	3.795E 01	1.077E 03	2.792E 02	9.028E 01	5.537E 02	9.028E 01	1.349E 01	6.574E 03	1.228E 04
14.001953	4.853E 01	3.798E 01	1.073E 03	2.791E 02	9.045E 01	5.532E 02	9.045E 01	1.286E 01	6.566E 03	1.202E 04
14.126953	4.841E 01	3.802E 01	1.070E 03	2.789E 02	9.062E 01	5.528E 02	9.062E 01	1.225E 01	6.548E 03	1.177E 04
14.251953	4.828E 01	3.805E 01	1.066E 03	2.787E 02	9.079E 01	5.524E 02	9.079E 01	1.166E 01	6.521E 03	1.153E 04
14.376953	4.814E 01	3.808E 01	1.063E 03	2.786E 02	9.096E 01	5.521E 02	9.096E 01	1.108E 01	6.484E 03	1.131E 04
14.501953	4.799E 01	3.811E 01	1.061E 03	2.784E 02	9.113E 01	5.518E 02	9.113E 01	1.052E 01	6.439E 03	1.110E 04
14.626953	4.784E 01	3.814E 01	1.058E 03	2.782E 02	9.130E 01	5.515E 02	9.130E 01	9.977E 00	6.385E 03	1.090E 04
14.751953	4.768E 01	3.817E 01	1.056E 03	2.780E 02	9.146E 01	5.513E 02	9.146E 01	9.453E 00	6.323E 03	1.071E 04
14.876953	4.752E 01	3.820E 01	1.055E 03	2.778E 02	9.162E 01	5.511E 02	9.162E 01	8.950E 00	6.252E 03	1.054E 04
15.001953	4.738E 01	3.823E 01	1.053E 03	2.776E 02	9.178E 01	5.509E 02	9.178E 01	8.476E 00	6.179E 03	1.037E 04
15.189453	4.721E 01	3.828E 01	1.049E 03	2.774E 02	9.206E 01	5.505E 02	9.206E 01	7.768E 00	6.096E 03	1.019E 04
15.439453	4.704E 01	3.834E 01	1.045E 03	2.771E 02	9.237E 01	5.500E 02	9.237E 01	7.017E 00	5.994E 03	9.925E 03
15.689453	4.692E 01	3.840E 01	1.040E 03	2.770E 02	9.267E 01	5.494E 02	9.267E 01	6.368E 00	5.925E 03	9.703E 03
15.939453	4.685E 01	3.845E 01	1.035E 03	2.769E 02	9.297E 01	5.487E 02	9.297E 01	5.800E 00	5.877E 03	9.508E 03
16.189453	4.678E 01	3.850E 01	1.029E 03	2.768E 02	9.327E 01	5.480E 02	9.327E 01	5.295E 00	5.842E 03	9.328E 03
16.439453	4.673E 01	3.856E 01	1.022E 03	2.767E 02	9.356E 01	5.473E 02	9.356E 01	4.841E 00	5.814E 03	9.152E 03
16.689453	4.668E 01	3.861E 01	1.016E 03	2.787E 02	9.385E 01	5.465E 02	9.385E 01	4.428E 00	5.788E 03	8.975E 03
16.939453	4.662E 01	3.866E 01	1.008E 03	2.766E 02	9.414E 01	5.456E 02	9.414E 01	4.051E 00	5.763E 03	8.795E 03
17.189453	4.656E 01	3.871E 01	1.001E 03	2.765E 02	9.443E 01	5.446E 02	9.443E 01	3.706E 00	5.736E 03	8.609E 03
17.439453	4.650E 01	3.876E 01	9.923E 02	2.764E 02	9.471E 01	5.436E 02	9.471E 01	3.391E 00	5.706E 03	8.418E 03
17.689453	4.637E 01	3.881E 01	9.837E 02	2.763E 02	9.499E 01	5.426E 02	9.499E 01	3.102E 00	5.672E 03	8.221E 03

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BETTIS

PRICE SHEET NO. 1-7320-SR

EFFECTIVE MARCH, 1970

ATTACHMENT #1
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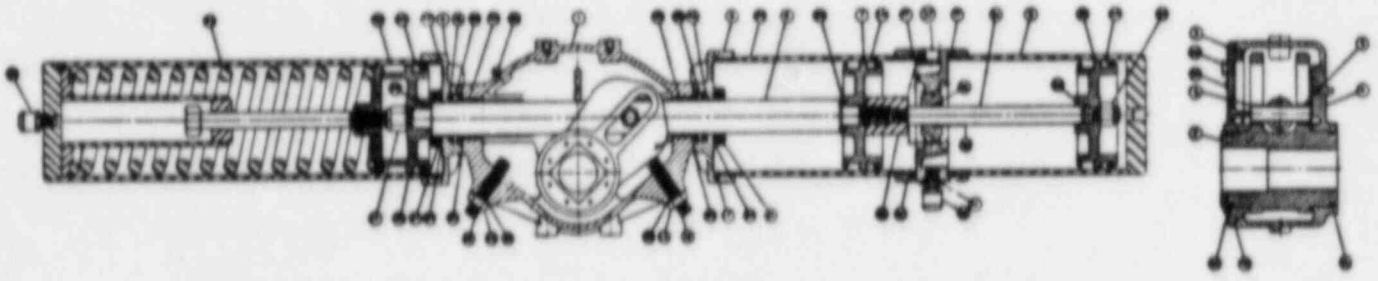
ALWAYS FURNISH SERIAL NUMBER OF ACTUATOR WHEN ORDERING PARTS

ROBOTARM® VALVE ACTUATOR PARTS

LIST PRICES
MODEL 733B-SR



MODEL 733B-SR

ITEM NO	PART NO	DESCRIPTION	MATERIAL	MATERIAL SPEC	QUAN	SPARE PARTS	PRICE EACH
1	211328	HOUSING	DUCTILE IRON	ASTM-A445-65T GRADE 60-45-15	1		$109.00
2	211329	YOKE	DUCTILE IRON	ASTM-A536-65T GRADE 65-45-12	1		62.00
3	211330	HOUSING COVER	DUCTILE IRON	ASTM-A536-65T GRADE 65-45-12	1		26.00
4	211331	YOKE PIN	STEEL	CYRESS PROOF	1		8.60
5	211415	YOKE PIN ROLLER	STEEL	CYRESS PROOF	2		5.00
6	211332	PISTON ROD	STEEL	CYRESS PROOF	1		54.00
7	203740	PISTON	GRAY IRON	ASTM-A126-67T CLASS B	1		33.60
8	202010	CYLINDER ADAPTER	DUCTILE IRON	ASTM-A536-65T GRADE 60-45-15	2		46.00
9	211333	CYLINDER	STEEL	TUBING AISI 1018 PLATE ASTM-A7	1		88.00
10	203037	PISTON ROD GUIDE BUSHING	BRONZE	ASTM-B143-52 GRADE 2B-10-2	2		12.60
11	203115	PISTON RETAINER NUT	STEEL & NYLON	ASTM-A194-65 GRADE 2	1		5.00
12	211335	STOP ADJUSTING SCREW	STEEL	416 STN Rc	2		3.80
13	211336	ADJUSTING SCREW JAM NUT	STEEL	ASTM-A194-65 GRADE 1	2		4.00
14	203037	PISTON SEAL	BUNA-N	DURO 70A	2	2	3.00
15	203226	YOKE SEAL	BUNA-N	DURO 70A	2	2	2.00
* 16	210878	PISTON ROD SEAL	BUNA-N	DURO 95A	2	2	10.00
17	203183	CYLINDER SEAL	BUNA-N	DURO 70A	2	2	2.60
18	211337	HOUSING COVER GASKET	COMPRESSED ASBESTOS	ASTM-D1170	1	1	2.00
19	204866	HOUSING COVER SCREW	STEEL	ASTM-A307-65 GRADE A	4		1.00
20	209025	CYLINDER ADAPTER GASKET	COMPRESSED ASBESTOS	ASTM-D1170	2	2	1.00
21	202690	CYLINDER ADAPTER SCREW	STEEL	303/12 Rc	8		1.00
22	204852	OIL FILL & DRAIN PLUG	STEEL	COMMERCIAL	2		1.00
23	203227	CYLINDER ADAPTER PLUG	STEEL	COMMERCIAL	4		1.00
24	205047	ADAPTER SCREW LOCK WASHER	STEEL	COMMERCIAL	8		.80
25	211337	ADJUSTING SCREW SEAL	NYLON	NYTEL 101	2	2	.60
26	203226	PISTON HEAD SEAL	BUNA-N	DURO 70A	2	2	1.00
27	203224	SERIAL NUMBER TAG	ALUMINUM		2		N.C.
28	210879	PISTON ROD AND EXTRUSION SEAL	POLYURETHANE*	CUP DURO 90A, O RING DURO 70A	2 SETS	2 SETS	SEE ITEM 16
29	209209	INNER CYLINDER	STEEL	AISI-1018	1		80.00
30	211338	OUTER BODY	DUCTILE IRON	ASTM-A536-65T GRADE 60-45-10	1		82.00
31	211339	OUTER PISTON ROD	STEEL	CYRESS PROOF	1		16.00
32	212338	PISTON ROD ADAPTER	STEEL	GRADE B-1112	1		13.50
33	202436	OUTER PISTON	GRAY IRON	ASTM-A126 CLASS B	1		27.00
34	205035	OUTER PISTON RETAINER NUT	STEEL & NYLON	ASTM-A194 GRADE 2	1		5.50
** 35	210878	OUTER ROD SEAL	BUNA-N	DURO 70A	1	1	6.00
36	203183	OUTER PISTON HEAD SEAL	BUNA-N	DURO 70A	1	1	.50
37	211340	OUTER BODY PORT PLUG	STEEL	COMMERCIAL	2		.80
38	211341	OUTER ROD SEAL BACK-UP RING	NYLON	ENG. GRADED NYLON	2	2	SEE ITEM 35
39	211342	AIR BREATHER & BODY PLUG	ALUMINUM & BUNA-N	ASTM-B211-61A GRADE 6061-T6	1		5.00
40	209209	SPRING PISTON	GRAY IRON	ASTM-A126 CLASS B			44.50
41	211340	OUTER BODY BREATHER BUSHING	STEEL	COMMERCIAL			3.00
42		SPRING CYLINDER	STEEL	TUBING AISI 1018 END CAP ASTM-A7			ON APPL
43		SPRING ASSEMBLY	STEEL & DUCTILE IRON				ON APPL

★ INCLUDES ITEM 28
★★ INCLUDES ITEM 36

ATTACHMENT #1
PAGE 18

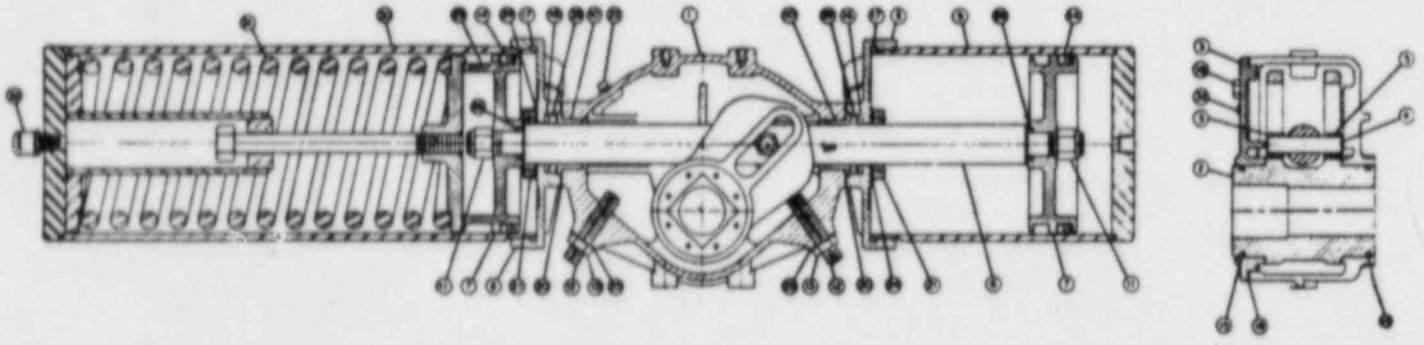
PRICE SHEET NO. 1-7320-SR
EFFECTIVE MARCH, 1970

ALWAYS FURNISH SERIAL NUMBER OF ACTUATOR WHEN ORDERING PARTS

ROBOTARM® VALVE ACTUATOR PARTS

LIST PRICES
MODEL 732B-SR

7a" C"
VT - 3"



MODEL 732B-SR

ITEM NO	PART NO	DESCRIPTION	MATERIAL	MATERIAL SPEC.	QUAN	SPARE PARTS	PRICE EACH
1	211328	HOUSING	DUCTILE IRON	ASTM-A445-63T GRADE 60-45-15	1		$103.00
2	211329	YOKE	DUCTILE IRON	ASTM-A536-65T GRADE 65-45-12	1		62.00
3	211330	HOUSING COVER	DUCTILE IRON	ASTM-A536-65T GRADE 65-45-12	1		78.00
4	211331	YOKE PIN	STEEL	STRESSPROOF	1		6.40
5	211415	YOKE PIN ROLLER	STEEL	STRESSPROOF	2		5.00
6	211332	PISTON ROD	STEEL	STRESSPROOF	1		54.00
7	203780	PISTON	GRAY IRON	ASTM-A126-61T CLASS B	1		33.80
8	202062	CYLINDER ADAPTER	DUCTILE IRON	ASTM-A536-65T GRADE 60-45-15	2		46.00
9	211333	CYLINDER	STEEL	TUBING AISI 1018/PLATE ASTM A7	1		58.00
10	209096	PISTON ROD GUIDE BUSHING	BRONZE	ASTM-B143-52 GRADE 88-10-2	2		12.40
11	208388	PISTON RETAINER NUT	STEEL-A NYLON	ASTM-A194-65 GRADE 2	2		6.00
12	211336	STOP ADJUSTING SCREW	STEEL	45/53 Rc	2		5.50
13	211337	ADJUSTING SCREW JAM NUT	STEEL	ASTM-A194-65 GRADE 1	2		4.00
14	208387	PISTON SEAL	BUNA-N	DURO 70A	2	2	5.00
15	205744	YOKE SEAL	BUNA-N	DURO 70A	2	2	2.00
☆ 16	210828	PISTON ROD SEAL	BUNA-N	DURO 65A	2	2	10.00
17	208383	CYLINDER SEAL	BUNA-N	DURO 70A	2	2	2.80
18	211334	HOUSING COVER GASKET	COMPRESSED ASBESTOS	ASTM-D1170	1	1	2.00
19	204684	HOUSING COVER SCREW	STEEL	ASTM-A307-65 GRADE A	4		1.00
20	209094	CYLINDER ADAPTER GASKET	COMPRESSED ASBESTOS	ASTM-D1170	2	2	1.00
21	204670	CYLINDER ADAPTER SCREW	STEEL	38/42 Rc	8		1.00
22	204633	OIL FILL & DRAIN PLUG	STEEL	COMMERCIAL	1		1.00
23	203727	CYLINDER ADAPTER PLUG	STEEL	COMMERCIAL	4		1.00
24	209017	ADAPTER SCREW LOCK WASHER	STEEL	COMMERCIAL	8		.60
25	211337	ADJUSTING SCREW SEAL	NYLON	ZYTEL® 101	2	2	.80
26	205716	PISTON HEAD SEAL	BUNA-N	DURO 70A	2	2	1.00
27	203294	SERIAL NUMBER TAG	ALUMINUM				N.C.
28	210921	PISTON ROD ANTI-EXTRUSION SEAL	MOLYTHANE®	CUP DURO 90A, O'RING DURO 70A	2 SETS	2 SETS	SEE ITEM 16
29	209267	SPRING PISTON	GRAY IRON	ASTM-A126-61T GRADE B	1		44.50
30		SPRING CYLINDER	STEEL	TUBING AISI 1018/PLATE ASTM A7	1		ON APPL.
31		SPRING ASSEMBLY	STEEL & DUCTILE IRON		1		ON APPL.
32	211523	AIR BREATHER & BODY PLUG	ALUMINUM & BUNA-N	ASTM-B145-4A GRADE 88-5-5	3		8.00

☆ INCLUDES ITEM 28

ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE

PRINTED IN U.S.A.

ATTACHMENT # 1
PAGE 19

SALES HANDBOOK

FISHER Controls

CONTINENTAL DIVISION

CFG 40B-10
PAGE 1
JANUARY 1973

BFV TORQUE DETERMINATION

Objective

The determining factor in accurately selecting the most economical actuator for a butterfly valve is the torque required to open and close the valve. The following is a quick and easy method of determining actuator torque required in both the open and the closed position of a butterfly valve.

It should be noted at this point that before valve torque is determined, the user should consult CFG 20D-20 to ensure that the pressure drop limitations are not exceeded for the specific valve construction in consideration.

Introduction

Butterfly valve torque is actually the sum of a number of torque components. To avoid confusion, a number of these have been combined and a number of calculations have been performed in advance. Thus, each valve type can be represented with the same simple, practical formula shown below. The various torque components and the process of simplification are explained fully in the appendix (See Page 23).

$$\text{TOTAL TORQUE (IN-LBS)} = A\,(\Delta P_{act\text{-}\alpha^\circ}) + B + C\begin{pmatrix}\Delta P_{act\text{-}\alpha^\circ} \\ \text{or} \\ \Delta P_{eff\text{-}\alpha^\circ}\end{pmatrix}\begin{matrix}\text{whichever} \\ \text{is} \\ \text{smaller}\end{matrix}$$

where: A, B, C = Tabulated coefficients
$\Delta P_{act\text{-}\alpha^\circ}$ = Actual pressure drop at angle α°
$\Delta P_{eff\text{-}\alpha^\circ}$ = Effective pressure drop at angle α°

Procedure

1. From the above table, determine the effective pressure drop, $\Delta P_{eff\text{-}\alpha^\circ}$*, at the desired maximum angle of opening.

2. Turn to the table for the valve type, class and disc type in consideration.

3. From the table, choose values for A, B and C according to the characteristics of the valve in the closed position (0°). Write the equation shown using the selected values and perform the simple calculation required. This determines the required actuator torque to move the valve disc away from its seat.

4. Select values for A, B and C again, this time according to the characteristics of the value at the desired maximum open angle (α°). Write the equation shown using the new values and perform the simple calculation required. This determines the required actuator torque (valve torque required) at the desired angle of opening.

5. An actuator may now be selected with either:

a) A constant torque output greater than the larger of the torques determined in 3 and 4.

b) A varying torque output which equals or exceeds both of the determined torques at their respective valve positions.

Refer to CFG 40F-20 for Fisher actuator selection.

* The effective pressure drop term, $\Delta P_{eff\text{-}\alpha^\circ}$, arises due to the flow conditions near the disc. It is a calculated value and will usually vary from the actual pressure drop. It may be described as the pressure drop seen by the disc in the region of flow which affects only the "C" multiplier in the torque formula. Note that, due to its nature, the effective pressure drop is used only at open angles ($\Delta P_{eff\text{-}0^\circ} = \Delta P_{act\text{-}0^\circ}$) and then only when it is less than the actual pressure drop ($\Delta P_{act\text{-}\alpha^\circ}$).

EFFECTIVE PRESSURE DROP

NOTE: P_1 = Upstream pressure (psia) at the indicated angle of opening (α°)

TABLE 1

Type of Disc	Type of Fluid	Angle of Disc Opening								
		0°	10°	20°	30°	40°	50°	60°	70°	80°-90°
Conventional or Offset	Liquid	$\Delta P_{act\text{-}0^\circ}$	$0.570P_1$	$0.730P_1$	$0.600P_1$	$0.690P_1$	$0.550P_1$	$0.450P_1$	$0.390P_1$	$0.350P_1$
	Gas	$\Delta P_{act\text{-}0^\circ}$	$\Delta P_{act\text{-}10^\circ}$	$0.500P_1$	$0.250P_1$	$0.250P_1$	$0.200P_1$	$0.200P_1$	$0.140P_1$	$0.140P_1$
Fishtail	Liquid	$\Delta P_{act\text{-}0^\circ}$	$0.700P_1$	$0.700P_1$	$0.700P_1$	$0.700P_1$	$0.670P_1$	$0.600P_1$	$0.500P_1$	$0.450P_1$
	Gas	$\Delta P_{act\text{-}0^\circ}$	$0.260P_1$	$0.350P_1$	$0.350P_1$	$0.350P_1$	$0.250P_1$	$0.180P_1$	$0.110P_1$	$0.090P_1$

ATTACHMENT #1 PAGE 20

TABLE 3 TYPES 7600 & 7700 CONVENTIONAL DISC – CLASS 2

Body Size In.	A (Select One Bushing Mat'l)					B*		C (Select One Angle)								
	TFE Lined SST	TFE Filled Acetal	Graph. Filled Bronze	Bronze	None, Alloy 6B	Metal Seat	Elastomer Seat	0°	10°	20°	30°	40°	50°	60°	70°	80°-90°
1	0.007	0.012	0.025	0.031	0.049	23.0		0	0.004	0.008	0.013	0.029	0.053	0.100	0.200	0.320
1-1/4	0.011	0.019	0.039	0.048	0.077	23.0		0	0.007	0.013	0.021	0.046	0.082	0.156	0.310	0.500
1-1/2	0.019	0.033	0.067	0.083	0.133	23.0		0	0.010	0.019	0.030	0.066	0.118	0.450	0.450	0.710
2	0.046	0.080	0.160	0.200	0.320	36.0		0	0.030	0.070	0.110	0.230	0.420	0.800	1.60	2.55
2-1/2	0.070	0.123	0.245	0.306	0.490	36.0		0	0.060	0.130	0.210	0.450	0.820	1.66	3.14	4.96
3	0.100	0.175	0.350	0.438	0.700	36.0		0	0.110	0.230	0.370	0.780	1.42	2.70	5.42	8.60
4	0.299	0.400	0.800	1.00	1.60	50.0		0	0.270	0.540	0.870	1.85	3.40	6.40	12.9	20.4
5	0.357	0.625	1.25	1.56	2.50	50.0		0	0.500	1.10	1.70	3.60	6.60	12.5	25.1	39.8
6	0.500	0.875	1.75	2.19	3.50	50.0		0	0.900	1.80	2.90	6.30	11.4	21.5	43.5	69.0
8	1.07	1.88	3.75	4.69	7.50	65.0		0	2.10	4.30	7.00	15.0	27.0	51.0	103	163
10	2.24	3.93	7.85	9.81	15.7	100		0	4.10	8.40	14.0	29.0	53.0	100	201	320
12	3.29	5.75	11.5	14.4	23.0	100		0	7.20	14.0	23.0	50.0	91.0	173	346	548
14	5.14	9.00	18.0	22.5	36.0	140		0	10.3	21.0	33.0	72.0	129	245	495	763
16	6.71	11.8	23.5	29.4	47.0	140		0	15.0	31.0	51.0	108	195	370	750	1160
18	10.3	18.0	36.0	45.0	72.0	184		0	22.0	45.0	73.0	156	282	535	1080	1710
20	12.6	22.0	44.0	55.0	88.0	184		0	32.0	61.0	99.0	210	381	720	1460	2310
24	21.6	37.8	75.5	94.4	151	232		0	53.0	106	173	368	667	1260	2550	4050
30	38.7	67.8	136	169	271	282*		0	105	211	344	734	1330	2520	5090	8050
36	54.9	96.0	192	240	384	282		0	179	360	585	1250	2260	4280	8600	13,700
42	94.3	165	330	413	660	396		0	287	578	936	2000	3620	6860	13,800	22,000
48	124	217	434	543	868	396		0	433	871	1410	3110	5450	10,300	20,800	33,100
54	189	331	662	828	1320	520		0	620	1250	2020	4320	7820	14,800	29,900	47,400
60	234	410	820	1020	1640	520		0	885	1720	2790	5960	10,800	20,400	41,200	65,400
66	332	581	1160	1450	2320	660		0	1140	2300	3730	8000	14,400	27,400	55,200	87,400
72	396	693	1390	1730	2770	660		0	1490	3000	4860	10,400	18,800	35,600	71,200	114,000
84	619	1080	2170	2710	4330	800		0	2380	4770	7630	16,700	30,000	57,200	114,000	181,000
96	911	1600	3190	3990	6380	800		0	3570	7140	10,400	25,000	45,000	85,700	171,000	272,000

See Page 10, Table 15

$$\text{TOTAL TORQUE (IN-LBS)} = A\,(\Delta P_{act\text{-}\alpha^\circ}) + B + C \begin{pmatrix} \Delta P_{act\text{-}\alpha^\circ} \\ \text{or} \\ \Delta P_{eff\text{-}\alpha^\circ} \end{pmatrix} \begin{matrix} \text{whichever} \\ \text{is} \\ \text{smaller} \end{matrix}$$

TABLE 4 TYPES 7600 & 7700 FISHTAIL–CLASS 2

Body Size In.	A (Select One Bushing Mat'l)					B*		C (Select One Angle)							
	TFE Lined SST	TFE Filled Acetal	Graph. Filled Bronze	Bronze	None, Alloy 6B	Metal Seat	Elastomer Seat	0°	10°	20° 30° 40°	50°	60°	70°	80°-90°
2	0.046	0.080	0.160	0.200	0.320	36.0		0	0.060	0.100	0.210	0.300	0.360	0.430
2-1/2	0.070	0.123	0.245	0.306	0.490	36.0		0	0.120	0.190	0.440	0.660	0.840	1.01
3	0.100	0.175	0.350	0.438	0.700	36.0		0	0.190	0.320	0.760	1.22	1.60	1.92
4	0.299	0.400	0.800	1.00	1.60	50.0		0	0.450	0.770	1.79	3.52	5.26	6.21
5	0.357	0.625	1.25	1.56	2.50	50.0		0	0.880	1.50	3.50	7.25	12.5	15.9
6	0.500	0.875	1.75	2.19	3.50	50.0		0	1.51	2.60	6.05	13.2	27.2	32.4
8	1.07	1.88	3.75	4.69	7.50	65.0		0	3.58	6.14	14.3	30.7	61.5	72.1
10	2.24	3.93	7.85	9.81	15.7	100		0	7.00	12.0	28.0	62.0	132	153
12	3.29	5.75	11.5	14.4	23.0	100		0	12.1	21.0	48.3	108	242	294
14	5.14	9.00	18.0	22.5	36.0	140		0	16.3	29.0	64.8	144	323	392
16	6.71	11.8	23.5	29.4	47.0	140		0	24.7	42.3	99.0	224	515	627
18	10.3	18.0	36.0	45.0	72.0	184		0	34.3	58.8	136	315	720	892
20	12.6	22.0	44.0	55.0	88.0	184		0	48.0	82.0	191	439	1030	1280
24	21.6	37.8	75.5	94.4	151	232		0	85.0	146	340	783	1910	2410
30	38.7	67.8	136	169	271	282		0	171	293	680	1580	3980	5200
36	54.9	96.0	192	240	384	282		0	301	516	1200	2820	7120	9600
42	94.3	165	330	413	660	396		0	484	828	1920	4480	11,500	15,500
48	124	217	434	543	868	396		0	725	1240	2890	6780	18,900	24,200
54	189	331	662	828	1320	520		0	1030	1780	4160	9720	24,800	33,800
60	234	410	820	1020	1640	520		0	1440	2460	5740	13,420	34,800	47,800
66	332	581	1160	1450	2320	660		0	1930	3300	7700	18,000	46,500	63,800
72	396	693	1390	1730	2770	660		0	2500	4290	10,000	23,400	60,800	83,000

See Page 10, Table 15

ATTACHMENT #1 PAGE 21

TABLE 25 TYPE 9200 OFFSET DISC T-RING – CLASS 2

Body Size In.	A (Select One Bushing Mat'l)					B (Select One)		C (Select One Angle)								
	TFE Lined SST	TFE Filled Acetal	Graphite Filled Bronze	Bronze	None, Alloy 6B	0°	10°-90°	0°	10°	20°	30°	40°	50°	60°	70°	80°-90°
4	0.299	0.400	0.800	1.00	1.60	52.2	52.2	0	0.270	0.540	0.870	1.85	3.40	6.40	12.9	20.4
5	0.357	0.625	1.25	1.56	2.50	54.0 •	54.0	0	0.500	1.10	1.70	3.60	6.60	12.5	25.1	39.8
6	0.500	0.875	1.75	2.19	3.50	54.8	54.8	0	0.900	1.80	2.90	6.30	11.4	21.5	43.5	69.0
8	1.07	1.88	3.75	4.69	7.50	76.0	76.0	0	2.10	4.30	7.00	15.0	27.0	51.0	103	163
10	2.24	3.93	7.85	9.81	15.7	116 •	116	0	4.10	8.40	14.0	29.0	53.0	100	201	320
12	3.29	5.75	11.5	14.4	23.0	123	123	0	7.20	14.0	23.0	50.0	91.0	173	346	548
14	5.14	9.00	18.0	22.5	36.0	185	185	0	10.3	21.0	33.0	72.0	129	245	495	763
16	6.71	11.8	23.5	29.4	47.0	198 •	198	0	15.0	31.0	51.0	108	195	370	750	1160
18	10.3	18.0	36.0	45.0	72.0	260	260	0	22.0	45.0	73.0	156	282	535	1080	1710
20	12.6	22.0	44.0	55.0	88.0	316	316	0	32.0	61.0	99.0	210	381	720	1460	2310
24	21.6	37.8	75.5	94.4	151	471 •	471	0	53.0	106	173	368	667	1260	2550	4050
30	38.7	67.8	136	169	271	782	782	0	105	211	344	734	1330	2520	5090	8050
36	54.9	96.0	192	240	384	995	995	0	179	360	585	1250	2260	4280	8600	13,700
42	94.3	165	330	413	660	2040 •	2040	0	287	578	936	2000	3620	6860	13,800	22,000
48	124	217	434	543	868	2200	2200	0	433	871	1410	3110	5450	10,300	20,800	33,100
54	189	331	662	828	1320	2420	2420	0	620	1250	2020	4320	7820	14,800	29,900	47,400
60	234	410	820	1020	1640	4520 •	4520	0	885	1720	2790	5960	10,800	20,400	41,200	65,400
66	332	581	1160	1450	2320	5760	5760	0	1140	2300	3730	8000	14,400	27,400	55,200	87,400
72	396	693	1390	1730	2770	6860	6860	0	1490	3000	4860	10,400	18,800	35,600	71,200	114,000
84	619	1080	2170	2710	4330	9150 •	9150	0	2380	4770	7630	16,700	30,000	57,200	114,000	181,000
96	911	1600	3190	3990	6380	11,400	11,400	0	3570	7140	10,400	25,000	45,000	85,700	171,000	272,000

TOTAL TORQUE (IN-LBS) = $A(\Delta P_{act\text{-}\alpha^\circ}) + B +$ (C or LSC { → ϕ / → ϕ) ($\Delta P_{act\text{-}\alpha^\circ}$ or $\Delta P_{eff\text{-}\alpha^\circ}$ whichever is smaller)

PREFERRED FOR EASIER T RING ADJUSTMENT

TABLE 26 TYPE 9200 OFFSET DISC T-RING – CLASS 3

Body Size In.	A (Select One Bushing Mat'l)					B (Select One)		C (Select One Angle)								
	TFE Lined SST	TFE Filled Acetal	Graphite Filled Bronze	Bronze	None, Alloy 6B	0°	10°-90°	0°	10°	20°	30°	40°	50°	60°	70°	80°-90°
8	1.43	2.49	4.99	6.23	9.98	111	111	0	2.10	4.30	7.00	15.0	27.0	51.0	103	163
10	2.80	4.91	9.81	12.3	19.6	156 •	156	0	4.10	8.40	14.0	29.0	53.0	100	201	320
12	4.11	7.19	14.4	18.0	28.8	163	163	0	7.20	14.0	23.0	50.0	91.0	173	346	548
14	6.17	10.8	21.6	27.0	43.2	229	229	0	10.3	21.0	33.0	72.0	129	245	495	763
16	8.06	14.1	28.2	35.3	56.4	242 •	242	0	15.0	31.0	51.0	108	195	370	750	1160
18	12.0	21.1	42.1	52.7	84.2	308	308	0	22.0	45.0	73.0	156	282	535	1080	1710
20	14.7	25.8	51.5	64.4	103	364	364	0	32.0	61.0	99.0	210	381	720	1460	2310
24	24.6	43.0	86.1	108	172	521 •	521	0	53.0	106	173	368	667	1260	2550	4050
30	48.4	84.7	169	212	339	896	896	0	105	211	344	734	1330	2520	5090	8050
36	68.6	120	240	300	480	1110	1110	0	179	360	585	1250	2260	4280	8600	13,700
42	113	198	396	495	792	2160 •	2160	0	287	578	936	2000	3620	6860	13,800	22,000
48	149	260	521	651	1040	2320	2320	0	433	871	1410	3110	5450	10,300	20,800	33,100
54	221	387	775	969	1550	3560	3560	0	620	1250	2020	4320	7820	14,800	29,900	47,400
60	274	480	959	1200	1920	4660 •	4660	0	885	1720	2790	5960	10,800	20,400	41,200	65,400
66	378	662	1320	1660	2650	5900	5900	0	1140	2300	3730	8000	14,400	27,400	55,200	87,400
72	451	790	1580	1970	3160	7000	7000	0	1490	3000	4860	10,400	18,800	35,600	71,200	114,000
84	699	1220	2450	3060	4890	9310 •	9310	0	2380	4770	7630	16,700	30,000	57,200	114,000	181,000
96	1030	1800	3610	4510	7210	11,600	11,600	0	3570	7140	10,400	25,000	45,000	85,700	171,000	272,000

ATTACHMENT #1, PAGE 22

TABLE 3 TYPES 7600 & 7700 CONVENTIONAL DISC – CLASS 2

Body Size In.	A (Select One Bushing Mat'l)					B*		C (Select One Angle)								
	TFE Lined SST	TFE Filled Acetal	Graph. Filled Bronze	Bronze	None, Alloy 6B	Metal Seat	Elastomer Seat	0°	10°	20°	30°	40°	50°	60°	70°	80°-90°
1	0.007	0.012	0.025	0.031	0.049	23.0	See Page 10, Table 15	0	0.004	0.008	0.013	0.029	0.053	0.100	0.200	0.320
1-1/4	0.011	0.019	0.039	0.048	0.077	23.0		0	0.007	0.013	0.021	0.046	0.082	0.156	0.310	0.500
1-1/2	0.019	0.033	0.067	0.083	0.133	23.0		0	0.010	0.019	0.030	0.066	0.118	0.450	0.450	0.710
2	0.046	0.080	0.160	0.200	0.320	36.0		0	0.030	0.070	0.110	0.230	0.420	0.800	1.60	2.55
2-1/2	0.070	0.123	0.245	0.306	0.490	36.0		0	0.060	0.130	0.210	0.450	0.820	1.56	3.14	4.96
3	0.100	0.175	0.350	0.438	0.700	36.0		0	0.110	0.230	0.370	0.780	1.42	2.70	5.42	8.60
4	0.299	0.400	0.800	1.00	1.60	50.0		0	0.270	0.540	0.870	1.85	3.40	6.40	12.9	20.4
5	0.357	0.625	1.25	1.56	2.50	50.0		0	0.500	1.10	1.70	3.60	6.60	12.5	25.1	39.8
6	0.500	0.875	1.75	2.19	3.50	50.0		0	0.900	1.80	2.90	6.30	11.4	21.5	43.5	69.0
8	1.07	1.88	3.75	4.69	7.50	65.0		0	2.10	4.30	7.00	15.0	27.0	51.0	103	163
10	2.24	3.93	7.85	9.81	15.7	100		0	4.10	8.40	14.0	29.0	53.0	100	201	320
12	3.29	5.75	11.5	14.4	23.0	100		0	7.20	14.0	23.0	50.0	91.0	173	346	548
14	5.14	9.00	18.0	22.5	36.0	140		0	10.3	21.0	33.0	72.0	129	245	495	763
16	6.71	11.8	23.5	29.4	47.0	140		0	15.0	31.0	51.0	108	195	370	750	1160
18	10.3	18.0	36.0	45.0	72.0	184		0	22.0	45.0	73.0	156	282	535	1080	1710
20	12.6	22.0	44.0	55.0	88.0	184		0	32.0	61.0	99.0	210	381	720	1460	2310
24	21.6	37.8	75.5	94.4	151	232		0	53.0	106	173	368	667	1260	2550	4050
30	38.7	67.8	136	169	271	282*		0	105	211	344	734	1330	2520	5090	8050
36	54.9	96.0	192	240	384	282		0	179	360	585	1250	2260	4280	8600	13,700
42	94.3	165	330	413	660	396		0	287	578	936	2000	3620	6860	13,800	22,000
48	124	217	434	543	868	396		0	433	871	1410	3110	5450	10,300	20,800	33,100
54	189	331	662	828	1320	520		0	620	1250	2020	4320	7820	14,800	29,900	47,400
60	234	410	820	1020	1640	520		0	885	1720	2790	5960	10,800	20,400	41,200	65,400
66	332	581	1160	1450	2320	660		0	1140	2300	3730	8000	14,400	27,400	55,200	87,400
72	396	693	1390	1730	2770	660		0	1490	3000	4860	10,400	18,800	35,600	71,200	114,000
84	619	1080	2170	2710	4330	800		0	2380	4770	7630	16,700	30,000	57,200	114,000	181,000
96	911	1600	3190	3990	6380	800		0	3570	7140	10,400	25,000	45,000	85,700	171,000	272,000

$$\text{TOTAL TORQUE (IN-LBS)} = A\,(\Delta P_{act\text{-}\alpha^\circ}) + B + C \begin{pmatrix} \Delta P_{act\text{-}\alpha^\circ} \\ \text{or} \\ \Delta P_{eff\text{-}\alpha^\circ} \end{pmatrix} \begin{matrix} \text{whichever} \\ \text{is} \\ \text{smaller} \end{matrix}$$

TABLE 4 TYPES 7600 & 7700 FISHTAIL–CLASS 2

Body Size In.	A (Select One Bushing Mat'l)					B*		C (Select One Angle)						
	TFE Lined SST	TFE Filled Acetal	Graph. Filled Bronze	Bronze	None, Alloy 6B	Metal Seat	Elastomer Seat	0°	10°	20° 30° 40°	50°	60°	70°	80°-90°
2	0.046	0.080	0.160	0.200	0.320	36.0	See Page 10, Table 15	0	0.060	0.100	0.210	0.300	0.360	0.430
2-1/2	0.070	0.123	0.245	0.306	0.490	36.0		0	0.120	0.190	0.440	0.660	0.840	1.01
3	0.100	0.175	0.350	0.438	0.700	36.0		0	0.190	0.320	0.760	1.22	1.60	1.92
4	0.299	0.400	0.800	1.00	1.60	50.0		0	0.450	0.770	1.79	3.52	5.26	6.21
5	0.357	0.625	1.25	1.56	2.50	50.0		0	0.880	1.50	3.50	7.25	12.5	15.9
6	0.500	0.875	1.75	2.19	3.50	50.0		0	1.51	2.60	6.05	13.2	27.2	32.4
8	1.07	1.88	3.75	4.69	7.50	65.0		0	3.58	6.14	14.3	30.7	61.5	72.1
10	2.24	3.93	7.85	9.81	15.7	100		0	7.00	12.0	28.0	62.0	132	153
12	3.29	5.75	11.5	14.4	23.0	100		0	12.1	21.0	48.3	108	242	294
14	5.14	9.00	18.0	22.5	36.0	140		0	16.3	29.0	64.8	144	323	392
16	6.71	11.8	23.5	29.4	47.0	140		0	24.7	42.3	99.0	224	515	627
18	10.3	18.0	36.0	45.0	72.0	184		0	34.3	58.8	136	315	720	892
20	12.6	22.0	44.0	55.0	88.0	184		0	48.0	82.0	191	438	1030	1280
24	21.6	37.8	75.5	94.4	151	232		0	85.0	146	340	783	1910	2410
30	38.7	67.8	136	169	271	282		0	171	293	680	1580	3980	5200
36	54.9	96.0	192	240	384	282		0	301	516	1200	2820	7120	9600
42	94.3	165	330	413	660	396		0	484	828	1920	4480	11,500	15,500
48	124	217	434	543	868	396		0	725	1240	2890	6780	18,900	24,200
54	189	331	662	828	1320	520		0	1030	1780	4160	9720	24,800	33,800
60	234	410	820	1020	1640	520		0	1440	2460	5740	13,420	34,800	47,800
66	332	581	1160	1450	2320	660		0	1930	3300	7700	18,000	46,500	63,800
72	396	693	1390	1730	2770	660		0	2500	4290	10,000	23,400	60,800	83,000

FISHER CONTROLS COMPANY
CONTINENTAL DIVISION

P-96940-01

Date	Report	Subject to Inspection
3-30-72		X

	Valve Type	Serial No.
2-17961	ODTTB	BF171050

SOLD TO:
Fisher Controls Company
P.O. Box 190
Marshalltown, Iowa 50158

SHIP TO:
Same
Center Street Plant
Receiving Plant
Marshalltown, Iowa

1 3/4" ϕ SHAFT

VIA: Truck - Prepay

VALVE DESCRIPTION

B.M. 171050 Pages 1 thru 4

Quan.	Size	Type	Flange	Class	Body	Seat	Disc
1	24"	9222	150RF	2	SA516 Gr.70	EPT	SA516 Gr.70
			Shaft (3356) 17-4PH	Pins 9357 316 S/S			Studs A193 / Nuts A194

Packing	Stuffing Box	Bushings	Seal System	Schematic No.
2 CRJ	Plain X	#15 (Bronze)	NO	J-10570

BRACKET AND LINKAGE

B.M.

Pipe Run: Horizontal X

Linkage Set: 0 Minimum Degrees — 90° Maximum Degrees

POWER ACTUATOR DESCRIPTION

B.M.

Qty.	Actuator Type
1	BETTIS 733 -SR

Bench Set: 90 to 120 # Pressure to Actuator — AIR; Position, Tel. Open X Close ☐

MANUAL ACTUATOR DESCRIPTION

B.M.

Qty.	Description	Position
1	LIMITORQUE H2BC w/SPUR	#3

VALVE SERVICE

Fluid	Max. Shut Off Pres.	Temp.	Stat. Pres.
AIR	56PSI	350°F.	

Mounting Instructions: X

PRINT INSTRUCTIONS

Cert. Trans.	Prints	Install Oper. & Maint. Inst.	Part List	Priced Parts List	Hold for Approval
1	1	40	40		NO

Special Instructions: ADJ. T-RING FOR INTERFERENCE FIT

Design Δ Po 56 PSI At 350F Max. Casing Pres. PSI CWT

Cust. Item # 1 Tag: 27AOV-114 Act. Serial #

* CHROME-PLATE DISC EDGE.

1D – FURNISH (2) D-2400-X LIMIT SWITCHES (to indicate OPEN & CLOSED POSITION)

1E – FURNISH ASCO 3-WAY SV. #HT-831653 (120V, 60HZ) (ENERGIZE TO OPEN VALVE)

– FURNISH (1SET) SPARE PACKING WITH VALVE.

SUBJECT TO INSPECTION

NUCLEAR

NUCLEAR N STAMP

"ADHERENCE TO NHB-2913 REQUIRED"

RT/CE

P-76940-01

FISHER CONTROLS COMPANY
CONTINENTAL DIVISION

SHOP ORDER P-96940-05

DATE 3-30-72

ORDER NO. 2-17961 | ODTTR | SERIAL NO. BF 171054

SOLD TO:
Fisher Controls Company
P.O. Box 190
Marshalltown, Iowa 50158

ATTACHMENT #1 PAGE # 24

SHIP TO:
Same
Center Street Plant
Receiving Plant
Marshalltown, Iowa

VIA: Truck - Prepay

VALVE DESCRIPTION — B.M. 171054 Page 1 thru 4

QUAN.	SIZE	TYPE	FLANGE	CLASS	BODY	SEAT	DISC
1	20"	9222	150RF	2	SA516 Gr.70	EPT	SA516 Gr.70
			SHAFT 17-4PH		PINS 3557 316 S/S		A193 STUD / A194 NUT

PACKING: 2 CRJ

BUSHING: #5 (Bushing) — SEAL SYSTEM: No — J-10570

BRACKET AND LINKAGE — LINKAGE SET: 0 minimum degrees / 90° maximum degrees

POWER ACTUATOR DESCRIPTION

QTY. 1 — ACTUATOR TYPE: Bettis 732-SR — 90 to 120 # pressure to actuator — AIR pressure to open

MANUAL ACTUATOR DESCRIPTION

QTY. 1 — Limitorque HBC w/spur — #3

VALVE SERVICE

FLUID	MAX. SHUT OFF PRES.	TEMP.
Air N2 H2O	56 PSI	350°F

PRINT INSTRUCTIONS: 1 | 1 | INSTALL OPER & MAINT. INST. 40 | PART LIST 40 | NO HOLD FOR APPROVAL

SPECIAL INSTRUCTIONS: ADJ. T-RING FOR INTERFERENCE FIT

Design Δ Po 56 PSI At 350°F Max. Casing Pres. PST CWT

Cust. Item # 5 Tag: 27AOV-115 Act. Serial #

* - CHROME-PLATE DISC EDGE.

10 - FURNISH (2) D-2400X LIMIT SWITCH (TO INDICATE OPEN & CLOSE POSIT.)

1E - FURNISH ASCO 3-WAY SOL. # HT 831655 (120V, 60 HZ) (ENERGIZE TO OPEN VALVE)

- FURNISH (1 SET) SPARE PACKING WITH VALVE

NUCLEAR

SUBJECT TO INSPECTION

ADHERENCE TO NHS-29 IS REQUIRED — NUCLEAR - "N" STAMP

RT/cs

P-96940-05

Manufacturer's Data: Air Operated Containment Butterfly Valves

Spec. No. JPS-70

Cont. Co. APC-70

Client: Power Authority of the State of New York

S.O. No. 11225

Project: James A. FitzPatrick Nuclear Power Plant

By ARM Date 1/15/71

DATA COMPLETED BY SELLER

Item No.	1	2	3
Operator Mark No.	27AOV-114	27AOV-113	27AOV-111
Valve Mark No.	VVF-7ERS	VVF-7ERS	VVF-7ERS
Quantity	1	1	1
Manufacturer	Fisher	Fisher	Fisher
Manufacturer's model No.	9222	9222	9222
Valve type	Butterfly Valve	Butterfly Valve	Butterfly Valve
Min valve ID, in.	23 3/4"	23 3/4"	23 3/4"
Min body thickness	2 3/16"	2 3/16"	2 3/16"
Min shaft diam, ID	1 3/4"	1 3/4"	1 3/4"
Size length along pipe, in.	FF = 5 1/2"	FF = 5 1/2"	FF = 5 1/2"
Max distance from C.L., in.			
Pressure drop, in. water @ max flow			
Shaft bearing lubrication	None	None	None
Shaft adjustment (yes or no)			
Packing gland (bolted preferred)	Bolted	Bolted	Bolted
Packing shape (Chevron preferred)	Braid	Braid	Braid
Materials			
Valve body, steel - ASTM	A516 Gr 70	A516 Gr 70	A516 Gr 70
Shaft, 18-8 St. St. - ASTM	17-4 PH	17-4 PH	17-4 PH
Disc, Stl. - ASTM	A515 Gr 70	A515 Gr 70	A515 Gr 70
Seating surfaces	EPT/CH. Plate	EPT/CH. Plate	EPT/CH. Plate
Seat retainer, 18-8 St. Stl. - ASTM	A516 Gr 70	A516 Gr 70	A516 Gr 70
Seat retainer fastening	Alloy Steel	Alloy Steel	Alloy Steel
Shaft bearing	Bronze	Bronze	Bronze
Shaft packing and seals	Crane 2CR5	Crane 2CR5	Crane 2CR5
Tapered pins and keys	17-4PH/Steel	17-4PH/Steel	17-4PH/Steel
Manual operator, mfr. and model	Phil Gear HB2S	Phil Gear HB2S	Phil Gear HB2S
Operating gear ratio	220:1	220:1	220:1
Handwheel diam, in.	18"	18"	18"
Torque to operate valve manually at max unbal. pressure, ft-lb	1000 ft-lb	1000 ft-lb	1000 ft-lb
Orientation of handwheel operator	Shaft mounted on end opposite actuator		
Pneumatic operator, mfr. and model	Bettis 733C-SR90	Bettis 733C-SR90	Bettis 733C-SR90
Pneumatic operator type	Spring Return	Spring Return	Spring Return
Min air pressure required	90 psi	90 psi	90 psi
3-way solenoid valve, mfr. and model	X	X	X
Position indicator switches, mfr. and model No.	Namiac Acme D2-8002	Namiac Acme D2-8002	Namiac Acme D2-8002
Total weight including operators, lb	1250	1250	1250

Engr. & By: Date

Engr. & By: Date

Engr. & By: Date

ATTACHMENT #1 PM

(Coolestenary Sheet)

Manufacturer's Data: Air Operated Containment Butterfly Valves

Page DS-10
Spec. No. APO-70
J.O.No. 11225
By ARM Date

Client Power Authority of the State of New York
Project James A. FitzPatrick Nuclear Power Plant

DATA COMPLETED BY SELLER

Item No.	7	8	27MOV-
Operator Mark No.	27AOV-117	27AOV-118	27MOV-
Valve Mark No.	VVM-7ENS	VVF-7ENS	VVM-7E
Quantity	1	1	
Manufacturer			
Manufacturer's model No.	9222	9222	92
Valve type	Butterfly/Wafer	Butterfly/Wafer	Butterfly
Min valve ID, in.	19½"	15½"	
Min body thickness	1" 2"	2"	
Min shaft diam, ID	1½" →		
Size length along pipe, in.	FE = 6½"	FE = 5"	F
Max distance from C.L., in.			
Pressure drop, in. water @ max flow			
Shaft bearing lubrication	NONE →	→	→
Shaft adjustment (yes or no)			
Packing gland (bolted preferred)	BOLTED →	→	→
Packing shape (Chevron preferred)	BRAID →	→	→
Materials			
Valve body, steel - ASTM	A216 GR WCB →	→	→
Shaft, 18-8 St. St. - ASTM	17-4 PH →	→	→
Disc, Stl. - ASTM	A515 GR 70 →	→	→
Seating surfaces	PTFE/CHEMRAZ →	→	→
Seat retainer, 18-8 St. Stl. - ASTM	A351 GR CF8 →	→	→
Seat retainer fastening	ALLOY STEEL →	→	→
Shaft bearing	BRONZE →	→	→
Shaft packing and seals	GRAPHITE →	→	GRAPHI
Tapered pins and keys	17-4 PH/S.S. →	→	→
Manual operator, mfr. and model	PHILGAS H215 →		
Operating gear ratio	280:1 →		
Handwheel diam, in.	12" →		
Torque to operate valve manually at max unbal. pressure, ft-lb	1,025 ft-lb →		
Orientation of handwheel operator	Shaft Mounted with Offset Reducer		
Pneumatic operator, mfr. and model	Series 7320-SR30 →		
Pneumatic operator type	Spring Return →		
Min air pressure required	90 psi →		
3-way solenoid valve, mfr. and model	—	✓	
Position indicator switches, mfr. and model No.	Namco Controls →		
Total weight including operators, lb	1425 →		

Rev. 3 By Date
Rev. 2 By Date
Rev. 1 By Date
Corrected

(Specification Sheet)

Manufacturer's Data: Air Operated Containment Isolation Valves

P.O.#: P3-9
Spec. No.: APC-70
S.O.#: 11825

Client: Power Authority of the State of New York
Project: James A. FitzPatrick Nuclear Power Plant

By: ADM Date: 11/15/71

DATA COMPLETED BY SELLER

Item No.	4	5	6
Operator Mark No.	27AOV-112	27AOV-115	27-AOV-116
Valve Mark No.	VVI-7EWS	VVE-7EWS	VVI-7EWS
Quantity	1	1	1
Manufacturer			
Manufacturer's model No.	9225	9225	9225
Valve type	[illegible]	[illegible]	[illegible]
Min valve ID, in.	22 28"	12 1/2"	12 1/2"
Min body thickness	[illegible] 2 3/4"	2"	2" 2"
Min shaft diam, ID	1 3/4"	1 1/2"	1 1/2"
Size length along pipe, in.	[illegible]	[illegible]	[illegible]
Max distance from C.L., in.			
Pressure drop, in. water @ max flow	NONE	NONE	NONE
Shaft bearing lubrication			
Shaft adjustment (yes or no)	BOLTED	BOLTED	BOLTED
Packing gland (bolted preferred)	BRAID	BRAID	BRAID
Packing shape (Chevron preferred)			
Materials			
Valve body, steel - ASTM	A516 GR 70	A516 GR 70	A516 GR 70
Shaft, 18-8 St. St. - ASTM	17-4 PH	17-4 PH	17-4 PH
Disc, Stl. - ASTM	A515 GR 70	A515 GR 70	A515 GR 70
Seating surfaces	[illegible]	ENT ION PLATE	ENT ION PLATE
Seat retainer, 18-8 St. Stl. - ASTM	A516 GR 70	A516 GR 70	A516 GR 70
Seat retainer fastening	ALLOY STEEL	ALLOY STEEL	ALLOY STEEL
Shaft bearing	BRONZE	BRONZE	BRONZE
Shaft packing and seals	CRANE 2CR3	CRANE 2CR3	CRANE 2CR3
Tapered pins and keys	17-4PH/STEEL	17-4 PH/STEEL	17-4PH/STEEL
Manual operator, mfr. and model	PHILGEAR HBIS	PHILGEAR HBIS	PHILGEAR HBIS
Operating gear ratio	230:1	230:1	230:1
Handwheel diam, in.	18"	12"	12"
Torque to operate valve manually at max unbal. pressure, ft-lb	1000 ft-lb	625 ft-lb	625 ft-lb
Orientation of handwheel operator	[illegible]	MOUNTED ON END OPPOSITE ACTUATOR	
Pneumatic operator, mfr. and model	BERMAD 732C-SR30	BERMAD 732C-SR30	BERMAD 732C-SR30
Pneumatic operator type	SPRING RETURN	SPRING RETURN	SPRING RETURN
Min air pressure required	90 psi	90 psi	90 psi
3-way solenoid valve, mfr. and model	✓	✓	✓
Position indicator switches, mfr. and model No.	NAMCO EA-740	NAMCO EA-740	NAMCO EA-740
Total weight including operators, lb	1350	1425	1425

Cert. Engr. _____ Date _____

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