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SUBJECT: Forwards "WPPSS 2 Purge & Vent Valves Seismic & Hydrodynamic Analysis," per SER Outstanding Issue 26.

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Washington Public Power Supply System
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

June 22, 1983
G02-83-550

Director of Nuclear Reactor Regulation
Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT 2
QUALIFICATION OF WNP-2 CONTAINMENT
VENT AND PURGE VALVES

References:
1) Letter, A. Schwencer (NRC) to R. L. Ferguson, (Supply System), "Request for Additional Information", dated September 16, 1982, Docket No. 50-397
2) NUREG-0892, WNP-2 SER, Outstanding Issue No. 26, "Operability of Purge Valves"
3) Letter, G. D. Bouchey (Supply System) to A. Schwencer (NRC), G02-83-170, "Nuclear Project No. 2, Qualification of WNP-2 Containment Vent and Purge Valves", dated February 24, 1983

Reference 3) provided partial response to the Purge and Vent valve operability concerns cited in Reference 1) and 2). This letter transmits stress analysis work to address the remaining open issues.

The enclosed reports provide the qualification stress analyses for the subject valves and their operators. Each has a positive margin of safety when the stress caused by a safe shutdown earthquake is combined with safety relief valve operation along with chugging or annulus pressurization. Acceptance criteria are from Section III of the ASME Boiler and Pressure Vessel Code or the AISC Steel Construction Manual, whichever is applicable.

These margins of safety were found only with the modifications described in the attached reports. These modifications will be performed prior to operation of WNP-2.

B001
1/6

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[illegible]

[illegible] [illegible]

With the modifications in place, these valves will remain functional through forty years of postulated hydrodynamic events, five operating basis earthquakes, and one safe shutdown earthquake.

G. D. Bouchey, Manager
Nuclear Safety and Regulatory Programs

RWH/sms

Attachments

cc: Mr. R. Auluck - NRC
Mr. W. S. Chin - BPA
Mr. A. Toth - NRC Site

Washington Public Power Supply System
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

The attached reports are the structural analysis of the purge and vent valves and operators installed at WNP-2. The loads used in the analysis are the valve operating loads combined with the dynamic loads which would result from seismic and hydrodynamic events as determined by the piping analyses for the plant.

There are three reports attached. They separately address:

1) The 24-inch butterfly valves manufactured by BIF (identified as QID 361106),

2) The 30-inch butterfly valves manufactured by BIF (identified as QID 361104), and

3) The air operators manufactured by Miller Fluid Power and supplied by BIF as a part of the valve assembly (identified as QID 018001).

These reports have been prepared by Cygna Energy Services for the Supply System's Equipment Qualification Group and are in their complete form in the Equipment Qualification files. However, in the interest of conserving space in the transmittal to the U.S. NRC, pages which are duplicated in the reports have been removed from all but one of the reports. Also, documents which have previously been submitted to the U.S. NRC are not attached as stated in the report.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

SUPPLIER TRANSMITTAL FORM

(AREA WITHIN HEAVY BORDER TO BE COMPLETED BY SUPPLIER)

TO THE ATTENTION OF: Dennis Armstrong
(COGNIZANT PURCHASE AGENT/BUYER/CONTRACT ADMIN.)
ADDRESS: 3000 George Washington Way, Richland
SUBJECT: Equip. Seismic/Hydrodynamic Requal.
FROM: Cygna Energy Services
ADDRESS: 1200 Jadwin, Suite 565, Richland, WA

THE FOLLOWING PUBLICATIONS/DRAWINGS ARE SUBMITTED FOR:
[x] APPROVAL [ ] REVIEW [ ] INFORMATION [ ] DISTRIBUTION

NO. OF PRINTS ____ OF EACH NO. OF REPRODUCIBLES ____ OF EACH
SUBMITTED BY: Fawaz Khanachet
TITLE: Assistant Project Manager
SUBVENDOR: ____ CONT./P.O. NO.: ____

PAGE 1 OF 1
TRANSMITTAL NO. 099
[x] NEW [ ] RE-SUBMITTAL
DATE SUBMITTED: 6/9/83
REQUESTED DATE OF RETURN:
CONTRACT NO: C-0892
P.O. NO:
WORK ORDER NO:
SPEC. NO:
SPEC. SECT. NO:

ITEM NO.	PUBLICATION OR DRAWING NO.	REV. NO.	PUBLICATION OR DRAWING TITLE	MANUFACTURER	WPPSS ACTION
1	361106	3	Original Requal. Rpt. for QID 361106		A
2	T-644RB		Cygna T-644RB		

COMMENTS: (USE ADDITIONAL SHEET, IF REQUIRED)

- TO BE REVIEWED BY -

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NAME DATE

TRANSMITTED BY: (PURCHASING ONLY)
NAME DATE

APPROVED BY: Dennis Armstrong TITLE [signature] DATE 6/10/83

ACTION LEGEND:
A = APPROVED FOR PUBLICATION
AN = APPROVED AS NOTED FOR FABRICATION
I = INFORMATION ONLY
NA = NOT APPROVED

WP-770 R1

Final Qualification Report

PROJECT: Equipment Seismic/Hydrodynamic Requalification

JOB NO: 82044

CALC NO: OT.01.F

CLIENT: Washington Public Power Supply System

QID NO: 361106

TITLE: Equipment Seismic and Hydrodynamic Requalification of 24" Cylinder Operated Butterfly Valves for:

CSP-V-3,4,5,6, and 9

CEP-V-3A, and 4A

PREPARED BY: [signature] Mark Scott 6/9/83 DATE

REVIEWED BY: [signature] Lourdes Fernandez 6/9/83 DATE

APPROVED BY: [signature] Fawaz Khanachet 6/9/83 DATE

REVISION: 3

SUPPLY SYSTEM REVIEW.

[signature] R. W. HICKMAN 6/10/83

QID # 361106

REVISION STATUS REPORT

REV	DATE	PRE'D BY / REV'D BY	APPROVED BY	DESCRIPTION
0	8/6th/82	R. Hsieh / H. Abolhoda	W. Schlofer	ORIGINAL ISSUE
1	10/27/82	R. Hsieh / H. Abolhoda	W. Schlofer	INCLUSION OF SUMMARY & REVISE CALC. TABLE OF CONTENTS
2	12/6/82	J.M. Foley / B. Bar[illegible]	[illegible]	Revised entire calc to reflect new cylinder [illegible] correct spring preloads and to include dynamic torque effects.
	5/12/83	D. E. [illegible] / D. E. [illegible]	[illegible]	Revise [illegible] [illegible] [illegible] Add [illegible] [illegible]
3	6/9/83	[illegible] / L.C. Fernández	[illegible]	REVISE EAR WELD STRESS CONCLUSION INCORPORATE COMMENTS

REVISION 3 1.1

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

REQUALIFICATION CERTIFICATE

WNP- 2

QID# 361106 3

COMPONENT NO: CSP-V-3, CSP-V-4, CSP-V-5, CSP-V-6, CSP-V-9, CEP-V-3A & CEP-V-4A

COMPONENT DESCRIPTION: 24" Cylinder Operated Butterfly Valves

MANUFACTURER: BIF

MODEL NO: A-206765

EQUIPMENT CLASSIFICATION: [X] ACTIVE [ ] PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:

Cygna Report 0t.01/F, QID 361106

"24" Cylinder-Operated Butterfly Valve"

[redacted]

Required action: 1) Remove A-307 Ear Bolts and replace with A-325.

2) Reinforce valve ear group with ½" shear plates to qualify air operators for required fatigue cycles. 3

THE ABOVE SEISMIC AND [redacted] QUALIFICATION REPORTS HAVE BEEN REEVALUATED IN ACCORDANCE WITH THE CURRENT NRC SEISMIC AND [redacted] CRITERIA:

1. IEEE STANDARDS 344 (1975)
2. USNRC REGULATORY GUIDES 1.92, 1.100
3. STANDARD REVIEW PLANS 3.9.2, 3.10, [redacted]

[redacted]

THE ABOVE COMPONENT HAS BEEN FOUND ACCEPTABLE FOR PERFORMING ITS INTENDED SAFETY RELATED FUNCTION WHEN SUBJECTED TO THE PLANT SPECIFIC VIBRATORY [redacted] LOADS.

PREPARED BY JE Rakowski [illegible] 3 [illegible]		DATE 5 [illegible]
REVIEWED BY D. E. Searle [illegible]		DATE 5/12/83
APPROVED BY RW Heckman		DATE 6/16/83

968-12576

2.0 SQRT FORM(S) AND REFERENCES

[illegible]

Ref. No.

[illegible]

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

Qualification Summary of Equipment

QID# 361106

Ref. No.

I. PLANT NAME: WNP-2 TYPE

PWR

1. NSSS: GE 2. A/E: Burns & Roe BWR 5, Mark II

II. COMPONENT NAME: 24" Cyl.Oper. Butterfly Valve COMPONENT NO. CSP-V-3,4,5,6,&9 CEP-V-3A & 4A (3)

1. SCOPE: ☐ NSSS ☒ BOP

2. MODEL NUMBER: A-206765 QUANTITY: 7

3. VENDOR: BIF

4. IF THE COMPONENT IS A CABINET OR PANEL, NAME AND MODEL NO. OF THE DEVICES INCLUDED:

N/A

5. PHYSICAL DESCRIPTION: a. APPEARANCE: Butterfly Valve with 8" Cyl Operator

b. DIMENSIONS: 24" nominal diameters

c. WEIGHT: 847# - Valve Assy; 676# - Operator & bracket

6. LOCATION: BUILDING: Reactor

ELEVATION: Maximum elevation: 495' (CSP-V-3A & 4A) (3)

7. FIELD MOUNTING CONDITIONS: ☒ BOLT (NO. ____ SIZE ____)

☐ WELD (LENGTH ____)

☐ ____

8. a. SYSTEM IN WHICH LOCATED: Containment Supply Purge Systems

b. FUNCTIONAL DESCRIPTION: Primary Containment isolation, prevention of the release of radioactive material to the environment.

c. IS THE EQUIPMENT REQUIRED FOR: ☐ HOT STANDBY ☐ COLD SHUTDOWN

☒ BOTH ☐ NEITHER

9. PERTINENT REFERENCE DESIGN SPECIFICATION: WPPSS Spec. 2808-68

III. IS EQUIPMENT AVAILABLE FOR INSPECTION IN THE PLANT: ☒ YES ☐ NO

Qualification Summary of Equipment (Continued)

QID# 361106

Ref. No.

IV. EQUIPMENT QUALIFICATION METHOD:

☐ TEST ☒ ANALYSIS ☐ COMBINATION OF TEST & ANALYSIS

QUALIFICATION REPORT: 24" Cylinder-Operated Butterfly Valve*

(NO., TITLE & DATE): OT.01.F, Revision 3, June, 1983 — 15

COMPANY THAT PREPARED REPORT: Cygna Energy Services

COMPANY THAT REVIEWED REPORT: Washington Public Power Supply Systems

*Plus original valve analysis — 3,4

V. VIBRATION INPUT:

1. LOADS CONSIDERED: a. ☐ SEISMIC ONLY

   b. ☐ HYDRODYNAMIC ONLY

   c. ☒ COMBINATON OF (a) AND (b)

2. METHOD OF COMBINING RRS: ☐ ABSOLUTE SUM ☒ SRSS ☐ OTHER (SPECIFY) ______

3. REQUIRED RESPONSE SPECTRA (ATTACH THE GRAPHS): Section 5.1 of QID 361106

4. DAMPING CORRESPONDING TO RSS: ☐ OBE ______ ☐ SSE ______

5. REQUIRED ACCELERATION IN EACH DIRECTION: ☐ ZPA ☒ OTHER (SPECIFY) Section 5.5 — 15

   OBE S/S = Attached F/B = ______ V = ______

   SSE S/S = Attached F/B = ______ V = ______

6. WERE FATIGUE EFFECTS OR OTHER VIBRATION LOADS CONSIDERED?

   ☒ YES ☐ NO

IF YES, DESCRIBE LOADS CONSIDERED AND HOW THEY WERE TREATED IN OVERALL QUALIFICATION PROGRAM:

The calculated stress ranges were compared to the AISC allowables, as the structures analyzed were not part of the pressure boundary.

NOTE: IF MORE THAN ONE REPORT, COMPLETE ITEMS IV THROUGH VII FOR EACH REPORT

Qualification Summary of Equipment (Continued)

QID# 361106

Ref. No.

VI. IF QUALIFICATION BY TEST, THEN COMPLETE*: N/A

1. ☐ SINGLE FREQUENCY ☐ MULTI-FREQUENCY ☐ RANDOM

2. ☐ SINGLE AXIS ☐ MULTI-AXIS ☐ SINE BEAT ☐ ________

3. NO. OF QUALIFICATION TESTS: OBE ________ SSE ________ OTHER (SPECIFY) ________

4. FREQUENCY RANGE: ________________

5. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL):

S/S = ________ F/B = ________ V = ________

6. METHOD OF DETERMINING NATURAL FREQUENCIES:

☐ LAB TEST ☐ IN SITU TEST ☐ ANALYSIS

7. TRS ENVELOPING RRS USING MULTI-FREQUENCY TEST: ☐ YES (ATTACH TRS & RRS GRAPHS) ☐ NO

8. INPUT g-LEVEL TEST: OBE S/S = ________ F/B = ________ V = ________

SSE S/S = ________ F/B = ________ V = ________

9. LABORATORY MOUNTING:

☐ BOLT (NO. ______, SIZE ______) ☐ WELD (LENGTH ______) ☐ ______

10. FUNCTIONAL OPERABILITY VERIFIED: ☐ YES ☐ NO ☐ NOT APPLICABLE

11. TEST REULTS INCLUDING MODIFICATIONS MADE:

____

____

____

12. OTHER TEST PERFORMED (SUCH AS AGING OR FRAGILITY TEST, INCLUDING RESULTS):

____

____

____

____

*NOTE: IF QUALIFICATION BY A COMBINTATION OF TEST AND ANALYSIS, ALSO COMPLETE ITEM VII.

Qualification Summary of Equipment (Continued)

QID# 361106

Ref. No.

VII. IF QUALIFICATION BY ANALYSIS, THEN COMPLETE:

1. METHOD OF ANALYSIS:

☐ STATIC ANALYSIS ☒ EQUIVALENT STATIC ANALYSIS

☐ DYNAMIC ANALYSIS ☐ TIME-HISTORY ☐ RESPONSE SPECTRUM

2. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL):

S/S = 10.81 Hz F/B = 26.1 Hz V = >100

3. MODEL TYPE:

☐ 3D ☐ 2D ☐ 1D ☐ FINITE ELEMENT ☒ BEAM ☐ CLOSED FORM SOLUTION

4. ☐ COMPUTER CODES: ______

FREQUENCY RANGE AND NO. OF MODES CONSIDERED: ______

☒ HAND CALCULATIONS

5. METHOD OF COMBINING DYNAMIC RESPONSES: ☐ ABSOULTE SUM ☒ SRSS ☐ OTHER (SPECIFY) ______

6. DAMPING: OBE ______ SSE ______ BASIS FOR THE DAMPING USED: N/A*

7. SUPPORT CONSIDERATIONS IN THE MODEL: pipe-mounted

8. CRITICAL STRUCTURAL ELEMENTS:

A.

IDENTIFICATION	LOCATION	GOVERNING LOAD OR RESPONSE COMBINATION	SEISMIC STRESS	TOTAL STRESS	STRESS ALLOWABLE	
Valve Ears	CSP-V-3&4	pipe-axial	15743	19538	26880	(PSI)
Ear Bolts	CSP-V-3&4	pipe-normal	15777	18382	66000	(PSI)
Drive Rod	CSP-V-4	rod-normal	8543	33019	86400	(PSI)
Ear Bolts	CSP-V-6	pipe-normal	57543	58884	66000	(PSI)

B.

MAX. CRITICAL DEFLECTION	LOCATION	MAXIMUM ALLOWABLE DEFLECTION TO ASSURE FUNCTIONAL OPERABILITY
<0.01"	Valve disk radial deflection	approx 1/8" radial clearance

*Final response accelerations from piping analysis were used.

Qualification Summary of Equipment (Continued)

#QID 361106

VIII. REFERENCES

1. BIF Drawings:

   D-207110-H, D-207110-G, (Valve Data Sheets)

   A-206767, 18", 24" & 30" Butterfly Valve - General

   C-26096, "Certified Dimension for Model A-83-B Cylinder"

2. WPPSS Unit 2 Drawings:

CSP-807-81.08	Containment Purge Air Supply
CSP-809-1.2	Suppression Pool Vacuum Breaker
CEP-625-3.4	From Reactor Nozzle X-67 to SGT-Fu-1A, 1B
CEP-625-1.2	From Reactor Nozzle X-67 to SGT-Fu-1A, 1B
D.220-0310	Support and Erection Isometric-IR64 (Johnson Controls)

3. BIF Report TR-27234 and TR-27235, "Dynamic Torque Calculation of Butterfly Valve; Sizes 24 and 30 inch", dated November 10, 1982.

4. Report #TR-74-7 by McPherson Assoc., Inc., "Design & Seismic Analysis 24" Cylinder operated Butterfly Valve." (Rev. 1) 1/5/76.

5. WPPSS letter to Cygna Energy Services, GE-02-RWH-018, 12/17/82.

REFERENCES CONTINUED ON PAGE 2.6

Completed By	E Rakowski (3) [signature] 6/9/83	Date	3/24/83
Reviewed By	[signature] [signature] 6/9/83	Date	5/12/83

Calculation Sheet

Project: Washington Public Power Supply System		Prepared By: L.C. Fernandez	Date: 5/27/83
Subject: Equipment Seismic/Hydrodynamic Requal.		Checked By: [signature]	Date: 5/27/83
System: CSP & CEP		Job No. 82044	File No. OT.01.F
~~Analysis No~~ QID 361106	Rev. No. 2	Sheet No. 2.6	

3 [signature] 6/8/83
L.C. Fernandez 6/9/83

SECTION 4.4

REFERENCES (CONTINUED):

6. Cygna Energy Services Communications Report, R. Ricappito, BIF Valve, and J. Rakowski, CES, "BIF Valve Dimensions", 2/11/83.

7. Cygna Energy Services, Project Manual Design Criteria, DC-1, Rev. 1, November, 1982.

8. Cygna Energy Services, Equipment Qualification Walkdown Verification Forms, Revision 1, dated 1/5/83.

9. WPPSS, WNP-2, Safety Related Mechanical Equipment List Summary Sheets, dated 2/10/83.

10. "AISC Manual of Steel Construction", American Institute of Steel Construction, 8th Edition, 1980.

11. Preliminary Transfer of Final Burns & Roe Piping Loads for CSP-V-1,2,3,4,5,6 and CEP-V-3A&4A, received 4/13/83.

12. Cygna Energy Services, "Equipment Seismic and Hydrodynamic Requalification of 30" Cylinder Operated Butterfly Valves for CSP-V-1, & 2, and CEP-V-1A, & 2A," File No. OS.01.F, QID No. 361104, Revision 1, June, 1983.

13. Cygna Energy Services, "Equipment Seismic and Hydrodynamic Requalification for 8", 10" and 12" Bore Air Cylinder Operators," File No. 1P.01.F, QID No. 018001, Revision 0, May, 1983.

14. USNRC, "Standard Review Plan, NUREG-0800"

15. Cygna Energy Services, "Equipment Seismic and Hydrodynamic Requalification of 24" Cylinder Operated Butterfly Valves for CSP-V-3,4,5,6, & 9 and CEP-V-3A & 4A," File No. OT.01.F, QID No. 361106, Revision 3, June, 1983.

CYGNA

Calculation Sheet

Project: NPPS - Equipment Qualification	Prepared By: [illegible]	Date: [illegible]
Subject: 24' Butterfly Valves	Checked By: [illegible]	Date: 5/15/93
System: [illegible]	Job No. 82044	File No. [illegible]
Analysis No. [illegible]	Rev. No. 2	Sheet No. 2.7

3 [illegible] 6/8/93 J Fernandez 6/9/93

Summary Table 1.1

24' Valve Required G-Levels (Faulted Condition)

[illegible]	[illegible]	FN	El. Ref.	Accelerations (G's) X	Y	Z	Equipment Classification 3
[illegible]-V-3	Y	F/C	[illegible]	[illegible]	[illegible]	3.76	A
CSP-V-4	Y	F/C	476	[illegible]	[illegible]	[illegible]	A
CSP-V-5	Y	F/O	[illegible]	2.96	3.44	[illegible]	A
CSP-V-6	Y	F/O	480	[illegible]	3.33	5.65	A
CSP-V-9	Y	F/O	[illegible]	3.57	[illegible]	2.67	A ***
CCA-V-3A	Y	F/C	[illegible]	4.57	1.26	0.90	A
CCA-V-4A	Y	F/C	[illegible]	[illegible]	1.34	[illegible]	A

	Emergency X	Y	Z	Upset X	Y	Z
CSP-V-3	2.48	[illegible]	[illegible]	1.73	[illegible]	0.96
CSP-V-4	2.30	[illegible]	[illegible]	1.14	1.40	1.50
CSP-V-5	[illegible]	2.69	[illegible]	0.97	1.40	1.71
CSP-V-6	11.37	3.18	5.63	2.69	3.09	[illegible]
CEA-V-3A	[illegible]	0.81	0.76	1.20	0.76	[illegible]
CEA-V-4A	[illegible]	0.93	[illegible]	[illegible]	[illegible]	[illegible]

NOTE: Above accelerations [illegible] transmittal (Schuchell to Armstrong) of latest curves [illegible] section 5.5, incorporating SAP model [illegible] B. The [illegible]

*** CSP-V-9, however, and previous accelerations are still applicable.

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QID# 361106

Revision 3

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QID# 361106

SECTION 4.0

REQUALIFICATION ANALYSIS

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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Calculation Cover Sheet

Project	Job No. 82044
Equipment Seismic & Hydrodynamic Requalification	File No. OT.01/F
Client	Calc. Set No. 1
Washington Public Power Supply System	No. of Sheets 66

Subject

Seismic Qualification of 24" Cylinder Operated Butterfly Valves
QID 361106, EPN #CSP-V-3,4,5,6 & 9, and CEP-V-3A & 4A

Statement of Problem

The equipment qualification was performed based on calculations using valve and operator response g-levels transmitted by the A/E,(Final piping loads dated 3/31/83).

Sources of Data

See sheets 4.3.65 and 4.3.66

Sources of Formulae & References

See sheets 4.3.65 and 4.3.66

Remarks

None

Originators	Checkers	Distribution	Revision No. 3
J. Rakowski	D. Searle	WPPSS-2	Supersedes Calculation Set No.
M. Kuntz	L. Kaner	Project File-1	Revision 2
M. Scott	LC Fernandez		Approved By: [signature] Date: 6/9/83

CYGNA

Calculation Sheet

Project		Prepared By:	Date
Subject		Checked By:	Date
System		Job No.	File No.
Analysis No.	Rev. No.	Sheet No.	

CONTENTS

Calculation Sheet

Project		Prepared By:	Date
Subject		Checked By:	Date
System		Job No.	File No.
Analysis No.	Rev. No.	Sheet No.	

SECTION 4.1

CONCLUSIONS

Calculation Sheet

Project: WPPSS Equipment Seismic Hydrodynamic Requalification		Prepared By: [signature]	Date: 6/9/83
Subject: BIF Valves/Miller Operators		Checked By: LC Fernandez	Date: 6/9/83
System: CEP & CSP		Job No. 82044	File No. 1T.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 4.1.1	

CONCLUSIONS

Seven 24-inch BIF Butterfly valves with Miller Air Products cylinder operators have been analyzed for structural integrity and operability for the plant specific seismic and hydrodynamic piping loads transmitted from Burns and Roe. These piping loads are in the form of air operator response G-levels (Section 5.5, dated March 31, 1983).

The valves will be qualified after incorporating the following modifications:

1) Remove the existing operator bracket attachment bolts (A-307) and replace with an A-325 or A-490 bolt.

2) Reinforce the operator support ears with the addition of shear plates as shown on page 4.3-48 or 4.3-54 of 361106, Rev. 3 (this report).

CYGNA

Calculation Sheet

Project		Prepared By:	Date
Subject		Checked By:	Date
System		Job No.	File No.
Analysis No.	Rev. No.	Sheet No.	

SECTION 4.2

SUMMARY OF RESULTS

CYGNA

Calculation Sheet

Project: WPPSS MECHANICAL EQ		Prepared By: E Rutkowski	Date 3/20/83
Subject: 24" Butterfly Valves		Checked By: A E Searle	Date 3/30/83
System: CSP & CEP		Job No. 82044	File No. OT.01.F
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.2-1	

SUMMARY OF RESULTS

Parametric data for the seven subject valves in this report is given in Table 1.1. Results of the requalification analyses, which include a comparison of calculated stresses to the allowables are given in Table 1.2. Allowable stresses for the various material types are given in Table 1.3.

Calculation Sheet

Project	TPSC - Equipment Qualification	Prepared By:	V.A.L.	Date	[illegible]
Subject	24" Butterfly Valve	Checked By:	[signature]	Date	5/15/93
System	[illegible]	Job No.	50044	File No.	2.01.F
Analysis No.	26110/3	Rev. No.	2	Sheet No.	[illegible]-4.2-2

△3 [signature] 6/3/93 J. C. Fernandez 6/9/93

Summary Table 1.1

24" Valve Required G-Levels (Faulted Condition)

EIN	Harsh	FN	El. Reac.	X	Y	Z	Equipment Classification △3
				Accelerations (G's)			
CSP-V-3	Y	F/C	460'	[illegible]	2.79	3.76	A
CSP-V-4	Y	F/C	470	2.16	3.17	4.17	A
CSP-V-5	Y	F/O	415'	2.96	3.44	5.22	A
CSP-V-6	Y	F/O	430'	[illegible]	3.33	5.65	A
CSP-V-9	Y	F/O	470'	2.57	1.73	2.67	A ***
CCP-V-3A	Y	F/C	475'	4.27	1.26	0.90	A
CCP-V-4A	Y	F/C	475'	[illegible]	1.34	0.37	A

	Emergency			Upset		
	X	Y	Z	X	Y	Z
CSP-V-3	2.48	2.09	3.62	1.75	1.60	0.96
CSP-V-4	2.30	1.77	1.71	1.14	1.40	1.50
CSP-V-5	[illegible]	2.69	5.52	0.97	1.40	1.71
CSP-V-6	11.37	3.18	5.83	2.69	2.09	1.48
CCP-V-3A	[illegible]	0.51	[illegible]	1.20	[illegible]	1.51
CCP-V-4A	2.66	0.73	0.73	1.05	[illegible]	[illegible]

Note: Above are changes made per transmittal (Schaefer to Armstrong) of latest [illegible]
to Armstrong) of latest [illegible] [illegible]
[illegible] S.E., incorporating [illegible] B. [illegible]
*** CSP-V-9, [illegible] and [illegible] [illegible] still [illegible]

1006 00

Calculation Sheet

Project: WPPSS EQUIPMENT QUAL. — Subject: 24" BF BUTTERFLY VALVE — System: CSP & CEP — Analysis No. 361106 — Rev. No. 3

Prepared By: [illegible] Date 6/8/83 — Checked By: Y.C. [illegible] Date 6/9/83 — Job No. 83044 — File No. 1P.01F — Sheet No. 361106-4.2-3

SUMMARY TABLE 1.2 FAULTED CONDITION
(STRESS IN PSI)

MEMBER	MAT'L TYPE	TYPE STRESS	CSP-V-3	CSP-V-4*	CSP-V-5	CSP-V-6	CSP-V-3A	CSP-V-4A	MATERIAL ALLOWABLE
TRUNNION PINS	SA-276	S			4108 MAX				11840
TAPERED PINS	SA-276	S			8710 MAX				11840
DRIVE LEVER	A-395	T			10420 MAX				43200
LEVER KEYWAY	A-395	T			27381 MAX				43200
MAIN SHAFT	SA-479	S			9127 MAX				14500
DRIVE ROD	4140	T	31629	33019	40631	33433	7462	7462	86400
EAR BOLTS	A-325**	T	16845	18392	20848	58254	23525	18018	66000
		S	14670	15475	19482	17564	4538	6136	26250
SHEAR PL WELD	E60	S	—	—	10437	—	—	—	28800
VALVE EAR WELD	E60	S	—	—	8050	—	—	—	28800

FATIGUE RESULTS - STRESS RANGE IN PSI

MEMBER	MAT'L TYPE	TYPE STRESS	CSP-V-3	CSP-V-4*	CSP-V-5	CSP-V-6	CSP-V-3A	CSP-V-4A	ALLOWABLE STRESS RANGE
TAPER PINS	SA276	S***							90000
DRIVE ROD	4140	T	63258	66038	81268	64866			90000
TRUNNION PINS	SA-276	S***			16432 MAX				90000
SHEAR PL WELD	E60				20854				22500
VALVE EAR WELD	E60				16100				22500

* EPN-CSP-V-7 ENVELOPED BY CSP-V-4 BY WIDE MARGIN

** AS INSTALLED BOLTS ARE CURRENTLY A-307 — REQUIRE CHANGING TO A-325

*** FATIGUE EVALUATION OF A SHEAR LOAD RESOLVES INTO A TENSILE STRESS RANGE AS FOLLOWS: $\sigma_{max} = 2\tau_{max}$ $SR = 2\sigma_{max} = 4\tau_{max}$

CYGNA

Calculation Sheet

Project: WPPSS EQ		Prepared By: E Rolanski	Date 3/25/83
Subject: 24" Butterfly Valves		Checked By: W E Swank	Date 3/30/83
System: CSP & CEP		Job No. 82044	File No. OT.01/F
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.2-4	

△3 [signature] 6/9/83 H Fernandez 6/9/83

SUMMARY TABLE 1.3

ALLOWABLE STRESSES

Since operability is required, the stresses for the faulted condition will be kept below yield*. The table below is based on AISC criteria and the yield stresses at temperature (340°F) from PG. 9 of REF. 4 for conservatism.

MATERIAL	YIELD STRS (PSI)	LEVEL A & B		LEVEL D **	
		.6 Fy BENDING ALLOW.	.4 Fy SHEAR ALLOW.	1.6×.6 Fy = 0.96 Fy BENDING ALLOW.	1.6×.4 Fy 0.64 Fy SHEAR ALLOW.
AISI-4140 HEAT TREATED	90,000	54,000	36,000	86,400	57,600
SA-276, GR 304	18,500	11,100	7,400	17,760	11,840
ASTM A-395-60-45-15	45,000	27,000	18,000	43,200	28,800
SA-307	23,300	13,980	9,320	22,370	14,900
AISI-1018 (MIN YIELD)	35,000	21,000	14,000	33,600	22,400
SA-193, GR 33, 304SS	31,000	18,600	12,400	29,760	19,840
SA-479, 304SS	22,650	13,590	9,060	21,744	14,500
SA-516, GR 60	28,000	16,800	11,200	26,880	[illegible]

** 1.6 FACTOR REFERENCE DESIGN CRITERIA DC-1, & REF 14.
* BRACKET BOLT ALLOWABLES TAKEN FROM AISC, 8TH ED., SEC. 1.5.2.2.

△3

SECTION 4.3

ANALYSIS

EQUIPMENT REQUALIFICATION FOR QID 36110
BIF 24" CYLINDER OPERATOR BUTTERFLY VALVES

4.3.1 Introduction

The seven valves in this file are classified according to the parametric data given in Summary Table 1.1.

Since hydrodynamic loads apply in certain cases, fatigue analyses were provided for components with the highest stress ranges.

The calculated stresses are based on valve and operator G-levels calculated from the piping analysis and received from Burns & Roe. Since these loads were initially too high to qualify all EPN's the response G-levels were subsequently recalculated with some of the conservatisms removed from the piping analysis. In addition, an SRSS analysis was set up in a computer program for each valve EPN in its specific orientation in the piping system (see Section 5.4). Each computer program (Appendix A) is compiled and hence not subject to subsequent change unless recompiled (and documented).

The method calculates stress from the north, vertical, and east component of operator response g-levels. The SRSS is taken at the stress level and operating loads due to seating torque force and dead weight are later combined by an absolute sum. Valve ear bending stress components due to any one response g-level component are combined by an absolute sum.

The computer analysis addresses only the more highly stressed components in the valve operator assembly. Separate analysis is given for the remaining components using a simpler approach with upper bound loads. This applies to all valve operator EPN's in QID 361106 (24" Valve/8" cylinders) and QID 361104 (30" valves/10" operators). Hand calculations which check selected portions of computer output are shown in Appendix C.

Appendix B of this section describes the air operator mass/stiffness model which was incorporated in the final piping analysis for calculation of operator response g-levels. The computer program includes an option for using the valve ear forces and moments which are directly output from the piping analysis with the valve/operator model included. This was not finally utilized, however, to qualify the subject equipment.

The equipment locations and elevations were taken from the P&ID's in section 6.0. Natural frequency calculations are given for the air operator assemblies in Section 4.3.2.1.

Preliminary analyses were performed which showed that, for operator response g-levels greater than approximately 3 g's, the air cylinder spring preload force would be exceeded and hence some disk flutter would occur when the valve is in the open position. The calculation in section 4.3.2.2 shows that the magnitude of the valve disk flutter vibration angle due to upper bound g-levels which occur in the hydrodynamic frequency range is approximately 6 degrees. This flutter was evaluated to have no detrimental effect on system safety function as noted in Reference 5.

Valve operability was addressed in the following manner. For the valves with Use Code 2, operability after the event can be assured by demonstrating that faulted condition stresses remain below elastic limits (see Summary of Results.

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: [signature]	Date: 1/10/83
Subject: 24" Butterfly Falves		Checked By: [signature]	Date: [illegible]
System: CSP and CEP		Job No.: 82044	File No.: OT 01/F
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106 43-3	

For valves CSP-V-3 and 4, which must operate from open to fail closed during an event, the following additional evaluations were made:

1) Dynamic flow torques were assessed per Ref. 3 and found to be less than the seating torque which controlled the equipment stresses. Furthermore these flow torques tend to move the valve disk toward the fail-closed position, as noted in the above report.

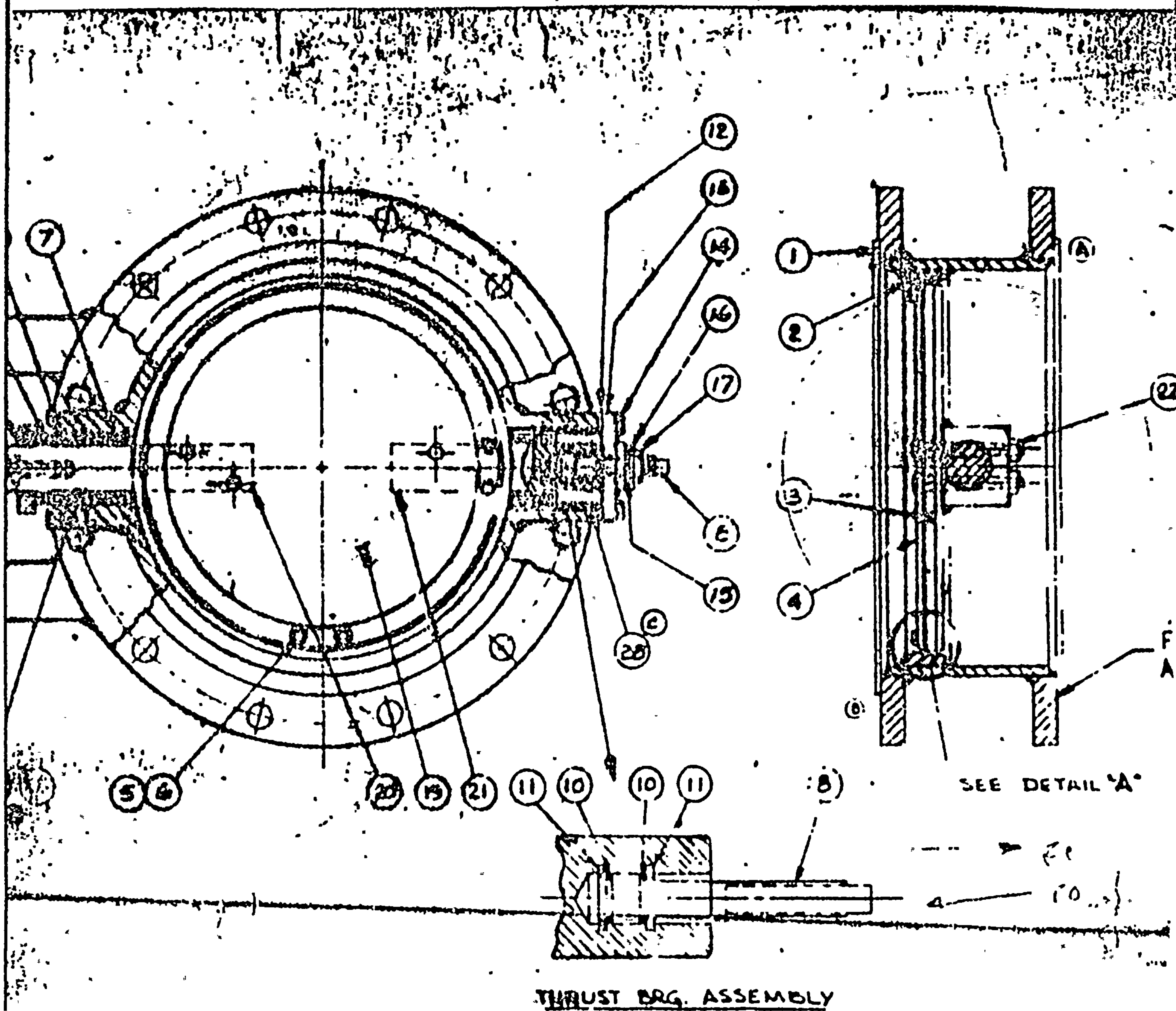
2) The details of BIF drawing 206 767, parts of which are shown in figures 1.1 and 1.2, allow the following conclusions to be made for valve operability:

   A) Figure 1.1 shows that thrust bearings are part of the shaft bearing design. This design prevents lateral movement of the disk in the direction of the shaft to eliminate interference with the valve body when closing. Further, it is noted on Page 26 of Ref. 3 that frictional torques in the shaft bearing system are negligible.

   B) Figures 1.1 and 1.2 show a circular valve cross section having an internal rim within which the valve seats in the closed position. The only mechanism remaining to affect valve closing which can be postulated is out-of-round distortion of the section due to DBE piping loads and dynamic loads on the valve.

These loads were accounted for in Ref. 4 in the overall valve sizing calculations, where analysis showed that the stress intensity in the 0.5 inch thick valve body remained below 1.2 S_m, or approximately 0.8 of yield. Stress contribution from dynamic loads on the valve and operator were relatively small. Further, as shown in the figures:

FIGURE 1.1 BIF DRAWING 206767



Calculation Sheet

Prepared By JE RAKOWSKI Date 3/25/83

Checked By Date 3/30/83

Job No.

File No

Rev. No 2

Sheet No. 4.3.4 3A

Calculation Sheet

Project [illegible]		Prepared By J E RAKOWSKI	Date 3/25/83
Subject [illegible] VALVES		Checked By [illegible]	Date 3-30-83
System CCW CSP		Job No. 82046	File No [illegible]
Analysis No. 361.116	Rev No. 2	Sheet No 361.116-4.3-5	

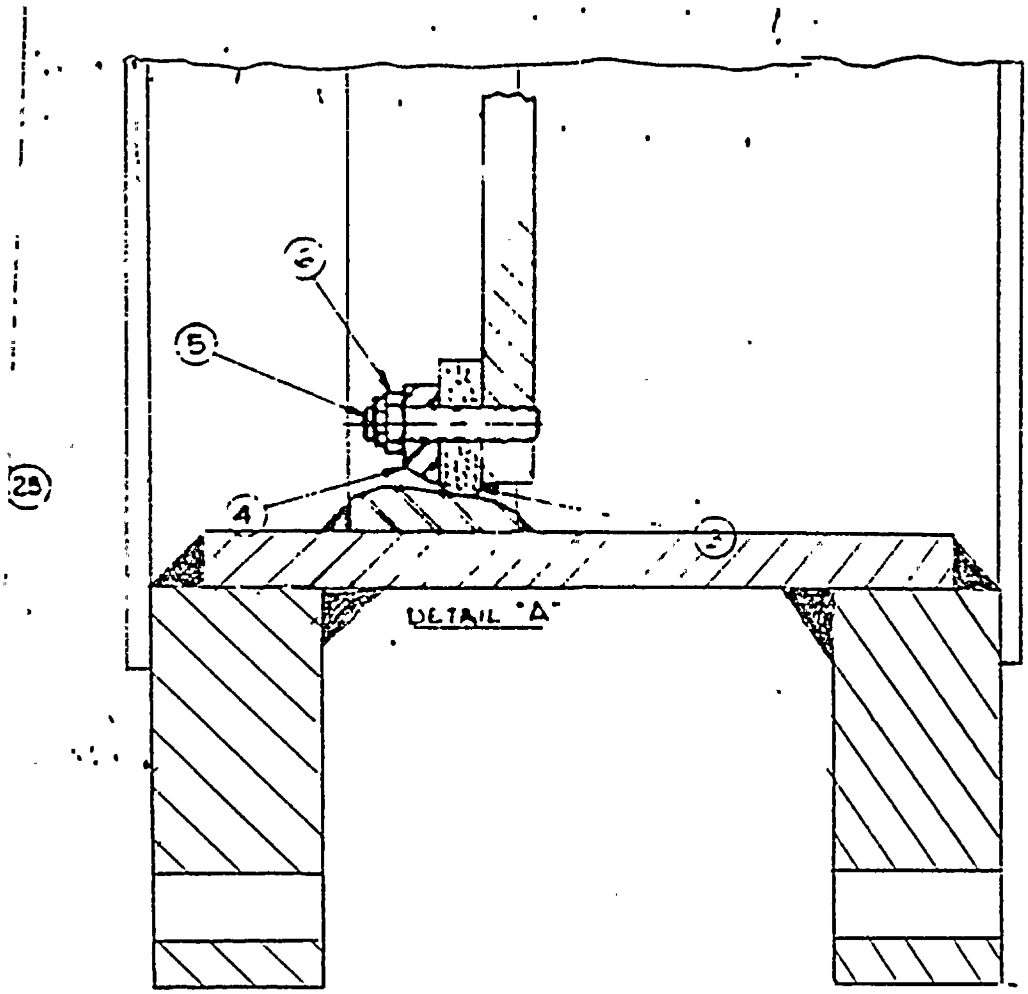


FIGURE 1.2 BIF DRAWING 206767, DETAIL A

1. The valve seat forms a heavily reinforced section made up of the valve body, internal hub and external flanges (including the mating flange of the piping). Hence the stress levels in this section are much lower than in the valve body and hence no distortion of the section could occur to affect seating of the valve. Valve flange dimensions are given below. Note the relatively large internal radial clearance of 1/8 inch.

2. Stress analysis of the valve extended structures are given in this report. Air operator operability is addressed in QID 018001.

   The design data used in the analyses are given in Summary Table 1.1 (pipe-orientations and elevations are taken from the appropriate P&ID's in Section 6.0). Other pertinant data is given below.

   1) Spring preload per communication report in Section 7.0 of QID 018001 are:

      Fail Open Preload = 350#
      Final = 1850#

      Fail Closed Preload = 1500#
      Final = 3000#

   2) Cylinder C.G.'s shown on the following sketches represent data received from BIF in the communication report of Section 7.0 of QID 018001.

   3) Closing torque values are taken from Ref. 3.

   4) Valve component dimensions: (Ref. Feb. 10, 11/83 communication report - Section 7)/

      Flange: width = 3.5", thickness = 1.78"
      Radial Clearance Disk/Seat 1/8"

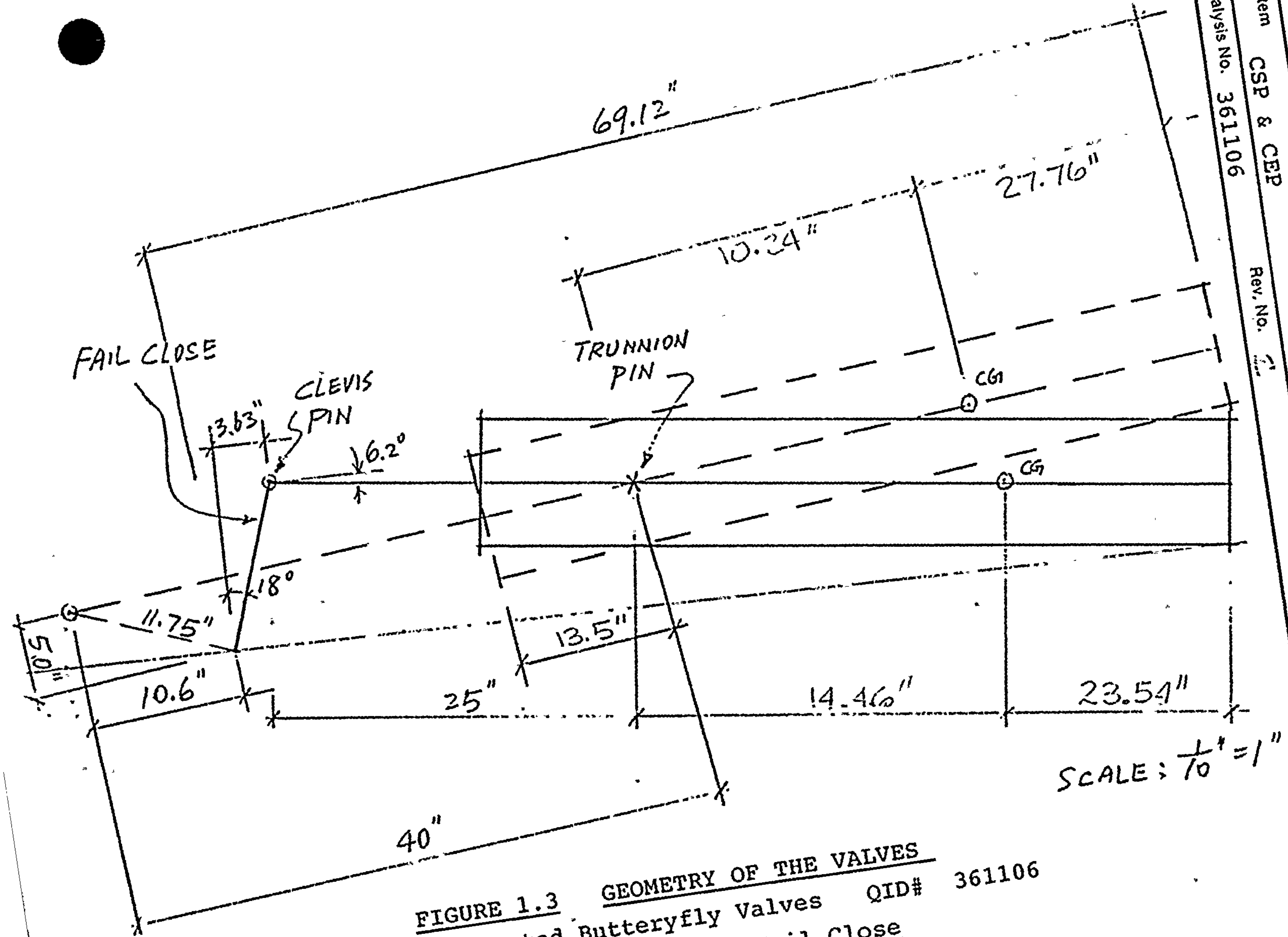


FIGURE 1.3 **GEOMETRY OF THE VALVES**

24" Cylinder Operated Butteryfly Valves QID# 361106

Group II; Cylinder Operator Fail Close

(Valves: CSP-V-3, 4 & CEP-V-3A & 4A)

(Info. taken from Ref. (1) & (4))

Calculation Sheet

Project: Supply System - EQ

Subject: 24" Butterfly Valve

System: CSP & CEP

Analysis No. 361106 Rev. No. 2

Prepared By: [signature] Date 3/25/83

Checked By: [signature] Date [illegible]

Job No. 82044 File No. OT.01/F

Sheet No. 361106-4.3-7

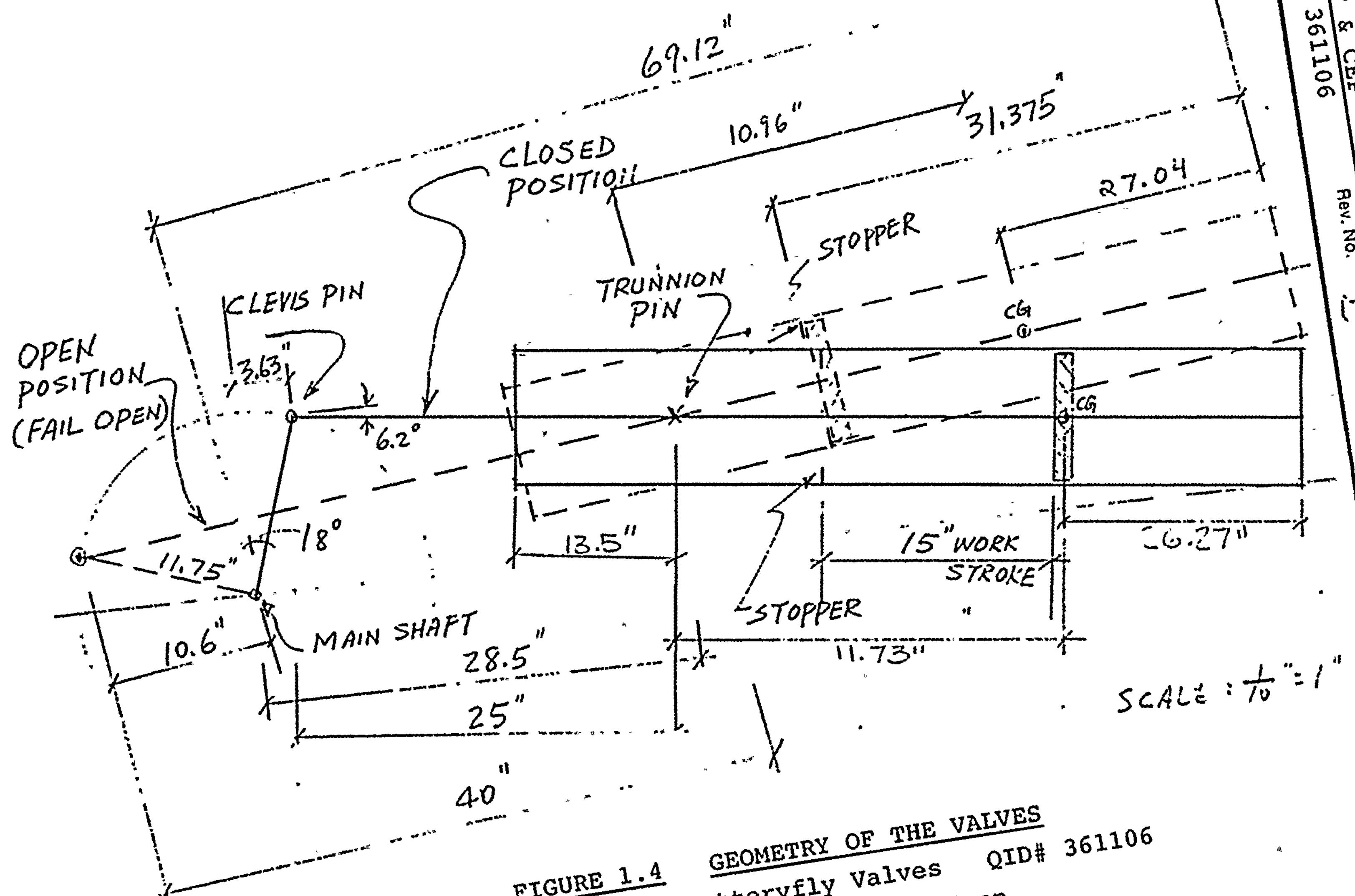


FIGURE 1.4 GEOMETRY OF THE VALVES

24" Cylinder Operated Butterfly Valves QID# 361106

Group I; Cylinder Operator Fail Open

(Valves: CSP-V-5, 6, 9)

(Info. taken from Ref. (1) & (4))

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: J. E. Rolowski	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: J. E. Smith	Date: 3.30.83
System: CSP and CEP		Job No. 82044	File No. OT.01/F
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.3-9	

4.3.2 CALCULATIONS

4.3.2.1 NATURAL FREQUENCY CALCULATIONS

Perform natural frequency calculations for the following four operator configurations:

Group I - Fail Open

EPN's CSP-V-5, 6, and 9

Case I Valve Open

Case II Valve Closed

Group II - Fail Closed

EPN's CSP-V- 3 and 4 and CEP-V-3A and 4A

Case I Valve Open

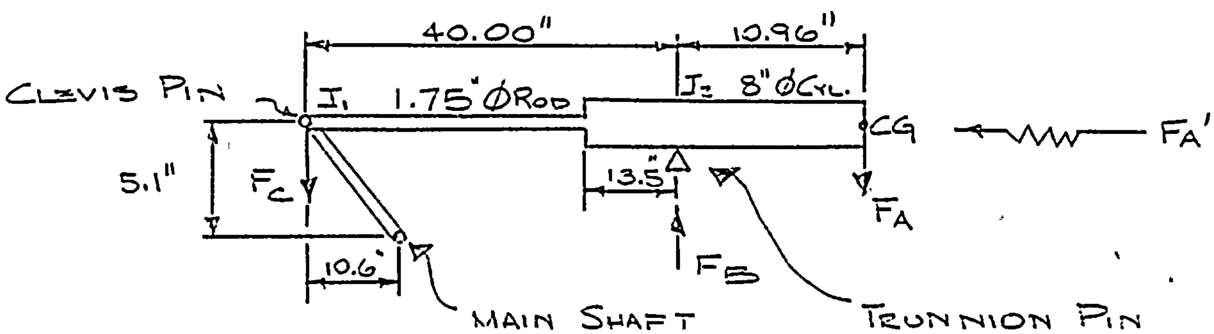
Case II Valve Closed

Calculation Sheet	Prepared By: [illegible]	Date 11/9/8[illegible]
Project SUPPLY SYSTEM	Checked By: [illegible]	Date 11/1[illegible]
Subject 24" BUTTERFLY VALVE	Job No. 32044	File No. OT.01/F
System CSP & CEP	Sheet No.	
Analysis No. 36" D.5 Rev. No. 2	361106-45-0	

GROUP I CYLINDER OPERATOR "FAIL OPEN"

CALCULATE THE NATURAL FREQUENCY OF THE CYLINDER OPERATOR DUE TO THE BENDING STIFFNESS OF THE DRIVE ROD AND THE CYLINDER OPERATOR. THESE CALCULATIONS ASSUME THAT OPERATOR PISTON REMAINS SEATED AGAINST THE OPEN OR CLOSED POSITION STOP BY ACTION OF THE SPRING.

CASE I VALVE OPEN



$I_1 = 0.46 \text{ in}^4$

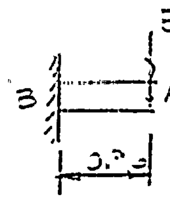
$I_2 = \frac{\pi}{64}(8.45^4 - 7.97^4) = 52.2 \text{ in}^4$

CALCULATION OF F_N:

$$\delta_A = \frac{Pl^3}{3EI} = \frac{500(10.96)^3}{3(29\times10^6)(52.2)} = .000145 \text{ IN}$$

WITH END B FIXED

UNIT LOAD 500

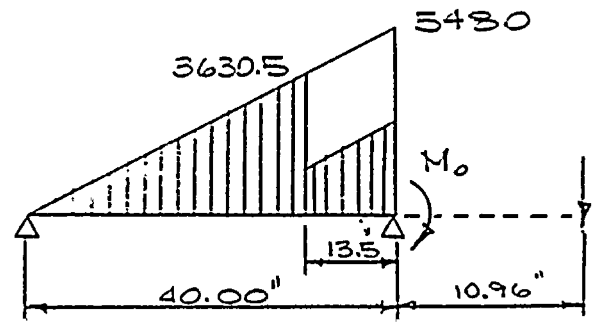


CYGNA

Calculation Sheet

Prepared By: M. Kunde — Date: 11/9/83
Checked By: [illegible] — Date: 11/10/83
Project: Spray System
Subject: 24" Butterfly Valve
System: CSP & CEP
Analysis No. 361106 Rev. No. 2
Job No. 82044
File No. 07.01/F
Sheet No. 361106-4.3-11

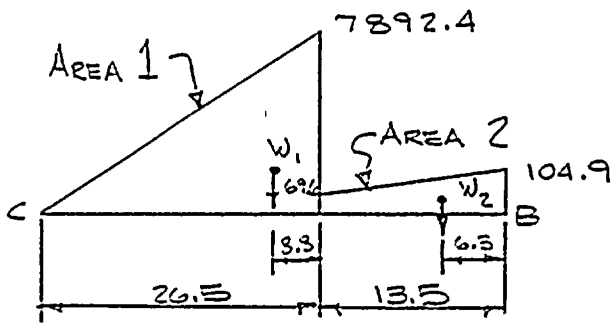
ROTATION AT "B" DUE TO M_o OF M/I DIAGRAM



$M_o = 500(10.96)$
$= 5480 \text{ in}^{\#}$

$\frac{5480}{52.2} = 104.9$ $\frac{3630.5}{52.2} = 69.55$ $\frac{3630.5}{0.46} = 7892.4$

$W_1 = 7892.4\left(\frac{26.5}{2}\right) = 104574.2$ $W_2 = \left(\frac{104.9+69.35}{2}\right)(13.5) = 1177.5$



AREA 1

$CG_{AREA\,1} = \frac{1}{3}(26.5) = 8.83 \text{ IN}$

AREA 2

RECTANGLE:

$CG_R = \frac{1}{2}(13.5) = 6.75$

$A_R = (13.5)(69.6) = 939.6$

TRIANGLE:

$CG_T = \frac{2}{3}(13.5) = 9.0$

$A_T = \frac{1}{2}(13.5)(35.3) = 238.3$

$CG_{AREA\,2} = \frac{(CG_{RECT})(A_{RECT}) + (CG_{TRI})(A_{TRI})}{(A_{RECT}) + (A_{TRI})}$

$= \frac{(6.75)(939.6) + (9)(238.3)}{939.6 + 238.3}$

$= 7.21 \text{ IN}$

$\therefore 13.5 - 7.21 = 6.3 \text{ IN}$

$R_B = 104574.2\left(\frac{17.67}{40}\right) + 1177.5\left(\frac{33.7}{40}\right) = 46195.7 + 99.21$

$= 47187.3$

$\theta_B = \frac{47187.3}{29 \times 10^6} = .00163 \text{ rad.}$

Calculation Sheet	Prepared By: [illegible]	Date 11/11/82
Project: SUPPLY SYSTEM	Checked By: [illegible]	Date [illegible]
Subject: 24" BUTTERFLY VALVE	Job No. 82044	File No. OT.01/F
System: CSP & CEP	Sheet No.	
Analysis No. 861106 Rev. No. 1	861106-4.3-12	

<u>DEFLECTION OF POINT A</u>

δ_A' due to θ_B

$= .00163\ (10.96)$

$= .0179$

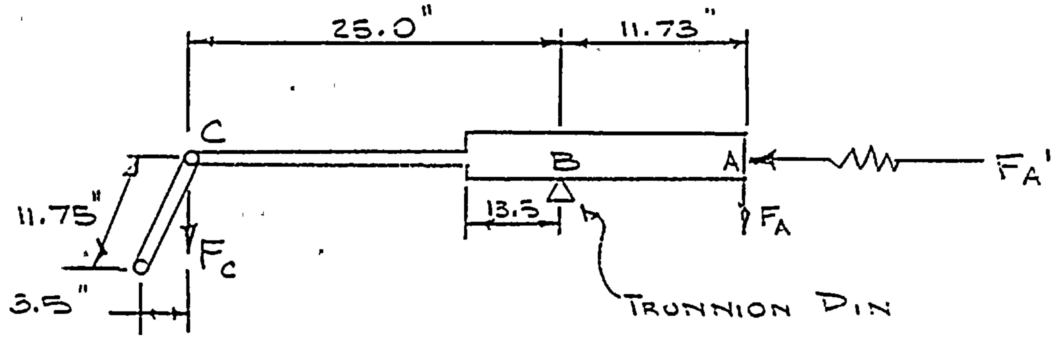
$\therefore$ TOTAL $\delta_A = .00045 + .0179 = .0181$

$K = \frac{500}{.0181} = 27700.8\ \#/\text{in}$

$f_N = \frac{1}{2\pi}\sqrt{\frac{27700.8\,(386.4)}{399^\#}} = 26.07\ \text{Hz.}$

(DEAD WT. OF CYL. OPERATOR = 399#)

<u>CASE II VALVE CLOSED</u>



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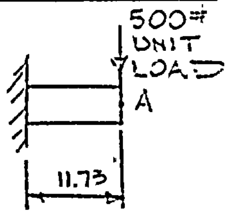
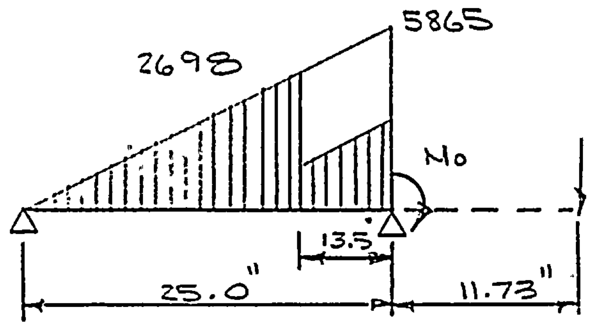
Calculation Sheet	Prepared By: M. Kim...	Date: 11/.. 82
	Checked By: L. K...	Date:
Project: Supply System	Job No. 82044	File No. 07.01.F
Subject: 24" Butterfly Valve		
System: CSP & CEP	Sheet No.	
Analysis No. 361106 Rev. No. 2	361106-4.3-13	

CALCULATION OF δ_A:

$$\delta_A = \frac{Pl^3}{3EI} = \frac{500^{\#}(11.73)^3}{3(29\times10^6)(52.2)} = .000178$$



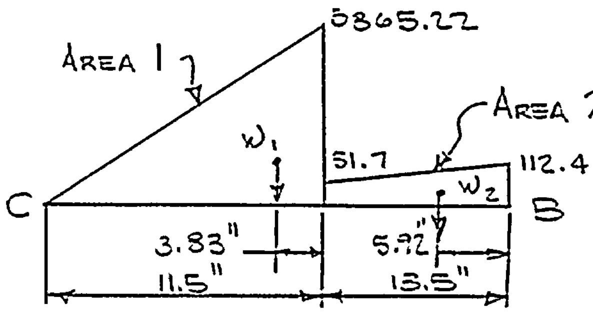
ROTATION AT "B" DUE TO Mo OF M/I DIAGRAM



$M_o = 500(11.73)$
$= 5865$ in#

$$\frac{5865}{52.2} = 112.36 \qquad \frac{2698}{52.2} = 51.69 \qquad \frac{2698}{0.46} = 5865.22$$

$$W_1 = 5865.22\left(\frac{11.5}{2}\right) = 33725 \qquad W_2 = \left(\frac{112.36 + 51.69}{2}\right)(13.5) = 1107.3$$



AREA 1

$CG_{AREA_1} = \frac{1}{3}(11.5) = 3.83$ IN

AREA 2

RECTANGLE:

$CG_R = \frac{1}{2}(13.5) = 6.75$

$A_R = (13.5)(51.7) = 697.95$

TRIANGLE:

$CG_T = \frac{2}{3}(13.5) = 9.0$

$A_T = \frac{1}{2}(13.5)(112.4 - 51.7) = 409.7$

$$CG_{AREA_2} = \frac{(CG_R)(A_R) + (CG_T)(A_T)}{A_R + A_T}$$

$$= \frac{(6.75)(697.95) + (9)(409.73)}{697.95 + 409.73}$$

$= 7.58$ IN

$\therefore$ $13.5 - 7.58 = 5.92$ IN

1006 00

Calculation Sheet	Prepared By:	Date
	Checked By:	Date
Project: SUPPLY SYSTEM	Job No. 82044	File No
Subject: 24" BUTTERFLY VALVE		
System: CSP & CEP	Sheet No.	
Analysis No. 36106 Rev. No. 2		

$$R_B = 33725\left(\frac{7.67}{25}\right) + 1107.3\left(\frac{19.1}{25}\right) = 10346.8 + 845.2$$
$$= 11191.99$$

$$\theta_B = \frac{11191.99}{29\times10^6} = .00039 \text{ rad}$$

DEFLECTION AT POINT "A"

$\delta A'$ due to θ_B
$= .00039(11.73)$
$= .0046$

TOTAL $\delta A = .000178 + .0046 = .00478$

$$K = \frac{500^{\#}}{.00478} = 104603^{\#}/\text{in}$$

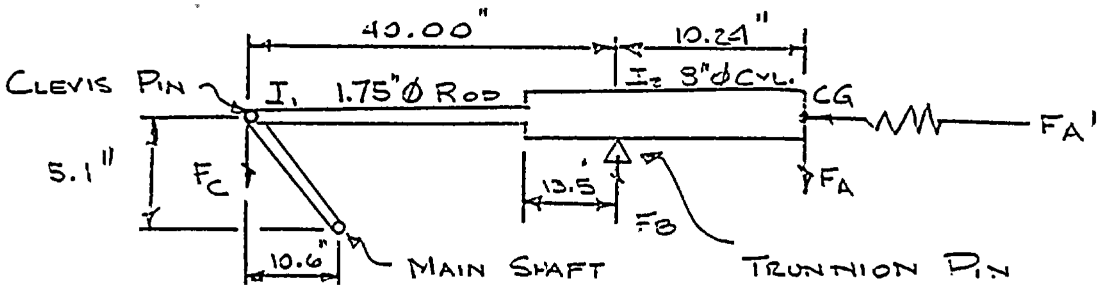
$$f_n = \frac{1}{2\pi}\sqrt{\frac{104603(386.4)}{399}} = 50.66 \text{ Hz}$$

Calculation Sheet		Prepared By: [illegible]	Date: 11/11/82
		Checked By: [illegible]	Date: [illegible]
Project: SUPPLY SYSTEM		Job No. 82044	File No. OT.01/F
Subject: 24" BUTTERFLY VALVE			
System: CSP & CEP		Sheet No.	
Analysis No. 361106	Rev. No. 2	361106-43-15	

GROUP II CYLINDER OPERATOR "FAIL CLOSE"

CALCULATE THE NATURAL FREQUENCY OF THE CYLINDER OPERATOR DUE TO THE BENDING STIFFNESS OF THE DRIVE ROD AND THE CYLINDER OPERATOR.

CASE I VALVE OPEN



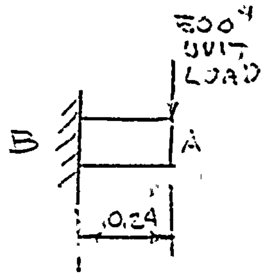
$I_1 = .46 \text{ IN}^4$

$I_2 = \frac{\pi}{64}(8.45^4 - 7.97^4) = 52.2 \text{ IN}^4$

CALCULATION OF f_N:

$$\delta_A = \frac{P\ell^3}{3EI} = \frac{500^{\#}(10.24^3)}{3(29)(10)^6(52.2)} = .000118 \text{ IN}$$

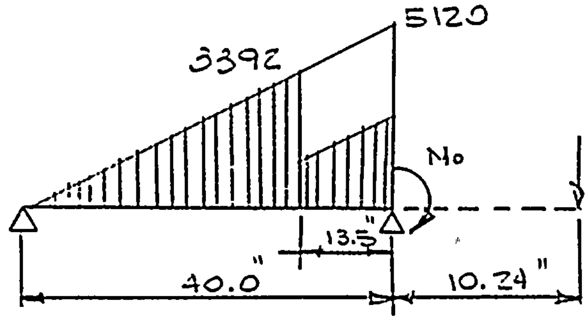
WITH END 'B' FIXED.



1006 00

Calculation Sheet	Prepared By: M. Kundi	Date 11/11/82
	Checked By: L. K...	Date ...
Project: Supply System	Job No. 82044	File No. OT.01/F
Subject: 24" Butterfly Valve		
System: CSP & CEP	Sheet No.	
Analysis No. 361106 Rev. No. 2	361106-4.3-16	

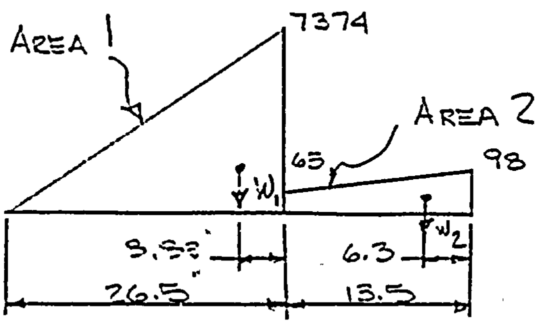
ROTATION AT "B" DUE TO M_o OF M/I DIAGRAM



$M_o = 500(10.24)$
$= 5120$ in#

$\frac{5120}{52.2} = 98.1$ $\qquad \frac{3392}{52.2} = 64.98$ $\qquad \frac{3392}{.46} = 7373.9$

$W_1 = (7373.9)\left(\frac{26.5}{2}\right) = 97704.35$ $\qquad W_2 = \left(\frac{98.1 + 64.98}{2}\right)(13.5) = 1100.8$



AREA 1

$CG_{AREA1} = \frac{1}{3}(26.5) = 8.83$ in

AREA 2

RECTANGLE:

$CG_R = \frac{1}{2}(13.5) = 6.75$

$A_R = (13.5)(65) = 877.5$

TRIANGLE:

$CG_T = \frac{2}{3}(13.5) = 9.0$

$A_T = \frac{1}{2}(13.5)(98-65) = 222.75$

$CG_{AREA2} = \frac{(CG_R)(A_R) + (CG_T)(A_T)}{A_R + A_T}$

$= \frac{(6.75)(877.5) + (9)(222.75)}{877.5 + 222.75}$

$= 7.21$ in

$\therefore 13.5 - 7.21 = 6.3$ in

$R_B = 97704.35\left(\frac{17.67}{40}\right) + 1100.8\left(\frac{33.7}{40}\right) = 43160.9 + 927.42$

$= 44088.32$

$\theta_B = \frac{44088.32}{29\times10^6} = .00152$ rad

Calculation Sheet	Prepared By: M. Kunz	Date
Project: Supply System	Checked By:	Date
Subject: 24" Butterfly Valve	Job No. 83044	File No. OT.01/F
System: CSP & CET	Sheet No.	
Analysis No. 361106 Rev. No. 2	361106-4.3-17	

DEFLECTION OF POINT A

δ_A' due to θ_B

$= .00152(10.24)$

$= .0156$

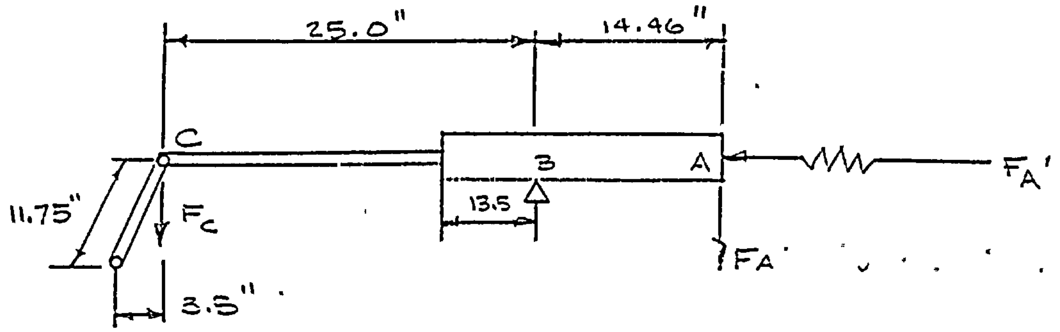
$\therefore$ TOTAL $\delta_A = .000113 + .0156 = .0157$

$k = \frac{500}{.0157} = 31810.7 \frac{\#}{in}$

$f_N = \frac{1}{2\pi}\sqrt{\frac{31810.7(386.4)}{399 \#}} = 27.93$ Hz

(DEAD WEIGHT OF CYL. OPERATOR = 399#)

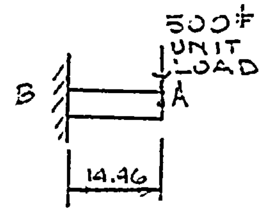
CASE II VALVE CLOSED



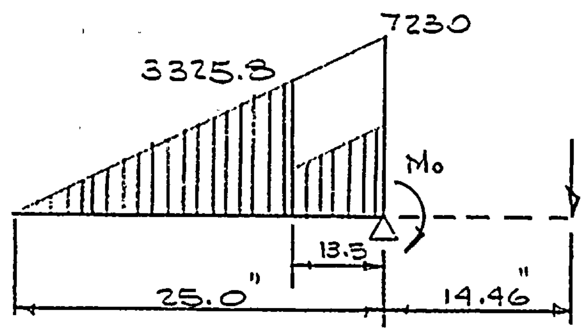
Calculation Sheet	Prepared By: M. Kind	Date: '82
Project: Supply System	Checked By:	Date
Subject: 24" Butterfly Valve	Job No. 32044	File No. 07.01/F
System: CSP & CEP	Sheet No.	
Analysis No. 361106 Rev. No. 2	361106-43-13	

CALCULATION OF f_N:

$$\delta_A = \frac{P l^3}{3EI} = \frac{500^{\#}(14.46)^3}{3(29\times10^6)(52.2)} = .000032$$



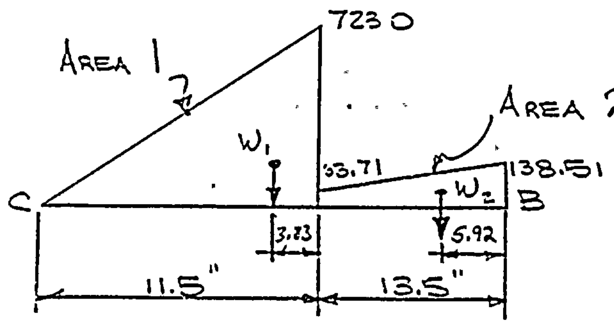
ROTATION AT "B" DUE TO M_0 OF M/I DIAGRAM



$$M_0 = 500(14.46) = 7230$$

$$\frac{7230}{52.2} = 138.51 \qquad \frac{3325.8}{52.2} = 63.71 \qquad \frac{3325.8}{0.46} = 7230$$

$$W_1 = 7230\left(\frac{11.5}{2}\right) = 41572.5 \qquad W_2 = \left(\frac{138.51+63.71}{2}\right)(13.5) = 1364.99$$



AREA 1

$$CG_{AREA\,1} = \frac{1}{3}(11.5) = 3.83 \text{ IN}$$

AREA 2

RECTANGLE:

$$CG_R = \frac{1}{2}(13.5) = 6.75$$

$$A_R = (13.5)(63.71) = 860.09$$

TRIANGLE:

$$CG_T = \frac{2}{3}(13.5) = 9.0$$

$$A_T = \frac{1}{2}(13.5)(138.51-63.71) = 504.9$$

$$CG_{AREA\,2} = \frac{(CG_R)(A_R) + (CG_T)(A_T)}{A_R + A_T}$$

$$= \frac{(6.75)(860.1)+(504.9)(9.0)}{860.09+504.9}$$

$$= 7.58 \text{ IN}$$

$$\therefore 13.5 - 7.58 = 5.92$$

1006 00

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: E. Rubzanski	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: J. L. Searle	Date: 3/30/83
System: CSP and CEP		Job No. 82044	File No. OT.01/F
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.3-19	

$$R_B = 41572.5\left(\frac{7.67}{25}\right) + 1364.99\left(\frac{19.1}{25}\right) = 12754.44 + 1042.85 = 13797.29$$

$$\theta_B = \frac{13797.29}{29\times10^6} = .000476 \text{ rad}$$

Deflection at Point "A"

$\delta A'$ due to θ_B

$= .000476(14.46)$

$= .0069$

Total $\delta A = .0069 + .000032 = .0069$

$$K = \frac{500\#}{.00699} = 72306.99\#/IN$$

$$fn = \frac{1}{2\pi}\sqrt{\frac{(72307)\ (386.4)}{399}} = 42.12 \text{ Hz}$$

CALCULATION OF f_N PARALLEL TO THE DRIVE ROD AND TRUNNION PINS :

(CONTINUED)

CALCULATION OF f_N PARALLEL TO THE DRIVE ROD AND TRUNNION PINS:

APP. B PG. 7/13

BRACKET STIFFNESS IS: (CANTILEVER BEAM OF EFFECTIVE I_{zz})

$$K = \frac{P}{\delta} = \frac{3EI}{l^3} = \frac{3 \times 2.9(10)^7 * 2.16}{(28.5)^3}$$

($2.16\ IN^4$ FOR 8" CYL)
($4.22\ IN^4$ FOR 10" CYL)

$$= .00081 * 10^{-7} = 8100\ lb/in$$

$$M = \frac{(\bar{w}_{AO} + \bar{w}_{BR})}{g} = \frac{(399+277)}{384.6} = 1.76\ \frac{lb\ sec^2}{in}$$

$$f = \frac{1}{2\pi}\sqrt{\frac{K}{M}} = \frac{1}{6.28}\sqrt{\frac{8100}{1.76}} = \underline{10.81}\ hz$$

B) PARALLEL TO DRIVE ROD

SAME MASS, STIFFNESS = EAR BENDING STIFFNESS

APP. B, PG 2/13

EAR STIFFNESS = $K_{yy} = 48 * 10^6\ lb/in$ (10"), $= 7.5(10)^6\ \frac{lb}{in}$ (8")

$$f_n|_{10"} = \frac{10^3}{2\pi}\sqrt{\frac{48}{2.38}} = 715\ Hz$$

$$f_n|_{8"} = \frac{10^3}{2\pi}\sqrt{\frac{7.5}{1.76}} = 328\ Hz$$

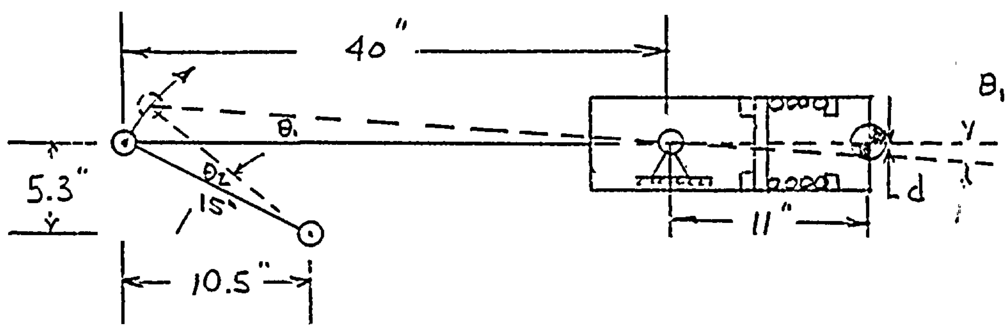
CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: E. R[illegible]	Date: 3/25/83
Subject: 24" Butterfly Valves		Checked By: [illegible]	Date: 3/30/83
System: CSP and CEP		Job No. 82044	File No. 0T.01/F
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4-3-21	

4.3.2.2 APPROXIMATE VALVE FLUTTER MAGNITUDE

USING DIMENSIONS FROM FIGURE 1.3 :



CONSERVATIVELY ASSUME THAT THE MAX ACCELERATION COMPONENT OUTPUT FROM THE PIPING ANALYSIS FOR CSP-V-5 (OPEN / FAIL-OPEN) PRODUCES DISPLACEMENTS OF THE AIR OPERATOR RELATIVE TO THE PIPE IN THE FORM OF

$$d_{max} = \frac{A}{\omega_n^2} \quad \text{WHERE } A = 9.35\,g\text{'s} * 386.4\ \text{in/s}^2 \ (\text{TABLE } 1.1)$$

FROM THE SPECTRA IN SECTION 5.1, FOR HYDRODYNAMIC LOADS:

$$\omega_n\big|_{min} = 2\pi\ (15\ Hz)\ (R/s)$$

$$\theta_1 = \tan^{-1}\frac{d}{11.0} = \tan^{-1}\left(\frac{1}{11}*\frac{9.35*386.4}{(94.2)^2}\right) = \left(\frac{.41}{11}\right) = \tan^{-1}(.04)$$

$$\theta_1 = 2.13^\circ$$

$$\therefore \theta_2 \sim 3 * \theta_1 \sim 6^\circ \quad (\text{SMALL})$$

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: E Rakowski	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: A E Searle	Date: 3/30/83	
System: CSP and CEP	Job No.: 82044	File No.: OT.01/F	
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-22	

4.3.2.3 STRESS ANALYSIS

The procedures for the analysis of the subject valves are outlined below:

1. Recalculate the valve appurtenance stresses addressed in Ref. 4 using response g-levels from the final piping analysis. Incorporate the current seating torque given in Ref. 3. Compare stresses to the appropriate percentage(s) of yield strength as indicated in Summary Table 1.3.

2. Perform a fatigue analysis on significantly stressed components. Determine allowable alternating stress ranges from AISC 8th Edition, Appendix B, noting commentary.

The fatigue analysis is to be performed only for those EPN's subject to hydrodynamic loads. The number of respective load cycles is given below.

LOAD COMBINATIONS & STRESS CYCLES

The following table lists the load combinations and the number of expected stress cycles for each combination. (From the design criteria)

	Combination	Cycles
1.	SRV Alone	13500-200=13300 cycles
2.	OBE+SRV	50
3.	SRV+AP+CHUG	140
4.	SSE+SRV+AP+CHUG	10

Note: Load combination #4 with 150 cycles can be used to conservatively bound combinations 3 and 4.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: R. [illegible]	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: W. E. Searle	Date: 3/30/83
System: CSP and CEP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-23	M

STRESS ANALYSIS OF VALVE AND AIR OPERATOR COMPONENTS NOT COVERED IN QID .018001

1) <u>TRUNNION PINS</u>

TRUNNION PINS WERE ANALYZED AND THE SHEAR STRESS WAS FOUND TO BE PRIMARILY DEPENDENT ON OVERTURNING IN THE 3-AXIS DIRECTION. WHEN ANALYZED WITH AN ACCELERATION IN THIS DIRECTION OF 13.9 g's, THE SHEAR STRESS WAS ONLY 35 PERCENT OF THE ALLOWABLE. THEREFORE THE PINS ARE SUFFICIENT FOR ALL EPN'S.

THIS CALCULATION FOLLOWS:

(CEP-V-3A)

	8"	10"
L_{CG}	14.46	21.50"
X	12.75"	13.38"
A_{TP}	2.41 IN²	2.41 IN²

$L_{ROD} = 25''$ (CLOSED) $\quad L_{CG} = 14.46''$

$$M_1 = \bar{W}_{AO}\, g_3 L_{CG} = (399)(13.9)(14.46) = 80{,}139 \text{ IN\#}$$

$$F_{23} = \frac{M_1}{X} = \frac{80139}{12.75} = 6285\ \#$$

$$F_{11} = \frac{(L_{ROD} + L_{CG})}{L_{ROD}} \frac{\bar{W}_{AO}}{2} g_1 = \frac{39.46(399)(1.04)}{25 \times 2} = 327\ \#$$

$$F_{22} = \frac{\bar{W}_{AO}}{2} g_2 = \frac{399(1.66)}{2} = 332\#$$

$$F_{ST2} = \frac{1201^{\#}}{2} = 601\ \#$$

$$F_{WEIGHT(2)} = \frac{399}{2} = 200\#$$

} $801^{\#}$ FIXED

$F_{ST2} = \dfrac{\text{SEAT TRQUE}}{11.75''} \times \cos 11.32°$

FOR 8"

$= \dfrac{13808^{\text{in\#}}}{} \times .66 = 1150^{\#}$

FOR 10"

$= \dfrac{22{,}174^{\text{in\#}}}{} \times .66 = 1647^{\#}$

SEE EIF R[illegible] [illegible]

CONSERVATIVE COMBINATION

$$\tau = \frac{1}{.75(2.41)} \left\{ \left[(F_{23} + F_{22})^2 + F_{11}^2 \right]^{\frac{1}{2}} + F_{FIXED} \right\} = 4103 \text{ PSI} < 11{,}840 \text{ PSI}$$

(SK)

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: E. Kobanowski Date 1/10/83
Subject: 24" Butterfly Valves	Checked By: D E Searle Date 3/30/83
System: CSP and CEP	Job No. 82044 File No. OT.01/F
Analysis No. 361106 Rev. No. 2	Sheet No. 361106-4.3-24

CLEVIS

4, 32 THE TOTAL LOAD ON THE CLEVIS IS THE VECTOR SUM OF FC → AND FST ↓.

	8"	10"
F_{ST2}	1201# (MAX)	1847#
CLEVIS AREA	2.44^2	2.44 in

$$F_{CLEVIS} = [F_C^2 + F_{STZ}^2]^{\frac{1}{2}}$$

ASSUME UPPER LIMIT OF $g_1 = 15g$'s JUST FOR

4, 33 THIS MEMBER, $F_{STZ} = 1847$#, $W_{Ao} = 539$# (10"), $L_{CG} = 21.5$"

$$F_{CLEVIS} = [1847^2 + 6953^2]^{\frac{1}{2}} = 7194 \#$$

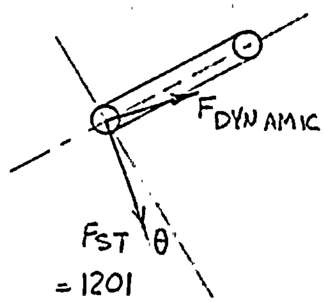
$$\tau_{CLEVIS} = 7194\# / 2.44'' = 2949 \text{ PSI} < 28{,}800 \text{ OK}$$

CLEVIS PIN $\tau = 7194\# / 3.53 \text{ IN}^2 * \frac{4}{3} = 2717 \text{ PSI} < 11{,}840$ OK

4, 32 ∴ CLEVIS & PIN ARE GOOD FOR ALL 8" & 10" A/O EPN'S.

DRIVE LEVER

IMPOSE THE SEATING TORQUE LOAD AND DYNAMIC REACTION FORCE ON THE DRIVE LEVER IN THEIR RESPECTIVE DIRECTIONS:



REF 4, PG 35 LOAD Fc WILL INCREASE THE AXIAL FORCE IN THE DRIVE LEVER, HOWEVER, THE MAXIMUM TORQUE ON THE LEVER IS THE SEATING TORQUE. THE AIR OPERATOR TRUNNIONS AND INTERNAL SPRING HOLD THE VALVE STABLE IN THE CLOSED POSITION.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: [signature]	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: D E Searle	Date: 3/30/83	
System: CSP and CEP	Job No. 82044	File No. OT.01/F	
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.3-25	

MAX NORMAL FORCE ON DRIVE LEVER:

$F_{ST}\cos\theta + F_C \sin\theta = 2524$ LB (ENVELOPE)

$1847 \times .99 + 6953 \times .10 =$

MAX AXIAL FORCE ON DRIVE LEVER:

$F_{ST}\sin\theta + F_C\cos\theta = 7068$ LB (ENVELOPE)

1847 .10 6953 .99

REF 4, Pg. 34 — MINIMUM DRIVE LEVER AREA = 1.875 IN², CONSIDERING FAILURE MODES.

AXIAL STRESS:

MAX BENDING MOMENT = 13,808 IN-LB (CONSERVATIVE FOR USE ON MIN. AREA ONLY NEAR CLEVIS PIN)

$\sigma_{AXIAL} = \frac{Mc}{I} + \frac{F_{AX}}{A}$

REF 4, Pg 35 — $\sigma_{AXIAL} = 13{,}808 \times \frac{1.44}{2.99} + \frac{7068}{1.875} = 10{,}420$ PSI

10,420 < 43,200 PSI OK

SHEAR STRESS:

$\tau = \frac{2524}{1.875} = 1346$ PSI < 28,800 PSI OK

DRIVE LEVER SUFFICIENT ON BOTH 8" & 10" A/O's.

1006 00

KEY WAY BEARING STRESS - DUE TO SEATING TORQUE

REF 4, PG 36

$A_B = 0.448 \text{ IN}^2$

$M = 13,800 \text{ IN-LB}$

$\frac{D_{MIN}}{2} = 1.125 \text{ IN}$

$F_{BRG} = \frac{M * 2}{D_{MIN}} = 12,267 \text{ LB}$

$\sigma_{BRG} = \frac{F_{BRG}}{A_B} = 27,381 \text{ PSI}$

27,381 < 43,200 PSI	OK MARGIN = 58%

REF 4, PG 37

SHEAR AREA OF KEY = 1.33 IN^2.

THEREFORE - BEARING STRESS CONTROLS.

MAIN SHAFT:

PRELIMINARY ANALYSIS SHOWS THIS IS NOT A HIGHLY STRESSED COMPONENT, ∴ ANALYZE FOR ENVELOPE LOADS.

STRESS = STRESS DUE TO SEATING TORQUE +
STRESS DUE TO SHEAR OF F_{STZ} +
STRESS DUE TO BENDING OF F_{STZ}.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: [signature]	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: [signature]	Date: 3/30/83	
System: CSP and CEP	Job No.: 82044	File No.: OT.01/F	
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-43-27	

	8"	10"
r =	1.1248"	1.25"
$J = 2I$ =	2.514 IN⁴	3.83 IN⁴
l_5 =	6.005"	6.32"
l_6 =	10.31"	11.18"
I_s =	1.257	1.916
T_s =	13808"#	22174"#

REF 4, PG 49

① $\tau_T = \frac{T\rho}{J} = 22{,}174 \frac{(1.25)}{3.83} = 7237 \text{ PSI}$

② $\tau_{AVE} = \frac{F_{COMB.}}{A}$ FROM FIG. ON PAGE 0, & PG. P

$F_{COMB} = [2524^2 + 7068^2]^{\frac{1}{2}} = 7505 \text{ LB}$

$\tau_{AVE} = \frac{7505}{3.97} = 1890 \text{ PSI}$

③ $M = 1847 \frac{(6.32)(11.18)}{16.315 = (l_6 + l_5)} = 7999 \text{ IN-LB}$

$\sigma = \frac{Mc}{I} = 7999 \frac{(1.1248)}{1.257} = 7158 \text{ PSI}$

CONSERVATIVELY ADDING SHEAR STRESSES

τ = 7237 + 1890 = 9127 PSI < 14,500 OK	
& σ = 7158 PSI < 21744 OK	

RESULT GOOD FOR BOTH 24" & 30" VALUES

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: [signature]	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: [signature]	Date: 3/30/83
System: CSP and CEP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-28	

Disc

The stresses in the disc were shown on page 51 of Ref. 4 to be due almost entirely to the pressure load. Since the stress found in Ref. 4 of 3871 PSI will not change significantly for the new accelerations, the disc is acceptable.

Taper Pins

The stress in these pins is due only to the seating torque. The stress in Ref. 4, page 53, is 10,753 PSI and is therefore acceptable. For the new, lower seating torque, the stress becomes 8710 PSI.

Analysis for: Drive Rod, cylinder bushing pressure, valve ears and valve ear bolts.

Method I: Use element forces and moments output from the piping analysis (Summary Table 1.1) and the absolute sum of stresses. The conservatism of SRSS summing of the component stresses cannot be assured because the independence of the six element forces (/moments) cannot be determined without analysis of modal participation.

Method II: Use the north, east and vertical operator accelerations output from the piping analysis. Absolute sum for stresses with each component then SRSS over results for N,E and V.

Note 1: Analysis of the distribution of stress on 4 valve ears to predict the maximum tensile stress cannot confirm a maximum value lower than the absolute sum of the elemental tensil stresses due to the six forces (from one acceleration direction, N,E or V). Therefore the absolute sum will be used at this level.

Note 2: Add stress due to the vector sum of deadweight plus seating torque force after above SRSS combinations are performed. (ABS)

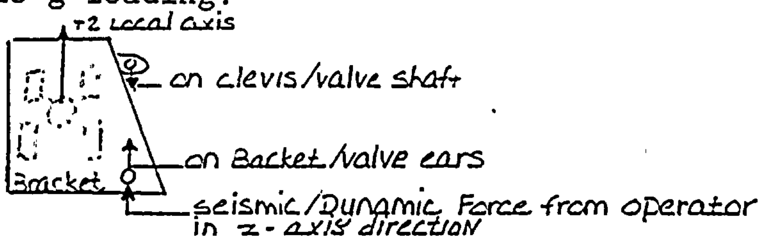
Note 3: 10" A/O parameters are shown for use in QID 361104.

Analysis of Seating Torque Forces

1) Seating Torque loads control the stress in the valve lever arm, keyway, shaft and taper pins. These stresses were less than allowables for the valves of seating torque given in Ref. 3, for all valves.

2) For valve EPN's which are Fail-Open with Use-Code 2, no seating torque forces are applied during the faulted and upset conditions (CSP-V-5,6).

3) For the Fail-Closed valves, the forces at the trunnion pins are shown below, along the cylinder axis, for +2-axis g-loading:



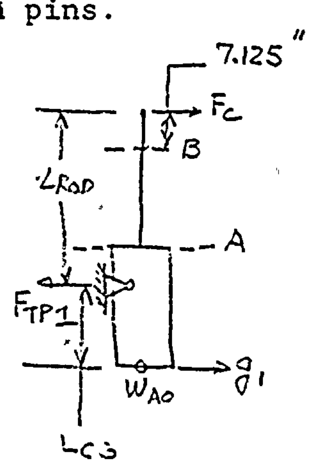
Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: [signature]	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: D. E. Searle	Date: 3/30/83	
System: CSP and CEP	Job No.: 82044	File No.: OT.01/F	
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-30	

As the bracket deflects in +2, under dynamic loads, the seating torque force is releived. The extent of relief depends on the relative stiffness of the bracket and valve ears relative to the valve seat. Since the steel backets and ears are very stiff in this direction, little relief can be expected. Hence seating torque forces will be added as an ABS sum to the valve ears. However, seating torque force will oppose operator weight when the brackets hangs downward from horizontal pipes.

Operator Drive Rod

Drive rod dynamic stress is due only to g_1 because g_3 and g_2 forces are taken out by trunnion pins. Add seating torque stresses.



$$F_c = \frac{L_{CG}}{L_{ROD}} \bar{W}_{AO} g_1$$

TWO POINTS ARE CRITICAL, PT A AT THE BUSHING AND PT B AT THE REDUCED THREAD DIAMETER

$$M_A = F_c (L_{ROD} - 13.5")$$

$$\sigma_A = \frac{M_A C_A}{I_A}$$

$$M_B = 7.125 \ F_c$$

$$\sigma_B = \frac{M_B C_B}{I_B}$$

	8"	10"
I_A	.4604 IN^4	same
C_A	.875 IN	Same
I_B	.1383 IN^4	Same
C_B	.6478 IN	Same
A_B	1.405 IN^2	✓
A_A	2.41 IN^2	2.41 IN^2

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: E. Kolanowski	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: D. E. Searle	Date: 3/30/83	
System: CSP and CEP	Job No.: 82044	File No.: OT.01/F	
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-31	

FINALLY:

$$\sigma_A)_{OPERATING} = \frac{F_{STZ}}{A_A} + \frac{M_A c}{I_A}\Big)_{DW}$$

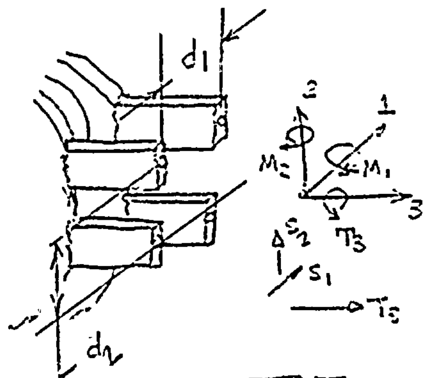
$$\sigma_B)_{OPERATING} = \frac{F_{STZ}}{A_B} + \frac{M_B c}{I_B}\Big)_{DW}$$

} ADD AS ABS SUM AFTER SRSS OF DYNAMIC COMPONENTS

SEISMIC / DYNAMIC FORCES ON VALVE EARS

A SAP-TYPE MASS / STIFFNESS MODEL WAS PREPARED FOR THE PIPING MODEL TO CALCULATE A/O RESPONSE G-LEVELS (SEE ATTACHMENT). THE VALVE-EAR SYSTEM BENDING AND TORSIONAL FLEXIBILITY WAS INCLUDED IN THE MODEL AND SRSS FORCES AND MOMENTS WILL ALSO BE OUTPUT FOR CONVERSION INTO VALVE EAR STRESSES. THE EQUATIONS ARE:

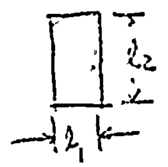
Tension due to M_1 & T_3:
(SEE LOCAL COORD. DEF'N - NEXT PG)



$2Pd_1 = M_1$

$$\sigma_{M_1} = \frac{P}{A} = \frac{M_1}{2d_2 A} \qquad A = \ell_1 \ell_2$$

	8"	10"
ℓ_2 =	2.5"	3"
ℓ_1 =	1.5	1.75
d_1 =	7.5"	9.5"
d_2 =	10.0"	10.5"

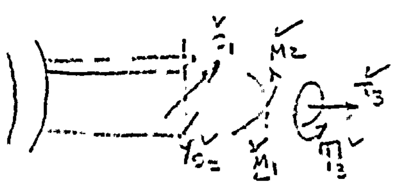


① $\sigma_{T_3} = \frac{P}{4A} = \frac{T_3}{4\ell_1\ell_2}$ (tension due to T_3) + WHEN T_3 = +

② $\sigma_{3\,tension\ due\ to\ M_1} = \frac{M_1}{2d_2\ell_1\ell_2}$

TOP IN TENSION (+) WHEN M_1 IS +

SAP-MODEL:
(SEE ATTCHMNT)
(APPENDIX B)



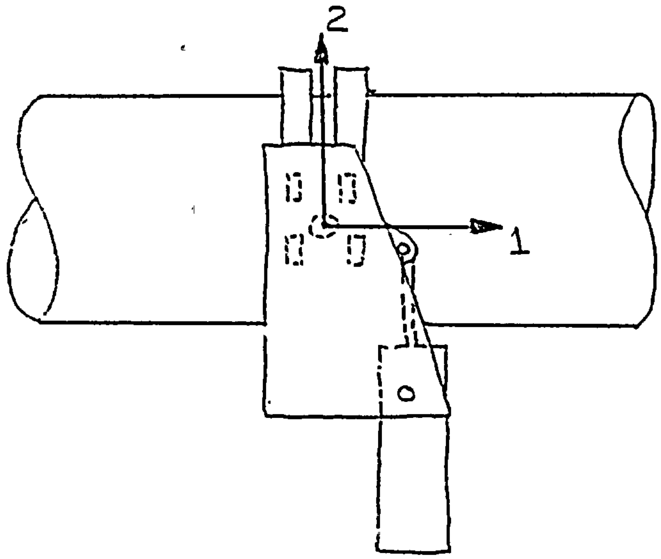
1005 00

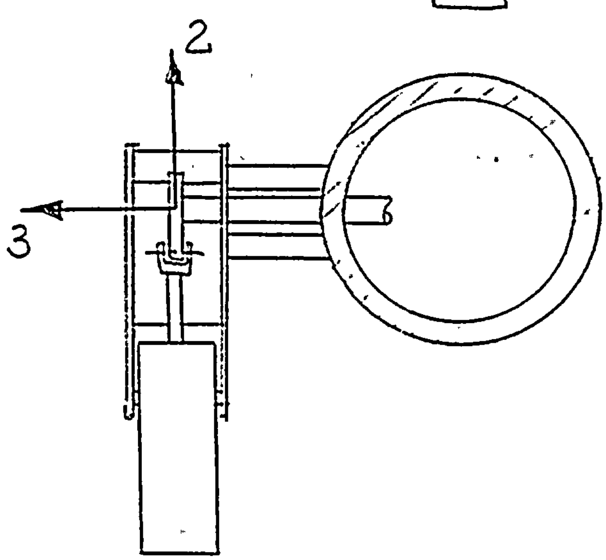
CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: J. E. Kobasuski	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: A. E. Searle	Date: 3/30/83
System: CSP and CEP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-32	D

COORDINATE SYSTEM (LOCAL)



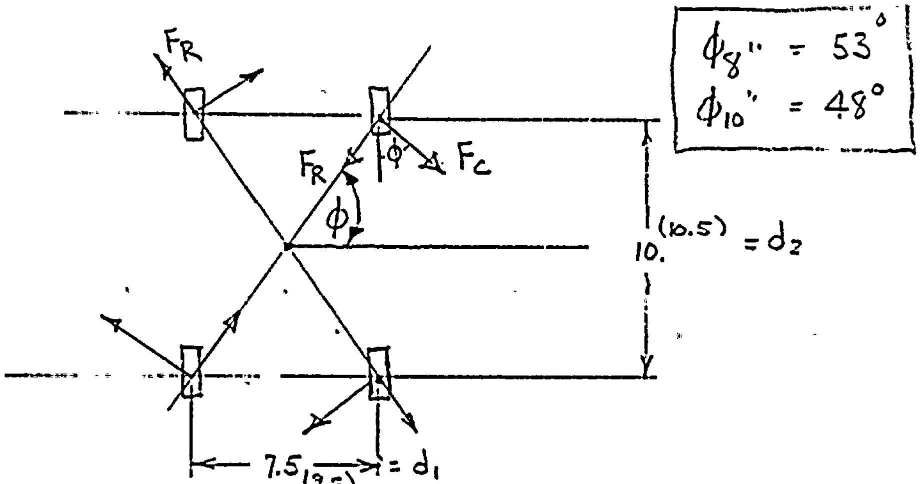


CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: [signature]	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: [signature]	Date: 3/30/83
System: CSP and CEP		Job No. 82044	File No. OT.01/F
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.3-33	

FORCES DUE TO TORQUE



F_R & F_C CONSTRAIN EAR DEFLECTION TO BE TANGENT TO CIRCLE.

F_C IS DETERMINED FROM TORQUE DUE TO d_{CL} * W_{A0+B} .. ETC.

OPERATOR STIFFNESS MODEL, APPENDIX B, DETERMINES THAT

$$F_R = 0.531\,F_C \text{ for } 8" \text{ A/O}$$
$$= 0.488\,F_C \text{ for } 10" \text{ A/O}$$

$$F_C = \frac{\Sigma M_{SHAFT}}{2D}$$

$$D = \frac{1}{2}\left[d_1^2 + d_2^2\right]^{\frac{1}{2}}$$

	8"	10"
d_1	7.5"	9.5"
d_2	10.0"	10.5"

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: [signature]	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: D. E. Searle	Date: 3/30/83	
System: CSP and CEP	Job No. 82044	File No. OT.01/F	
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.3-34	

TENSILE STRESS DUE TO M_Z:

$$2 P d_1 = M_z, \quad \sigma_{M_z} = \frac{P}{A} = \frac{M_z}{2 d_1 A} = \frac{M_z}{2 d_1 l_1 l_2}$$

③ $$\sigma_{M_z \text{tension}} = \frac{M_z}{2 d_1 l_1 l_2}$$

(i.e. LEFT EARS TENSION (+) WHEN $M_z = +$)

Bending due to S_1, S_2 & T_2:

Shear due to T_3:

$$F_c = \frac{T_3}{2D} \qquad D = \text{bolt-circle (dia.)} = \left[(d_1)^2 + (d_2)^2\right]^{\frac{1}{2}} \text{ in}$$

From derivation of stiffness model: (SEE APPENDIX B)

$$F_R = X F_c \qquad X = .531 \text{ for } 8'' \text{ Ao}$$
$$= .488 \quad '' \quad 10'' \text{ Ao}$$

Net force in 1-direction for ear: (any ear) due to T_3 only:

$$F_{11} = -(F_c \sin\phi - F_R \cos\phi) \qquad \phi_{8''} = 53^\circ, \quad \phi_{10''} = 48^\circ$$

$$= -(F_c \sin\phi - X F_c \cos\phi)$$

$$F_{11} = -F_c(\sin\phi - X\cos\phi)$$

$$F_{11} \begin{cases} = -F_c * A_{F_{X8}} \\ = -F_c * A_{F_{X10}} \end{cases} \qquad \begin{matrix} 8'' & A_{F_{X8}}'' = +.47 \\ 10'' & A_{F_{X10}}'' = +.42 \end{matrix}$$

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: E. Rolnowski	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: D. E. Searle	Date: 3/30/83
System: CSP and CEP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-35	

(3) [initials] 6/3/83 J C Fernandez 6/9/83

SHEAR FORCE DUE TO T_3 ON EACH EAR IN THE Z-AXIS DIRECTION.

$$\underline{F_{zz}} : (F_c \cos\phi + F_R \sin\phi)$$
$$\cdots (F_c \cos\phi + xF_c \sin\phi)$$

$$F_{zz} = F_c(\cos\phi + x\sin\phi) = AF_y * F_c$$

F_{zz}			
	$AF_y)_{8''}$ =	1.03	SAME ϕ-fn for 8" & 10"
	$AF_y)_{10''}$ =	1.03	

F_{11} & F_{zz} ARE SHEAR FORCES DUE TO T_3 IN THE 1 AND Z-AXIS DIRECTIONS RESPECTIVELY. S_1 & S_2 ARE SIMILAR SHEAR FORCES OUTPUT FROM THE FINAL PIPING ANALYSIS USING THE MODEL IN APPENDIX B.

FOR THE FOLLOWING BENDING EQ, SEE ⟶ ROARK, PG. 96, #1b (a=0)

BENDING MOMENT AT EITHER END OF THE EAR (SEE REF. FOR GEOMETRY)

$$M = \frac{-W\ell^2}{2\ell} = -\frac{W\ell}{2}$$

NOTE: SEE PAGE 4.3-53 OF REVISION 3 (3)

BENDING STRESS AT EAR-CORNER:

$$\sigma_B)_{\text{due to } F_{11}} + \sigma_B)_{\text{due to } F_{zz}} = \sigma_B \text{ DUE TO } T_3$$

(4) $$\sigma_{\text{Bend due to } T_3\text{-Shear}} = \left|\left[(F_{11}\quad)\frac{l_{ave}}{2}\right]\frac{C_1}{I_2}\right| + \left|\left[(F_{zz}\quad)\frac{l_{ave}}{2}\right]\frac{C_2}{I_1}\right|$$

	8"	10"
l_{ave} =	7.125	4.95"
C_1 =	.75	.53
C_2 =	1.25 (max)	1.50

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J E Roborski	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: D. E. Sears	Date: 3/30/83	
System: CSP and CEP	Job No.: 82044	File No.: OT.01/F	
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-36	

and:

Bending due to S_1 & S_2:

(5) $\sigma_{BS1} = \frac{S_1 C_1}{4 I_2}$ love $z=8I_2$ (6) $\sigma_{BS2} = \frac{S_2 C_2}{4 I_1}$ love $z=8I_1$

		8"	10"
$I_1 = \frac{1}{12}bh^3 = \frac{1}{12}l_1 l_2^3 =$		$\frac{1.5}{12}2.5^3 = 1.95\ IN^4$	$\frac{1.75}{12}3^3 = 3.94\ IN^4$
$I_2 = \frac{1}{12}bh^3$	$\frac{1}{12}l_2 l_1^3 =$	$\frac{2.5}{12}1.5^3 = 0.70\ IN^4$	$\frac{3}{12}1.75^3 = 1.34\ IN^4$

EAR TENSILE STRESS IS THE ABSOLUTE SUM OF THE ABOVE EXPRESSIONS (1) ⟶ (6). [USE 10" A/O PARAMETERS FOR QID361104]

SHEAR STRESS ON EARS

$$\tau = \frac{P}{A}$$

DUE TO $S_1 + F_{11}$ $= \frac{S_1}{4 l_1 l_2} + \frac{F_{11}}{l_1 l_2} = \tau_{11}$

AND

DUE TO $S_2 + F_{22}$ $= \frac{S_2}{4 l_1 l_2} + \frac{F_{22}}{l_1 l_2} = \tau_{22}$

EAR SHEAR STRESS RESULTANT $= [\tau_{11}^2 + \tau_{22}^2]^{1/2}$ (VECTOR SUM)

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: E. R[illegible]	Date 1/10/83	
Subject: 24" Butterfly Valves	Checked By: D. E. Searle	Date 3/30/83	
System: CSP and CEP	Job No. 82044	File No. OT.01/F	
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-43-37	

BOLTS HOLDING BRACKETS TO EARS:

BOLT TENSION IS DUE TO M_1, M_2, T_3

BOLT SHEAR IS DUE TO S_1, S_2, T_3

	8"	10"
$A_B = \frac{\pi D^2}{4}$	0.31 IN²	.43 IN²
D	.6273"	.7387"

Tension (ABS SUM):

$$\sigma_{T3} = \frac{T_3}{4 A_B}$$

$$\sigma_T)_{M1} = \frac{M_1}{2 d_2 A_B}$$

$$\sigma_T)_{M2} = \frac{M_2}{2 d_1 A_B}$$

Shear:

$$F_{11}/\text{bolt} = F_C * AF_x$$
$$F_{22}/\text{bolt} = F_C * AF_y$$

(PREVIOUS PAGES ___)

$$\tau_1 = \frac{F_{11}}{A_B} = \frac{F_C * AF_x}{A_B} \longrightarrow \quad (1)$$

$$\tau_2 = \frac{F_{22}}{A_B} = \frac{F_C * AF_y}{A_B} \downarrow \quad (2)$$

Similarly:

$$\tau_{S1} = \frac{S_1}{4 A_B} \longrightarrow \quad (3)$$

$$\tau_{S2} = \frac{S_2}{4 A_B} \downarrow \quad (4)$$

COMBINE IN SAME MANNER AS ON PREVIOUS PAGE FOR EARS BUT SUBSTITUTE A_B FOR $l_1 \times l_2$

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: [signature]	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: D. E. Searle	Date: 5/30/83	
System: CSP and CEP	Job No.: 82044	File No.: OT.01/F	
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-38	

METHOD II — THE PREVIOUS EQUATIONS FOR STRESS BY METHOD I ARE APPLICABLE. HOWEVER,

1) EXPRESSIONS FOR THE SIX FORCES/MOMENTS ARE DERIVED BELOW IN TERMS OF g-level COMPONENTS IN THE LOCAL AXIS SYSTEM (SUBSEQUENTLY DIRECTION COSINES WILL BE USED TO CONVERT THE N, E & V ACCELERATION VECTORS, IN TURN, IN TO LOCAL AXES). (SEE SECTION 5.4)

2) THESE EQUATIONS ARE TO BE USED TO FIND THE FORCES AND MOMENTS ON THE EARS DUE TO THE DEADWEIGHT AND SEATING TORQUE FORCES, FOR CALCULATION OF OPERATING STRESS, FOR USE IN EITHER METHOD 1 & 2.

SEE FORCES & BRACKET ORIENTATION IN LOCAL COORDINATES, NEXT PAGE.

1: T_3 = TORSION ABOUT LOCAL AXIS # 3

$$T_3 = \Sigma M_{SHAFT} (+) = F_{TR_1} e_3 + F_{BR_1} e_4 + F_{AO2} e_2 + F_{BE2} e_1$$

$$= F_{TR1} e_3 + \bar{W}_{BR} g_1 e_4 + \bar{W}_{AO} g_2 e_2 + \bar{W}_{BE} g_2 e_1$$

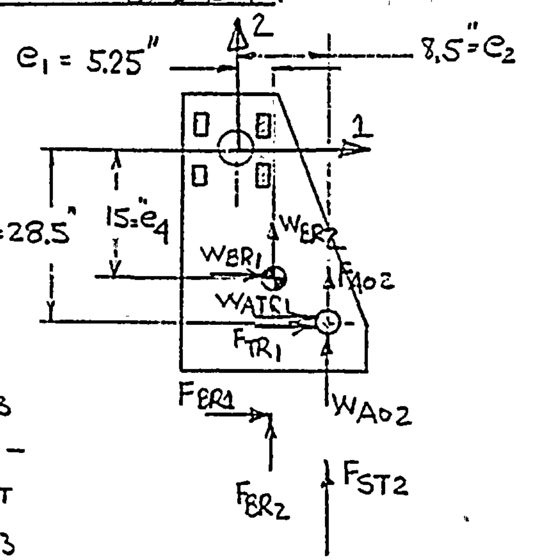
$T_3 = (+)$	$= F_{TR1} e_3 + \bar{W}_{BR} g_1 e_4 + g_2 (\bar{W}_{AO} e_2 + \bar{W}_{ER} e_1)$
$T_{3\ FIXED} = (+)$	$= W_{ATR1} e_3 + (W_{AO2} + F_{ST2}) e_2 + W_{PE1} e_4 + W_{PE2} e_1$

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: E Rolongowski	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: W.E. Searle	Date: 3/30/83
System: CSP and CEP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-39	

<u>FORCES ON SUPPORT EARS DUE TO LOCAL-AXIS ACCELERATIONS g_1, g_2, g_3</u>

<u>FORCES IN THE LOCAL COORDINATE SYSTEM:</u>



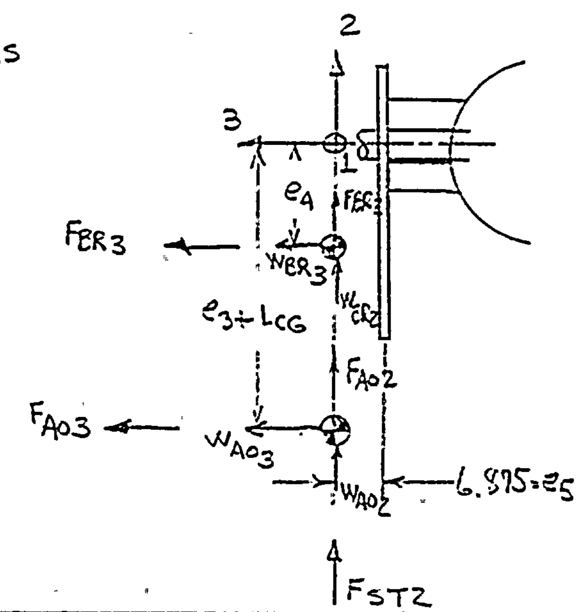
ELEVEN FORCES ACT IN THE LOCAL 1,2,3 A/O AXIS SYSTEM:

DYNAMIC:

- $F_{AO\,2,3} = \bar{W}_{AO} * g_{2,3}$
- $F_{TR\,1}$ = 1-AXIS COMPONENT OF DYNAMIC FORCE AT TRUNNION
- $F_{BR\,1,2,3}$ - 1,2,3 AXIS COMPONENTS OF BRACKET INERTIA $= \bar{W}_{BR} * g_{1,2,3}$

STATIC:

- W_{ATR1} = FORCE AT TRUNNION IN 1-AXIS <u>DUE TO</u> A/O WEIGHT
- $W_{AO\,2,3}$ = WEIGHT OF A/O IN AXES 1,2,3
- $W_{BR\,1,2,3}$ = WEIGHT OF BRACKET IN THE 1,2&3-AXIS DIRECTIONS
- $F_{ST\,2}$ = SEATING TORQUE FORCE, IS ALWAYS ALONG 2-AXIS.



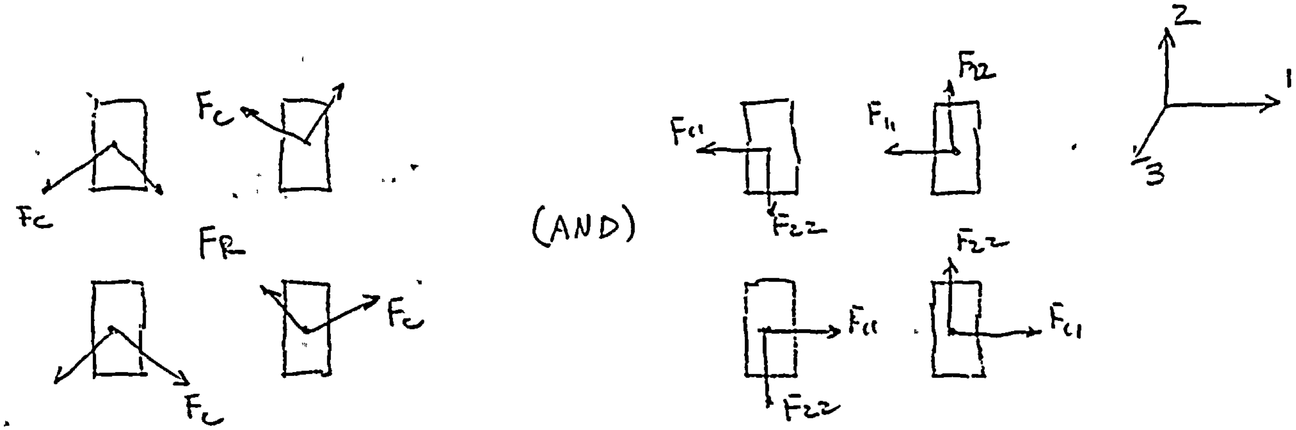
1006 00

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: [signature]	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: D. E. Searle	Date: 3/30/83	
System: CSP and CEP	Job No. 82044	File No. OT.01/F	
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.3-40	

FORCE ORIENTATIONS ON EAES: IF (+ T_3)



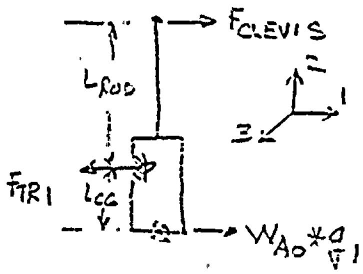
$$S_1 = F_{TR1} + F_{BR1} = \overrightarrow{F_{TR1} + \bar{W}_{ER}\, g_1}^{+}$$

$$S_{1\,FIXED} = \overrightarrow{W_{ER1} + W_{ATR1}}^{+}$$

FROM A FORCE BALANCE OF THE OPERATOR:

$$F_{TR1} = \pm \frac{(L_{ROD} + L_{CG}) * \bar{W}_{AO} * g_1}{L_{ROD}} \quad (+ \text{ FORCES ON BRKT})$$

$$W_{ATR1} = + \frac{(L_{ROD} + L_{CG})\, W_{AO1}}{L_{ROD}}$$



	8"		10"	
	OPEN	CLOSED	OPEN	CLOSED
LROD	40"	25"	40"	25"
LCG	10.96"	14.46	16.25"	21.5"

1006 00

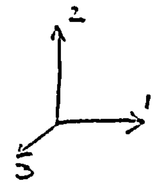
CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: E. Dobrowski	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: D.E. Searle	Date: 3/30/83
System: CSP and CEP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-41	

$$S_2 = F_{AO2} + F_{BR2} = (\bar{W}_{AO} + \bar{W}_{BR})g_2 \quad +\uparrow$$

$$S_{2\,FIXED} = \quad = W_{BR2} + W_{AO2} + F_{ST2} \quad +\uparrow$$

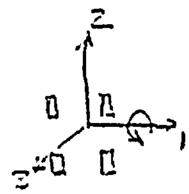


FOR OUT OF PLANE BENDING:

$$M_1 = \circlearrowleft(+) = -F_{AO2}e_5 - F_{BR2}e_5 - F_{AO3}(e_3 + LCG) - F_{BR3}e_4$$

$$M_1 = -(\bar{W}_{AO} + \bar{W}_{BR})g_2 e_5 - \bar{W}_{AO}g_3(e_3 + LCG) - \bar{W}_{BR}g_3 e_4$$

$$M_{1\,FIXED} = (W_{AO2} + W_{BR2} + F_{ST2})e_5 - W_{AO3}(e_3 + LCG) - W_{BR3}e_4$$

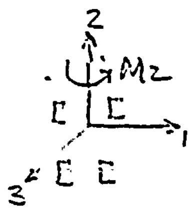


+ = TOP EARS IN TENSION

$$M_2 = (+) = +F_{TR1}e_5 + F_{BR1}e_5 - F_{AO3}e_2 - F_{BR3}e_1$$

$$M_2 = +(F_{TR1} + \bar{W}_{BR}g_1)e_5 - (\bar{W}_{AO}e_2 + \bar{W}_{BR}e_1)g_3$$

$$M_{2\,FIXED} = +(W_{ATR1} + W_{BR1})e_5 - W_{AO3}e_2 - W_{BR3}e_1$$



+ = LEFT EARS IN TENSION

$T_3 = +\swarrow$ (+3 AXIS) $= (\bar{W}_{AO} + \bar{W}_{BR})g_3$	$T_{3\,FIXED} = W_{AO3} + W_{BR3}$

T_3, M_1, M_2, S_1, S_2, & T_3 COMPLETE

4.3.4 Upset Condition Stresses

The cylinder drive rod and valve ears were separately analyzed for upset condition loads for the EPN's and associated response g-levels noted below. All other component faulted stresses are less than the upset allowables except for taper pins and keyway bearing stress. No additional analysis was performed for these components because the stress is controlled by the seating torque only. The allowable stress for the bracket bolts also holds for upset conditions per the AISC manual, 8th Edition. Bolt fatigue is considered as presented in Section 4.3.5.

Upset g-levels (per revised B&R piping analysis, Sec. 5.5)

EPN	N	V	E
CSP-V-3	1.73	1.60	0.96
CSP-V-4	1.14	1.40	1.50
CSP-V-5	0.97	1.40	1.71
CSP-V-6	1.64	1.44	0.59

Component stresses are given in Table 1.2.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: E R Dowski	Date: 1/10/83
Subject: 24" Butterfly Valves		Checked By: A. E. Searle	Date: 3/30/83
System: CSP and CEP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106 - 4.3-43	

Section 4.3.5 - Fatigue Analysis

Discussion

The operator and bracket assembly are not part of the pressure boundary, therefore, the fatigue analysis will be performed in accordance with Appendix B of the AISC Manual for Steel Construction. The following assumptions apply to the fatigue analysis.

1) Faulted stresses (based on piping-analysis accelerations) will be used. This is necessary to insure operability after a design basis event.

2) The actual stresses used will be the ones calculated in Section 4.3.

3) If the alternating portion of the stress has been calculated separately only this part will be used. If the operating loads (i.e. seating torque effects) are already included in the stress analysis it will be conservative to use the calculated stress value. As long as no failures occur, the operating stress does not need to be extracted.

4) The allowable stress will be based on Table B3 of Appendix B in the AISC Manual of Steel Construction.

5) A factor of 1.5 will be applied to the allowable because of the low number of cycles. (Per Section 1.7 of the Commentary on the AISC Manual).

6) The actual stress range is taken as 2 times the maximum stress for components subject to alternating tension and compression.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: E Rokowski	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: A. Searle	Date: 3/30/83	
System: CSP and CEP	Job No.: 82044	File No.: OT.01/F	
Analysis No.: 361106	Rev. No.: 2	Sheet No.: 361106-4.3-44	

7) Bracket bolting is assumed to be properly tightened and will not be considered for fatigue per Section B3.1 of the AISC Manual.

The table on the following page gives the calculated stress range, stress category, and allowable for the critical components. The following page gives excerpts from Appendix B of the AISC Manual showing the descriptions of the relevent stress categories.

Fatigue Analysis (cont.)

ITEM	STRESS TYPE	STRESS (PSI)	STRESS RANGE (PSI)	STRESS CATEGORY	1.5 x ALLOW (FROM AISC)
TRUNNION PIN	τ	4108	8216	F(1)	22500
DRIVE ROD (MAX)	σ	- SEE TABLE 1.2 -		A	90000
SUPPORT EARS	σ	- SEE TABLE 1.2 -		A	90000
MAIN SHAFT	σ τ	9127 8064	18,254 16,128	A A	90000 90000

NOTES:

(1) Assume shear stress on nominal area of a stud type shear connection.

Note that this comparison includes all of the load combinations in one conservative comparison using the maximum stress and the total number of cycles ([3 x 4478] + 60 = 13494 cycles).

Calculation Sheet	Prepared By: [illegible]	Date 11/19/82
Project [illegible]	Checked By: [illegible]	Date [illegible]
Subject [illegible]	Job No. 8C044	File No. OT.01/F
System CSP & CSP	Sheet No.	
Analysis No. 361106 Rev. No. [illegible]	361106-4.3-46	

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FATIGUE ANALYSIS (CONT.)

THE TABLE BELOW HAS BEEN CONDENSED FROM APPENDIX B OF THE AISC MANUAL OF STEEL CONSTRUCTION. THE CASES USED ARE MARKED WITH AN ARROW.

General Condition	Situation	Kind of Stress[a]	Stress Category. (See Table B3)	
Plain material	Base metal with rolled or cleaned surfaces.	T or Rev.	A	⟵ (90,000)
Built-up members	Base metal and weld metal in members, without attachments, built-up of plates or shapes connected by continuous full- or partial-penetration groove welds or continuous fillet welds parallel to the direction of applied stress.	T or Rev.	B	
	Calculated flexural stress, f_b, in base metal at toe of welds on girder webs or flanges adjacent to welded transverse stiffeners.	T or Rev.	C	
	Base metal at end of partial-length welded cover plates having square or tapered ends, with or without welds across the ends.	T or Rev.	E	
Mechanically fastened connections	Base metal at gross section of high-strength-bolted friction-type connections, except connections subject to stress reversal and axially loaded joints which induce out-of-plane bending in connected material.	T or Rev.	B	
	Base metal at net section of other mechanically fastened joints.	T or Rev.	D	
	Base metal at net section of high-strength bolted bearing connections.	T or Rev.	B	
Attachments	Shear stress on nominal area of stud-type shear connectors.	S	F	⟵ (22,500)

1006 00

CYGNA

Calculation Sheet

Project: WPPSS - Equipment Qualification	Prepared By: [illegible]	Date: 4.29.83
Subject: 24" Butterfly Valves	Checked By: [illegible]	Date: 5/16/83
System: CSP & CCP	Job No. 82044	File No. 17.01.F
Analysis No. 36106	Rev. No. 2	Sheet No. 36106-[illegible] 67

8" Miller Air Cylinder

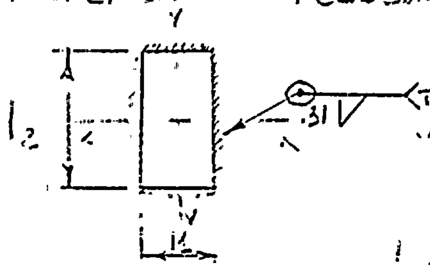
WELD STRESS COMPUTATION - VALVE FLANGE "EAR" CONNECTION

COMPILED PROGRAMS - APPENDIX A - SECTION 4
WILL BE MODIFIED IN THE FOLLOWING MANNER

1.) "EAR" PROPERTIES (AREA, SECTION, MODULUS OF INERTIA ETC) PREVIOUSLY HAVE BEEN USED IN THE DISTRIBUTION OF THE TOTAL LOAD ABOUT THE "EAR" GROUP, TO EVALUATE THE STRESSES DUE TO THIS LOADING (ABSOLUTE SUM/WORST CASE) ON AN INDIVIDUAL EAR. THESE PROPERTIES WILL BE CHANGED TO REFLECT A WELD GROUP VS "EAR" CROSS SECTION.

2.) PROGRAMS WILL BE RERUN YIELDING STRESSES ON AN INDIVIDUAL WELD GROUP ONLY.

REFERENCE: TELECON D. SEARLE (CEC) / R. RICAPPITO (CIF) 4/28/83 (FIELD SKETCH)



ASSUME CS.[illegible] $S_W = bd + \frac{d^2}{3}$

REF: BLODGETT [illegible]

$l_1 = 1.5"$
$l_2 = 2.5"$

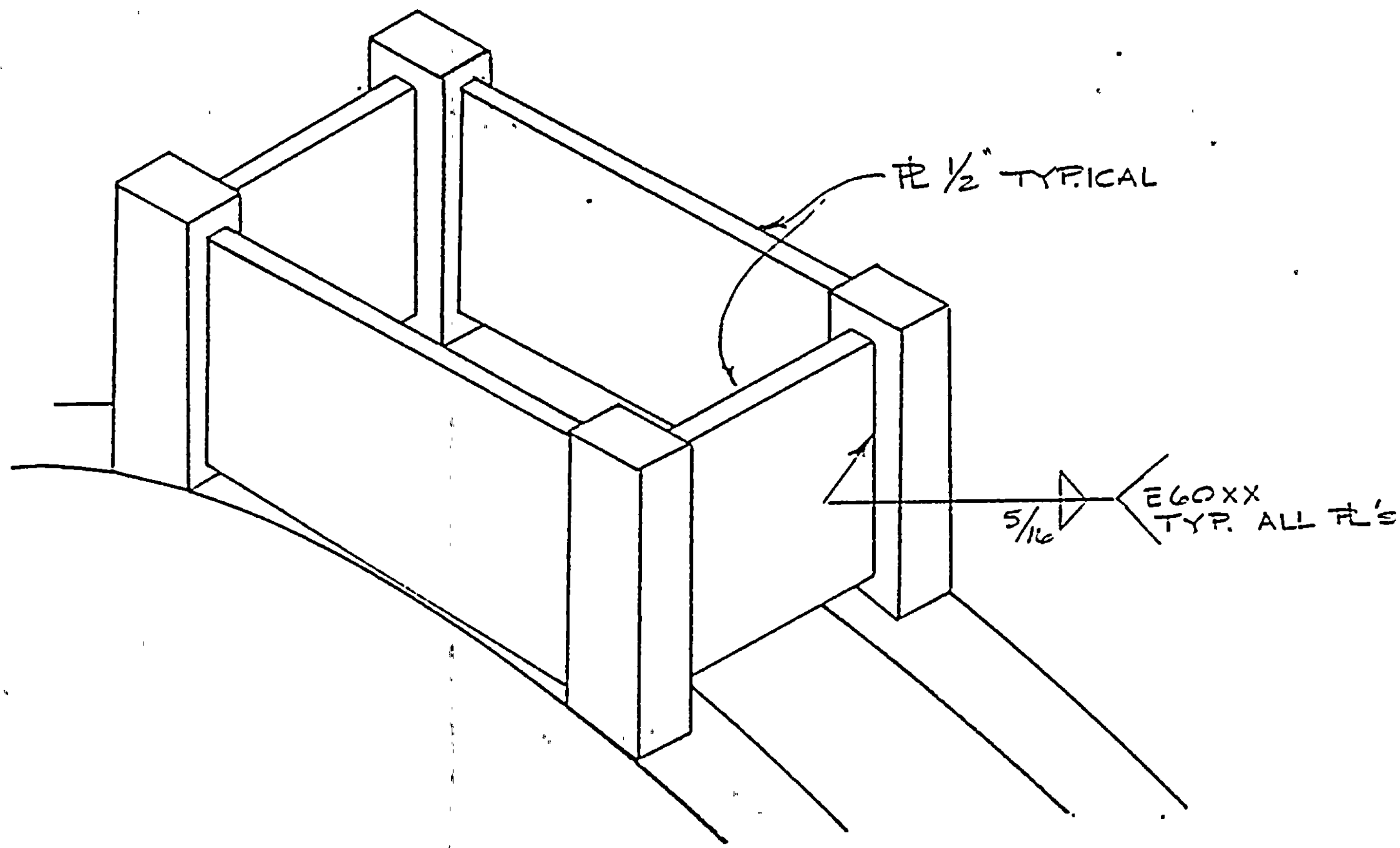
$I_{wx} = .707(.31)(.25)\left[(2.5)(1.5) + \frac{(2.5)^2}{3}\right] = 1.60\ in^4$

$I_{wy} = .707(.31)(.75)\left[(2.5)(1.5) + \frac{(1.5)^2}{3}\right] = 0.74\ in^4$

TOTAL SHEAR AREA $= (2)(2.5 + 1.5)(.707)(.31) = 1.77\ in^2$

Calculation Sheet

Project: WPPSS-EQUIPMENT QUALIFICATION	Prepared By: Don Searle	Date: 5/5/83	
Subject: BIF VALVES / MILLER OPERATORS	Checked By: [illegible]	Date: 5/16/83	
System: CEP & CSP	Job No: 82044	File No: CT.01.F	
Analysis No: 01D	Rev. No: .361106 2.	Sheet No: 361106-4.3.48	



PROPOSED

BRACKET EARS AND SHEAR PLATE ARRANGEMENT

1/2" PLATES TYP.

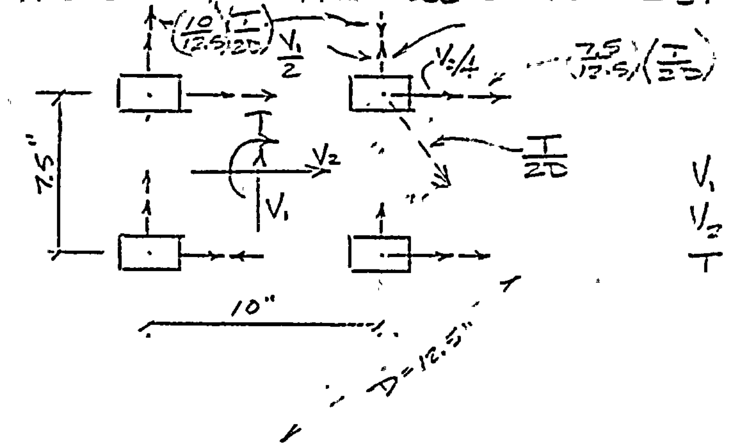
Calculation Sheet

Project: WPPSS Equipment Qualification	Prepared By: [signature]	Date: 5/15/85	
Subject: 24" R/F Butterfly Valve/w3" Hillerhoek	Checked By: [signature]	Date: 5/16/85	
System: CEP · CSP	Job No. 82044	File No. 17.01.F	
Analysis No. 361106	Rev. No. 2	Sheet No. 361106 - 4.3 · 49	△3

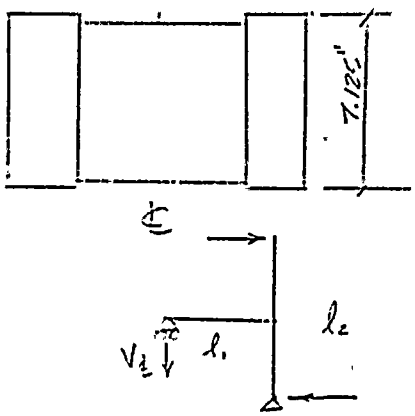
△3 [signature] 6/9/85 [signature] 6/9/85

WEB PLATE DESIGN

THE WEB PLATE RESISTS ONLY THE SHEAR LOADS APPLIED TO THE TOP OF THE SUPPORT EAR CONFIGURATION. THE WORST CASE RESULTS FROM CSP-V-5 WILL BE USED FOR DESIGN. THE MOMENTS ARE RESOLVED BY PURE AXIAL LOADS IN THE EARS, AS IS THE TENSILE LOAD. THE SHEAR AND TORSIONAL LOADS PRODUCE STRESSES IN THE WEB PLATES.



$V_1 = 4772^{\#}$
$V_2 = 3021^{\#}$
$T = 106483''^{\#}$



Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 5/11/83
Subject: 24" BIF Butterfly Valve w/ 8" Miller Oper.		Checked By: [signature]	Date: 5/13/83
System: CEP / CSP		Job No. 82044	File No. 17.01.=
Analysis No. 361106	Rev. No. 2	Sheet No. 361106 4.3-50 △3	

△3 [signature] 6/9/83

For PL on 10" side

$$V_{CL}(l_1) = \left[\frac{V_2}{4} + \left(\frac{7.5}{12.5}\right)\left(\frac{T}{2D}\right)\right] l_2$$

$$V_{CL} = \frac{\left[\frac{3021}{4} + \left(\frac{7.5}{12.5}\right)\left(\frac{106643}{2(12.5)}\right)\right] 7.125}{(10/2)}$$

$$= \frac{(755 + 2559)\, 7.125}{5}$$

$$= 1076 + 3647 = 4723$$

For PL on 7.5" side

$$V_{CL}(l_1) = \left[\frac{V_1}{4} + \left(\frac{10}{12.5}\right)\left(\frac{T}{2D}\right)\right] l_2$$

$$V_{CL} = \frac{\left[\frac{4772}{4} + \left(\frac{10}{12.5}\right)\left(\frac{106643}{2(12.5)}\right)\right] 7.125}{(7.5/2)}$$

$$= \frac{(1193 + 3413)\, 7.125}{3.75}$$

$$= 2267 + 6485 = 8751$$

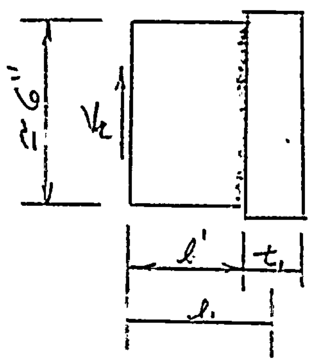
CYGNA

Calculation Sheet

Project: WPPSS EQUIPMENT QUALIFICATION	Prepared By: [signature]	Date: 5/15/83	
Subject: 24" B/F BUTTERFLY VALVE /W 9" WELLER OP	Checked By: [signature]	Date: 5/17/83	
System: CEP & CSP	Job No. 82044	File No. IT.1.F	
Analysis No. 361106	Rev. No. 2	Sheet No. 361106 4.3-51	(3)

(3) [initials] 6/2/93 FC [initials] 6/9/93

THE RESULTING STRESS ON THE WELDMENT IS A RESULT OF BOTH BENDING STRESS AND DIRECT SHEAR:



FOR 10" SIDE

$V_{CL} = 4723$ LB $t_1 = 2.5"$

$l_1 = 5"$

$M = V_{CL} \times l'$ $l' = 3.75"$

$= 4723(3.75)$

$= 17711$ IN LB

DETERMINE THE THE LOAD PER UNIT LENGTH OF THE WELDMENT ASSUMING A FILLET WELD ON EACH SIDE OF THE PLATE.

$l_w = 2(6") = 12"$

$S_w = \frac{d^2}{3} = \frac{6^2}{3} = 12\ IN^2$

$f_v = \frac{4723^{\#}}{12\ IN} = 394$ LB/IN

$f_b = \frac{17711^{\#"}}{12\ IN^2} = 1476$ LB/IN

$f_{tot} = \sqrt{394^2 + 1476^2} = 1528\ ^{\#}/IN$

CYGNA

Calculation Sheet

Project: WPPSS Equipment Requalification	Prepared By: [signature]	Date: 5/13/83	
Subject: 24" BIF Butterfly Valve w/ 8" Miller	Checked By: [signature]	Date: 5/18/83	
System: CEP & CSP	Job No. 82042	File No. 17.01.F	
Analysis No. 361106	Rev. No. 2	Sheet No. 361106-4.3-52	⚠3

⚠3 [signature] 6/9/93 J.C. Fernandez 6/9/93

For 7½" Side

$V_{\mathcal{L}} = 8751$ $t_1 = 1.5$

$l_1 = 3.75''$

$l' = 3''$ ⚠3

$M = V_{CL} l' =$

$= 26254$ in-lb

The resulting load per unit length is then:

$f_1 = \frac{8751}{12 in} = 729$ #/in

$f_b = \frac{26254}{12 in^2} = 2188$ #/in ⚠3

$f_t = \sqrt{729^2 + 2188^2} = 2306$ #/in

To remain below the allowable fatigue alternating stress allowable of (1.5)(15 ksi) = 22.5 ksi the weldment stress should be equal to or less than half that value

$f_{allow} = \frac{22.5}{2} = 11.25$ ksi

$\left(\tau_{weld} = \frac{2306}{(.707)(.3125)} = 10437 \text{ psi}\right)$ The required weld leg size is then

$\frac{f_{reqd}}{(.707)(f_{allow})} = \frac{2306}{11.25(.707)} = .289 in \Rightarrow 5/16$ ⚠3

CYGNA

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date 6/3/83
Subject: 24" BIF Butterfly Valves/w 8" Miller OP		Checked By: J. Fernandez	Date 6/9/83
System: CEP & CSP		Job No. 82044	File No. 1T.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 361106-4.3-53	

A REVIEW OF REVISION 2 OF THIS REPORT REVEALED THE MISSJUDGEMENT IN ASSUMING THE OPERATOR BRACKET SUPPORT EARS TO BE A FIXED CANTILEVER AS SHOWN ON PAGE 4.3-B5. THE EFFECT ON THE BALANCE OF THE REPORT IS AS FOLLOWS.

1) THE PREVIOUSLY CALCULATED STRESSES FOR THE SUPPORT EARS AND EAR WELDS WOULD BE 2 TIMES THOSE PREVIOUSLY CALCULATED. THIS NECESSITATES MODIFICATION OF THE SUPPORT EARS.

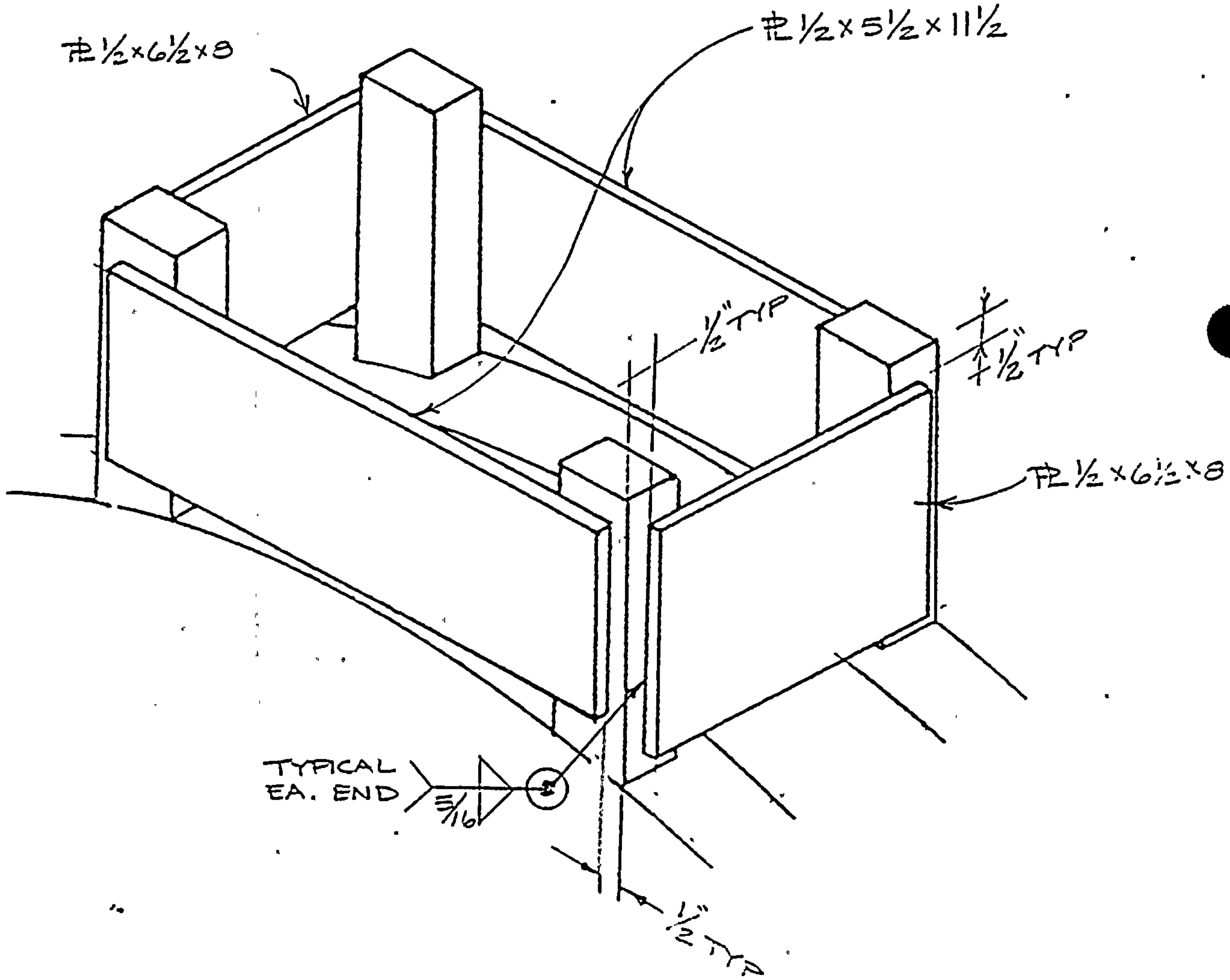
2) THE CALCULATED STIFFNESS USED IN THE B&R PIPING ANALYSIS CAME FROM IN-SITU DEFLECTION TESTS. THIS WOULD REMAIN UNAFFECTED.

THE MODIFICATION OF THE EAR SUPPORT - BRACKET WILL BE ON THE FOLLOWING PAGES. CSP-1-5 WILL BE EXAMINED BECAUSE OF THE HIGHEST EAR AND EAR WELD STRESSES. THE ADDITION OF A SHEAR PLATE ON THE SIDE OF THE EARS WILL NEARLY ELIMINATE ALL OF THE BENDING STRESS ON THE EARS. THE STRESS IN THE EAR: WELDS WILL BE PRIMARILY TO THE AXIAL LOADS AND SHEAR.

CYGNA

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date 5/2/83
Subject: 24" Butterfly Valves with 8" Miller Operator		Checked By: J C Fernandez	Date 6/9/83
System: CEP & CSP		Job No. 82044	File No. 1T.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 361106-4.3-54	



Calculation Sheet

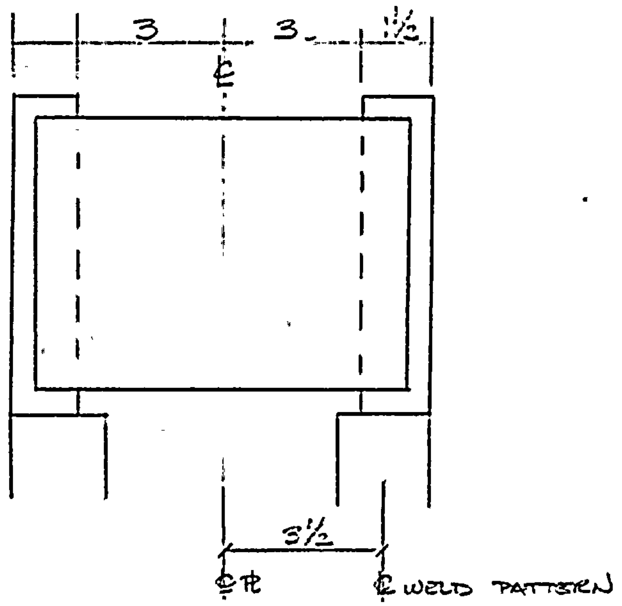
Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 6/3/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: FC Fernandez	Date: 6/9/83
System: CEP & CSP		Job No. 82044	File No. 1T.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 361106-4.3-55	

REINFORCMENT PLATES FOR 24 IN. VALVES

CSPV-5

V_1	4772	SHEAR
V_2	3021	SHEAR
T_3	2325	TENSILE
M_1	76145	MOMENT
M_2	37604	MOMENT
T	106643	TORQUE

DESIGN THE PLATE TO LAP THE SIDE OF THE EAR. FROM PAGE 4.3-52 THE 7½ SIDE IS WORST CASE LOADING.



CYGNA

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 3/3/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: [signature]	Date: 6/9/83
System: CEP & CSP		Job No.: 82044	File No.: 1T.01.F
Analysis No.: 361106	Rev. No.: 3	Sheet No.: 361106-4.3-56	

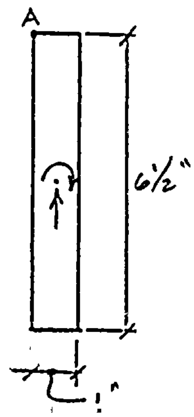
THE SHEAR ON THE WELDMENT IS:

$V_{\mathrm{CL}} = 9376$ IN-LB

THE RESULTING MOMENT IS:

$$M_{\mathrm{WELD}} = V_{\mathrm{CL}} \times 3\tfrac{1}{2}'' = 32816 \text{ IN-LB}$$

THE MOMENT AND SHEAR ARE RESISTED BY THE FOLLOWING WELD PATTERN



THE SECTION PROPERTIES FROM BLODGETT.

$$A_w = (1 + 6\tfrac{1}{2})2t_w = 15t_w$$

$$J_w = \frac{(6\tfrac{1}{2}+1)^3}{6} = 70.3$$

@ POINT A THE HORIZONTAL COMPONENT OF WELD FORCE IS DUE TO TWISTING ONLY

$$f_h = \frac{(M_{\mathrm{WELD}})c}{J_w} = \frac{32816(3.25)}{70.3} = 1517 \text{ LB/IN}$$

@ POINT A THE VERTICAL COMPONENT OF OF THE WELD FORCE IS DUE TO BOTH SHEAR AND TWISTING

$$f_v = \frac{V_{\mathrm{CL}}}{A_w} + \frac{Mc}{J_w} = \frac{9376}{15} + \frac{32816(.5)}{70.3} = 625 + 233$$

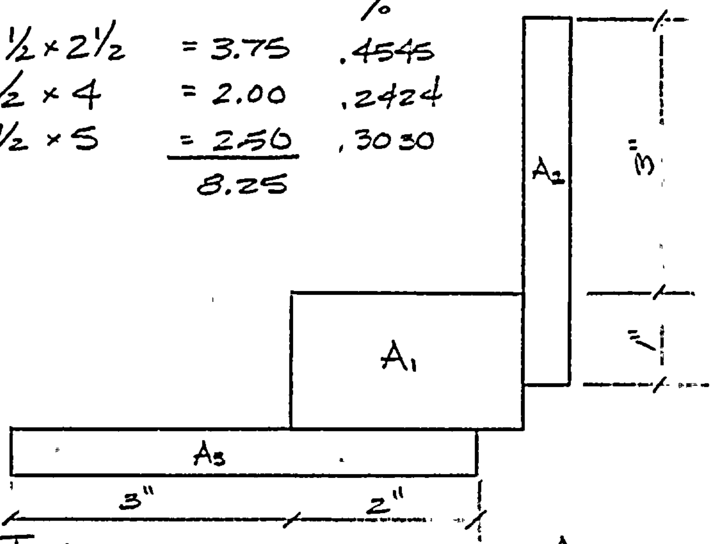
$$= 858 \text{ LB/IN}$$

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 6/8/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: R. C. Fernandez	Date: 6/9/83
System: CEP & CSP		Job No.: 82044	File No.: 1T.01.F
Analysis No.: 361106	Rev. No.: 3	Sheet No.: 361106-4.3-57	

@POINT A A VERTICAL COMPONENT OF THE WELD EXISTS DUE TO AXIAL LOAD IN THE EAR ITSELF. ASSUMING THE PLATE AREA EFFECTIVE IN RESISTING AXIAL LOAD IS 1/2 THE DEPTH THE EFFECTIVE LENGTH WOULD BE 3 IN = 6/2.

			%
A_1 =	$1\frac{1}{2} \times 2\frac{1}{2}$	= 3.75	.4545
A_2 =	$\frac{1}{2} \times 4$	= 2.00	.2424
A_3 =	$\frac{1}{2} \times 5$	= 2.50	.3030
		8.25	



THE TENSILE LOAD APPLIED TO A_1 IS AS FOLLOWS

APPLIED LOAD

V_1	⇒	4772 (7.125) / 7.5 (2)	= 2267
V_2	⇒	3021 (7.125) / 10 (2)	= 1076
P	⇒	2325 / 4	= 531
M_1	⇒	76145 / 2 (10)	= 3807
M_2	⇒	37604 / 2 (7.5)	= 2507
T.	⇒	(6485 - 3647)	= 2838
			13076

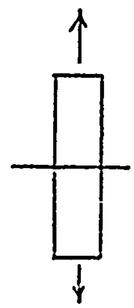
SEE PAGE 4.3-50 FOR DIFFERENCE IN TORSIONAL AXIAL LOADS.

CYGNA

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 6/8/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: L. C. Fernandez	Date: 6/9/83
System: CEP & CSP		Job No. 82044	File No. 1T.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 361106-4.3-58	

SINCE PLATE A, CARRIES 24% OF THE AXIAL LOAD @ ℄ THE WELDMENT ABOVE AND BELOW MUST BE CAPABLE OF TAKING THE LOAD INTO AND OUT OF THE PLATE.



ASSUMING A SHEAR DISTRIBUTION MAXIMUM AT EACH END AND GOING TO ZERO AT THE ℄.

THE RESULTING LOAD @ POINT A WOULD BE

$$\frac{(.2424)(13076)(2)}{(15)(2)} = 211 \text{ \#/in}$$

COMBINE THE VERTICAL LOAD COMPONENTS DIRECTLY AND SUM WITH THE HORIZONTAL BY SRSS.

$$f_{TOT} = \left[(858+211)^2 + 1517^2\right]^{1/2} = 1856 \text{ \#/in}$$

TO REMAIN BELOW THE ALLOWABLE FATIGUE ALTERNATING STRESS VALUE OF $(1.5)(15) = 22.5$ ksi THE WELDMENT STRESS SHOULD REMAIN BELOW HALF OF THAT VALUE.

$$f_{allow} = \frac{22.5}{2} = 11.25 \text{ ksi}$$

Calculation Sheet

CYGNA

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 6/3/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: JC Fernandez	Date: 6/9/83
System: CEP & CSP		Job No.: 82044	File No.: 1T.01.F
Analysis No.: 361106	Rev. No.: 3	Sheet No.: 361106-4.3-59	

THE REQUIRED WELDMENT IS THEN

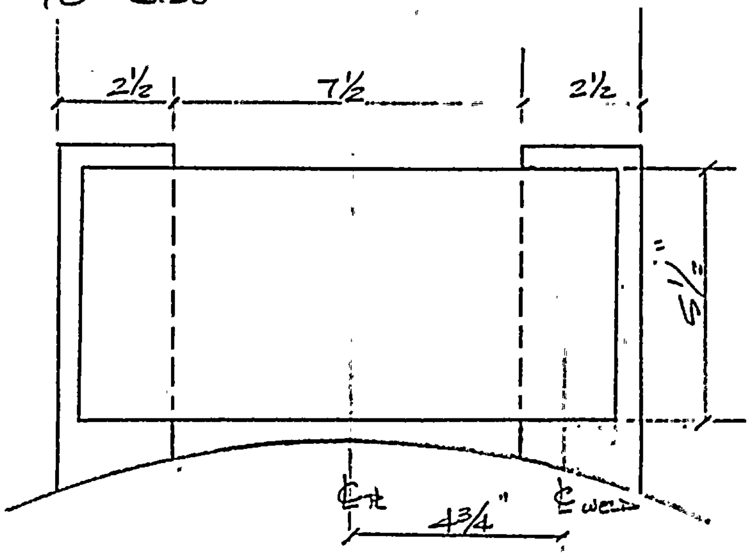
$$\frac{1856}{(t_w)(.707)} \leq 11,250 \text{ PSI}$$

$$t_w \geq \frac{1856}{.707(11250)} = .233 \text{ IN} \quad \text{MIN } 1/4 \text{ FILLET}$$

USE 5/16

$$\sigma_{WELD} = \frac{1856}{(.707)(.3125)} = 8401 \text{ PSI}$$

FOR THE 10" SIDE



FROM PAGE 4.3-50 THE SHEAR @ THE ℄ OF THE PL IS

$$V_{℄} = 4723 \#$$

THE RESULTING MOMENT @ THE ℄ OF THE WELDMENT IS

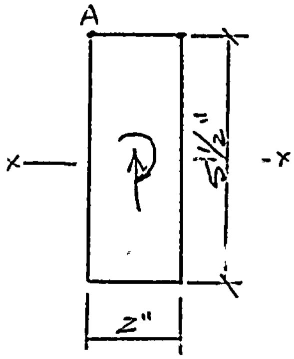
$$M_{WELD} = 4723(4.75) = 22434 \text{ IN LB}$$

CYGNA

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 5/3/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: L.C. Fernandez	Date: 6/9/83
System: CEP & CSP		Job No.: 82044	File No.: 1T.01.F
Analysis No.: 361106	Rev. No.: 3	Sheet No.: 361106-4.3-60	

THE WELDMENT PROPERTIES ARE AS DEFINED BELOW, TREATED AS A LINE



$$\text{AREA} = A_w = (5\tfrac{1}{2}+2)2 = 15\ \text{IN}^2$$

$$J_{WELD} = \frac{(5\tfrac{1}{2}+2)^3}{6} = 70.3$$

$$S_{xx} = bd + \frac{d^2}{3} = (2)(5\tfrac{1}{2}) + \frac{(5\tfrac{1}{2})^2}{3}$$

$$= 11 + 10.1 = 21.1$$

@ POINT A THE HORIZONTAL COMPONENT OF THE WELD FORCE DUE TO TWISTING ONLY IS

$$f_h = \frac{(M_{WELD})C_{VERT}}{J_w} = \frac{22454(5.5/2)}{70.3} = 878\ \text{LB/IN}$$

@ POINT A THE VERTICAL COMPONENT OF THE WELD FORCE DUE TO BOTH SHEAR AND TWISTING

$$f_v = \frac{V_{CL}}{A_w} + \frac{(M_{WELD})C_{HORIZ}}{J_w} = \frac{4723}{15} + \frac{22454(2/2)}{70.3}$$

$$= 315 + 319 = 634\ \#/\text{in}$$

@ POINT A DUE TO AXIAL COMPONENT ON THE EAR

$$f_a = \frac{(.3030)(13076)(2)}{(2)(15)} = 264\ \#/\text{in}$$

CYGNA

Calculation Sheet

Project	WPPSS Equipment Qualification	Prepared By: [signature]	Date 5/3/83
Subject	24" BIF Butterfly Valves with 8" Miller Operator	Checked By: [signature]	Date 6/9/83
System	CEP & CSP	Job No. 82044	File No. 1T.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 361106-4.3-61	

THE ECCENTRIC LOAD OF SHEAR TO THE WELD GROUP DUE TO THE PLATE THICKNESS

$$M_e = V(t/2) = (4723)(.5/2) = 1181$$

$$f_p = \frac{M_e}{S_{xx}} = \frac{1181}{21.1} = 56 \ \#/_{in}$$

COMBINING THE VERTICAL LOADS DIRECTLY AND SRSS THE PERPENDICULAR COMPONENTS THE TOTAL LOAD IS THEN:

$$f_t = \left(878^2 + (634 + 264)^2 + 56^2\right)^{1/2}$$

$$= 1257 \ \#/in$$

USING THE ALLOWABLE STRESS OF 11.25 KSI THE REQUIRED WELDMENT IS THEN

$$t_{REQ'D} = \frac{1257}{.707(11250)} = .158 \text{ IN} \Rightarrow 3/16$$

USE 5/16

$$\tau_{WELD} = \frac{1257}{(.707)(.3125)} = 5689$$

CYGNA

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date 5/3/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: [signature]	Date 6/9/83
System: CEP & CSP		Job No. 82044	File No. 1T.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 361106-4.3-62	

THE AXIAL LOAD IN THE EARS PRODUCED BY THE MOMENTS AND AXIAL LOADS ARE AS FOLLOWS.

FOR CSP-V-5

	AXIAL LOADS	SHEAR LOADS
①	$\frac{4772(7.125)}{7.5(2)} = 2267$	$\frac{4772}{4} = 1193^{\#}\ (V_1)$
②	$\frac{3021(7.125)}{10(2)} = 1067$	$\frac{3021}{4} = 755^{\#}\ (V_2)$
③	$\frac{2325}{4} = 581$	0
④	$\frac{76145}{2(10.0)} = 3807$	0
⑤	$\frac{37604}{2(7.5)} = 2507$	0
⑥	$6485 - 3647 = 2838$ THE DIFFERENCE IN SHEARS DUE TO THE TORSIONAL LOADING FROM PAGE 4.3-60	$3413 = V_{2T}$ $2559 = V_{1T}$ THE SHEAR DUE TO TORSION IS BROKEN UP INTO THE TWO HORIZONTAL DIRECTIONS ON PAGE 4.3-60

TOTAL SUM $= 13076^{\#}$ TENSILE/EAR

TOTAL SUM OF SHEAR $\left((1193+2559)^2+(755+3413)^2\right)^{1/2}$
$= 5608$ LBS SHEAR/EAR

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 6/3/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: [signature]	Date: 6/9/83
System: CEP & CSP		Job No. 82044	File No. IT.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 361106-4.3-63	

THE WELDMENT LENGTH OF THE SUPPORT EAR IS

$$L_w = (1.5" + 2.5")2 = 8"$$

COMBINING THE TENSILE AND SHEAR LOAD BY SRSS AND DIVIDING BY THE LENGTH OF WELD GIVES THE LOAD PER UNIT LENGTH:

$$f_{WELD} = \frac{(13076^2 + 5603^2)^{1/2}}{8\,IN} = 1778\ \#/IN$$

THE RESULTING WELD STRESS FOR A 5/16" WELD IS THEN:

$$\tau_{WELD} = \frac{1778}{(.707)(.3125)} = 8050\ \#/IN^2 \leq 11250\ \#/IN^2$$

∴ OK

THE ALLOWABLE STRESS FOR FATIGUE LOADING OF FILLET WELDS ASSUMING THE ALLOWABLE STRESS TO BE ONE-HALF OF THE AISC ALTERNATING STRESS RANGE AS DEFINED IN APPENDIX B AND COMMENTARY. FOR CATEGORY F, LOADING CONDITION 1, UTILIZING THE 50% INCREASE SPECIFIED IN PARAGRAPH 2 ON PAGE 5-122 OF AISC, THE ALTERNATING STRESS RANGE IS

$$F_{SR} = (15)(1.5) = 22.5\ KSI$$

THE RESULTING ALLOWABLE STRESS IS THEN

$$F_{ALLOW} = F_{SR}/2 = 22.5/2 = 11.25\ KSI$$

CYGNA

Calculation Sheet

Project: WPPSS Equipment Qualification		Prepared By: [signature]	Date: 6/3/83
Subject: 24" BIF Butterfly Valves with 8" Miller Operator		Checked By: J. C. Fernandez	Date: 6/9/83
System: CEP & CSP		Job No. 82044	File No. 1T.01.F
Analysis No. 361106	Rev. No. 3	Sheet No. 361106- 4.3-64	

THE LOADS ON CSP-V-6 HAVE LOWER SHEAR LOADS BUT HIGHER BENDING MOMENTS. REVIEW OF THE BURNS AND ROE LOADS SHOWS THE BRACKET ACCELERATION @ 11.4 g AND THE OPERATING CYLINDER ACCELERATION IN THE SAME DIRECTION AS 2.55 g. THE WEIGHT OF THE BRACKET WAS 277 POUNDS AND THE WEIGHT OF THE CYLINDER WAS 399 LBS. THE TOTAL ASSEMBLY WAS ACCELERATED @ 11.4 g WHEN IN ACTUALITY THE INDIVIDUAL COMPONENTS SHOULD HAVE BEEN ACCELERATED AT THEIR RESPECTIVE "g" LEVELS. UTILIZING THE PROPER GEOMETRY AND ACCELERATIONS THE LOADS APPLIED TO THE SUPPORT BASE IS COMPARABLE TO CSP-V-5. THE BALANCE OF THE COMPONENTS WILL HAVE CONSERVATIVE FINAL STRESSES DUE TO THE HIGH ACCELERATIONS.

CYGNA

Calculation Sheet

Project: Washington Public Power Supply System	Prepared By: [signature]	Date 3/25/83	
Subject: Equipment Seismic/Hydrodynamic Requal.	Checked By: [signature]	Date 3/30/83	
System: CSP & CEP	Job No. 82044	File No. OT.01/F	
Analysis No. 361106	Rev. No. 2	Sheet No. 361106 - 4.3.65	△3

SECTION 4.4 △3 [signature] 6/3/83 J C Fernandez 6/9/83

REFERENCES:

1. BIF Drawings:

   D-207110-H, D-207110-G, (Valve Data Sheets)

   A-206767, 18", 24" & 30" Butterfly Valve - General

   C-26096, "Certified Dimension for Model A-83-B Cylinder"

2. WPPSS Unit 2 Drawings:

CSP-807-81.08	Containment Purge Air Supply
CSP-809-1.2	Suppression Pool Vacuum Breaker
CEP-625-3.4	From Reactor Nozzle X-67 to SGT-Fu-1A, 1B
CEP-625-1.2	From Reactor Nozzle X-67 to SGT-Fu-1A, 1B
D.220-0310	Support and Erection Isometric-IR64 (Johnson Controls)

3. BIF Report TR-27234 and TR-27235, "Dynamic Torque Calculation of Butterfly Valve; Sizes 24 and 30 inch", dated November 10, 1982.

4. Report #TR-74-7 by McPherson Assoc., Inc., "Design & Seismic Analysis 24" Cylinder operated Butterfly Valve." (Rev. 1) 1/5/76.

5. WPPSS letter to Cygna Energy Services, GE-02-RWH-018, 12/17/82.

CYGNA

Calculation Sheet

Project: Washington Public Power Supply System	Prepared By: L.C. Fernandez	Date: 5/27/83	
Subject: Equipment Seismic/Hydrodynamic Requal.	Checked By: [signature]	Date: 5/27/83	
System: CSP & CEP	Job No. 82044	File No. OT.01.F	
~~Analysis No.~~ QID 361106	Rev. No. 2	Sheet No. 4.3.66	△3

△3 [signature] 6/3/83 L.C. Fernandez 6/9/83

SECTION 4.4

REFERENCES (CONTINUED):

6. Cygna Energy Services Communications Report, R. Ricappito, BIF Valve, and J. Rakowski, CES, "BIF Valve Dimensions", 2/11/83.

7. Cygna Energy Services, Project Manual Design Criteria, DC-1, Rev. 1, November, 1982.

8. Cygna Energy Services, Equipment Qualification Walkdown Verification Forms, Revision 1, dated 1/5/83.

9. WPPSS, WNP-2, Safety Related Mechanical Equipment List Summary Sheets, dated 2/10/83.

10. "AISC Manual of Steel Construction", American Institute of Steel Construction, 8th Edition, 1980.

11. Preliminary Transfer of Final Burns & Roe Piping Loads for CSP-V-1,2,3,4,5,6 and CEP-V-3A&4A, received 4/13/83.

12. Cygna Energy Services, "Equipment Seismic and Hydrodynamic Requalification of 30" Cylinder Operated Butterfly Valves for CSP-V-1, & 2, and CEP-V-1A, & 2A," File No. OS.01.F, QID No. 361104, Revision 1, June, 1983.

13. Cygna Energy Services, "Equipment Seismic and Hydrodynamic Requalification for 8", 10" and 12" Bore Air Cylinder Operators," File No. 1P.01.F, QID No. 018001, Revision 0, May, 1983. △3

14. USNRC, "Standard Review Plan, NUREG-0800"

APPENDIX A

COMPILED PROGRAMS AND RESULTS FOR

CSP-V-3

CSP-V-4

CSP-V-5

CSP-V-6

CEP-V-3A

CEP-V-4A

```
sbasic csp34
      tm
?-BASIC Compiler Version 5.4b

REM***** BIF VALVE AND AIR OPERATOR SEISMIC STRESS *****
REM*************** CSP-V/AO-3/4 **************************
REM**SAME ORIENTATION FOR EPN 3&4,SAME PARAMTERS, VARY G'S
REM
var i,j,k = integer
var lrod,lcg,x,phi,lave,ablt,l1,l2,e1,e2,e3,e4,e5 = real
var fst2, ca,ia,cb,ib,aa,ab,d1,d2,c1,i1,c2,i2=real
var lrodo,lcgo,ldr,d, abush, pbush=real
var fcof, fco, ma,mb, siga, sigb, fcdr, fcdrf,maf, mbf=real
var dear, fcear,fr, f11,f22,la, ci12,ci21,stt3,seml=real
var sem2,set3,ses1,ses2,sr,tau11,tau22,tauear,aear=real
var btens, taublt, set3f,sem1f,sem2f,fcearf, frf,f11f=real
var f22f,stt3f,ses1f,ses2f,srf,tau1f,tau2f,taurf=real
var taubf,btf, dsr,dtaur,dtaub,dbten,dsa,dsb,dpb=real
var sdraf,sdrbf,pbushf,tau11f,tau22f=real
var wao,wbr,ftr1,watr1,s1,s1f,s2,s2f,m1,m1f,m2=real
var m2f,t3,t3f,tt3,tt3f,lbr,wtot=real
var bs1,bs2,bt3,bm1,bm2,btt3=real
dim real av(3)
dim real wa(3)
dim real wb(3)
REM
REM *** BURNS 7 ROE EAR FORCES ARE bs1 etc TURN ON WITH K=1***
REM
REM
dim real a(3,3)
dim real b(3)
dim real glc(3,3)
1 - data 7.5, 10, .75, 1.95, 1.25, .7
2   data 25,14.46,.531,53.,7.125,.31,1.5,2.5
3   data 1150.,.875,.46,.648,.138,2.41,1.4
4   data 399,277,5.25,8.5,28.5,15.,6.875
5   data 40.,10.96,26.5,30.5,2.075
6   data 90.,90.,180.,0.,90.,90.
7   data 90.,180.,90.,180.,90.,90.
REM DATA 6&7 FOR VALVE/GLOBAL-G ORIENTATIONS AND WEIGHT VECTOR
restore
read d1,d2,c1,i1,c2,i2
restore 2
read lrod,lcg,x,phi,lave,ablt,l1,l2
restore 3
read fst2,ca,ia,cb,ib,aa,ab
restore 4
read wao,wbr,e1,e2,e3,e4,e5
restore 5
read lrodo,lcgo,ldr,d,abush
restore 6
read  a(1,1),a(2,1),a(3,1),a(1,2),a(2,2),a(3,2)
restore 7
read  a(1,3),a(2,3),a(3,3),av(1),av(2),av(3)
text 0,& INPUT GLOBAL ACCELERATIONS &
input b(1),b(2),b(3)
print
text 0,& INPUT DATA &
print
print "GLOBAL G-LEVELS           = ";b(1),b(2),b(3)
                         LES     = ";a(1,1),a(2,1),a(3,1)
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. A-1

csp(3)4

I' 'UT GLOBAL ACCELERATIONS

? _.66,2.99,3.76

INPUT DATA

GLOBAL G-LEVELS =	2.66	2.99	3.76
NORTH VECTOR ANGLES =	90	90	180
VERTICAL VECTOR ANGLES=	0 90	90	
EAST VECTOR ANGLES =	90	180	90
WEIGHT VECTOR ANGLES =	180	90	90

LOCAL G-LEVELS

-1.01471E-5	2.99	-1.43433E-5
-1.01471E-5	-1.14059E-5	-3.76
-2.66	-1.14059E-5	-1.43433E-5

OPERATING DRIVE ROD STRESS AT A	5525.52
OPERATING DRIVE ROD STRESS AT B	8542.57
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING VALVE EAR TENSILE STR	3795.21
OPERATING VALVE EAR SHEAR STRES	244.962
OPERATING EAR BOLT SHEAR STRESS	2963.25
OPERATING EAR BOLT TENSILE STR	2615.86

D. AMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	15094.5
DRIVE ROD TENSILE STRESS AT B	23086.2
BUSHING PRESSURE	294.409
VALVE EAR TENSILE STRESS	14765.9
VALVE EAR SHEAR STRESS	967.76
EAR BOLT SHEAR STRESS	11706.8
EAR BOLT TENSILE STRESS	14229.2

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	20620.1
DRIVE ROD TENSILE STRESS AT B	31628.7
PUSHING PRESSURE	392.874
VALVE EAR TENSILE STRESS	18561.1
VALVE EAR SHEAR STRESS	1212.72
EAR BOLT SHEAR STRESS	14670
EAR BOLT TENSILE STRESS	16845.1

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01/F
SHEET NO. A-2

csp34
INPUT GLOBAL ACCELERATIONS   (BOLTED WELD)
? 2.66,2.99,3.76

INPUT DATA

GLOBAL G-LEVELS	=	2.66	2.99	3.76
NORTH VECTOR ANGLES	=	90	90	180
VERTICAL VECTOR ANGLES	=	0 90	90	
EAST VECTOR ANGLES	=	90	180	90
WEIGHT VECTOR ANGLES	=	180	90	90

LOCAL G-LEVELS

-1.01471E-5	2.99	-1.43433E-5
-1.01471E-5	-1.14059E-5	-3.76
-2.66	-1.14059E-5	-1.43433E-5

OPERATING DRIVE ROD STRESS AT A	5525.52
OPERATING DRIVE ROD STRESS AT B	8542.57
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING EAR WELD TENSILE STR	4338.59
OPERATING EAR WELD SHEAR STRES	519.72
OPERATING EAR BOLT SHEAR STRESS	2963.24
OPERATING EAR BOLT TENSILE STR	2615.86

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	15094.5
DRIVE ROD TENSILE STRESS AT B	23086.2
BUSHING PRESSURE	294.409
EAR WELD TENSILE STRESS	16435.2
EAR WELD SHEAR STRESS	2053.24
EAR BOLT SHEAR STRESS	11706.8
EAR BOLT TENSILE STRESS	14229.2

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	20620.1
DRIVE ROD TENSILE STRESS AT B	31628.7
PUSHING PRESSURE	392.874
EAR WELD TENSILE STRESS	20773.8
EAR WELD SHEAR STRESS	2572.96
EAR BOLT SHEAR STRESS	14670
EAR BOLT TENSILE STRESS	16845.1

csp34
INPUT GLOBAL ACCELERATIONS
? 66,2.99,3.76

INPUT DATA

GLOBAL G-LEVELS =	2.66	2.99	3.76
NORTH VECTOR ANGLES =	90	90	180
VERTICAL VECTOR ANGLES=	0 90	90	
EAST VECTOR ANGLES =	90	180	90
WEIGHT VECTOR ANGLES =	180	90	90

LOCAL G-LEVELS

-1.01471E-5	2.99	-1.43433E-5
-1.01471E-5	-1.14059E-5	-3.76
-2.66	-1.14059E-5	-1.43433E-5

OPERATING DRIVE ROD STRESS AT A 5525.52
OPERATING DRIVE ROD STRESS AT B 8542.57
OPERATING CYLINDER BRG PRESSURE -98.4646
OPERATING VALVE EAR TENSILE STR 3795.21
OPERATING VALVE EAR SHEAR STRES 244.962
OPERATING EAR BOLT SHEAR STRESS 2963.25
OPERATING EAR BOLT TENSILE STR 2615.86

s1 -906.782
s2f= 1150
t3f=-2.57873E-3
m1f=-7906.15
m2f=-6234.1
tt3f=-12328.8

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 15094.5
DRIVE ROD TENSILE STRESS AT B 23086.2
BUSHING PRESSURE 294.409
VALVE EAR TENSILE STRESS 14765.9
VALVE EAR SHEAR STRESS 967.76
EAR BOLT SHEAR STRESS 11706.8
EAR BOLT TENSILE STRESS 14229.2

s1d= 2711.27
s2d= 2541.76
t3d= 1798.16
m1d= 59281.6
m2d= 22662.6
tt3d= 68555.7

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-4

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 20620.1
DRIVE ROD TENSILE STRESS AT B 31628.7
PUSHING PRESSURE 392.874
VALVE EAR TENSILE STRESS 18561.1
VALVE EAR SHEAR STRESS 1212.72

EAR BOLT SHEAR STRESS 14670
EAR BOLT TENSILE STRESS 16845.1

s1t= 3618.06
s2t= 3691.76
t3t= 1798.16
m1t= 67187.8
m2 28896.7
tt3t= 80884.5

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-5

csp3(4)

INPUT GLOBAL ACCELERATIONS

? 2.96,3.17,4.19

INPUT DATA

GLOBAL G-LEVELS =	2.96	3.17	4.19
NORTH VECTOR ANGLES =	90	90	180
VERTICAL VECTOR ANGLES= 0	90	90	
EAST VECTOR ANGLES =	90	180	90
WEIGHT VECTOR ANGLES =	180	90	90

LOCAL G-LEVELS

-1.12915E-5	3.17	-1.59836E-5
-1.12915E-5	-1.20926E-5	-4.19
-2.96	-1.20926E-5	-1.59836E-5

OPERATING DRIVE ROD STRESS AT A	5525.52
OPERATING DRIVE ROD STRESS AT B	8542.57
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING VALVE EAR TENSILE STR	3795.21
OPERATING VALVE EAR SHEAR STRES	244.962
OPERATING EAR BOLT SHEAR STRESS	2963.25
OPERATING EAR BOLT TENSILE STR	2615.86

D. AMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	16003.2
DRIVE ROD TENSILE STRESS AT B	24476
BUSHING PRESSURE	312.133
VALVE EAR TENSILE STRESS	15743
VALVE EAR SHEAR STRESS	1034.29
EAR BOLT SHEAR STRESS	12511.6
EAR BOLT TENSILE STRESS	15776.8

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	21528.7
DRIVE ROD TENSILE STRESS AT B	33018.6
PUSHING PRESSURE	410.597
VALVE EAR TENSILE STRESS	19538.2
VALVE EAR SHEAR STRESS	1279.26
EAR BOLT SHEAR STRESS	15474.9
EAR BOLT TENSILE STRESS	18392.7

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 0T.01/F
SHEET NO. A-8

sp3④
INPUT GLOBAL ACCELERATIONS
? : ›6,3.17,4.19

FAULTED WELD)

INPUT DATA

GLOBAL G-LEVELS =	2.96	3.17	4.19
NORTH VECTOR ANGLES =	90	90	180
VERTICAL VECTOR ANGLES=	0 90	90	
EAST VECTOR ANGLES =	90	180	90
WEIGHT VECTOR ANGLES =	180	90	90

LOCAL G-LEVELS

-1.12915E-5	3.17	-1.59836E-5
-1.12915E-5	-1.20926E-5	-4.19
-2.96	-1.20926E-5	-1.59836E-5

OPERATING DRIVE ROD STRESS AT A	5525.52
OPERATING DRIVE ROD STRESS AT B	8542.57
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING EAR WELD TENSILE STR	4338.59
OPERATING EAR WELD SHEAR STRES	519.72
OPERATING EAR BOLT SHEAR STRESS	2963.24
OPERATING EAR BOLT TENSILE STR	2615.86

D'. MIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	16003.2
DRIVE ROD TENSILE STRESS AT B	24476
BUSHING PRESSURE	312.133
EAR WELD TENSILE STRESS	17548.3
EAR WELD SHEAR STRESS	2194.4
EAR BOLT SHEAR STRESS	12511.6
EAR BOLT TENSILE STRESS	15776.8

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	21528.7
DRIVE ROD TENSILE STRESS AT B	33018.6
PUSHING PRESSURE	410.597
EAR WELD TENSILE STRESS	21886.9
EAR WELD SHEAR STRESS	2714.12
EAR BOLT SHEAR STRESS	15474.9
EAR BOLT TENSILE STRESS	18392.7

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 0T.01.F
SHEET NO. A-7

csp34)
INPUT GLOBAL ACCELERATIONS
? ~ 96,3.17,4.19

INPUT DATA

GLOBAL G-LEVELS =	2.96	3.17	4.19
NORTH VECTOR ANGLES =	90	90	180
VERTICAL VECTOR ANGLES= 0	90	90	
EAST VECTOR ANGLES =	90	180	90
WEIGHT VECTOR ANGLES =	180	90	90

LOCAL G-LEVELS

-1.12915E-5	3.17	-1.59836E-5
-1.12915E-5	-1.20926E-5	-4.19
-2.96	-1.20926E-5	-1.59836E-5

OPERATING DRIVE ROD STRESS AT A	5525.52
OPERATING DRIVE ROD STRESS AT B	8542.57
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING VALVE EAR TENSILE STR	3795.21
OPERATING VALVE EAR SHEAR STRES	244.962
OPERATING EAR BOLT SHEAR STRESS	2963.25
OPERATING EAR BOLT TENSILE STR	2615.86

s1 -906.782
s2+- 1150
t3f=-2.57873E-3
m1f=-7906.15
m2f=-6234.1
tt3f=-12328.8

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	16003.2
DRIVE ROD TENSILE STRESS AT B	24476
BUSHING PRESSURE	312.133
VALVE EAR TENSILE STRESS	15743
VALVE EAR SHEAR STRESS	1034.29
EAR BOLT SHEAR STRESS	12511.6
EAR BOLT TENSILE STRESS	15776.8

s1d= 2874.49
s2d= 2832.44
t3d= 2000.96
m1d= 65975.4
m2d= 24418.8
tt3d= 72951.2

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. ΔT.01.F
SHEET NO. A-8

F .ED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	21528.7
DRIVE ROD TENSILE STRESS AT B	33018.6
PUSHING PRESSURE	410.597
VALVE EAR TENSILE STRESS	19538.2
VALVE EAR SHEAR STRESS	1279.26
EAR BOLT SHEAR STRESS	15474.9

EAR BOLT TENSILE STRESS 18392.7

s1t= 3781.28
s2t= 3982.44
s3t= 2000.96
m1t= 73881.5
m2' - 30652.9
t,t. .= 85280

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-9

csp3④
INPUT GLOBAL ACCELERATIONS EMERGENCY (ENVELOPES CSA-V-3)
? : :0,1.97,1.71

INPUT DATA

GLOBAL G-LEVELS	=	2.8	1.97	1.71
NORTH VECTOR ANGLES	=	90	90	180
VERTICAL VECTOR ANGLES	=	0 90	90	
EAST VECTOR ANGLES	=	90	180	90
WEIGHT VECTOR ANGLES	=	180	90	90

LOCAL G-LEVELS

-1.06811E-5	1.97	-6.52313E-6
-1.06811E-5	-7.51495E-6	-1.71
-2.8	-7.51495E-6	-6.52313E-6

OPERATING DRIVE ROD STRESS AT A	5525.52
OPERATING DRIVE ROD STRESS AT B	8542.57
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING EAR WELD TENSILE STR	4338.59
OPERATING EAR WELD SHEAR STRES	519.72
OPERATING EAR BOLT SHEAR STRESS	2963.24
OPERATING EAR BOLT TENSILE STR	2615.86

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	9945.23
DRIVE ROD TENSILE STRESS AT B	15210.7
BUSHING PRESSURE	193.975
EAR WELD TENSILE STRESS	10668.6
EAR WELD SHEAR STRESS	1296.94
EAR BOLT SHEAR STRESS	7394.64
EAR BOLT TENSILE STRESS	14365.1

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	15470.8
DRIVE ROD TENSILE STRESS AT B	23753.2
PUSHING PRESSURE	292.44
EAR WELD TENSILE STRESS	15007.2
EAR WELD SHEAR STRESS	1816.66
EAR BOLT SHEAR STRESS	10357.9
EAR BOLT TENSILE STRESS	16980.9

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-10

sp3(4)
INPUT GLOBAL ACCELERATIONS   UPSET   ENVELOPES CSP 1-3)
?^1 14,1.40,1.5

INPUT DATA

GLOBAL G-LEVELS =	1.14	1.4	1.5
NORTH VECTOR ANGLES =	90	90	180
VERTICAL VECTOR ANGLES=	0 90	90	
EAST VECTOR ANGLES =	90	180	90
WEIGHT VECTOR ANGLES =	180	90	90

LOCAL G-LEVELS

-4.34875E-6	1.4	-5.72204E-6
-4.34875E-6	-5.34057E-6	-1.5
-1.14	-5.34057E-6	-5.72204E-6

OPERATING DRIVE ROD STRESS AT A	5525.52
OPERATING DRIVE ROD STRESS AT B	8542.57
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING EAR WELD TENSILE STR	4338.59
OPERATING EAR WELD SHEAR STRES	519.72
OPERATING EAR BOLT SHEAR STRESS	2963.24
OPERATING EAR BOLT TENSILE STR	2615.86

DY''AMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	7067.68
DRIVE ROD TENSILE STRESS AT B	10809.6
BUSHING PRESSURE	137.85
EAR WELD TENSILE STRESS	7558.92
EAR WELD SHEAR STRESS	940.809
EAR BOLT SHEAR STRESS	5364.13
EAR BOLT TENSILE STRESS	6129.04

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	12593.2
DRIVE ROD TENSILE STRESS AT B	19352.2
PUSHING PRESSURE	236.315
EAR WELD TENSILE STRESS	11897.5
EAR WELD SHEAR STRESS	1460.53
EAR BOLT SHEAR STRESS	8327.37
EAR BOLT TENSILE STRESS	8744.9

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. A-11

```
sbasic csp5
      tm
S-BASIC Compiler Version 5.4b

REM***** BIF VALVE AND AIR OPERATOR SEISMIC STRESS *****
REM*************** CSP-V/AO-5 **************************
REM
var i,j,k = integer
var lrod,lcg,x,phi,lave,ablt,l1,l2,e1,e2,e3,e4,e5 = real
var fst2, ca,ia,cb,ib,aa,ab,d1,d2,c1,i1,c2,i2=real
var lrodo,lcgo,ldr,d, abush, pbush=real
var fcof, fco, ma,mb, siga, sigb, fcdr, fcdrf,maf, mbf=real
var dear, fcear,fr, f11,f22,la, ci12,ci21,stt3,sem1=real
var sem2,set3,ses1,ses2,sr,tau11,tau22,tauear,aear=real
var btens, taublt, set3f,sem1f,sem2f,fcearf, frf,f11f=real
var f22f,stt3f,ses1f,ses2f,srf,tau1f,tau2f,taurf=real
var taubf,btf, dsr,dtaur,dtaub,dbten,dsa,dsb,dpb=real
var sdraf,sdrbf,pbushf,tau11f,tau22f=real
var wao,wbr,ftr1,watr1,s1,s1f,s2,s2f,m1,m1f,m2=real
var m2f,t3,t3f,tt3,tt3f,lbr,wtot=real
var bs1,bs2,bt3,bm1,bm2,btt3=real
dim real av(3)
dim real wa(3)
dim real wb(3)
REM
REM *** BURNS 7 ROE EAR FORCES ARE bs1 etc TURN ON WITH K=1***
REM
REM
dim real a(3,3)
dim real b(3)
dim real glc(3,3)
1   data 7.5, 10, .75, 1.95, 1.25, .7
2   data 25,14.46,.531,53.,7.125,.31,1.5,2.5
3   data 0.,.875,.46,.648,.138,2.41,1.4
4   data 399,277,5.25,8.5,28.5,15.,6.875
5   data 40.,10.96,26.5,30.5,2.075
6   data 42.5,47.5,90.,90.,90.,0.
7   data 47.5,137.5,90.,180.,90.,90.
REM DATA 6&7 FOR VALVE/GLOBAL-G ORIENTATIONS AND WEIGHT VECTOR
restore
read d1,d2,c1,i1,c2,i2
restore 2
read lrod,lcg,x,phi,lave,ablt,l1,l2
restore 3
read fst2,ca,ia,cb,ib,aa,ab
restore 4
read wao,wbr,e1,e2,e3,e4,e5
restore 5
read lrodo,lcgo,ldr,d,abush
restore 6
read  a(1,1),a(2,1),a(3,1),a(1,2),a(2,2),a(3,2)
restore 7
read  a(1,3),a(2,3),a(3,3),av(1),av(2),av(3)
text 0,& INPUT GLOBAL ACCELERATIONS &
input b(1),b(2),b(3)
print
text 0,& INPUT DATA &
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/E
SHEET NO. A-12

```
csp5
 I''"UT GLOBAL ACCELERATIONS
? _.?6,3.44,5.42

 INPUT DATA

GLOBAL G-LEVELS          = 2.96            3.44        5.42
NORTH VECTOR ANGLES      = 42.5            47.5        90
VERTICAL VECTOR ANGLES=    90              90         0
EAST VECTOR ANGLES       = 47.5            137.5       90
WEIGHT VECTOR ANGLES     = 180             90          90

 LOCAL G-LEVELS

 2.18234      -1.31225E-5    3.66169
 1.99974      -1.31225E-5   -3.99606
-1.12915E-5    3.44         -2.06756E-5

OPERATING DRIVE ROD STRESS AT A  5048.35
OPERATING DRIVE ROD STRESS AT B  7721.14
OPERATING CYLINDER BRG PRESSURE -98.4646
OPERATING VALVE EAR TENSILE STR  4664.25
OPERATING VALVE EAR SHEAR STRES  297.614
OPERATING EAR BOLT SHEAR STRESS  3600.17
OPERATING EAR BOLT TENSILE  STR  1340.69

 D. .AMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 21519.6
DRIVE ROD TENSILE STRESS AT B 32912.8
BUSHING PRESSURE              419.724
VALVE EAR TENSILE STRESS      20190.5
VALVE EAR SHEAR STRESS        1312.91
EAR BOLT SHEAR STRESS         15882
EAR BOLT TENSILE STRESS       19507

 FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 26567.9
DRIVE ROD TENSILE STRESS AT B 40633.9
PUSHING PRESSURE              518.189
VALVE EAR TENSILE STRESS      24854.8
VALVE EAR SHEAR STRESS        1610.53
EAR BOLT SHEAR STRESS         19482.2
EAR BOLT TENSILE STRESS       20847.7
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. A-13

csp5

INPUT GLOBAL ACCELERATIONS

FAULTED WELD STRESS

? ?6,3.44,5.42

INPUT DATA

GLOBAL G-LEVELS	=	2.96	3.44	5.42
NORTH VECTOR ANGLES	=	42.5	47.5	90
VERTICAL VECTOR ANGLES	=	90	90	0
EAST VECTOR ANGLES	=	47.5	137.5	90
WEIGHT VECTOR ANGLES	=	180	90	90

LOCAL G-LEVELS

2.18234	-1.31225E-5	3.66169
1.99974	-1.31225E-5	-3.99606
-1.12915E-5	3.44	-2.06756E-5

OPERATING DRIVE ROD STRESS AT A	5048.35
OPERATING DRIVE ROD STRESS AT B	7721.14
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING EAR WELD TENSILE STR	5107.51
OPERATING EAR WELD SHEAR STRES	631.431
OPERATING EAR BOLT SHEAR STRESS	3600.17
OPERATING EAR BOLT TENSILE STR	1340.69

D. ?MIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	21519.6
DRIVE ROD TENSILE STRESS AT B	32912.8
BUSHING PRESSURE	419.724
EAR WELD TENSILE STRESS	22736.7
EAR WELD SHEAR STRESS	2785.52
EAR BOLT SHEAR STRESS	15882
EAR BOLT TENSILE STRESS	19507

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	26567.9
DRIVE ROD TENSILE STRESS AT B	40633.9
PUSHING PRESSURE	518.189
EAR WELD TENSILE STRESS	27844.2
EAR WELD SHEAR STRESS	3416.95
EAR BOLT SHEAR STRESS	19482.2
EAR BOLT TENSILE STRESS	20847.7

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. A-14

:sp5
INPUT GLOBAL ACCELERATIONS
? 96,3.44,5.42

INPUT DATA

GLOBAL G-LEVELS	=	2.96	3.44	5.42
NORTH VECTOR ANGLES	=	42.5	47.5	90
VERTICAL VECTOR ANGLES	=	90	90	0
EAST VECTOR ANGLES	=	47.5	137.5	90
WEIGHT VECTOR ANGLES	=	180	90	90

LOCAL G-LEVELS

2.18234	-1.31225E-5	3.66169
1.99974	-1.31225E-5	-3.99606
-1.12915E-5	3.44	-2.06756E-5

OPERATING DRIVE ROD STRESS AT A	5048.35
OPERATING DRIVE ROD STRESS AT B	7721.14
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING VALVE EAR TENSILE STR	4664.25
OPERATING VALVE EAR SHEAR STRES	297.614
OPERATING EAR BOLT SHEAR STRESS	3600.17
OPERATING EAR BOLT TENSILE STR	1340.69

s1 -906.782
s2f=-2.57874E-3
t3f=-2.57873E-3
m1f= 9.89667E-2
m2f=-6234.1
tt3f=-22103.8

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	21519.6
DRIVE ROD TENSILE STRESS AT B	32912.8
BUSHING PRESSURE	419.724
VALVE EAR TENSILE STRESS	20190.5
VALVE EAR SHEAR STRESS	1312.91
EAR BOLT SHEAR STRESS	15882
EAR BOLT TENSILE STRESS	19507

s1d= 3865.34
s2d= 3020.7
t3d= 2325.44
m1d= 76145
m2d= 31369.7
tt3d= 84539.5

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-15

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	26567.9
DRIVE ROD TENSILE STRESS AT B	40633.9
PUSHING PRESSURE	518.189
VALVE EAR TENSILE STRESS	24854.8
VALVE EAR SHEAR STRESS	1610.53

CSD5

INPUT GLOBAL ACCELERATIONS   UPSET

? .97,1.4,1.71

INPUT DATA

GLOBAL G-LEVELS =	.97	1.4	1.71
NORTH VECTOR ANGLES =	42.5	47.5	90
VERTICAL VECTOR ANGLES=	90	90	0
EAST VECTOR ANGLES =	47.5	137.5	90
WEIGHT VECTOR ANGLES =	180	90	90

LOCAL G-LEVELS

.715158	-5.34057E-6	1.15526
-.655321	-5.34057E-6	-1.26075
-3.70025E-6	1.4	-6.52313E-6

OPERATING DRIVE ROD STRESS AT A	5048.35
OPERATING DRIVE ROD STRESS AT B	7721.14
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING EAR WELD TENSILE STR	5107.51
OPERATING EAR WELD SHEAR STRES	631.431
OPERATING EAR BOLT SHEAR STRESS	3600.17
OPERATING EAR BOLT TENSILE STR	1340.69

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	6859.18
DRIVE ROD TENSILE STRESS AT B	10490.7
BUSHING PRESSURE	133.784
EAR WELD TENSILE STRESS	7323.31
EAR WELD SHEAR STRESS	892.936
EAR BOLT SHEAR STRESS	5091.16
EAR BOLT TENSILE STRESS	7599.75

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	11907.5
DRIVE ROD TENSILE STRESS AT B	18211.9
PUSHING PRESSURE	232.249
EAR WELD TENSILE STRESS	12430.8
EAR WELD SHEAR STRESS	1524.37
EAR BOLT SHEAR STRESS	8691.33
EAR BOLT TENSILE STRESS	8940.43

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-18

```
sbasic csp6
tm
S-BASIC Compiler Version 5.4b

REM***** BIF VALVE AND AIR OPERATOR SEISMIC STRESS *****
REM************** CSP-V/AO-6 *************************
REM
var i,j,k = integer
var lrod,lcg,x,phi,lave,ablt,l1,l2,e1,e2,e3,e4,e5 = real
var fst2, ca,ia,cb,ib,aa,ab,d1,d2,c1,i1,c2,i2=real
var lrodo,lcgo,ldr,d, abush, pbush=real
var fcof, fco, ma,mb, siga, sigb, fcdr, fcdrf,maf, mbf=real
var dear, fcear,fr, f11,f22,la, ci12,ci21,stt3,sem1=real
var sem2,set3,ses1,ses2,sr,tau11,tau22,tauear,aear=real
var btens, taublt, set3f,sem1f,sem2f,fcearf, frf,f11f=real
var f22f,stt3f,ses1f,ses2f,srf,tau1f,tau2f,taurf=real
var taubf,btf, dsr,dtaur,dtaub,dbten,dsa,dsb,dpb=real
var sdraf,sdrbf,pbushf,tau11f,tau22f=real
var wao,wbr,ftr1,watr1,s1,s1f,s2,s2f,m1,m1f,m2=real
var m2f,t3,t3f,tt3,tt3f,lbr,wtot=real
var bs1,bs2,bt3,bm1,bm2,btt3=real
dim real av(3)
dim real wa(3)
dim real wb(3)
REM
REM *** BURNS 7 ROE EAR FORCES ARE bs1 etc TURN ON WITH K=1***
REM
REM
dim real a(3,3)
dim real b(3)
dim real glc(3,3)
1   data 7.5, 10, .75, 1.95, 1.25, .7
2   data 25,14.46,.531,53.,7.125,.31,1.5,2.5
3   data 0.,.875,.46,.648,.138,2.41,1.4
4   data 399,277,5.25,8.5,28.5,15.,6.875
5   data 40.,10.96,26.5,30.5,2.075
6   data 90.,90.,0.,0.,90.,90.
7   data 90.,0.,90.,180.,90.,90.
REM DATA 6&7 FOR VALVE/GLOBAL-G ORIENTATIONS AND WEIGHT VECTOR
restore
read d1,d2,c1,i1,c2,i2
restore 2
read lrod,lcg,x,phi,lave,ablt,l1,l2
restore 3
read fst2,ca,ia,cb,ib,aa,ab
restore 4
read wao,wbr,e1,e2,e3,e4,e5
restore 5
read lrodo,lcgo,ldr,d,abush
restore 6
read  a(1,1),a(2,1),a(3,1),a(1,2),a(2,2),a(3,2)
restore 7
read  a(1,3),a(2,3),a(3,3),av(1),av(2),av(3)
text 0,& INPUT GLOBAL ACCELERATIONS &
input b(1),b(2),b(3)
print
text 0,& INPUT DATA &
print
print "GLOBAL G-LEVELS        = ";b(1),b(2),b(3)
print "NORTH VECTOR ANGLES    = ";a(1,1),a(2,1),a(3,1)
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01/E
SHEET NO. A-19

```
0059:00 print
0060:00 for i=1 to 3
0061:01 for j=1 to 3
0062:02   a(j,i)=a(j,i)*2.*3.1416/360.
0063:02   glc(j,i)=b(i)*cos(a(j,i))
0064:02 next j
0065:01 next i
0066:00 for j=1 to 3
0067:01 av(j)=av(j)*2.*3.1416/360.
0068:01 next j
0069:00 print
0070:00 text 0,& LOCAL G-LEVELS &
0071:00 print
0072:00 print glc(1,1),glc(1,2),glc(1,3)
0073:00 print glc(2,1),glc(2,2),glc(2,3)
0074:00 print glc(3,1),glc(3,2),glc(3,3)
0075:00 REM WEIGHT COMPONENTS
0076:00 for j=1 to 3
0077:01 wa(j)=wao*cos(av(j))
0078:01 wb(j)=wbr*cos(av(j))
0079:01 next j
0080:00 phi=phi*2.*3.1416/360.
0081:00 la=lave/2
0082:00 ci12=c1/i2
0083:00 ci21=c2/i1
0084:00 aear=l1*l2
0085:00 REM CALCULATE EAR FORCES USE B&R LOADS AS OPTION LATER
0086:00 REM FIXED COMPONENTS ARE ALWAYS THERE
0087:00 lbr=lrod+lcg
0088:00 watr1=lbr*wa(1)/lrod
0089:00 s1f=wb(1)+watr1
0090:00 wtot=wao+wbr
0091:00 s2f=wb(2)+wa(2)+fst2
0092:00 t3f=wa(3)+wb(3)
0093:00 m1f=-(wa(2)+wb(2)+fst2)*e5-wa(3)*(e3+lcg)-wb(3)*e4
0094:00 m2f=(watr1+wb(1))*e5-wa(3)*e2-wb(3)*e1
0095:00 tt3f=watr1*e3+(wa(2)+fst2)*e2+wb(1)*e4+wb(2)*e1
0096:00 fcdrf=lcg*wa(1)/lrod
0097:00 maf=fcdrf*(lrod-13.5)
0098:00 mbf=fcdrf*7.125
0099:00 sdraf=fst2/aa+abs(maf*ca/ia)
0100:00 sdrbf=fst2/ab+abs(mbf*cb/ib)
0101:00 fcof=lcgo*wa(1)/lrodo
0102:00 pbushf=fcof*(ldr+d)/(d*abush)
0103:00 REM STRESSES FROM FIXED COMPONENTS
0104:00 dear=(d1*d1+d2*d2)**.5
0105:00 set3f=abs(t3f/(4*aear))
0106:00 sem1f=abs(m1f/(2*d2*aear))
0107:00 sem2f=abs(m2f/(2*d1*aear))
0108:00 fcearf=tt3f/(2*dear)
0109:00 frf=x*fcearf
0110:00 f11f=-(fcearf*sin(phi)-frf*cos(phi))
0111:00 f22f=fcearf*cos(phi)+frf*sin(phi)
0112:00 stt3f=abs(f11f*la*ci12)+abs(f22f*la*ci21)
0113:00 ses1f=abs(s1f*ci12*la/4.)
0114:00 ses2f=abs(s2f*ci21*la/4.)
0115:00 srf=set3f+sem1f+sem2f+ses1f+ses2f+stt3f
0116:00 REM EAR SHEAR
0117:00 tau11f=abs(s1f/(4*aear))+abs(f11f/aear)
0118:00 tau22f=abs(s2f/(4*aear))+abs(f22f/aear)
0119:00 taurf=(tau11f*tau11f+tau22f*tau22f)**.5
0120:00 taubf=taurf*aear/ablt
0121:00 REM EARBOLT TENSION
0122:00 btf=(set3f+sem1f+sem2f)*aear/ablt
0123:00 print
0124:00 print"OPERATING DRIVE ROD STRESS AT A ";sdraf
0125:00 print"OPERATING DRIVE ROD STRESS AT B ";sdrbf
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 6T.01/E
SHEET NO. A-90

```
0126:00 print"OPERATING CYLINDER BRG PRESSURE ";pbushf
0127:00 print"OPERATING VALVE EAR TENSILE STR ";srf
0128:00 print"OPERATING VALVE EAR SHEAR STRES ";taurf
0129:00 print"OPERATING EAR BOLT SHEAR STRESS ";taubf
0130:00 print"OPERATING EAR BOLT TENSILE  STR ";btf
0131:00 print
0132:00 REM
0133:00 REM CALCULATE VARIABLE COMPONENTS
0134:00 REM
0135:00 dsr=0.
0136:00 dtaur=0.
0137:00 dtaub=0.
0138:00 dbten=0.
0139:00 dsa=0.
0140:00 dsb=0.
0141:00 dpb=0.
0142:00 for j=1 to 3
0143:01 fco=lcgo*wao*glc(1,j)/lrodo
0144:01 pbush=fco*(ldr+d)/(d*abush)
0145:01 ftr1=lbr*wao*glc(1,j)/lrod
0146:01 s1=ftr1+wbr*glc(1,j)
0147:01 s2=wtot*glc(2,j)
0148:01 t3=wtot*glc(3,j)
0149:01 m1=-wtot*glc(2,j)*e5-wao*glc(3,j)*(e3+lcg)-wbr*glc(3,j)*e4
0150:01 m2=(ftr1+wbr*glc(1,j))*e5-(wao*e2+wbr*e1)*glc(3,j)
0151:01 tt3=ftr1*e3+wbr*glc(1,j)*e4+glc(2,j)*(wao*e2+wbr*e1)
0152:01 fcdr=lcg*wao*glc(1,j)/lrod
0153:01 ma=fcdr*(lrod-13.5)
0154:01 mb=fcdr*7.125
0155:01 siga=ma*ca/ia
0156:01 sigb=mb*cb/ib
0157:01 REM CALCULATE EAR TENSION
0158:01 set3=abs(t3/(4*aear))
0159:01 sem1=abs(m1/(2*d2*aear))
0160:01 sem2=abs(m2/(2*d1*aear))
0161:01 fcear=tt3/(2*dear)
0162:01 fr=x*fcear
0163:01 f11=-(fcear*sin(phi)-fr*cos(phi))
0164:01 f22=fcear*cos(phi)+fr*sin(phi)
0165:01 stt3=abs(f11*la*ci12)+abs(f22*la*ci21)
0166:01 ses1=abs(s1*ci12*la/4.)
0167:01 ses2=abs(s2*ci21*la/4.)
0168:01 sr=set3+sem1+sem2+ses1+ses2+stt3
0169:01 REM EAR SHEAR
0170:01 tau11=abs(s1/(4.*aear))+abs(f11/aear)
0171:01 tau22=abs(s2/(4.*aear))+abs(f22/aear)
0172:01 tauear=(tau11*tau11+tau22*tau22)**.5
0173:01 taublt=tauear*aear/ablt
0174:01 REM EARBOLT TENSION
0175:01 btens=(set3+sem1+sem2)*aear/ablt
0176:01 dsa=dsa+siga*siga
0177:01 dsb=dsb+sigb*sigb
0178:01 dpb=dpb+pbush*pbush
0179:01 dsr=dsr+sr*sr
0180:01 dtaur=dtaur+tauear*tauear
0181:01 dtaub=dtaub+taublt*taublt
0182:01 dbten=dbten+btens*btens
0183:01 next j
0184:00 REM COMBINE STRESSES
0185:00 dsa=dsa**.5
0186:00 dsb=dsb**.5
0187:00 dpb=dpb**.5
0188:00 dsr=dsr**.5
0189:00 dtaur=dtaur**.5
0190:00 dtaub=dtaub**.5
0191:00 dbten=dbten**.5
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 0T.01/F
SHEET NO. A-21

```
dbten=dbten**.5
print
text 0,& DYNAMIC COMPONENTS &
print
print "DRIVE ROD TENSILE STRESS AT A";dsa
print "DRIVE ROD TENSILE STRESS AT B";dsb
print "BUSHING PRESSURE             ";dpb
print "VALVE EAR TENSILE STRESS     ";dsr
print "VALVE EAR SHEAR STRESS       ";dtaur
print "EAR BOLT SHEAR STRESS        ";dtaub
print "EAR BOLT TENSILE STRESS      ";dbten
dsa=dsa+abs(sdraf)
dsb=dsb+abs(sdrbf)
dpb=dpb+abs(pbushf)
dsr=dsr+abs(srf)
dtaur=dtaur+abs(taurf)
dtaub=dtaub+abs(taubf)
dbten=dbten+abs(btf)
print
text 0,& FIXED PLUS DYNAMIC COMPONENTS &
print
print "DRIVE ROD TENSILE STRESS AT A";dsa
print "DRIVE ROD TENSILE STRESS AT B";dsb
print "PUSHING PRESSURE             ";dpb
print "VALVE EAR TENSILE STRESS     ";dsr
print "VALVE EAR SHEAR STRESS       ";dtaur
print "EAR BOLT SHEAR STRESS        ";dtaub
print "EAR BOLT TENSILE STRESS      ";dbten
end

         ****** End of program ******
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. A-22

csp6
INPUT GLOBAL ACCELERATIONS
? 11.39,3.33,5.85

INPUT DATA

GLOBAL G-LEVELS =	11.39	3.33	5.85
NORTH VECTOR ANGLES =	90	90	0
VERTICAL VECTOR ANGLES=	0	90	90
EAST VECTOR ANGLES =	90	0	90

LOCAL G-LEVELS

-4.34494E-5	3.33	-2.2316E-5
-4.34494E-5	-1.27029E-5	5.85
11.39	-1.27029E-5	-2.2316E-5

OPERATING DRIVE ROD STRESS AT A	5048.35
OPERATING DRIVE ROD STRESS AT B	7721.14
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING VALVE EAR TENSILE STR	4664.25
OPERATING VALVE EAR SHEAR STRES	297.614
OPERATING EAR BOLT SHEAR STRESS	3600.17
OPERATING EAR BOLT TENSILE STR	1340.69

DYNAMIC COMPONENTS

DR E ROD TENSILE STRESS AT A	16811
DRIVE ROD TENSILE STRESS AT B	25711.4
BUSHING PRESSURE	327.887
VALVE EAR TENSILE STRESS	17822.1
VALVE EAR SHEAR STRESS	1154.32
EAR BOLT SHEAR STRESS	13963.6
EAR BOLT TENSILE STRESS	57543

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	21859.4
DRIVE ROD TENSILE STRESS AT B	33432.5
PUSHING PRESSURE	426.352
VALVE EAR TENSILE STRESS	22486.4
VALVE EAR SHEAR STRESS	1451.93
EAR BOLT SHEAR STRESS	17563.7
EAR BOLT TENSILE STRESS	58883.7

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.011F
SHEET NO. A-23

csp6

~~INPUT~~ GLOBAL ACCELERATIONS
? ,39,3.33,5.85

INPUT DATA

GLOBAL G-LEVELS =	11.39	3.33	5.85
NORTH VECTOR ANGLES =	90	90	0
VERTICAL VECTOR ANGLES=	0 90	90	
EAST VECTOR ANGLES =	90	0	90

LOCAL G-LEVELS

-4.34494E-5	3.33	-2.2316E-5
-4.34494E-5	-1.27029E-5	5.85
11.39	-1.27029E-5	-2.2316E-5

OPERATING DRIVE ROD STRESS AT A	5048.35
OPERATING DRIVE ROD STRESS AT B	7721.14
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING EAR WELD TENSILE STR	5107.51
OPERATING EAR WELD SHEAR STRES	631.431
OPERATING EAR BOLT SHEAR STRESS	3600.17
OPERATING EAR BOLT TENSILE STR	1340.69

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	16811
DRIVE ROD TENSILE STRESS AT B	25711.4
BUSHING PRESSURE	327.887
EAR WELD TENSILE STRESS	21586.2
EAR WELD SHEAR STRESS	2449.05
EAR BOLT SHEAR STRESS	13963.6
EAR BOLT TENSILE STRESS	57543

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	21859.4
DRIVE ROD TENSILE STRESS AT B	33432.5
PUSHING PRESSURE	426.352
EAR WELD TENSILE STRESS	26693.7
EAR WELD SHEAR STRESS	3080.48
EAR BOLT SHEAR STRESS	17563.7
EAR BOLT TENSILE STRESS	58883.7

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-24

```
sp6
 INPUT GLOBAL ACCELERATIONS
?   .39,3.33,5.85

 INPUT DATA

GLOBAL G-LEVELS        =  11.39              3.33           5.85
NORTH VECTOR ANGLES    =  90                 90             0
VERTICAL VECTOR ANGLES= 0    90              90
EAST VECTOR ANGLES     =  90                0               90


 LOCAL G-LEVELS

-4.34494E-5    3.33          -2.2316E-5
-4.34494E-5  -1.27029E-5      5.85
 11.39        -1.27029E-5    -2.2316E-5

OPERATING DRIVE ROD STRESS AT A  5048.35
OPERATING DRIVE ROD STRESS AT B  7721.14
OPERATING CYLINDER BRG PRESSURE -98.4646
OPERATING VALVE EAR TENSILE STR  4664.25
OPERATING VALVE EAR SHEAR STRES  297.614
OPERATING EAR BOLT SHEAR STRESS  3600.17
OPERATING EAR BOLT TENSILE  STR  1340.69

 1f=-906.782
s2. -2.57874E-3
t3f=-2.57873E-3
m1f= 9.89667E-2
m2f=-6234.1
tt3f=-22103.8


 DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 16811
DRIVE ROD TENSILE STRESS AT B 25711.4
BUSHING PRESSURE              327.887
VALVE EAR TENSILE STRESS      17822.1
VALVE EAR SHEAR STRESS        1154.32
EAR BOLT SHEAR STRESS         13963.6
EAR BOLT TENSILE STRESS       57543

s1d= 3019.58
s2d= 3954.6
t3d= 7699.63
m1d= 2.44083E+5
m2d= 58968.3
tt3d= 78875.3

 F  ED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 21859.4
DRIVE ROD TENSILE STRESS AT B 33432.5
PUSHING PRESSURE              426.352
VALVE EAR TENSILE STRESS      22486.4
VALVE EAR SHEAR STRESS        1451.93
EAR BOLT SHEAR STRESS         17563.7
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 0T.01.F
SHEET NO. A-25

EAR BOLT TENSILE STRESS 58883.7

```
s1t= 3926.36
s2t= 3954.6
t3t= 7699.64
m1t= 2.44083E+5
m2t= 65202.4
tt  = 1.00979E+5
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-26

cspA
II JT GLOBAL ACCELERATIONS   EMERGENCY
? 11.37,3.18,5.83

INPUT DATA

GLOBAL G-LEVELS	=	11.37	3.18	5.83
NORTH VECTOR ANGLES	=	90	90	0
VERTICAL VECTOR ANGLES	=	0 90	90	
EAST VECTOR ANGLES	=	90	0	90

LOCAL G-LEVELS

-4.33731E-5	3.18	-2.22397E-5
-4.33731E-5	-1.21307E-5	5.83
11.37	-1.21307E-5	-2.22397E-5

OPERATING DRIVE ROD STRESS AT A	5048.35
OPERATING DRIVE ROD STRESS AT B	7721.14
OPERATING CYLINDER BRG PRESSURE	-98.4646
OPERATING EAR WELD TENSILE STR	5107.51
OPERATING EAR WELD SHEAR STRES	631.431
OPERATING EAR BOLT SHEAR STRESS	3600.17
OPERATING EAR BOLT TENSILE STR	1340.69

DY MIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	16053.7
DRIVE ROD TENSILE STRESS AT B	24553.2
BUSHING PRESSURE	313.117
EAR WELD TENSILE STRESS	20967
EAR WELD SHEAR STRESS	2365.96
EAR BOLT SHEAR STRESS	13489.8
EAR BOLT TENSILE STRESS	57426.5

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	21102.1
DRIVE ROD TENSILE STRESS AT B	32274.4
PUSHING PRESSURE	411.582
EAR WELD TENSILE STRESS	26074.5
EAR WELD SHEAR STRESS	2997.39
EAR BOLT SHEAR STRESS	17090
EAR BOLT TENSILE STRESS	58767.2

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 0T.01.F
SHEET NO. A-27

```
csp6
 INPUT GLOBAL ACCELERATIONS    UPSET
? 2.69,3.09,1.48

 IN. JT DATA

GLOBAL G-LEVELS         =  2.69            3.09          1.48
NORTH VECTOR ANGLES     =  90              90           0
VERTICAL VECTOR ANGLES= 0    90            90
EAST VECTOR ANGLES      =  90             0              90

 LOCAL G-LEVELS

-1.02615E-5   3.09         -5.64575E-6
-1.02615E-5  -1.17874E-5    1.48
 2.69        -1.17874E-5   -5.64575E-6

OPERATING DRIVE ROD STRESS AT A  5048.35
OPERATING DRIVE ROD STRESS AT B  7721.14
OPERATING CYLINDER BRG PRESSURE -98.4646
OPERATING EAR WELD  TENSILE STR  5107.51
OPERATING EAR WELD  SHEAR STRES  631.431
OPERATING EAR BOLT SHEAR STRESS  3600.17
OPERATING EAR BOLT TENSILE  STR  1340.69

 DYNAMIC COMPONENTS

DR   : ROD TENSILE STRESS AT A 15599.4
DRIVE ROD TENSILE STRESS AT B 23858.3
BUSHING PRESSURE              304.256
EAR WELD  TENSILE STRESS      16110.8
EAR WELD  SHEAR STRESS        1976.81
EAR BOLT SHEAR STRESS         11271
EAR BOLT TENSILE STRESS       14173.8

 FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 20647.7
DRIVE ROD TENSILE STRESS AT B 31579.4
PUSHING PRESSURE              402.72
EAR WELD  TENSILE STRESS      21218.3
EAR WELD  SHEAR STRESS        2608.24
EAR BOLT SHEAR STRESS         14871.2
EAR BOLT TENSILE STRESS       15514.5
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. A-28

```
print "WEIGHT VECTOR ANGLES   = ";av(1),av(2),av(3)


sbasic cep3a
      tm
S-BASIC Compiler Version 5.4b

REM***** BIF VALVE AND AIR OPERATOR SEISMIC STRESS *****
REM*************** CEP-V/AO-3A ************************
REM
var i,j,k = integer
var lrod,lcg,x,phi,lave,ablt,l1,l2,e1,e2,e3,e4,e5 = real
var fst2, ca,ia,cb,ib,aa,ab,d1,d2,c1,i1,c2,i2=real
var lrodo,lcgo,ldr,d, abush, pbush=real
var fcof, fco, ma,mb, siga, sigb, fcdr, fcdrf,maf, mbf=real
var dear, fcear,fr, f11,f22,la, ci12,ci21,stt3,sem1=real
var sem2,set3,ses1,ses2,sr,tau11,tau22,tauear,aear=real
var btens, taublt, set3f,sem1f,sem2f,fcearf, frf,f11f=real
var f22f,stt3f,ses1f,ses2f,srf,tau1f,tau2f,taurf=real
var taubf,btf, dsr,dtaur,dtaub,dbten,dsa,dsb,dpb=real
var sdraf,sdrbf,pbushf,tau11f,tau22f=real
var wao,wbr,ftr1,watr1,s1,s1f,s2,s2f,m1,m1f,m2=real
var m2f,t3,t3f,tt3,tt3f,lbr,wtot=real
var bs1,bs2,bt3,bm1,bm2,btt3=real
dim real av(3)
dim real wa(3)
dim real wb(3)
REM
REM *** BURNS 7 ROE EAR FORCES ARE bs1 etc TURN ON WITH K=1***
REM
REM
dim real a(3,3)
dim real b(3)
dim real glc(3,3)
1   data 7.5, 10, .75, 1.95, 1.25, .7
2   data 25,14.46,.531,53.,7.125,.31,1.5,2.5
3   data 1150.,.875,.46,.648,.138,2.41,1.4
4   data 399,277,5.25,8.5,28.5,15.,6.875
5   data 40.,10.96,26.5,30.5,2.075
6   data 90.,90.,0.,90.,0.,90.
7   data 180.,90.,90.,90.,180.,90.
REM DATA 6&7 FOR VALVE/GLOBAL-G ORIENTATIONS AND WEIGHT VECTOR
restore
read d1,d2,c1,i1,c2,i2
restore 2
read lrod,lcg,x,phi,lave,ablt,l1,l2
restore 3
read fst2,ca,ia,cb,ib,aa,ab
restore 4
read wao,wbr,e1,e2,e3,e4,e5
restore 5
read lrodo,lcgo,ldr,d,abush
restore 6
read  a(1,1),a(2,1),a(3,1),a(1,2),a(2,2),a(3,2)
restore 7
read  a(1,3),a(2,3),a(3,3),av(1),av(2),av(3)
text 0,& INPUT GLOBAL ACCELERATIONS &
input b(1),b(2),b(3)
print
text 0,& INPUT DATA &
print
print "GLOBAL G-LEVELS        = ";b(1),b(2),b(3)
print "NORTH VECTOR ANGLES    = ";a(1,1),a(2,1),a(3,1)
print "VERTICAL VECTOR ANGLES= ";a(1,2),a(2,2),a(3,2)
print "EAST VECTOR ANGLES     = ";a(1,3),a(2,3),a(3,3)
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01|F
SHEET NO. A-24

Compilation complete

ce a

INPUT GLOBAL ACCELERATIONS   CEP-V-3A (FAULTED)

? 4.57,1.26,.86

INPUT DATA

GLOBAL G-LEVELS	=	4.57	1.26	.86
NORTH VECTOR ANGLES	=	90	90	0
VERTICAL VECTOR ANGLES	=	90	0	90
EAST VECTOR ANGLES	=	180	90	90
WEIGHT VECTOR ANGLES	=	90	180	90

LOCAL G-LEVELS

-1.74332E-5	-4.80652E-6	-.86
-1.74332E-5	1.26	-3.28064E-6
4.57	-4.80652E-6	-3.28064E-6

OPERATING DRIVE ROD STRESS AT A	477.198
OPERATING DRIVE ROD STRESS AT B	821.458
OPERATING CYLINDER BRG PRESSURE	-3.75613E-4
OPERATING VALVE EAR TENSILE STR	1136.52
OPERATING VALVE EAR SHEAR STRES	89.1706
OPERATING EAR BOLT SHEAR STRESS	1078.68
OPERATING EAR BOLT TENSILE STR	525.595

s1f=-3.4591E-3
s2f= 474
t3f=-2.57873E-3
m1f=-3258.67
m2f=-5.29623E-3
tt3f= 4929.17

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	4341.57
DRIVE ROD TENSILE STRESS AT B	6640.18
BUSHING PRESSURE	84.6795
VALVE EAR TENSILE STRESS	4711.31
VALVE EAR SHEAR STRESS	285.935
EAR BOLT SHEAR STRESS	3458.89
EAR BOLT TENSILE STRESS	22999.3

s1d= 779.831
s2d= 851.76
t3d= 3089.31
m1d= 97498.6
m2d= 22785
tt = 19965.7

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	4818.76
DRIVE ROD TENSILE STRESS AT B	7461.64
PUSHING PRESSURE	84.6799

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-30

VALVE EAR TENSILE STRESS	5847.84
VALVE EAR SHEAR STRESS	375.106
EAR BOLT SHEAR STRESS	4537.57
EAR BOLT TENSILE STRESS	23524.9

s1t= 779.835
s2t= 1325.76
t3 3089.32
m1t= 1.00757E+5
m2t= 22785
tt3t= 24894.9

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. A-31

```
Compilation complete

cep3
 INI   GLOBAL ACCELERATIONS
? 4.57,1.26,0.86

 INPUT DATA

GLOBAL G-LEVELS       =  4.57          1.26       .86
NORTH VECTOR ANGLES   =  90            90         0
VERTICAL VECTOR ANGLES=  90            0          90
EAST VECTOR ANGLES    =  180           90         90
WEIGHT VECTOR ANGLES  =  90            180        90


 LOCAL G-LEVELS

-1.74332E-5  -4.80652E-6  -.86
-1.74332E-5   1.26        -3.28064E-6
 4.57        -4.80652E-6  -3.28064E-6

OPERATING DRIVE ROD STRESS AT A  477.198
OPERATING DRIVE ROD STRESS AT B  821.458
OPERATING CYLINDER BRG PRESSURE -3.75613E-4
OPERATING EAR WELD  TENSILE STR  1326.01
OPERATING EAR WELD  SHEAR STRES  189.188
OPERATING EAR BOLT SHEAR STRESS  1078.68
OPERATING EAR BOLT TENSILE  STR  525.595


 DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 4341.57
DRIVE ROD TENSILE STRESS AT B 6640.18
BUSHING PRESSURE              84.6795
EAR WELD  TENSILE STRESS      6247.02
EAR WELD  SHEAR STRESS        606.65
EAR BOLT SHEAR STRESS         3458.89
EAR BOLT TENSILE STRESS       22999.3


 FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 4818.76
DRIVE ROD TENSILE STRESS AT B 7461.64
BUSHING PRESSURE              84.6799
EAR WELD  TENSILE STRESS      7573.03
EAR WELD  SHEAR STRESS        795.838
EAR BOLT SHEAR STRESS         4537.57
EAR BOLT TENSILE STRESS       23524.9
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-32

```
sbasic cep4a
      tm
^-BASIC Compiler Version 5.4b

REM***** BIF VALVE AND AIR OPERATOR SEISMIC STRESS *****
REM*************** CEP-V/AO-4A **************************
REM
var i,j,K = integer
var lrod,lcg,x,phi,lave,ablt,l1,l2,e1,e2,e3,e4,e5 = real
var fst2, ca,ia,cb,ib,aa,ab,d1,d2,c1,i1,c2,i2=real
var lrodo,lcgo,ldr,d, abush, pbush=real
var fcof, fco, ma,mb, siga, sigb, fcdr, fcdrf,maf, mbf=real
var dear, fcear,fr, f11,f22,la, ci12,ci21,stt3,sem1=real
var sem2,set3,ses1,ses2,sr,tau11,tau22,tauear,aear=real
var btens, taublt, set3f,sem1f,sem2f,fcearf, frf,f11f=real
var f22f,stt3f,ses1f,ses2f,srf,tau1f,tau2f,taurf=real
var taubf,btf, dsr,dtaur,dtaub,dbten,dsa,dsb,dpb=real
var sdraf,sdrbf,pbushf,tau11f,tau22f=real
var wao,wbr,ftr1,watr1,s1,s1f,s2,s2f,m1,m1f,m2=real
var m2f,t3,t3f,tt3,tt3f,lbr,wtot=real
var bs1,bs2,bt3,bm1,bm2,btt3=real
dim real av(3)
dim real wa(3)
dim real wb(3)
REM
REM *** BURNS 7 ROE EAR FORCES ARE bs1 etc TURN ON WITH K=1***
REM
REM
dim real a(3,3)
dim real b(3)
dim real glc(3,3)
1   data 7.5, 10, .75, 1.95, 1.25, .7
2   data 25,14.46,.531,53.,7.125,.31,1.5,2.5
3   data 1150.,.875,.46,.648,.138,2.41,1.4
4   data 399,277,5.25,8.5,28.5,15.,6.875
5   data 40.,10.96,26.5,30.5,2.075
6   data 90.,-38.,52.,90.,52.,142.
7   data 180.,90.,90.,90.,-128.,-38.
REM DATA 6&7 FOR VALVE/GLOBAL-G ORIENTATIONS AND WEIGHT VECTOR
restore
read d1,d2,c1,i1,c2,i2
restore 2
read lrod,lcg,x,phi,lave,ablt,l1,l2
restore 3
read fst2,ca,ia,cb,ib,aa,ab
restore 4
read wao,wbr,e1,e2,e3,e4,e5
restore 5
read lrodo,lcgo,ldr,d,abush
restore 6
read  a(1,1),a(2,1),a(3,1),a(1,2),a(2,2),a(3,2)
restore 7
read  a(1,3),a(2,3),a(3,3),av(1),av(2),av(3)
text 0,& INPUT GLOBAL ACCELERATIONS &
input b(1),b(2),b(3)
print
text 0,& INPUT DATA &
print
print "GLOBAL G-LEVELS        = ";b(1),b(2),b(3)
print "NORTH VECTOR ANGLES    = ";a(1,1),a(2,1),a(3,1)
print "VERTICAL VECTOR ANGLES= ";a(1,2),a(2,2),a(3,2)
print "EAST VECTOR ANGLES     = ";a(1,3),a(2,3),a(3,3)
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. A-33

```
print "WEIGHT VECTOR ANGLES  = ";av(1),av(2),av(3)
print
for i=1 to 3
  for j=1 to 3
    a(j,i)=a(j,i)*2.*3.1416/360.
    glc(j,i)=b(i)*cos(a(j,i))
  next j
next i
for j=1 to 3
  av(j)=av(j)*2.*3.1416/360.
next j
print
text 0,& LOCAL G-LEVELS &
print
print glc(1,1),glc(1,2),glc(1,3)
print glc(2,1),glc(2,2),glc(2,3)
print glc(3,1),glc(3,2),glc(3,3)
REM WEIGHT COMPONENTS
for j=1 to 3
  wa(j)=wao*cos(av(j))
  wb(j)=wbr*cos(av(j))
next j
phi=phi*2.*3.1416/360.
la=lave/2
ci12=c1/i2
ci21=c2/i1
aear=l1*l2
REM CALCULATE EAR FORCES USE B&R LOADS AS OPTION LATER
REM FIXED COMPONENTS ARE ALWAYS THERE
lbr=lrod+lcg
watr1=lbr*wa(1)/lrod
s1f=wb(1)+watr1
wtot=wao+wbr
s2f=wb(2)+wa(2)+fst2
t3f=wa(3)+wb(3)
m1f=-(wa(2)+wb(2)+fst2)*e5-wa(3)*(e3+lcg)-wb(3)*e4
m2f=(watr1+wb(1))*e5-wa(3)*e2-wb(3)*e1
tt3f=watr1*e3+(wa(2)+fst2)*e2+wb(1)*e4+wb(2)*e1
fcdrf=lcg*wa(1)/lrod
maf=fcdrf*(lrod-13.5)
mbf=fcdrf*7.125
sdraf=fst2/aa+abs(maf*ca/ia)
sdrbf=fst2/ab+abs(mbf*cb/ib)
fcof=lcgo*wa(1)/lrodo
pbushf=fcof*(ldr+d)/(d*abush)
REM STRESSES FROM FIXED COMPONENTS
dear=(d1*d1+d2*d2)**.5
set3f=abs(t3f/(4*aear))
sem1f=abs(m1f/(2*d2*aear))
sem2f=abs(m2f/(2*d1*aear))
fcearf=tt3f/(2*dear)
frf=x*fcearf
f11f=-(fcearf*sin(phi)-frf*cos(phi))
f22f=fcearf*cos(phi)+frf*sin(phi)
stt3f=abs(f11f*la*ci12)+abs(f22f*la*ci21)
ses1f=abs(s1f*ci12*la/4.)
ses2f=abs(s2f*ci21*la/4.)
srf=set3f+sem1f+sem2f+ses1f+ses2f+stt3f
REM EAR SHEAR
tau11f=abs(s1f/(4*aear))+abs(f11f/aear)
tau22f=abs(s2f/(4*aear))+abs(f22f/aear)
taurf=(tau11f*tau11f+tau22f*tau22f)**.5
taubf=taurf*aear/ablt
REM EARBOLT TENSION
btf=(set3f+sem1f+sem2f)*aear/ablt
print
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. A-34

```
print"OPERATING DRIVE ROD STRESS AT A ";sdraf
print"OPERATING DRIVE ROD STRESS AT B ";sdrbf
print"OPERATING CYLINDER BRG PRESSURE ";pbushf
print"OPERATING VALVE EAR TENSILE STR ";srf
print"OPERATING VALVE EAR SHEAR STRES ";taurf
print"OPERATING EAR BOLT SHEAR STRESS ";taubf
print"OPERATING EAR BOLT TENSILE  STR ";btf
print
REM
REM CALCULATE VARIABLE COMPONENTS
REM
dsr=0.
dtaur=0.
dtaub=0.
dbten=0.
dsa=0.
dsb=0.
dpb=0.
for j=1 to 3
fco=lcgo*wao*glc(1,j)/lrodo
pbush=fco*(ldr+d)/(d*abush)
ftr1=lbr*wao*glc(1,j)/lrod
s1=ftr1+wbr*glc(1,j)
s2=wtot*glc(2,j)
t3=wtot*glc(3,j)
m1=-wtot*glc(2,j)*e5-wao*glc(3,j)*(e3+lcg)-wbr*glc(3,j)*e4
m2=(ftr1+wbr*glc(1,j))*e5-(wao*e2+wbr*e1)*glc(3,j)
tt3=ftr1*e3+wbr*glc(1,j)*e4+glc(2,j)*(wao*e2+wbr*e1)
fcdr=lcg*wao*glc(1,j)/lrod
ma=fcdr*(lrod-13.5)
mb=fcdr*7.125
siga=ma*ca/ia
sigb=mb*cb/ib
REM CALCULATE EAR TENSION
set3=abs(t3/(4*aear))
sem1=abs(m1/(2*d2*aear))
sem2=abs(m2/(2*d1*aear))
fcear=tt3/(2*dear)
fr=x*fcear
f11=-(fcear*sin(phi)-fr*cos(phi))
f22=fcear*cos(phi)+fr*sin(phi)
stt3=abs(f11*la*ci12)+abs(f22*la*ci21)
ses1=abs(s1*ci12*la/4.)
ses2=abs(s2*ci21*la/4.)
sr=set3+sem1+sem2+ses1+ses2+stt3
REM EAR SHEAR
tau11=abs(s1/(4.*aear))+abs(f11/aear)
tau22=abs(s2/(4.*aear))+abs(f22/aear)
tauear=(tau11*tau11+tau22*tau22)**.5
taublt=tauear*aear/ablt
REM EARBOLT TENSION
btens=(set3+sem1+sem2)*aear/ablt
dsa=dsa+siga*siga
dsb=dsb+sigb*sigb
dpb=dpb+pbush*pbush
dsr=dsr+sr*sr
dtaur=dtaur+tauear*tauear
dtaub=dtaub+taublt*taublt
dbten=dbten+btens*btens
next j
REM COMBINE STRESSES
dsa=dsa**.5
dsb=dsb**.5
dpb=dpb**.5
dsr=dsr**.5
dtaur=dtaur**.5
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT-01/F
SHEET NO. A-35

```
dtaub=dtaub**.5
dbten=dbten**.5
print
text 0,& DYNAMIC COMPONENTS &
print
print "DRIVE ROD TENSILE STRESS AT A";dsa
print "DRIVE ROD TENSILE STRESS AT B";dsb
print "BUSHING PRESSURE              ";dpb
print "VALVE EAR TENSILE STRESS      ";dsr
print "VALVE EAR SHEAR STRESS        ";dtaur
print "EAR BOLT SHEAR STRESS         ";dtaub
print "EAR BOLT TENSILE STRESS       ";dbten
dsa=dsa+abs(sdraf)
dsb=dsb+abs(sdrbf)
dpb=dpb+abs(pbushf)
dsr=dsr+abs(srf)
dtaur=dtaur+abs(taurf)
dtaub=dtaub+abs(taubf)
dbten=dbten+abs(btf)
print
text 0,& FIXED PLUS DYNAMIC COMPONENTS &
print
print "DRIVE ROD TENSILE STRESS AT A";dsa
print "DRIVE ROD TENSILE STRESS AT B";dsb
print "PUSHING PRESSURE              ";dpb
print "VALVE EAR TENSILE STRESS      ";dsr
print "VALVE EAR SHEAR STRESS        ";dtaur
print "EAR BOLT SHEAR STRESS         ";dtaub
print "EAR BOLT TENSILE STRESS       ";dbten
end

          ****** End of program ******
```

cep4a
INPUT GLOBAL ACCELERATIONS
? ~ 35,1.34,.86

INPUT DATA

GLOBAL G-LEVELS	=	3.35	1.34	.86
NORTH VECTOR ANGLES	=	90	-38	52
VERTICAL VECTOR ANGLES	=	90	52	142
EAST VECTOR ANGLES	=	180	90	90
WEIGHT VECTOR ANGLES	=	90	-128	-38

LOCAL G-LEVELS

-1.27792E-5	-5.11169E-6	-.86
2.63983	.824984	-3.28064E-6
2.06246	-1.05594	-3.28064E-6

OPERATING DRIVE ROD STRESS AT A	477.198
OPERATING DRIVE ROD STRESS AT B	821.458
OPERATING CYLINDER BRG PRESSURE	-3.75613E-4
OPERATING VALVE EAR TENSILE STR	1946.57
OPERATING VALVE EAR SHEAR STRES	128.033
OPERATING EAR BOLT SHEAR STRESS	1548.79
OPERATING EAR BOLT TENSILE STR	4771.17

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	4341.57
DRIVE ROD TENSILE STRESS AT B	6640.18
BUSHING PRESSURE	84.6795
VALVE EAR TENSILE STRESS	5948.81
VALVE EAR SHEAR STRESS	379.211
EAR BOLT SHEAR STRESS	4587.24
EAR BOLT TENSILE STRESS	13246.5

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	4818.76
DRIVE ROD TENSILE STRESS AT B	7461.64
PUSHING PRESSURE	84.6799
VALVE EAR TENSILE STRESS	7895.38
VALVE EAR SHEAR STRESS	507.244
EAR BOLT SHEAR STRESS	6136.03
EAR BOLT TENSILE STRESS	18017.7

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01/F
SHEET NO. A-37

A>b:
B>cep4a
INPUT GLOBAL ACCELERATIONS
? ? 35,1.34,.86

INPUT DATA

FAULTED WELD;

GLOBAL G-LEVELS	=	3.35	1.34	.86
NORTH VECTOR ANGLES	=	90	-38	52
VERTICAL VECTOR ANGLES	=	90	52	142
EAST VECTOR ANGLES	=	180	90	90
WEIGHT VECTOR ANGLES	=	90	-128	-38

LOCAL G-LEVELS

-1.27792E-5	-5.11169E-6	-.86
2.63983	.824984	-3.28064E-6
2.06246	-1.05594	-3.28064E-6

OPERATING DRIVE ROD STRESS AT A	477.198
OPERATING DRIVE ROD STRESS AT B	821.458
OPERATING CYLINDER BRG PRESSURE	-3.75613E-4
OPERATING EAR WELD TENSILE STR	2592.98
OPERATING EAR WELD SHEAR STRES	271.64
OPERATING EAR BOLT SHEAR STRESS	1548.79
OPERATING EAR BOLT TENSILE STR	4771.17

DY'NAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	4341.57
DRIVE ROD TENSILE STRESS AT B	6640.18
BUSHING PRESSURE	84.6795
EAR WELD TENSILE STRESS	7493.12
EAR WELD SHEAR STRESS	804.547
EAR BOLT SHEAR STRESS	4587.22
EAR BOLT TENSILE STRESS	13246.5

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	4818.76
DRIVE ROD TENSILE STRESS AT B	7461.64
PUSHING PRESSURE	84.6799
EAR WELD TENSILE STRESS	10086.1
EAR WELD SHEAR STRESS	1076.19
EAR BOLT SHEAR STRESS	6136.01
EAR BOLT TENSILE STRESS	18017.7

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. A-38

```
cep
CEP?

B>  cep4a
 INPUT GLOBAL ACCELERATIONS
?, 3.35,1.34,.86

 INPUT DATA

GLOBAL G-LEVELS         =  3.35          1.34       .86
NORTH VECTOR ANGLES     =  90            -38        52
VERTICAL VECTOR ANGLES=    90            52         142
EAST VECTOR ANGLES      =  180           90         90
WEIGHT VECTOR ANGLES    =  90            -128       -38

 LOCAL G-LEVELS

-1.27792E-5   -5.11169E-6   -.86
 2.63983       .824984      -3.28064E-6
 2.06246      -1.05594      -3.28064E-6

OPERATING DRIVE ROD STRESS AT A   477.198
OPERATING DRIVE ROD STRESS AT B   821.458
OPERATING CYLINDER BRG PRESSURE -3.75613E-4
OPERATING VALVE EAR TENSILE STR   1946.57
OPERATING VALVE EAR SHEAR STRES   128.033
OPERATING EAR BOLT SHEAR STRESS   1548.79
OP ATING EAR BOLT TENSILE  STR    4771.17

s1f=-3.4591E-3
s2f= 733.811
t3f= 532.695
m1f=-21826.4
m2f=-3818.52
tt3f= 6791.56

 DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 4341.57
DRIVE ROD TENSILE STRESS AT B 6640.18
BUSHING PRESSURE              84.6795
VALVE EAR TENSILE STRESS      5948.81
VALVE EAR SHEAR STRESS        379.211
EAR BOLT SHEAR STRESS         4587.24
EAR BOLT TENSILE STRESS       13246.5

s1d= 779.831
s2d= 1869.64
t3d= 1566.33
m1d= 59205.9
m2d= 12442.3
t.  = 23258.6

 FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A 4818.76
DRIVE ROD TENSILE STRESS AT B 7461.64
BUSHING PRESSURE              84.6799
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 0T.01.F
SHEET NO. A-39

VALVE EAR TENSILE STRESS	7895.38
VALVE EAR SHEAR STRESS	507.244
EAR BOLT SHEAR STRESS	6136.03
EAR BOLT TENSILE STRESS	18017.7

s1t= 779.835
s2t= 2603.45
t3 2099.02
m1t= 81032.3
m2t= 16260.8
tt3t= 30050.1

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. A-40

APPENDIX B

VALVE/AIR OPERATOR MODEL FOR
FINAL PIPING RESPONSE G-LEVEL CALCULATION.

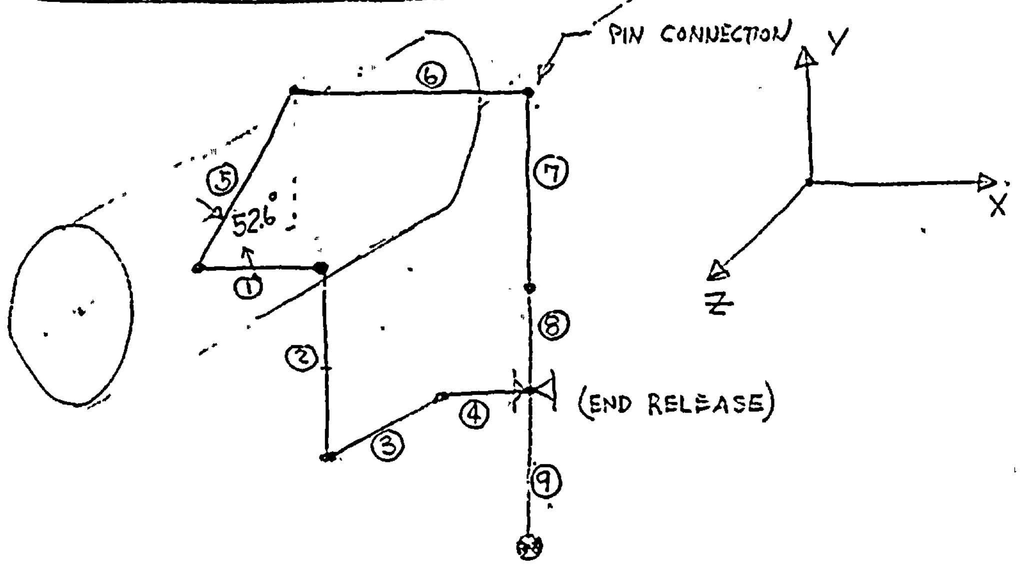
CYGNA

Calculation Sheet

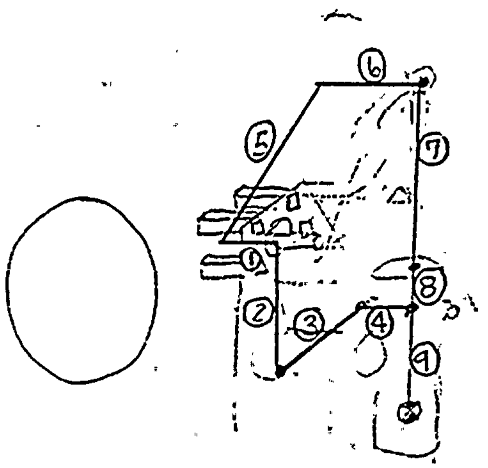
Project: WPPSS EQ		Prepared By: [signature]	Date: 1/3/83
Subject: BIF VALVE / ACTUATOR MODEL SUMMARY		Checked By: [signature]	Date: 3/24/83
System: CSP		Job No. 82044	File No. OT.01/F
Analysis No. 361104 + 106	Rev. No. 0	Sheet No. 361106-4.3-B1	

SUMMARY

A) MODEL CONFIGURATION



B) ACTUAL STRUCTURE



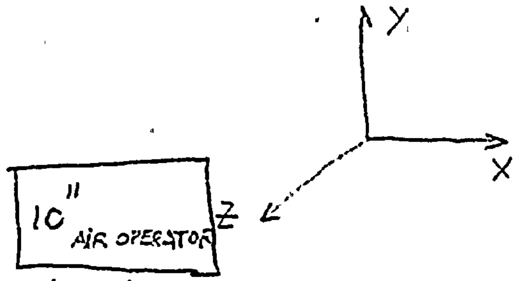
STRUCTURAL MEMBER DIRECTIONS

1	+X
2	−Y
3	−Z
4	+X
5	YZ − PLANE
6	+X
7	+Y
8	+Y
9	−Y

Calculation Sheet

CYGNA

Project	WPPSS	Prepared By:	Date 1/3/83
Subject	B.I.F. VALVE / ACTUATOR MODEL SUMMARY	Checked By:	Date 3/24/83
System	CSP	Job No. 82044	File No. 07.01/F
Analysis No. 361104 & 361106	Rev. No. 0	Sheet No. 361106-4.3-B3	



① VALVE EARS

8" CYL (24" VALVE)

$A_x = A_y = A_z = 15\ IN^2$	(21)
$I_{xx} = 106\ IN^4$	(657)
$I_{yy} = 11.2$ "	(21.4)
$I_{zz} = 31.2$ "	(63)
$C_y = 5.60$	(5.25)
$C_z = 3.75$	(4.75)
$E = 28 \times 10^6$ PSI $E_s = 11.6 \times 10^6$ PSI	✓
$\ell = 7.125"$	(4.85")

② BRACKET

(Put e = 0 & add 277# 15" down) 321#

$A_x = A_y = A_z = 6.84\ IN^2$	(8.5)
$I_{xx} = 102\ IN^4$	(255)
$I_{yy} = 1000\ IN^4$	($1000\ IN^4$)
$I_{zz} = 2.16\ IN^4$	($4.22\ IN^4$)
$C_x = .25$ IN	(.313)
$C_z = 6.84$ IN	(8.5)
$E = 28 \times 10^6$ PSI $E_s = 11.6 \times 10^6$ PSI	✓
$\ell = 28.5"$ (15" down to CG)	

③ & ④ BRACKET OFFSETS $L_3 = 8.8"$ (8.5") $L_4 = 6.875$ (8.0")

③ MASSLESS, RIGID LINK, 8.8" LONG (8.5)

④ " " , 6.875" " (8.0)

(END RELEASE FOR ROTATION θ_{xx} ON ④)

CYGNA

Calculation Sheet

Project	WPPSS EQ	Prepared By:	[illegible]	Date	1/7/83
Subject	BIF VALVE/ACTUATOR MODEL SUMMARY	Checked By:	[illegible]	Date	2/22/83
System	CSP	Job No.	82044	File No.	OT.01/F
Analysis No.	361106-361104	Rev. No. 0	Sheet No.	361106-4.3-B3	

(5) SHAFT OFFSET

RIGID LINK 14.48" LONG (14.30)
AT 52.6° ↑ AS SHOWN

(6) SHAFT

$A_x = A_y = A_z = 3.98 \text{ IN}^2$ (4.91)
$I_{xx} = 2.52 \text{ IN}^4$ (3.04)
$I_{yy} = 4$ " (5.75)
$I_{zz} = 1.26$ " (1.92)
$C_y = 1.125$ (1.25)
$C_z = 1.125$ (1.25)
$E = 29 \times 10^6$ PSI $E_S = 11.6 \times 10^6$ PSI
$\ell = 14$ in. (12.85")

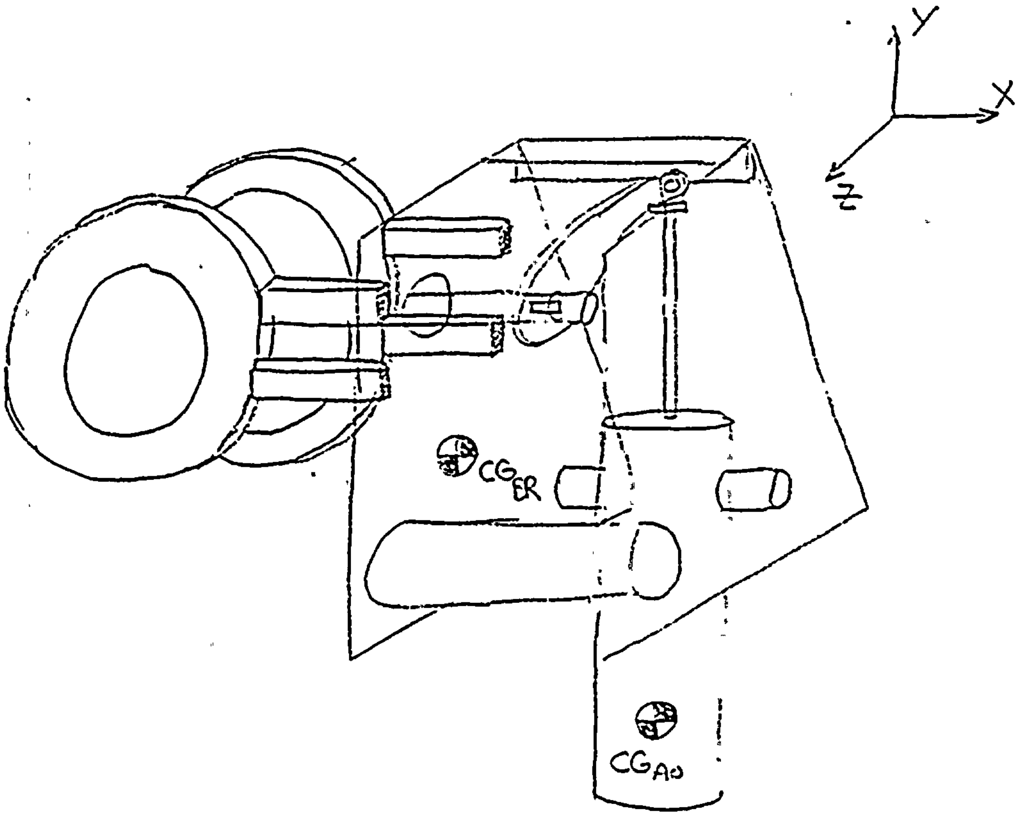
(7) DRIVE ROD

$A_x = 2.41$ $A_y = 2.41$ $A_z = 2.41 \text{ IN}^2$ (2.41 IN²)
$I_{xx} = I_{zz} = .46 \text{ IN}^4$ (.46 IN⁴)
$I_{yy} = .92 \text{ IN}^4$ (.92 IN⁴)
$C_x = C_z = .815$ IN (.875 IN)
HIGH STREN. ☆ $E = 30 \times 10^6$ PSI $E_S = 12 \times 10^6$ PSI

(8) & (9) CYLINDER
(PUT ρ = 0. & ADD 399# AT END.) → (593#)
$L_{(8)} = 13.5$" (13.5")
$L_{(9)} = 14.0$" (19")
$I_{yy} = 74 \text{ IN}^4$ (180 IN⁴)
$I_{xx} = I_{zz} = 52 \text{ IN}^4$ (127 IN⁴)
$A_x = A_y = A_z = 50 \text{ IN}^2$ (78 IN²)
$C_x = C_z = 4$" (5 IN)

Calculation Sheet

Project: WPPSS EQ		Prepared By: [signature]	Date: 1/3/83
Subject: SAP MODEL - E1F VALVE / AO		Checked By: [signature]	Date: 3/24/83
System: CSP		Job No. 82044	File No. OT.OF/01
Analysis No. 361104 + 361106	Rev. No. 0	Sheet No. 361106-...-B4	



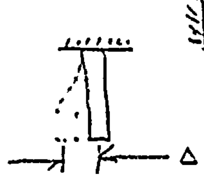
DESCRIPTION OF AO MODEL INCLUDING VALVE EARS:

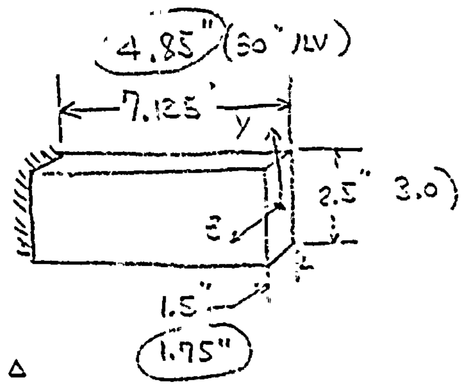
8" AO

① Derive Ear Model

K_{zz} = 4 * stiffness of 1 ear
= 4 * $F_z / \Delta z$

Use Roark, Pg 96, # 1b.:





Calculation Sheet

CYGNA

Project: WPPSS EQ		Prepared By: [illegible]	Date: 1/3/83
Subject: BTF Valve/Actuator Model Summary		Checked By: [illegible]	Date: 3/24/83
System: CSP		Job No. 82044	File No. 07.01/F
Analysis No. 3611041106	Rev. No. 0	Sheet No. 361104-4.3-135	

△ [illegible] 4/8/83 [illegible] 6/7/83

NOTE: SEE PAGE 4.3-53 OF REVISION 3

$M_A = \frac{W(l-a)^2}{2l}$ $\theta_A = 0$

$y_A = -\frac{W}{12EI}(l-a)^2(l+2a) = -\frac{W}{12EI} l^3$

$\therefore \frac{F_z}{\Delta z} = \frac{12EI}{(l)^3}$ $(a=0)$ =

$= \frac{12 * 29\times10^6 * 0.7 \; (1.34)}{(7.125)^3 = 361.7 \;\; ((4.85)^3 = 114.08)\; 10''} = .673 \times 10^6$ (4.08) $\frac{lb}{in}$

(units: $\frac{F}{L^2} \cdot \frac{L^4}{L^3} = \frac{F}{L}$ (ok))

$E_{all} \cong 29\times10^6$ PSI

$l = 7.125''$ (4.85")

I_{min} (for z-axis) = 0.70 in^4 $(\frac{1}{12}\cdot 3 \cdot 1.75^3 = 1.34)$

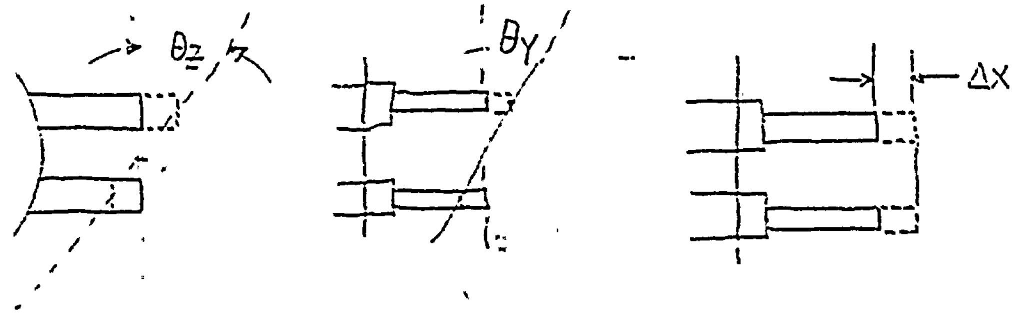
I_{max} (for y-axis) = 1.95 in^4 $(\frac{1}{12}\cdot 1.75 \cdot 3^3 = 3.94)$

THE SECOND VALUES IN PARENTHESIS ARE FOR 30" VALVES INSTEAD OF 24"

$K_{zz} = 4 * \frac{F_z}{\Delta z} = 2.694 \times 10^6 \frac{lb}{in}$ (16.34)

$K_{yy} = 4 * \frac{F_y}{\Delta y} = 4 * \frac{12 \, E I_{max}}{l^3} = K_{zz} * \frac{1.95}{.7} = 7.50 \frac{lb}{in} \times 10^6$ (3.94/1.34 = 48)

θ:

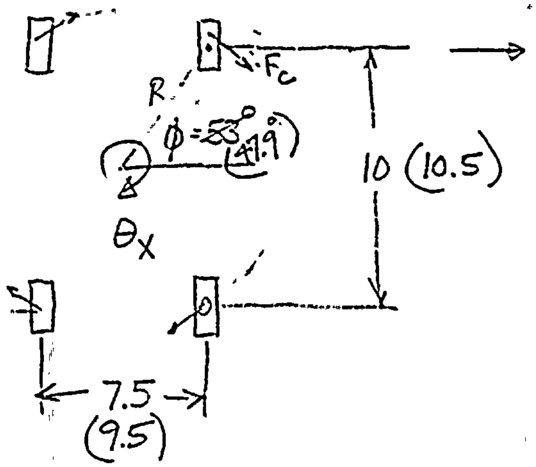


CONSIDER THE FAL-SYSTEM STIFFNESS IN THESE MODES VERY LARGE. BECAUSE OPERATOR BRACKET BENDING WILL CONTROL

CYGNA

Calculation Sheet

Project: WPP3? EQ		Prepared By: [illegible]	Date: 1/3/93
Subject: BIF VALVE/ACTUATOR MODEL SUMMARY		Checked By: [illegible]	Date: 3/24/93
System: CSP		Job No.: 82044	File No.: 0T.01/F
Analysis No.: 361104 & 106	Rev. No.: 0	Sheet No.: 361106-4.3-B6	

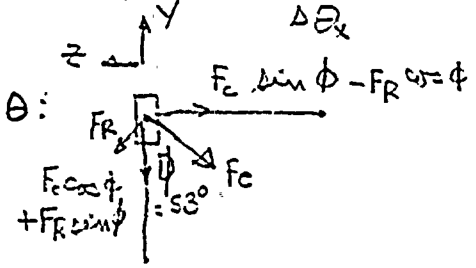


The attached plate forces the ears to deflect tangent to the circle. The force on each ear is:

$$4F_cR = T \quad , \quad R = \left[3.75^2 + 5^2\right]^{\frac{1}{2}} = 6.25''$$
$$\left(4.75^2 + 5.25^2 = 7.08\right)$$

$$\text{Stiffness} = \frac{T}{\Delta\theta_x} = \frac{4F_c\,\cancel{(6.25)}\,(7.08)}{\Delta\theta_x}$$

θ:



There is a restraint force which acts through the plate keeping the ear deflection on the circle. This must be a radially-directed force: F_R (no torque contribution)

$$\text{Deflection:} \quad \Delta Y = -\left(F_c\cos\phi + F_R\sin\phi\right)\left[\frac{\ell^3}{12EI_{max}} + \frac{\ell}{k\,1.5\,AG}\right]$$

$$\Delta Z = -\left(F_c\sin\phi - F_R\cos\phi\right)\frac{\ell^3}{12EI_{min}}$$

1006 CO

CYGNA

Calculation Sheet

Project: WFP?? E?)		Prepared By: [signature]	Date: 1/5/83
Subject: RTF VALVE/ACTUATOR MODEL SUMMARY		Checked By: [signature]	Date: 3/24/83
System: CSP		Job No. 82041	File No. DT.01/F
Analysis No. 361104 & 106	Rev. No. 0	Sheet No. 361106-4.3-B7	

$$\tan\phi = \frac{-\Delta Z}{-\Delta Y} = \frac{\Delta Z}{\Delta Y} = \frac{I_{max}}{I_{min}} \frac{(F_c \sin\phi - F_R \cos\phi)}{(F_c \cos\phi + F_R \sin\phi)} = 1.327 \; (1.105)$$

$$\frac{I_{max}}{I_{min}} = \frac{1.95 \; (3.94)}{.70 \; (1.34)} = 2.786 \; (2.94), \quad \sin\phi = .799 \; (.742), \quad \cos\phi = .602 \; (.671)$$

$$\therefore \frac{1.327 \; (1.105)}{2.786 \; (2.94)} = \frac{F_c \, .799 \, (.742) - .602 \, (.671) F_R}{.602 \, (.671) F_c + .799 \, (.742) F_R} = .476 \; (.376)$$

$$.799 \, (.742) F_c - .602 \, (.671) F_R = .278 \, (.252) F_c + .380 \, (.279) F_R$$

$$.521 \, (.464) F_c = .982 \, (.950) F_R$$

$$\boxed{F_R = .531 \, (.488) F_c}$$

NOTE: Another force F_R acts on valve + needs to include in stress analysis.

(2) ☆ SIGN CHANGES FOR F_R ON ALTERNATE EARS.

To find θ:

$$\Delta\theta = \frac{\Delta c}{R} = \frac{-\Delta Y}{R\cos\phi} = \frac{+(F_c \cos\phi + F_R \sin\phi)\dfrac{l^3}{12EI_{max}}}{R\cos\phi}$$

$$= \frac{l^3}{12EI_{max}} \left(\frac{F_c}{R} + \frac{.531 \, (488) F_c}{R} \tan\phi \right), \quad \tan\phi = 1.327 \; (1.105)$$

$$\Delta\theta_x = \frac{l^3 F_c}{12 R EI_{max}} \left(1.704 \; (1.540) \right) = \frac{51.362 \; (14.64) F_c}{R EI_{max}}$$

$$K^{J}_{\theta_x\theta_x} = \frac{T}{\Delta\theta_x} = \frac{4 F_c R}{\dfrac{51.362 F_c}{R EI_{max}}} = \frac{4}{51.362 \; (14.64)} R^2 EI_{max}$$

$$\frac{L^2 \, L^4}{(k^3)} : \; = L = FL(3k)$$

1CC8 00

CYGNA

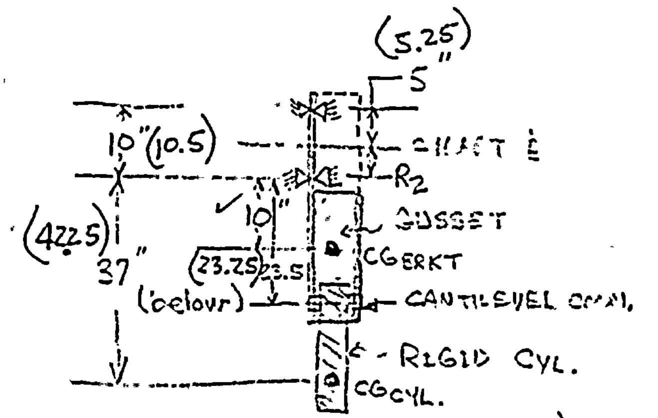
Calculation Sheet

Project: WPPSS-EO	Prepared By: J E Rabinowitz	Date: 3/25/83	
Subject: BIF Valve-Actuator Assy. Summary	Checked By: [illegible]	Date: 3.25.83	
System: CSP	Job No.: 82044	File No.: 07.04F	
Analysis No.: 361106-361106	Rev. No.: 0	Sheet No.: 361106-4.3-B3	

$$K_{\theta\theta} = .078(6.25)^2(29)(10)^6(1.95) = 172(10)^6 \text{ in lb/rad}$$
$$(7.08) \quad (3.94) \quad (1565)$$

$$K_{\theta\theta} = 1.72(10)^8 \text{ in lb/rad}$$
$$(1.565(10)^9) \quad ''$$

SUPPORT BRACKET PLATE BENDING



28.5" shaft → Tr. pin + ~13.5" to CG (~19")
= 42" − 5" = 37"

FOR CALCULATION OF BRACKET FLEXIBILITY, THE FOLLOWING MEASUREMENTS WERE TAKEN ON CSP-AO-5 & 3. DATA IS APPROXIMATE.

DEFLECTION AT END OF CYL (IN): .125, .125, .155
FORCE AT END OF CYL (LB): 85, 150, 170

Calculation Sheet

Project		Prepared By:	Date
Subject		Checked By:	Date
System		Job No.	File No.
Analysis No	Rev. No.	Sheet No.	

SECTION 4.2

SUMMARY OF RESULTS

Calculation Sheet

Project	WPPSS Mechanical Equipment Requalification	Prepared By:	L.C. Fernandez	Date	6/13/83
Subject	30" Cylinder Operated Butterfly Valves	Checked By:	M.A. Scott	Date	6/13/83
System	CAC & CEP	Job No.	82044	File No.	OS.01.F
~~Analysis No.~~	QID 361104 Rev. No. 1	Sheet No.	4.1.1		

4.1 Conclusions

Four 30" BIF butterfly valves with Miller Fluid Power cylinder operators have been analyzed for structural integrity and operability to the seismic and hydrodynamic piping analysis loads. These Burns and Roe piping analysis loads are in the form of operator response g-levels. (see Ref. 9).

All four EPN's, i.e., CSP-v-1, CSP-V-2, CEP-V-1A and CEP-V-2A qualify with the following modifications:

1. Manufacturer supplied A-307 bolts must be replaced with A-325 bolts.

2. Shear plates must be added to reduce the ear weld stress (see sheets 4.3.30 through 4.3.48).

Valve operability was also demonstrated (see p. 4.3.20) while cylinder operability is addressed in QID No. 018001.

CYGNA

Calculation Sheet

Project WPPSS Mechanical Equipment		Prepared By: J.E. Rakowski	Date 3/25/83
Subject 30" Butterfly Valves		Checked By: [signature]	Date 6/10/83
System CSP & CEP		Job No. 82044	File No. 0S.01.F
Analysis No. 361104	Rev. No. 1	Sheet No. 4.2.1	

SUMMARY OF RESULTS

Parametric data for the four subject valves in this report is given in Table 1.1. Results of the requalification analyses, which include a comparison of calculated stresses to the allowables are given in Table 1.2. Allowable stresses for the various material types are given in Table 1.3.

SUMMARY TABLE 1.1
30" VALVE PARAMETRIC DATA

EPN	HYDRO LOADS	FUNCTION	ELEV-'R'	PIPE ORIENT	G LOADS FAULTED CONDITION*		
					NORTH	VERT	EAST
CSP-V-1	Y	CONTAINMENT ISOLATION	508	H	1.46	3.67	1.74
CSP-V-2	Y	CONTAINMENT ISOLATION	508	H	1.44	3.57	1.90
CEP-V-1A	Y	DRYWELL EXHAUST	558	V	1.93	2.23	1.85
CEP-V-2A	Y	DRYWELL EXHAUST	558	V	0.96	2.11	1.16

* TRANSMITTED FROM THE FINAL PIPING ANALYSIS, REFER TO SECTION 5.6.5, AT VALVE OPERATOR. (REFER TO SECTION 5.5)

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification
Prepared By: L.C. Fernandez Date: 6/15/83
Subject: 30" Cylinder Operated Butterfly Valve
Checked By: M.A. Scott Date: 6/15/83
System: CSP and CEP
Job No. 82044 File No. OS.01.F
~~Analysis~~ QID 361104 Rev. No. 1 Sheet No. 4.3.3

SUMMARY TABLE 1.2 ~ FAULTED CONDITIONS (STRESS IN PSI)

MEMBER	MATERIAL TYPE	TYPE STRESS	VALVE EPNS CSP-V-1	CSP-V-2	CEP-V-1A[1]	CEP-V-2A[1]	MATERIAL ALLOWABLE
TRUNNION PINS	SA-276	S	4108 MAX				11840
TAPERED PINS	SA-276	S	8985 MAX				11840
DRIVE LEVER	A-395	T	12169 MAX				43200
LEVER KEYWAY	A-395	T	27381 MAX				43200
MAIN SHAFT	SA-479	S	9127 MAX				14500
DRIVE ROD	4140	T	44732 MAX	30082			86400
EAR BOLTS	A-325[2]	T	12150 MAX	8790			66000
		S	9500 MAX	7539			26250
SHEAR P WELD	E60	S	12577				28800
VALVE EAR WELD	E60	S	13277				28800
~ FATIGUE RESULTS (STRESS RANGE IN PSI)							ALLOWABLE STRESS RANGE
TAPER PINS	SA-276	S[3]	35940 MAX				90000
DRIVE ROD	4140	T	86826 MAX	57526			90000
TRUNNION PINS	SA-276	S[3]	16432 MAX				22500
SHEAR P WELD	E60	S	25154				28000
VALVE EAR WELD	E60	S	26554				28000

1 EPNS CEP-V-1A AND CEP-V-2A ENVELOPED BY CSP-V-2 BY A WIDE MARGIN

2 AS INSTALLED BOLTS ARE CURRENTLY A-307 REQUIRE CHANGING TO A-325

3 FATIGUE EVALUATION OF A SHEAR LOAD RESOLVES INTO A TENSILE STRESS RANGE AS FOLLOWS: $\sigma_{MAX} = 2\tau_{MAX}$ $SR = 2\sigma_{MAX} = 4\tau_{MAX}$

CYGNA

Calculation Sheet

Project WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date 3/25/83	
Subject 30" Butterfly Valves	Checked By: L.C. Fernandez	Date 4/29/83	
System CSP and CEP	Job No. 82044	File No. OS.01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.2.4	

△1 M. [signature] 6/14/83
J.C. Fernández 6/15/83

THIS SHEET NOT USED

Calculation Sheet

Project: WPPSS EQ		Prepared By: J.E.Rakowski	Date: 3/25/83
Subject: 30' Butterfly Valves		Checked By: L.C. Fernández	Date: 4/29/83
System: CSP & CEP		Job No.: 82044	File No.: OS.01/F
Analysis No.: 361104	Rev. No.: 1	Sheet No.: 4.2.5	

SUMMARY TABLE 1.3

ALLOWABLE STRESSES

Since operability is required, the stresses for the faulted condition will be kept below yield*. The table below is based on AISC criteria and the yield stresses at temperature (340°F) from PG. 9 of REF. 4 for conservatism.

		LEVEL A & B		LEVEL D	
MATERIAL	YIELD STRS (PSI)	.6 Fy BENDING ALLOW.	.4 Fy SHEAR ALLOW.	1.6×.6 Fy = 0.96 Fy BENDING ALLOW.	1.6×.4 Fy 0.64 Fy SHEAR ALLOW.
AISI-4140 HEAT TREATED	90,000	54,000	36,000	86,400	57,600
SA-276, GR 304	18,500	11,100	7,400	17,760	11,840
ASTM A-395-60-45-15	45,000	27,000	18,000	43,200	28,800
SA-307	23,300	13,980	9,320	22,370	14,900
AISI-1018 (MIN YIELD)	35,000	21,000	14,000	33,600	22,400
SA-193, GR B3, 304SS	31,000	18,600	12,400	29,760	19,840
SA-479, 304SS	22,650	13,590	9,060	21,744	14,500
SA-516, GR 60	28,000	16,800	11,200	26,880	17,920

* BRACKET BOLT ALLOWABLES TAKEN FROM AISC, 8TH ED., SEC. 1.5.2.2

SECTION 4.3

ANALYSIS

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: L.C. Fernandez	Date 6/13/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: M.A. Scott	Date 6/13/83
System: CAC & CEP		Job No. 82044	File No. OS.01.F
~~Analysis No.~~ QID 361104	Rev. No. 1	Sheet No. 4.3.1	

EQUIPMENT REQUALIFICATION FOR QID NO. 361104

BIF 30"CYLINDER OPERATED BUTTERFLY VALVES

4.3.1 Introduction

The four valves in this file are classified according to the parametric data given in Summary Table 1.1.

Since hydrodynamic loads apply (Ref. 7) fatigue analyses were provided for components with the highest stress range.

The analysis method calculates stress from north, vertical and east components of operator response g-levels. These g-levels are the result of the Burns & Roe piping analyses. (Ref. 9)

An SRSS analysis was set up in a computer program for each value assembly in its specific orientation. The SRSS is taken at the maximum stress level due to seismic g-loading. Operating loads due to seating torque force and dead weight are combined with the seismic stress by absolute sum. Valve ear bending stress components due to any one response g-level component are combined by absolute sum.

CYGNA

Calculation Sheet

Project WPPSS Mechanical Equipment Qualification	Prepared By J.E.Rakowski	Date 1/10/83	
Subject 30" Butterfly Valves	Checked By L. C. Fernandez	Date 4/28/83	
System CSP & CEP	Job No. 82044	File No. OS.01/F	
Analysis No 361104	Rev. No. 1	Sheet No. 4.3.2	

The computer analysis addresses only the more highly stressed components in the valve operator assembly. Separate analysis is given for the remaining components using a simpler approach with upper bound loads. This applies to all valve operator EPN's in QID 361106 (24" Valve/8" cylinders) and QID 361104 (30" valves/10" operators). Hand calculations which check selected portions of computer output is shown in Appendix C.

Appendix B of this section describes the air operator mass/stiffness model which was incorporated in the final piping analysis for calculation of operator response g-levels. The computer program includes an option for using the valve ear forces and moments which are directly output from the piping analysis with the valve/operator model included. This was not finally utilized, however, to qualify the subject equipment.

The equipment locations and elevations were taken from the P&ID's in section 6.0. Natural frequency calculations are given for the air operator assemblies in Section 4.3.2.1.

Preliminary analyses were performed which showed that, for operator response g-levels greater than approximately 3 g's, the air cylinder spring preload force would be exceeded and hence some disk flutter would occur when the valve is in the open position. The calculation in section 4.3.2.2 shows that the magnitude of the valve disk flutter vibration angle due to upper bound g-levels which occur in the hydrodynamic frequency range is approximately 6 degrees. This flutter was evaluated to have no detrimental effect on system safety function as noted in Reference 5.

Valve operability was addressed in the following manner. All valves have a Use Code of 1-3. It is noted that the g-levels pertaining to CSP-V-2 envelope CEP-V-1A and CEP-V-2A.

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E.Rakowski	Date: 1/10/83	
Subject: 30' Butterfly Valves	Checked By: L.C. Fernández	Date: 2/29/83	
System: CSP and CEP	Job No. 82044	File No. OS-01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.3	

For valves CSP-V-1 and 2, which must operate from open to fail closed during an event, the following additional evaluations were made:

1) Dynamic flow torques were assessed per Ref. 3 and found to be less than the seating torque which controlled the equipment stresses. Furthermore these flow torques tend to move the valve disk toward the fail-closed position, as noted in the above report.

2) The details of BIF drawing 206 767, parts of which are shown in figures 1.1 and 1.2, allow the following conclusions to be made for valve operability:

   A) Figure 1.1 shows that thrust bearings are part of the shaft bearing design. This design prevents lateral movement of the disk in the direction of the shaft to eliminate interference with the valve body when closing. Further, it is noted on Page 26 of Ref. 3 that frictional torques in the shaft bearing system are negligible.

   B) Figures 1.1 and 1.2 show a circular valve cross section having an internal rim within which the valve seats in the closed position. The only mechanism remaining to affect valve closing which can be postulated is out-of-round distortion of the section due to DBE piping loads and dynamic loads on the valve.

These loads were accounted for in Ref. 4 in the overall valve sizing calculations, where analysis showed that the stress intensity in the 0.5 inch thick valve body remained below 1.2 Sm, or approximately 0.8 of yield. Stress contribution from dynamic loads on the valve and operator were relatively small. Further, as shown in the figures:

CYGNA

Calculation Sheet

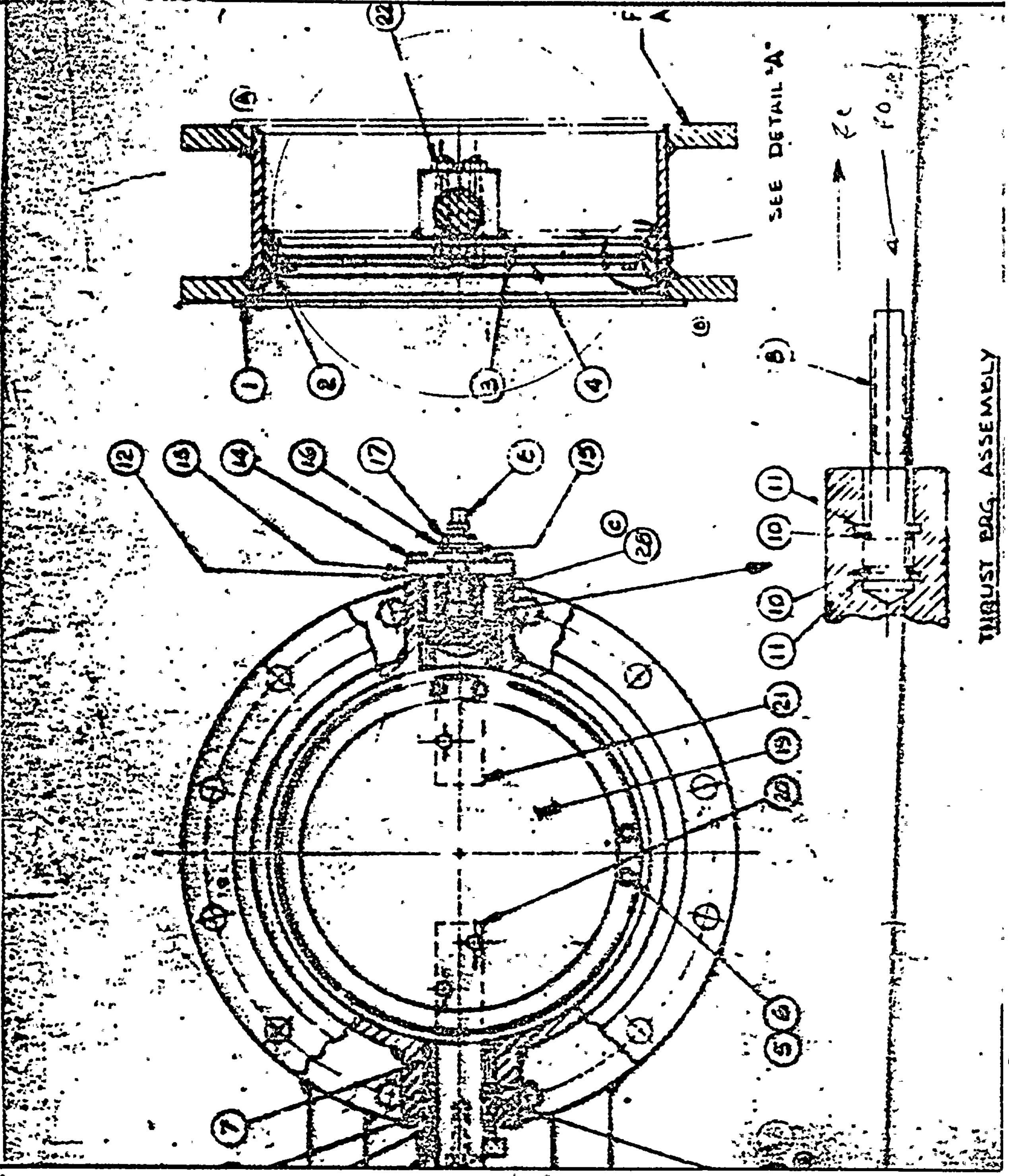
Project: WPPSS Mechanical Equipment Qualification | Prepared By: J.E.Rakowski | Date 1/10/83

Subject: 30" Butterfly Valves | Checked By: L.C. Fernández | Date 4/29/83

System: CEP and CSP | Job No. 82044 | File No. OS.01.F

Analysis No. 361104 | Rev. No. 1 | Sheet No. 4.3.4

FIGURE 1.1 B/F DRAWING 206767



Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E.Rakowski		Date: 1/10/83
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez		Date: 4/27/83
System: CEP and CSP	Job No. 82044	File No. OS.01.F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.5	

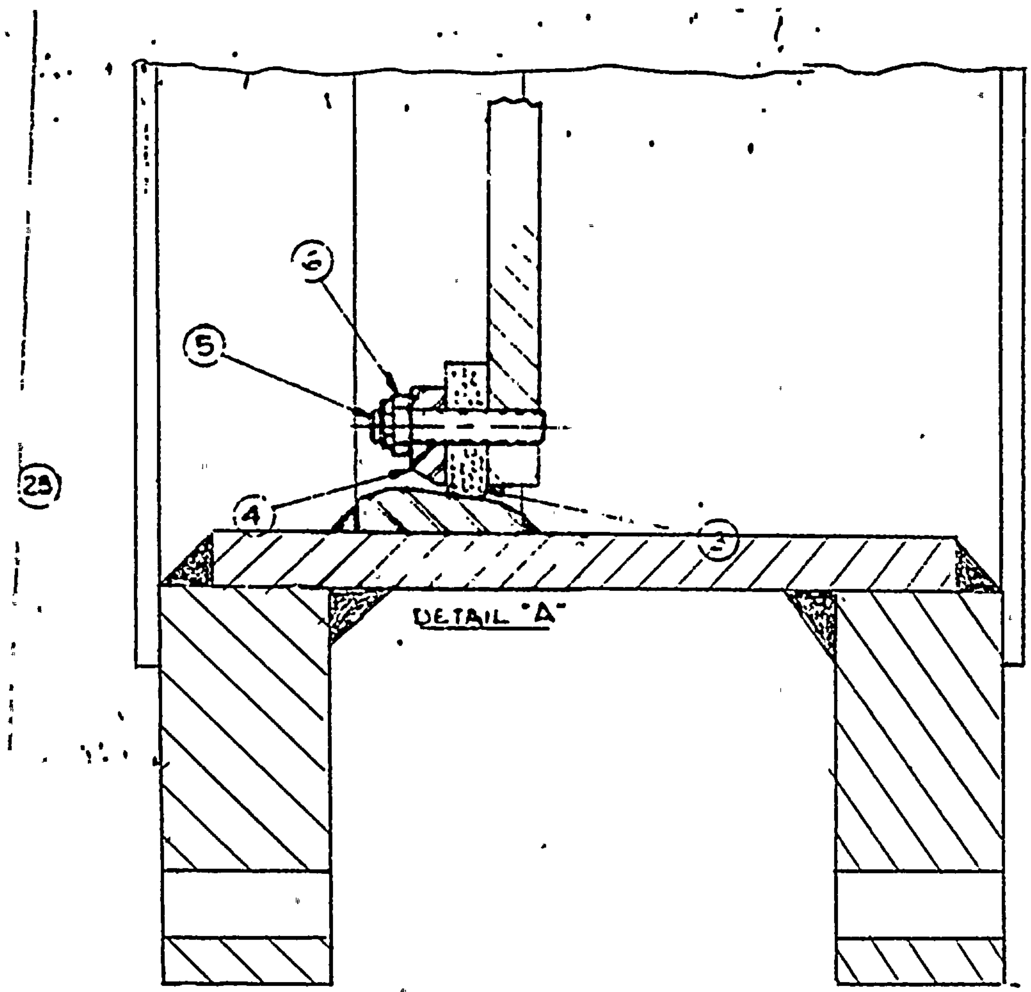


FIGURE 1.2 B/F DRAWING 206767, DETAIL A

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: J.E.Rakowski	Date 3/25/83
Subject: 30" Butterfly Valves		Checked By: L. C. Fernández	Date 4/28/83
System: CSP and CEP		Job No. 82044	File No. OS.01/F
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.6	

1. The valve seat forms a heavily reinforced section made up of the valve body, internal hub and external flanges (including the mating flange of the piping). Hence the stress levels in this section are much lower than in the valve body and hence no distortion of the section could occur to affect seating of the valve. Valve flange dimensions are given below. Note the relatively large internal radial clearance of 1/8 inch.

2. Stress analysis of the valve extended structures are given in this report. Air operator operability is addressed in QID 018001.

   The design data used in the analyses are given in Summary Table 1.1 (pipe-orientations and elevations are taken from the appropriate P&ID's in Section 6.0). Other pertinant data is given below.

   1) Spring preload per communication report in Section 7.0 of QID 018001 are:

      Fail Closed Preload = 2800
      Final = 4800

   2) Cylinder C.G.'s shown on the following sketches represent data received from BIF in the communication report of Section 7.0 of QID 018001.

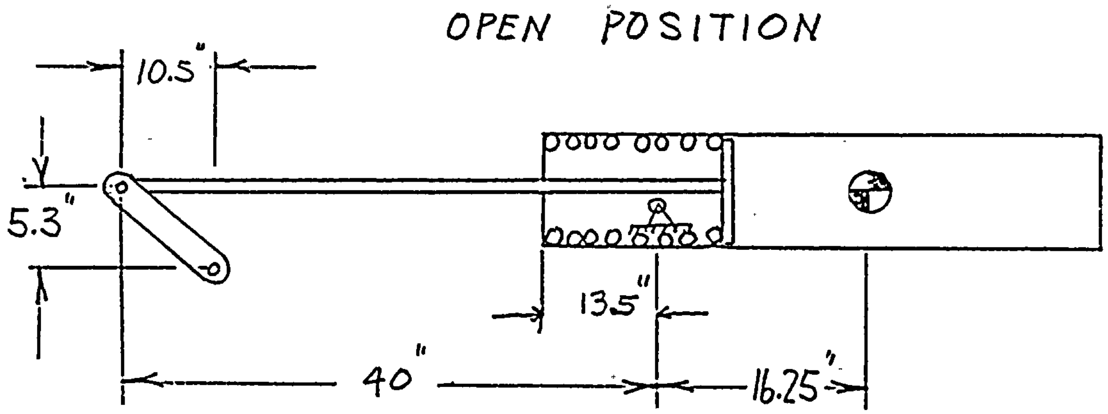
   3) Closing torque values are taken from Ref. 3.

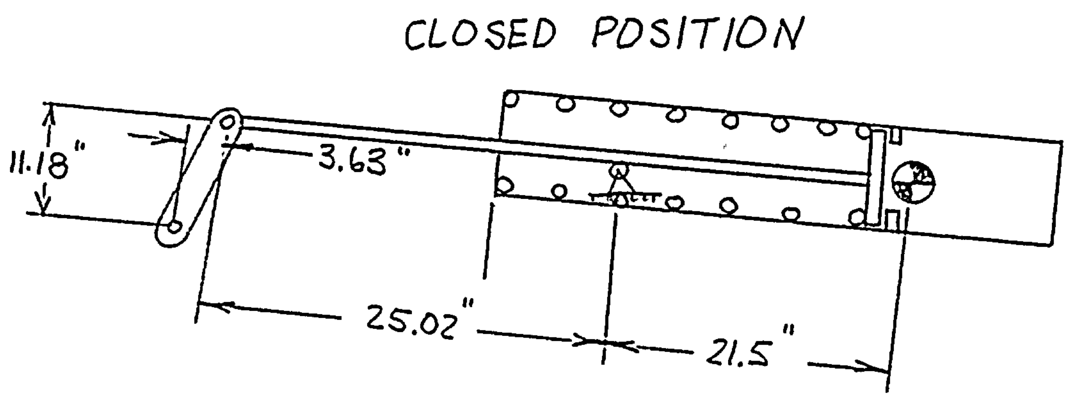
   4) Valve component dimensions: (Ref. Feb. 10, 11/83 communication report - Section 7)

      Flange: width = 3.88", thickness - 2.625"
      Radial Clearance Disk/Seat 1/8"

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: J.E. Rakowski	Date: 3/25/83
Subject: 30" Butterfly Valves		Checked By: L.C. Fernandez	Date: 4/27/83
System: CSP and CEP		Job No. 82044	File No. OS.01/F
Analysis No. 361104	Rev. No. 1	Sheet No 4.3.7	





CYGNA

Calculation Sheet

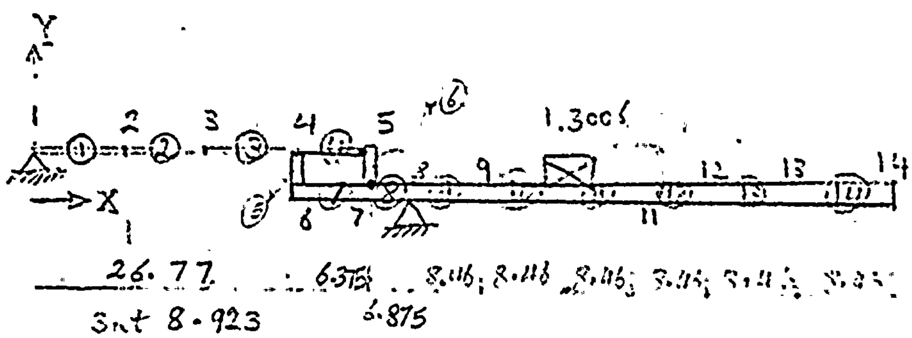
Project: WPPSS Mechanicla Equipment Qualification	Prepared By: H. Abolhoda, J.E. Rakowski		Date: 3/25/83
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez		Date: 4/27/83
System: CSP and CEP	Job No. 82044	File No. OS.01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.0	

4.3.2 CALCULATIONS

4.3.2.1 NATURAL FREQUENCY CALCULATIONS

SINCE THE 10" CYLINDERS ARE SIMILAR TO THE 8" CYLINDERS IN QID 361106, THE LOWEST NATURAL FREQUENCY OCCURS WHEN THE CYLINDER IS IN THE OPEN POSITION DUE TO THE GREATER FLEXIBILITY OF THE EXTENDED DRIVE ROD.

A SAP-ANALYSIS WAS PEFORMED TO CALCULATE NATURAL FREQUENCY. THE MODEL IS DESCRIBED BELOW.



CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: H. Abolhoda, J.E. Rakowski	Date: 3/25/83	
Subject: 30" Butterfly Valves	Checked By: A. Sioale	Date: 4.20/83	
System: CSP and CEP	Job No. 82044	File No. OS.01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.9	

IN THE MODEL, NO MOMENT RESISTANCE TAKES PLACE AT NODE 4 (SHAFT PINNED AT NODE 4), AND AT THE PISTON DISK, NODE 8.

PRESENTED BELOW ARE CALCULATIONS FOR THE GEOMETRICAL AND STRUCTURAL PROPERTIES OF THE MODEL ELEMENTS. THE COMPUTER INPUT AND OUTPUT ARE SHOWN ON PAGE 4.3.A.

$$\text{ROD AREA} = \pi/4 (D)^2 = \pi/4 (1.75)^2 = 2.405 \ \text{IN}^2$$

$$\text{CYL. AREA} = \pi/4 (D_o^2 - D_i^2) = 3.976 \ \text{IN}^2$$

Total length of drive rod $= 25.02 + (50.75 - 42.625)$

$= 33.145$ inches

mass of rod per inch $= 2.4055 \times \frac{.283}{386.4} \doteq .0017$

Total mass of Rod $= 33.145 \times .0017 = .056$

mass of cylind per inch $= 3.9761 \times \frac{.286}{386.4} = .0028$

Total mass of cylinder $= .0028 \times 64 = .1781$

Total mass of system $= \frac{593}{386.4} = 1.53417$

c.g. $= 34.50''$ from cylinder end

Calculation Sheet

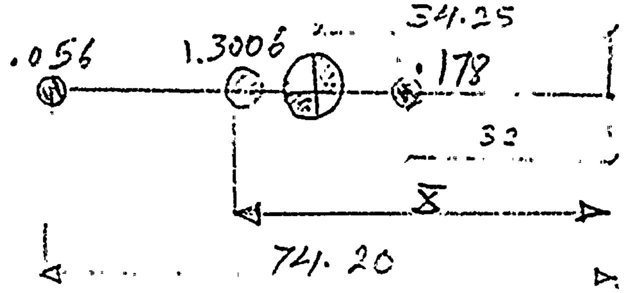
CYGNA

Project: WPPSS Mechanical Equipment Qualification	Prepared By: H. Abolhoda, J.E. Rakowski	Date: 3/25/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez	Date: 4/28/83	
System: CSP and CEP	Job No. 82044	File No. OS.01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.10	

$$C.g.\ of\ Rod = \frac{33.145}{2} + (64 - 6.375) = 74.20$$

C.g. of cylinder = 32"

total mass - mass of Rod & cylinder = 1.3006
a concentrated mass should be placed in certain distance (see below) to obtain an equivalent c.g. for total system



$$\bar{X} = \frac{34.25(1.5347) - .178(32) - 74.20(.056)}{1.3006} = 32.84$$

CALCULATION OF STIFFNESS

$$I_{ROD} = \frac{\pi * 1.75^4}{64} = .4604 \qquad J_{ROD} = 0.9208$$

$$I_{CYL} = \frac{\pi}{64}(10.25^4 - 10.0^4) = 50.96\ IN^4 \qquad J_{CYL} = 101.92\ IN^4$$

(CYLINDER THICKNESS MODELED AS 0.125")

CYGNA

CALCULATION SHEET

PROJECT Susq. Steam Elec. Station
SUBJECT 30" Butterfly Valve
SYSTEM CCP/CSP
ANALYSIS NO. N/A   REV. NO. 0

PREPARED BY [illegible]   DATE 7/15/82
CHECKED BY R. Hsieh   DATE 7/15/82
JOB NO. 8204   FILE NO. [illegible]
SHEET NO. 4.3.11

Computer Input to SAP RD

Related Info.
UFD = WPSS0S
SAP-INPUT-FILE = BV30 OFRS
SAP-OUTPUT-FILE = BV30 RS OUT

```
    $LIST BV300PRS
CALCULATION OF NATURAL FREQUNCY OF 30 INCHES BUTTERFLY VALVE (OPEN)
   15    1    0    1    3
    1    1    1    1    1    1    0              5.0
    2    0    0    1    1    1    0   8.923      5.0
    4    0    0    1    1    1    0   26.77      5.0                    1
    5    0    0    1    1    1    0   33.145     5.0
    6    0    0    1    1    1    0   26.77      0.0
    7    0    0    1    1    1    0   33.145     0.0
    8    1    1    1    1    1    0   40.02      0.0        0.0
    9    0    0    1    1    1    0   48.48
   14    0    0    1    1    1    0   90.780     0.0        0.0        1
   15    1    1    1    1    1    1    0.0      20.0
    2   14    2         1
  129000000.          3      .0007
    1    2.41
    2    3.98                          .921      .4604      .4604
                                     101.92     50.96      50.96

    1    1    2   15    1    1
    4    4    5   15    1    1                                  1    1
    5    4    6    5    1    2                    010001
    6    5    7    4    1    2                                  1
    7    6    7   15    1    2                                       1
   14   13   14   15    1    2
   10    0   1.3006     1.3006

      386.4      386.4       0.0      1
A RESPONSE SPECTRUM WITH CONSTANT ACCLELERATION OF 1 G
    2
      .01        1.0
     100.        1.0
```

$f_{n_1} = 11.45$ Hz (OUTPUT)

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: J.E. Rakowski	Date 3/25/83
Subject: 30" Butterfly Valves		Checked By: L.C. Fernández	Date 4/28/83
System: CSP and CEP		Job No. 82044	File No. OS.01/F
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.12	

CALCULATION OF f_N PARALLEL TO THE DRIVE ROD AND TRUNNION PINS:

APP. B PG. 43.B3

BRACKET STIFFNESS IS: (CANTILEVER BEAM OF EFFECTIVE I_{zz})

$$K = \frac{P}{\delta} = \frac{3EI}{l^3} = \frac{3 \times 2.9(10)^7 * 4.22}{(28.5)^3}$$

(2.16 IN^4 FOR 8" CYL)
(3.54 IN^4 FOR 10" CYL)

$$= 15820 \text{ lb/in}$$

$$M = \frac{(\bar{W}_{AO} + \bar{W}_{BR})}{g} = \frac{(593 + 321)}{384.6} = 2.38 \ \frac{\text{lb sec}^2}{\text{in}}$$

$$f = \frac{1}{2\pi}\sqrt{\frac{K}{M}} = \frac{1}{6.28}\sqrt{\frac{15820}{2.38}} = 12.98 \text{ hz}$$

B) PARALLEL TO DRIVE ROD

SAME MASS, STIFFNESS = EAR BENDING STIFFNESS

APP. B, PG 43.B6

EAR STIFFNESS = $K_{yy} = 48 \times 10^6$ lb/in (10"), $= 7.5(10)^6$ lb/in (8")

$$f_n\Big|_{10"} = \frac{10^3}{2\pi}\sqrt{\frac{48}{2.38}} = 715 \text{ Hz}$$

$$f_n\Big|_{8"} = \frac{10^3}{2\pi}\sqrt{\frac{7.5}{1.76}} = 328 \text{ Hz}$$

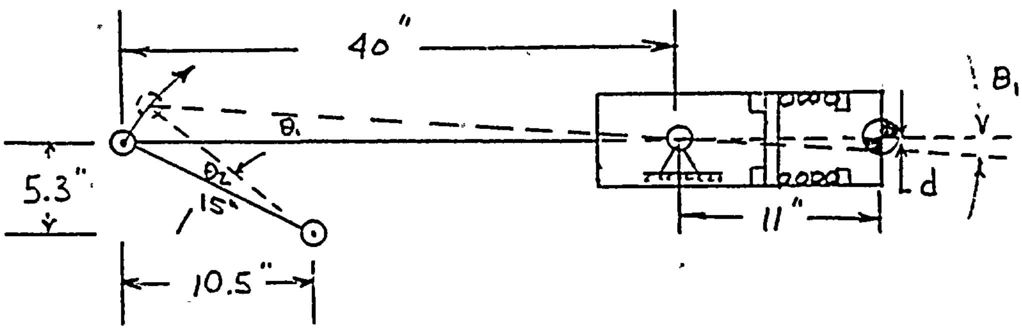
CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date: 3/25/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez	Date: 4/28/83	
System: CSP and CEP	Job No. 82044	File No. OS.01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.13	

4.3.2.2 APPROXIMATE VALVE FLUTTER MAGNITUDE

USING DIMENSIONS FROM FIGURE 1.3 :



CONSERVATIVELY ASSUME THAT THE MAX ACCELERATION COMPONENT OUTPUT FROM THE PIPING ANALYSIS FOR CSP-V-5 (OPEN / FAIL-OPEN) PRODUCES DISPLACEMENTS OF THE AIR OPERATOR RELATIVE TO THE PIPE IN THE FORM OF

$$d_{max} = \frac{A}{\omega_n^2} \quad \text{WHERE } A = 9.35\,g\text{'s} * 386.4\ \text{in}/s^2 \quad (\text{TABLE } 1.1)$$

FROM THE SPECTRA IN SECTION 5.1, FOR HYDRODYNAMIC LOADS:

$$\omega_n\big|_{MIN} = 2\pi\,(15\ Hz)\ (R/s)$$

$$\theta_1 = \tan^{-1}\frac{d}{11.0} = \tan^{-1}\left(\frac{1}{11} * \frac{9.35*386.4}{(94.2)^2}\right) = \left(\frac{.41}{11}\right) = \tan^{-1}(.04)$$

$$\theta_1 = 2.13^\circ$$

$$\therefore \theta_2 \sim 3 * \theta_1 \sim 6^\circ \quad (\text{SMALL})$$

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date 1/10/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez	Date 4/28/83	
System: CSP and CEP	Job No. 82044	File No. O.S.01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.14	

⚠ 6/14/83
JC Fernandez 6/15/83

4.3.2.3 STRESS ANALYSIS

The procedures for the analysis of the subject valves are outlined below:

1. Recalculate the valve appurtenance stresses addressed in Ref. 4 using response g-levels from the Burns & Roe piping analysis. Incorporate the current seating torque given in Ref. 3. Compare stresses to the lower yield strengths in Summary Table 1.3.

2. If faulted condition stresses exceed the upset condition allowable stresses, repeat the analysis for the affected components using upset accelerations from the piping analysis.

3. Perform a fatigue analysis on significantly stressed components. Determine allowable alternating stress ranges from AISC 8th Edition, Appendix B, noting commentary.

The fatigue analysis is to be performed only for those EPN's subject to hydrodynamic loads. The number of respective load cycles is given below.

LOAD COMBINATIONS & STRESS CYCLES

The following table lists the load combinations and the nubmer of expected stress cycles for each combination. (From the design criteria)

	Combination	Cycles
1.	SRV Alone	3(4500)=13500
2.	OBE+SRV	50
3.	OBE+SRV+Chugging	2000
4.	SSE+SRV+Chugging/ SSE+AP	10

⚠

Note: Load combination #4 with 15560 cycles can be used to conservatively bound all combinations.

1006 CC

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date: 3/25/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernández	Date: 4/29/83	
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STRESS ANALYSIS OF VALVE AND AIR OPERATOR COMPONENTS NOT COVERED IN QID 018001

1) TRUNNION PINS

TRUNNION PINS WERE ANALYZED AND THE SHEAR STRESS WAS FOUND TO BE PRIMARILY DEPENDENT ON OVERTURNING IN THE 3-AXIS DIRECTION. WHEN ANALYZED WITH AN ACCELERATION IN THIS DIRECTION OF 13.9 g's, THE SHEAR STRESS WAS ONLY 35 PERCENT OF THE ALLOWABLE. THEREFORE THE PINS ARE SUFFICIENT FOR ALL EPN'S.

THIS CALCULATION FOLLOWS:
[10" A/O ENVELOPED BELOW]

	8"	10"
L_{CG}	14.46"	21.50"
X	12.75"	13.38"
A_{TP}	2.41 IN²	2.41 IN²

$L_{ROD} = 25''$ (CLOSED) $L_{CG} = 14.46''$

$M_1 = \bar{W}_{AO}\, g_3 L_{CG} = (399)(13.9)(14.46) = 80{,}139$ IN#

$F_{23} = \frac{M_1}{X} = \frac{80139}{12.75} = \underline{6285}$ # (CONTROLS STRESS, ENVELOPES 10" A/O G's BY WIDE MARGIN)

$F_{11} = \frac{(L_{ROD} + L_{CG})}{L_{ROD}} \frac{\bar{W}_{AO}}{2} g_1 = \frac{39.46}{25 * 2}(399)(1.04) = 327$ #

$F_{22} = \frac{\bar{W}_{AO}}{2} g_2 = \frac{399(1.66)}{2} = 332$ #

$F_{ST2} = \frac{1201^{\#}}{2} = 601$ #

$F_{WEIGHT(2)} = \frac{399}{2} = 200$ #

} 801# FIXED

$F'_{ST2} = \frac{\text{SEAT TRQUE}}{11.75''} \times \cos 11.82°$

FOR 8": $= \frac{13808''\#}{} \times .86 = 1150$ #

FOR 10": $= \frac{22{,}174''\#}{} \times .86 = 1847$ #

SEE BIF RPT & McPHEARSON RPT

CONSERVATIVE COMBINATION

$\tau = \frac{1}{.75(2.41)} \left\{ \left[(F_{23} + F_{22})^2 + F_{11}^2 \right]^{\frac{1}{2}} + F_{FIXED} \right\} = 4108$ PSI < 11,840 PSI (OK)

Calculation Sheet

CYGNA

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CLEVIS

4, 32 THE TOTAL LOAD ON THE CLEVIS IS THE VECTOR SUM OF FC → AND FST ↓.

	8"	10"
F_{ST2}	1201# (MAX)	1847#
CLEVIS AREA	2.44 in^2	2.44 in^2

$$F_{CLEVIS} = \left[F_C^2 + F_{ST2}^2 \right]^{\frac{1}{2}}$$

ASSUME UPPER LIMIT OF $g_1 = 15g$'s JUST FOR

4, 33 THIS MEMBER, $F_{ST2} = 1847$#, $W_{AO} = 539$# (10"), $L_{CG} = 21.5"$

$$F_{CLEVIS} = [1847^2 + 6953^2]^{\frac{1}{2}} = 7194 \#$$

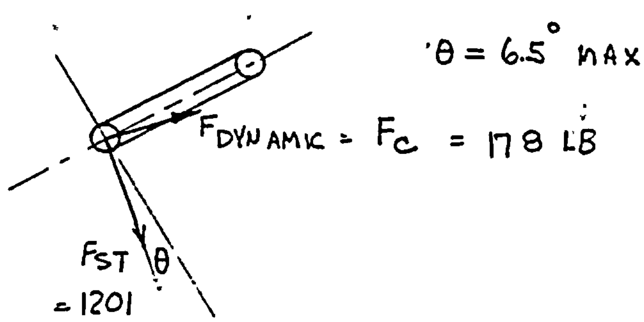
$$\tau_{CLEVIS} = 7194\# / 2.44 in^2 = 2949 \text{ PSI} < 28,800 \text{ (OK)}$$

CLEVIS PIN $\tau = 7194\# / 3.53 \text{ IN}^2 * \frac{4}{3} = 2717 \text{ PSI} < 11,840$ (OK)

4, 32 ∴ CLEVIS & PIN ARE GOOD FOR ALL 8" & 10" A/O EPN'S.

DRIVE LEVER

IMPOSE THE SEATING TORQUE LOAD AND DYNAMIC REACTION FORCE ON THE DRIVE LEVER IN THEIR RESPECTIVE DIRECTIONS:



REF 4, Pg 35 LOAD Fc WILL INCREASE THE AXIAL FORCE IN THE DRIVE LEVER, HOWEVER, THE MAXIMUM TORQUE ON THE LEVER IS THE SEATING TORQUE. THE AIR OPERATOR TRUNNIONS AND INTERNAL SPRING HOLD THE VALVE STABLE IN THE CLOSED POSITION.

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date: 3/25/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernández	Date: 4/22/83	
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MAX NORMAL FORCE ON DRIVE LEVER:

$F_{ST} \cos\theta + F_C \sin\theta = 2524$ LB (ENVELOPE)

$1847 * .99 + 6953 * .10 =$

MAX AXIAL FORCE ON DRIVE LEVER:

$F_{ST} \sin\theta + F_C \cos\theta = 7068$ LB (ENVELOPE)

$1847 \quad .10 \quad 6953 \quad .99$

REF 4, Pg. 34 — MINIMUM DRIVE LEVER AREA = 1.875 IN^2, CONSIDERING FAILURE MODES.

AXIAL STRESS:

MAX BENDING MOMENT = 22,174 IN-LB (CONSERVATIVE FOR USE ON MIN. AREA OUT NEAR CLEVIS PIN)

$\sigma_{AXIAL} = \frac{Mc}{I} + \frac{F_{AX}}{A}$

REF 4, PG 35 — $\sigma_{AXIAL} = 22{,}174 * \frac{1.625}{4.29} + \frac{7068}{1.875} = 12{,}169$ PSI

12,169 < 43,200 PSI OK

SHEAR STRESS:

$\tau = \frac{2524}{1.875} = 1346$ PSI < 28,800 PSI OK

DRIVE LEVER SUFFICIENT ON BOTH 8" & 10" A/O's.

Calculation Sheet

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Subject: 30" Butterfly Valves		Checked By: L.C. Fernández	Date: 4/29/83
System: CSP and CEP		Job No. 82044	File No. OS.01/F
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KEY WAY BEARING STRESS - DUE TO SEATING TORQUE

30" VALVE PARAMETERS:

REF 4, PG 36 — $A_B = 0.448\ IN^2$ — $A_B = .675\ IN^2$

REF 3, PG 3 — $M = 13,800$ IN-LB — $M = 22,174$ IN-LB

REF 4, PG 36 — $\frac{D_{MIN}}{2} = 1.125$ IN — $\frac{D_{MIN}}{2} = 1.25$ IN

$F_{BRG} = \frac{M * 2}{D_{MIN}} = 12,267$ LB (17,739)

$\sigma_{BRG} = \frac{F_{BRG}}{A_B} = 27,381$ PSI (26,280) ∴ 24" VALVE CONTROLS

27,381 < 43,200 PSI

OK MARGIN = 58%

REF 4, PG 37 — SHEAR AREA OF KEY = $1.33\ IN^2$.

THEREFORE - BEARING STRESS CONTROLS.

MAIN SHAFT:

PRELIMINARY ANALYSIS SHOWS THIS IS NOT A HIGHLY STRESSED COMPONENT, ∴ ANALYZE FOR ENVELOPE LOADS.

STRESS = STRESS DUE TO SEATING TORQUE +
STRESS DUE TO SHEAR OF F_{STZ} +
STRESS DUE TO BENDING OF F_{STZ}.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: J.E. Rakowski	Date: 3/25/83
Subject: 30" Butterfly Valves		Checked By: L.C. Fernández	Date: 4/28/83
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	8"	10"
r =	1.1248"	1.25"
$J = 2I$ =	2.514 IN^4	3.83 IN^4
l_5 =	6.005"	6.32"
l_6 =	10.31"	11.18"
I_S =	1.257	1.916
T_S	13,808"#	22,174 "#

REF 4, PG 49

① $\tau_T = \frac{T_S \rho}{J} = \frac{13,808\,(1.1248)}{2.514} = 6174$ PSI $\left\{ \frac{22174(1.25)}{3.83} = 7237\text{ PSI} > 6174\text{ PSI} \right\}$

② $\tau_{AVE} = \frac{F_{COMB.}}{A}$ FROM FIG. ON PAGE 4.3.16 & PG 4.3.17:

$F_{COMB} = [2524^2 + 7068^2]^{\frac{1}{2}} = 7505$ LB

$\tau_{AVE} = \frac{7505}{3.97} = 1890$ PSI

③ $M = \frac{1847\,(6.32)(11.18)}{16.315 = (l_6 + l_5)} = 7999$ IN-LB

$\sigma = \frac{Mc}{I} = \frac{7999 \times (1.1248)}{1.257} = 7158$ PSI

CONSERVATIVELY ADDING SHEAR STRESSES

$\tau = 7237 + 1890 = 9127$ PSI < 14,500 OK
& $\sigma = 7158$ PSI < 21744 OK

RESULT GOOD FOR BOTH 24" & 30" VALVES

Disc

The stresses in the disc were shown on page 51 of Ref. 4 to be due almost entirely to the pressure load. Since the stress found in Ref. 4 of 4540 PSI will not change significantly for the new accelerations, the disc is acceptable.

Taper Pins

The stress in these pins is due only to the seating torque. The stress in Ref. 4, page 53, is 11265 PSI and is therefore acceptable. For the new, lower seating torque, the stress becomes 8985 PSI.

Analysis for: Drive Rod, cylinder bushing pressure, valve ears and valve ear bolts.

Method I: Use element forces and moments output from the piping analysis (Summary Table 1.1) and the absolute sum of stresses. The conservatism of SRSS summing of the component stresses cannot be assured because the independence of the six element forces (/moments) cannot be determined without analysis of modal participation.

Calculation Sheet

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Method II: Use the north, east and vertical operator accelerations output from the piping analysis. Absolute sum for stresses with each component then SRSS over results for N,E and V.

Note 1: Analysis of the distribution of stress on 4 valve ears to predict the maximum tensile stress cannot confirm a maximum value lower than the absolute sum of the elemental tensil stresses due to the six forces (from one acceleration direction, N,E or V). Therefore the absolute sum will be used at this level.

Note 2: Add stress due to the vector sum of deadweight plus seating torque force after above SRSS combinations are performed. (ABS)

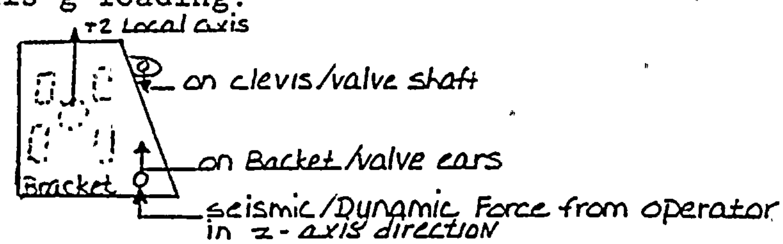
Note 3: 10" A/O parameters are shown for use in QID 361104.

Analysis of Seating Torque Forces

1) Seating Torque loads control the stress in the valve lever arm, keyway, shaft and taper pins. These stresses were less than allowables for the valves of seating torque given in Ref. 3, for all valves.

2) For valve EPN's which are Fail-Open with Use-Code 2, no seating torque forces are applied during the faulted and upset conditions (CSP-V-5,6).

3) For the Fail-Closed valves, the forces at the trunnion pins are shown below, along the cylinder axis, for +2-axis g-loading:



1006 CC

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date: 1/10/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez	Date: 4/29/83	
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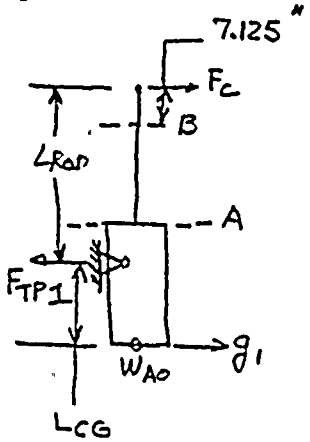
As the bracket deflects in +2, under dynamic loads, the seating torque force is releived. The extent of relief depends on the relative stiffness of the bracket and valve ears relative to the valve seat. Since the steel backets and ears are very stiff in this direction, little relief can be expected. Hence seating torque forces will be added as an ABS sum to the valve ears. However, seating torque force will oppose operator weight when the brackets hangs downward from horizontal pipes.

Operator Drive Rod

Drive rod dyanmic stress is due only to g_1 because g_3 and g_2 forces are taken out by trunnion pins. Add seating torque stresses.



$$F_c = \frac{L_{CG}}{L_{ROD}} \bar{W}_{AO} g_1$$

TWO POINTS ARE CRITICAL, PT A AT THE BUSHING AND PT B AT THE REDUCED THREAD DIAMETER

$$M_A = F_c (L_{ROD} - 13.5")$$

$$\sigma_A = \frac{M_A C_A}{I_A}$$

$$M_B = 7.125\ F_c$$

$$\sigma_B = \frac{M_B C_B}{I_B}$$

	8"	10"
I_A	.4604 IN^4	Same
C_A	.875 IN	Same
I_B	.1383 IN^4	Same
C_B	.6478 IN	Same
A_B	1.405 IN^2	Same
A_A	2.41 IN^2	2.41 IN^2

CYGNA | **Calculation Sheet**

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FINALLY:

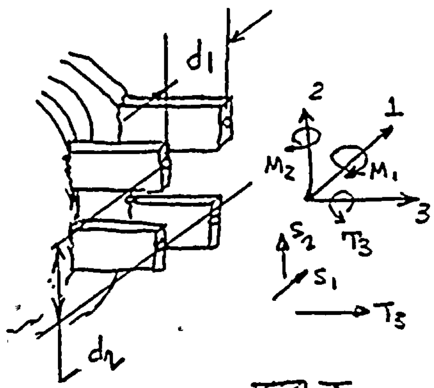
$$\sigma_A)_{OPERATING} = \frac{F_{STZ}}{A_A} + \frac{M_A c}{I_A}\Big)_{DW}$$

$$\sigma_B)_{OPERATING} = \frac{F_{STZ}}{A_B} + \frac{M_B c}{I_B}\Big)_{DW}$$

ADD AS ABS SUM AFTER SRSS OF DYNAMIC COMPONENTS

SEISMIC / DYNAMIC FORCES ON VALVE EARS

A SAP-TYPE* MASS / STIFFNESS MODEL WAS PREPARED FOR THE PIPING MODEL TO CALCULATE A/O RESPONSE G-LEVELS (SEE ATTACHMENT). THE VALVE-EAR SYSTEM BENDING AND TORSIONAL FLEXIBILITY WAS INCLUDED IN THE MODEL AND SRSS FORCES AND MOMENTS WILL ALSO BE OUTPUT FOR CONVERSION INTO VALVE EAR STRESSES. THE EQUATIONS ARE:

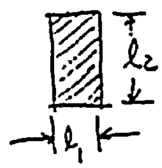


Tension due to M_1 & T_3:
(SEE LOCAL COORD. DEF'N – NEXT PG)

$$2Pd_1 = M_1$$

$$\sigma_{M_1} = \frac{P}{A} = \frac{M_1}{2d_1 A} \qquad A = l_1 l_2$$

	8"	10"
l_2 =	2.5"	3"
l_1 =	1.5	1.75
d_1 =	7.5"	9.5"
d_2 =	10.0"	10.5"

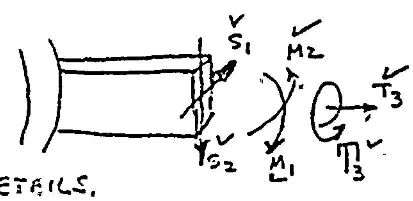


① $\sigma_{T_3} = \frac{P}{4A} = \frac{T_3}{4 l_1 l_2}$ (tension due to T_3) + WHEN T_3 = +

② $\sigma_{3\,tension} = \frac{M_1}{2 d_2 l_1 l_2}$ due to M_1

TOP IN TENSION (+) WHEN M_1 IS +

SAP-MODEL:
(SEE ATTCHMNT)
(APPENDIX B)



* STRUCTURAL ANALYSIS PROGRAM, SEE APPENDIX A FOR ADDITIONAL DETAILS.

1006 00

Calculation Sheet

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Subject: 30" Butterfly Valves	Checked By: L.C. Fernandy	Date: 4/29/83	
System: CSP and CEP	Job No: 82044	File No: OS.01/F	
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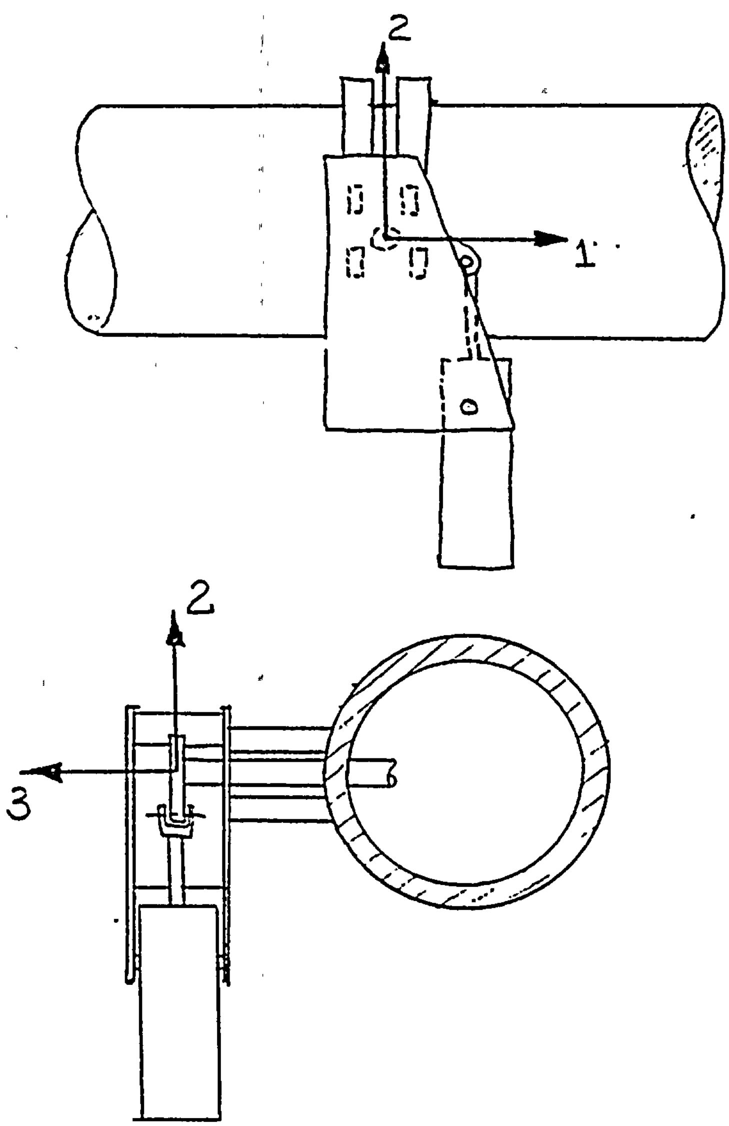
COORDINATE SYSTEM (LOCAL)



CYGNA

Calculation Sheet

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Subject: 30" Butterfly Valves		Checked By: L.C. Fernandez	Date: 6/15/83
System: CSP and CEP		Job No.: 82044	File No.: OS.01/F
Analysis No.: 361104	Rev. No.: 1	Sheet No.: 4.3.25	

△1 L.C. Fernandez 6/15/83

BOLTS HOLDING BRACKETS TO EARS:

BOLT TENSION IS DUE TO M_1, M_2, T_3

BOLT SHEAR IS DUE TO S_1, S_2, T_3

Tension (ABS SUM):

$$\sigma_{T3} = \frac{T_3}{4 A_B}$$

$$\sigma_T)_{M1} = \frac{M_1}{2 d_2 A_B}$$

$$\sigma_T)_{M2} = \frac{M_2}{2 d_1 A_B}$$

AREA

	8"	10"
$A_B = \frac{\pi D^2}{4}$	$0.31 IN^2$	$.43 IN^2$
D	.6273"	.7387"

Shear:

$$F_{11}/\text{bolt} = F_C * AF_x$$
$$F_{22}/\text{bolt} = F_C * AF_y$$

(PREVIOUS PAGES 4.3.26, 27)

$$\tau_1 = \frac{F_{11}}{A_B} = \frac{F_C * AF_x}{A_B} \longrightarrow \quad (1)$$

$$\tau_2 = \frac{F_{22}}{A_B} = \frac{F_C * AF_y}{A_B} \downarrow \quad (2)$$

Similarly:

$$\tau_{S1} = \frac{S_1}{4 A_B} \longrightarrow \quad (3)$$

$$\tau_{S2} = \frac{S_2}{4 A_B} \downarrow \quad (4)$$

COMBINE IN SAME MANNER AS ON PREVIOUS PAGE, FOR EARS BUT SUBSTITUTE A_B FOR $\ell_1 * \ell_2$

Calculation Sheet

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METHOD II – THE PREVIOUS EQUATIONS FOR STRESS BY METHOD I ARE APPLICABLE. HOWEVER,

1) EXPRESSIONS FOR THE SIX FORCES/MOMENTS ARE DERIVED BELOW IN TERMS OF g-level COMPONENTS IN THE LOCAL AXIS SYSTEM (SUBSEQUENTLY DIRECTION COSINES WILL BE USED TO CONVERT THE N, E & V ACCELERATION VECTORS, IN TURN, INTO LOCAL AXES). (SEE SECTION 5.4)
2) THESE EQUATIONS ARE TO BE USED TO FIND THE FORCES AND MOMENTS ON THE EARS DUE TO THE DEADWEIGHT AND SEATING TORQUE FORCES, FOR CALCULATION OF OPERATING STRESSES, FOR USE IN EITHER METHOD 1 & 2.

SEE FORCES & BRACKET ORIENTATION IN LOCAL COORDINATES, NEXT PAGE.

1: T_3 = TORSION ABOUT LOCAL AXIS # 3

$$T_3 = \Sigma M_{SHAFT} (+) = F_{TR1} e_3 + F_{BR1} e_4 + F_{AO2} e_2 + F_{BR2} e_1$$

$$= F_{TR1} e_3 + \bar{W}_{BR} g_1 e_4 + \bar{W}_{AO} g_2 e_2 + \bar{W}_{BR} g_2 e_1$$

$T_3 = (+)$		$= F_{TR1} e_3 + \bar{W}_{BR} g_1 e_4 + g_2 (\bar{W}_{AO} e_2 + \bar{W}_{BR} e_1)$
$T_{3\,FIXED} = (+)$		$= W_{ATR1} e_3 + (W_{AO2} + F_{ST2}) e_2 + W_{BR1} e_4 + W_{BR2} e_1$

CYGNA

Calculation Sheet

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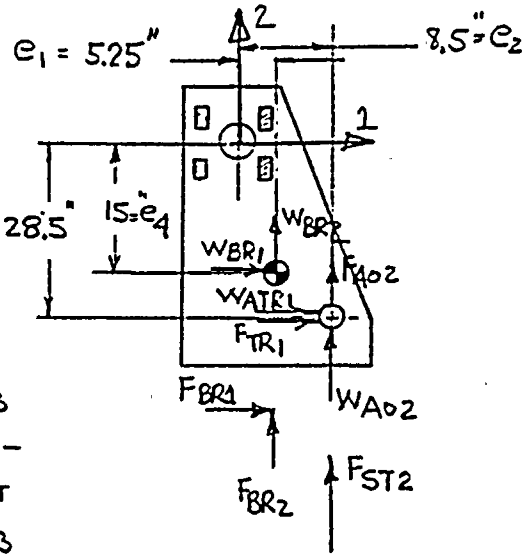
FORCES ON SUPPORT EARS DUE TO LOCAL-AXIS ACCELERATIONS g_1, g_2, g_3

FORCES IN THE LOCAL COORDINATE SYSTEM:



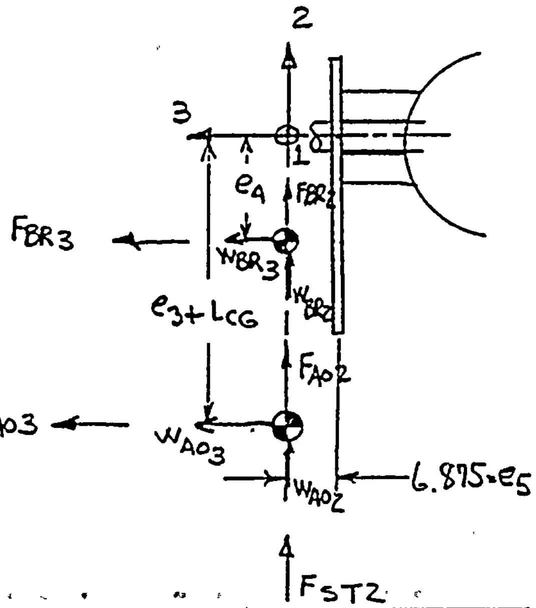
ELEVEN FORCES ACT IN THE LOCAL 1,2,3 A/O AXIS SYSTEM:

DYNAMIC:

- $F_{AO\,2,3} = \bar{W}_{AO} * g_{2,3}$
- $F_{TR\,1}$ = 1-AXIS COMPONENT OF DYNAMIC FORCE AT TRUNNION
- $F_{BR\,1,2,3}$ - 1,2,3 AXIS COMPONENTS OF BRACKET INERTIA $= \bar{W}_{BR} * g_{1,2,3}$

STATIC:

- W_{ATR1} = FORCE AT TRUNNION IN 1-AXIS DUE TO A/O WEIGHT
- $W_{AO\,2,3}$ = WEIGHT OF A/O IN AXES 1,2,3
- $W_{BR\,1,2,3}$ = WEIGHT OF BRACKET IN THE 1,2 & 3-AXIS DIRECTIONS
- $F_{ST\,2}$ = SEATING TORQUE FORCE, IS ALWAYS ALONG 2-AXIS.



Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski — Date: 3/25/83
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez — Date: 6/15/83
System: CSP and CEP	Job No. 82044 — File No. OS.01/F
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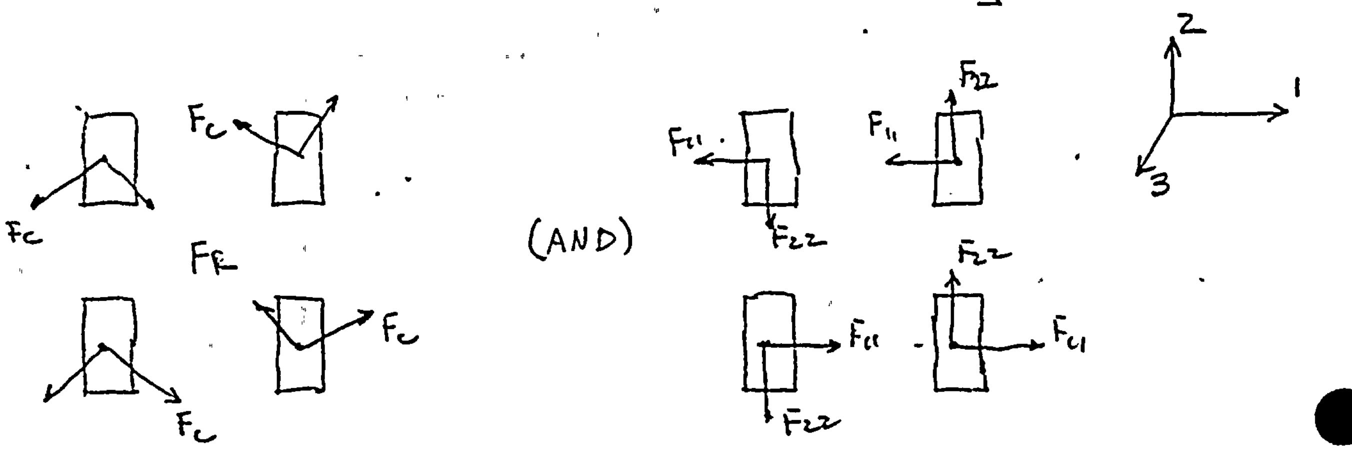
FORCE ORIENTATIONS ON EARS: IF (+ T_3)



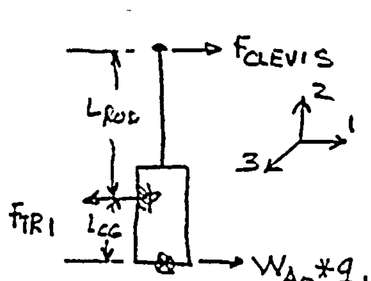
$$S_1 = F_{TR1} + F_{BR1} = \overrightarrow{F_{TR1} + \bar{W}_{BR}\, g_1}^{+}$$

$$S_{1FIXED} = \;\; = \overrightarrow{W_{BR_1} + W_{ATR1}}^{+}$$

FROM A FORCE BALANCE OF THE OPERATOR:

$$F_{TR1} = + \frac{(L_{ROD} + L_{CG})}{L_{ROD}} * \bar{W}_{AO} * g_1 \quad (+\text{ FORCE ON BRKT})$$

$$W_{ATR1} = + \frac{(L_{ROD} + L_{CG})}{L_{ROD}} W_{AO1}$$



LENGTH

	8" OPEN	8" CLOSED	10" OPEN	10" CLOSED
LROD	40"	25"	40"	25"
LCG	10.96"	14.46	16.25"	21.5"

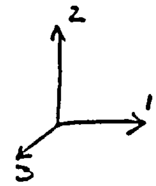
1006 0C

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date: 3/25/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez	Date: 6/15/83	
System: CSP and CEP	Job No. 82044	File No. OS.01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.29	

$$S_2 = F_{AO2} + F_{BR2} = (\bar{w}_{AO} + \bar{w}_{BR}) g_2 \quad +\uparrow$$

$$S_{2\,FIXED} = w_{BR2} + w_{AO2} + F_{ST2} \quad +\uparrow$$

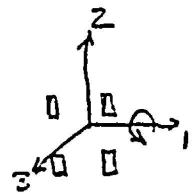


FOR OUT OF PLANE BENDING:

$$M_1 = (+) = -F_{AO2}\, e_5 - F_{BR2}\, e_5 - F_{AO3}(e_3 + L_{CG}) - F_{BR3}\, e_4$$

$$M_1 = -(\bar{w}_{AO} + \bar{w}_{BR}) g_2\, e_5 - \bar{w}_{AO} g_3 (e_3 + L_{CG}) - \bar{w}_{BR} g_3\, e_4$$

$$M_{1\,FIXED} = (w_{AO2} + w_{BR2} + F_{ST2}) e_5 - w_{AO3}(e_3 + L_{CG}) - w_{BR3}\, e_4$$

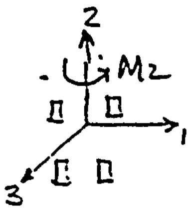


+ = TOP EARS IN TENSION

$$M_2 = (+) = +F_{TR1}\, e_5 + F_{BR1}\, e_5 - F_{AO3}\, e_2 - F_{BR3}\, e_1$$

$$M_2 = +(F_{TR1} + \bar{w}_{BR} g_1) e_5 - (\bar{w}_{AO}\, e_2 + \bar{w}_{BR}\, e_1) g_3$$

$$M_{2\,FIXED} = +(w_{ATR1} + w_{BR1}) e_5 - w_{AO3}\, e_2 - w_{BR3}\, e_1$$



+ = LEFT EARS IN TENSION

$$T_3 = +\swarrow\ (+3\text{AXIS}) = (\bar{w}_{AO} + \bar{w}_{BR}) g_3 \qquad T_{3\,FIXED} = w_{AO3} + w_{BR3}$$

T_3, M_1, M_2, S_1, S_2, & T_3 COMPLETE

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification	Prepared By: M.A. Scott		Date: 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves	Checked By: L.C. Fernandez		Date: 6/15/83
System: CSP and CEP	Job No. 82044		File No. OS.01.F
~~Analysis No.~~ QID 361104	Rev. No. 1	Sheet No. 4.3.30	

Section 4.3.4 - Ear Support Weld Stress

Comparison of a similar file (QID No. 361106) to this file noted the unconservative assumption of considering the bracket support ears to be a guided cantilever (fixed-fixed). The resulting ear weld stresses exceeded the allowable stresses. The ear weld stresses can be lowered by the addition of shear plates to stiffen the whole assembly. The resulting weld stresses (both existing and modified) are to be kept within the fatigue allowable stress, i.e., ½ stress range. The allowable fatigue stress range from AISC for fillet welds in shear with less than 20000 cycles of loading is:

$$SR = (1.5)(15000) = 22500 \text{ PSI}$$

This includes the 50% increase due to fewer than 20000 cycles. The weld stresses are calculated using faulted loads. These loads produce less than one percent of the total 15560 cycles of faulted/hydrodynamic loading. Since the upset and emergency conditions are considerably lower in magnitude, small margins of overstress in fatigue will be tolerated for faulted stress levels. The following allowables will be adhered to in the ear weld stress calculations.

Allowable stress for welds for faulted conditions:

$$\sigma_{allow} = 1.6(0.3)Fu = 28800 \text{ PSI}$$

Allowable stress for welds subject to fatigue. This is ½ the allowable stress range of AISC Appendix B:

$$\sigma_{allow_{fat}} = \frac{1.25(1.5)(15)}{2} = 14 \text{ KSI}$$

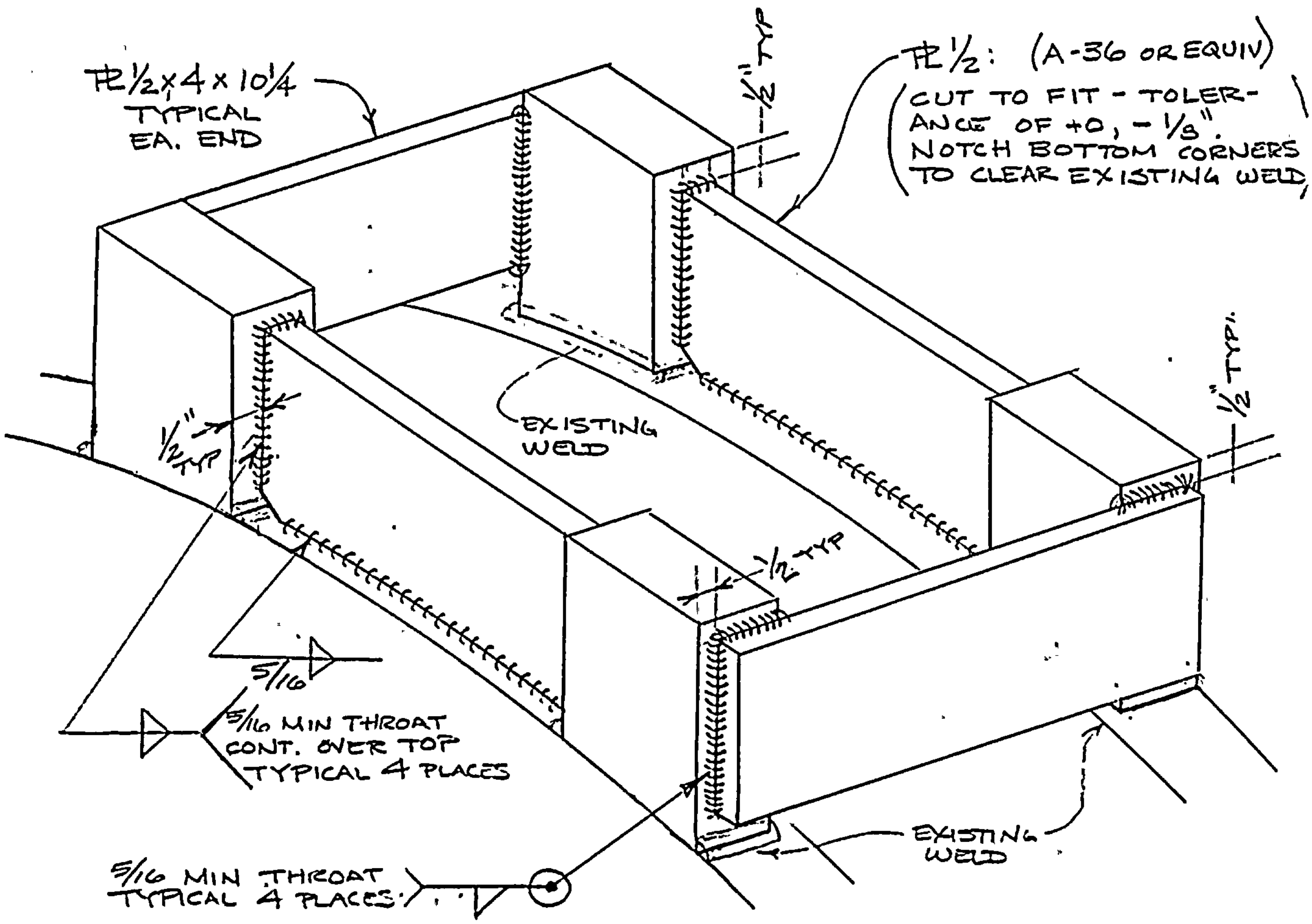
1.25 = 25% increase due to previous comments

1.5 = 50% increase due to AISC commentary

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification	Prepared By: M.A. Scott	Date: 6/15/83	
Subject: 30" Cylinder Operated Butterfly Valves	Checked By: L.C. Fernandez	Date: 6/15/83	
System: CSP and CEP	Job No. 82044	File No: OS.01.F	
~~Analysis No~~ QID 361104	Rev. No. 1	Sheet No. 4.3.31	



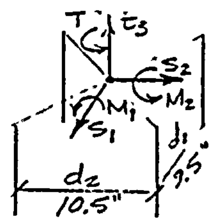
ALL WELD METAL E7018
PREHEAT 200°F MIN
3/4" MAX FILLET
EXEMPTED FOR POST WELD
HEAT TREATMENT PER
ASME III NC-4622.7.

TO BE REPAIRED UNDER
SECTION 11 GUIDELINES

Calculation Sheet

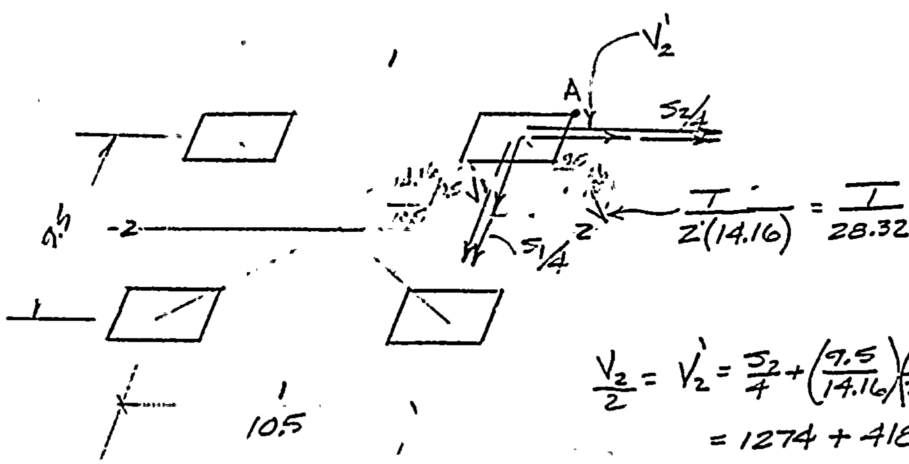
Project: WPPSS Mechanical Equipment Requalification	Prepared By: M.A. Scott	Date: 6/15/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez	Date: 6/15/83	
System: CSP and CEP	Job No. 82044	File No. OS.01.F	
~~Analysis No.~~ OID 361104	Rev. No. 1	Sheet No. 4.3.32	

CSP-V-1



APPLIED LOADS @ TOP OF SUPPORT EARS

	S_1	S_2	t_3	M_1	M_2	T_3
OPERATING	0	2761	0	21398	0	22425
DYNAMIC	5094	3309	3270	148924	142329	154013
COMBINED	5094	6070	3270	170322	142329	176439



$$\frac{T}{2(14.16)} = \frac{T}{28.32}$$

$$\frac{V_2}{2} = V_2' = \frac{S_2}{4} + \left(\frac{9.5}{14.16}\right)\left(\frac{T}{28.32}\right)$$

$$= 1274 + 4180 = 5454^{\#}$$

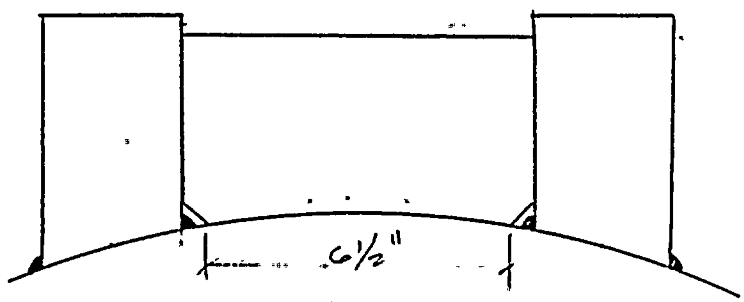
$$\frac{V_1}{2} = V_1' = \frac{S_1}{4} + \left(\frac{10.5}{14.16}\right)\left(\frac{T}{28.32}\right)$$

$$= 1518 + 4620 = 6138^{\#}$$

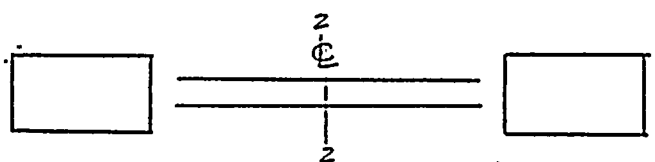
Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification	Prepared By: M.A. Scott	Date 6/15/83	
Subject: 30" Cylinder Operated Butterfly Valve	Checked By: L.C. Fernandez	Date 6/15/83	
System: CSP and CEP	Job No. 82044	File No. OS.01.F	
~~Analysis No.~~ OID 361104	Rev. No. 1	Sheet No. 4.3.33	

FOR THE 10½" SIDE, DUE TO THE RELATIVE STIFFNESS OF THE EARS TO THE PLATE ATTACH THE SHEAR PL TO THE FLANGE OF THE VALVE.



THE RESULTING WELD PROPERTIES @ THE FLANGE ARE THEN



$$A = \left(2\left[(3+1.75)2\right] + 2\left(6\tfrac{1}{2}\right)\right)t_w =$$

$$= (19.0 + 13.0)\,t_w = 32\,t_w \text{ in}^2$$

$$I_2 = \left(2\left[\frac{3(1.75)^2}{2} + \frac{3^3}{6}\right] + \frac{6.5^3}{6} + 2\left(19.0(5.25)^2\right)\right)t_w$$

(I EAR WELDS; PL WELD; $A\ l^2$)

$$= t_w\left[18.188 + 45.771 + 1047.375\right] = 1111.33\,t_w \text{ in}^4$$

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: M.A. Scott	Date 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date 6/15/83
System: CSP and CEP		Job No. 82044	File No. OS.01.F
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THE RESULTING SECTION MODULUS IS THEN

$$S = \frac{1111.33\ t_w}{(5.25+1.5)} = 164.6\ t_w\ \text{IN}^3$$

THE SETION PROPERTIES OF THE WELDMENT OF THE EARS ABOUT THE 1-1 AXIS WILL IGNORE THE CONTRIBUTION OF THE SHEAR ~~TE~~ WELDMENT. SINCE THE STRESS CALCULATIONS WILL ONLY USE THE INDIVIDUAL EAR THE PROPERTIES WILL BE CALCULATED THUS.

$$A_{EAR\ WELD} = t_w(3+1.75)2 = 9.5\ t_w\ \text{IN}^2$$

$$S_{1\ EAR} = \left[3(1.75) + \frac{1.75^2}{3}\right] = 6.271\ t_w\ \text{IN}^2$$

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: M.A. Scott	Date: 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date: 6/15/83
System: CSP and CEP		Job No.: 82044	File No.: OS.01.F
~~Analysis No.~~ QID 361104	Rev. No.: 1	Sheet No.: 4.3.35	

THE STRESSES ON THE WELDMENT ABOUT THE 1-1. AXIS IS DUE TO THE FOLLOWING LOAD

MOMENT @ WELDMENT

$$M_{11} = 170322 + 2(5454)(5") = 224862 \text{ IN-LB}$$

54540

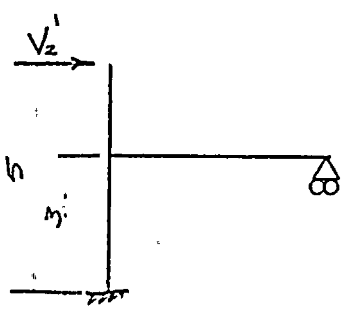
$$V_1 = 2(5454) = 10908 \text{ LB}$$

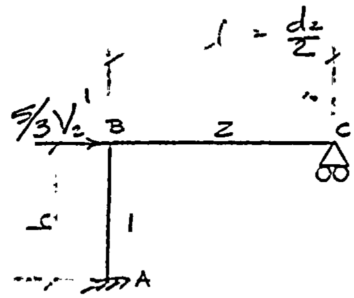
THE RESULTING WELD LOAD IS THEN:

$$f_{b_A} = M/S = 224862/164.6 = 1366 \text{ LB/IN}$$

$$f_{VH_A} = V/A = 10908/32 = 341 \text{ LB/IN}$$

THE V_2 SHEAR AND THE M_1 MOMENT APPLICATION TO THE EAR GROUP IS TREATED AS FOLLOWS





Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification	Prepared By: M.A. Scott	Date: 6/15/83	
Subject: 30" Cylinder Operated Butterfly Valves	Checked By: L.C. Fernandez	Date: 6/15/83	
System: CSP and CEP	Job No.: 82044	File No.: OS.01.F	
~~Analysis~~ QID 361104	Rev. No.: 1	Sheet No.: 4.3.36	

IN REVIEWING THE PROPORTIONS OF THE MEMBERS, THE BENDING DEFLECTIONS WILL BE NEGLIGABLE IN COMPARISON TO SHEAR. THE RESULTING RESPONSE OF BENDING OF THE EAR IN COMPARISON TO THE HORIZONTAL SHEAR DEFLECTION OF THE PLATE

$$\delta_b = \frac{Pl^3}{3EI} = \frac{6138(5)^3}{3(30E^6)\left(\frac{3(1.75)^3}{12}\right)} = .00636$$

ASSUMING THE 1/2" PL AND THE EARS ARE EFFECTIVE IN SHEAR

$$A_s = 2(3)(1.75) + 7.75(.5) = 14.375$$

$$\delta_s = \frac{PL}{AE_s} = \frac{2(6138)(5.0)}{14.375(12E^6)} = .000356$$

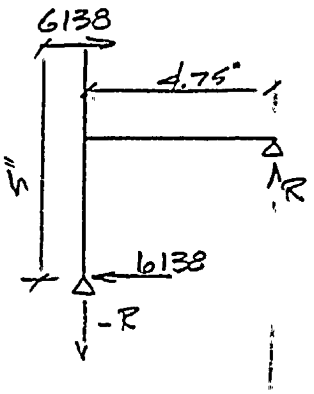
$$\frac{\delta_b}{\delta_s} = 17.88$$ ⇒ SHEAR STIFFNESS IS ABOUT 18 TIMES AS STIFF AS BENDING

∴ ASSUME ~~THAT~~ THE RESULTING LOAD GOES PRIMARILY TO AXIAL AND SHEAR ON THE WELDMENT.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: M.A. Scott	Date: 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date: 6/15/83
System: CSP and CEP		Job No.: 82044	File No.: OS.01.F
~~Analysis No.~~: QID 361104	Rev. No.: 1	Sheet No.: 4.3.37	



$$R = \frac{6138(5)}{4.75} = 6461\ \#$$

THE VERTICAL LOAD ON THE WELD DUE TO SHEAR AND BENDING MOMENT IS

$$f_{axial} = \frac{P}{A} + \frac{M_z}{d_z \cdot A_g} = \frac{6461}{9.5} + \frac{142329/9.51}{32}$$

$$= 680 + 468 = 1148\ \#/in$$

THE HORIZONTAL LOAD PRODUCES THE FOLLOWING SHEAR LOAD ON THE WELD.

$$f_{shear} = \frac{V_z}{A_s} = \frac{6138}{9.5} = 646\ \#/in$$

SINCE THE BENDING DOES CONTRIBUTE TO THE WELD STRESS CONSERVATIVELY ASSUME THE BENDING TO BE 10% EFFECTIVE OF TOTAL BENDING NEGLECTING SHEAR STIFFNESS.

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: M.A. Scott	Date 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date 6/15/83
System: CSP and CEP		Job No. 82044	File No. OS.01.F
~~Analysis No.~~ OID 361104	Rev. No. 1	Sheet No. 4.3.38	

FROM KLEINLOGEL'S "RIGID FRAME FORMULAS" FOR FRAME 5

$$I_1 = \frac{3(1.75)^3}{12} = 1.34\ \text{in}^4$$

$$I_2 = \frac{.5(4)^3}{12} = 2.67\ \text{in}^4$$

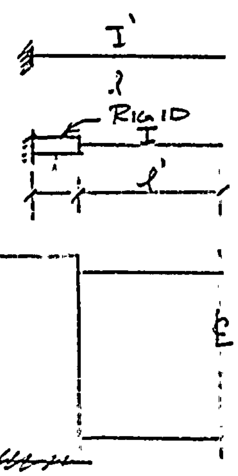
$$l_1 = 3\ \text{in}$$
$$l_2 = 9.5/2 = 4.75\ \text{in}$$

SINCE A PORTION OF THE SHEAR PLATE IS PART OF THE EAR MODIFY THE STIFFNESS (I) TO COMPENSATE FOR THE "RIGID" PORTION

$$\frac{I_2}{l'^3} = \frac{I_2'}{l^3}$$

$$I_2' = \frac{I_2 l^3}{l'^3} \cdot \frac{(2.67)(4.75)^3}{(4.75 - 1.75/2)^3}$$

$$= 4.917$$



FROM KLEINLOGEL

$$k = \frac{I_2'}{I_1} \cdot \frac{h}{l} = \frac{4.917\,(3.0)}{1.34\,(4.75)} = 2.318$$

$$N = 3k + 1 = 7.954$$

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: M.A. Scott	Date: 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date: 6/15/83
System: CSP and CEP		Job No.: 82044	File No.: OS.01.F
~~Analysis No.~~ QID 361104	Rev. No.: 1	Sheet No.: 4.3.39	

$$M_B = \frac{3Phk}{2N} = \frac{3(5/3(6138))(3.0)(2.318)}{2(7.954)} = 13415 \text{ IN LB}$$

$$M_A = -Ph + M_B = -(5/3)(6138)(3.0) + 13415$$

$$= -30690 + 13415 = -17274$$

THE AXIAL VERTICAL REACTION @ EITHER A OR C DUE TO HORIZONTAL SHEAR:

$$V_c = -V_A = \frac{M_B}{d} = \frac{13415}{4.75} = 2824 \text{ LB}$$

THE RESULTING LOAD IN THE WELD IN THE EAR: AXIAL DIRECTION DUE TO BENDING IS THEN

$$f_b = \frac{M}{S} = \frac{17274}{6.271} = 2755$$

TEN PERCENT OF THIS VALUE IS THEN

$$f_b' = 2755(.10) = 276 \text{ \#/IN}$$

TOTAL COMBINED LOAD

THE AXIAL LOAD t_3 WHEN APPLIED TO THE TOTAL AREA OF ATTACMENT TO THE FLANGES PRODUCES THE FOLLOWING AXIAL LOAD ON THE WELD

$$f_1 = \frac{t_3}{2A} = \frac{3270}{2(32)} = 51.1 \text{ LB/IN}$$

THE TOTAL COMBINED LOAD ON THE WELD IS THEN

$$f_{tot} = \left[(1366 + 1148 + 276 + 51)^2 + (341^2 + 646^2)\right]^{1/2}$$

$$= 2933 \text{ LB/IN}$$

THE RESULTING WELD STRESS IS THEN

$$\tau_{WELD} = \frac{2933}{(.707)(.3125)} = 13277 \text{ PSI} \leq 14000$$

* THIS STRESS LEVEL IS SOMEWHAT GREATER THAN THE ALLOWABLE STRESS FOR FATIGUE BUT CONTAINS THE OPERATING LOADS WHICH WOULD BRING THE ACTUAL ALTERNATING STRESS RANGE WITHIN ACCEPTABLE LIMITS.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification	Prepared By: M.A. Scott	Date 6/15/83	
Subject: 30" Cylinder Operated Butterfly Valves	Checked By: L.C. Fernandez	Date 6/15/83	
System: CSP and CEP	Job No. 82044	File No. OS.01.F	
~~Analysis No.~~ QID 361104	Rev. No. 1	Sheet No. 4.3.41	

THE STRESS LEVEL IN THE CORNER WELD DUE TO OPERATING LOADS IS

BENDING ABOUT THE 1-1 AXIS

$$V_2' = \frac{S_2}{4} + \left(\frac{9.5}{14.16}\right)\left(\frac{T}{28.32}\right)$$

$$V_2' = 690.3 + 531.5 = 1222 \text{ LB}$$

$$V_2 = 2V_2' = 2444$$

$$M_{11} = 21398 + 2444(5) = 33618$$

$$f_{b_{11}} = \frac{M_{11}}{S_{11}} = \frac{33618}{164.6} = 204 \text{ \#/IN}$$

SHEAR ALONG THE 2-2 AXIS

$$f_{v_{22}} = \frac{V_2'}{A} = \frac{1222}{32} = 38 \text{ \#/IN}$$

LOAD DUE TO SHEAR IN 1-1 DIRECTION

$$V_1' = \left(\frac{10.5}{14.16}\right)\left(\frac{T}{28.32}\right) = 587 \text{ \#}$$

THE SHEAR ALONG THE 1-1 AXIS IS THEN:

$$f_{v_{11}} = \frac{587}{9.5} = 62 \text{ \#/IN}$$

CYGNA

Calculation Sheet

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Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date 6/15/83
System: CSP and CEP		Job No. 82044	File No. OS.01.F
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THE AXIAL LOAD ON THE WELD IS THEN

$$f_a = \frac{587(5)}{(4.75)9.5} \doteq 65. \#/\text{IN}$$

THE 10 PERCENT CONTRIBUTION FROM BENDING IS THEN

$$f_b = 276\left(\frac{587}{6138}\right) = 26 \#/\text{IN}$$

THE COMBINED LOAD FOR OPERATING IS THEN

$$f_t = \left[(204 + 65 + 26)^2 + (38^2 + 62^2)\right]^{1/2}$$

$$= 303.8 \#/\text{IN}$$

THE RESULTING STRESS LEVEL IS THEN

$$\sigma_{WELD} = \frac{303.8}{.707(.3125)} = 1375 \text{ PSI}$$

CYGNA

Calculation Sheet

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Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date 6/15/83
System: CSP and CEP		Job No. 82044	File No. OS.01.F
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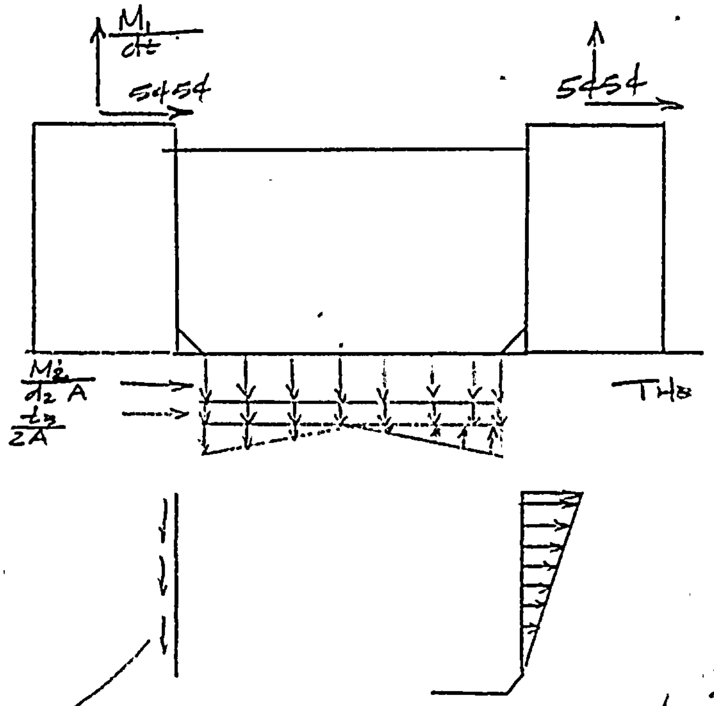
THE WELD STRESS ON THE STIFFENING PL OF THE 10.5" DIRECTION IS CALCULATED AS FOLLOWS. CONSERVATIVELY COMBINE WORST CASE TENSILE AND SHEAR STRESS.



THE AREA OF WELD MENT OF PL TO FLANGE

$A_F = 2(6\tfrac{1}{2}") = 13 \text{ IN}$

GROSS PL & EAR PROP

$Q@_{WELD} = (5.25)(5.75) = 30.2$

$$I_g = \frac{3(13.5)^3}{12} - \frac{2.5(7.5)^3}{12} = 527.2$$

TO GET PEAK STRESS @ END

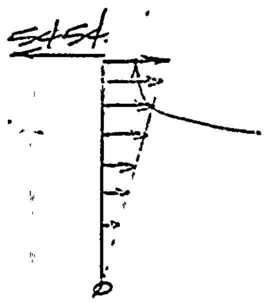
$$\frac{M_2}{d_2 A}\frac{(13/2)}{4_{IN}} + \frac{t_3}{2A}\frac{(13/2)}{4_{IN}} + \frac{VQ}{I}(2)$$

$$= \frac{468(6.5)}{4} + \frac{(51.1)6.5}{4} + \frac{2(5454)\cdot 30.2(.2)}{527.2}$$

$$= 761 + 83. + 1250 = 2094 \text{ LB/IN}$$

WELD SHEAR LOAD

THE MAXIMUM TENSILE LOAD IS THEN



ASSUMING PINNED @ THE BOTTOM AND EQUATING MOMENTS,

$$5454\,l = \frac{wl}{2}\,\frac{2l}{3}$$

$$w = \frac{5454(3)}{l} = 4091 \ \#/\text{IN}$$

COMBINE THE TENSILE AND THE SHEAR TO COME UP WITH THE REQUIRED WELD SIZE

$$f_{tot} = (4091^2 + 2094^2)^{1/2} = 4596 \text{ LB/IN}$$

TO STAY BELOW THE STRESS VALUE OF 11500 PSI FOR FATIGUE AND USING 2 WELDS ALONG THE LENGTH

$$t_w = \frac{4596}{(11{,}500)(.707)(2)} = .283 \text{ IN}$$

$\Rightarrow$ USE 5/16 FILLET EA SIDE

FOR THE WELDMENT @ THE BOTTOM OF THE SHEAR PLATE THE LOADS AND RESULTING STRESSES ARE AS FOLLOWS.

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: M.A. Scott	Date: 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date: 6/15/83
System: CSP and CEP		Job No. 82044	File No. OS.01.F
~~Analysis No.~~ QID 361104	Rev. No. 1	Sheet No. 4.3.45	

THE SHEAR LOAD PER LENGTH IS

$$f_v = \frac{(5454)(2)(}{32} = 341 \text{ LB/IN}$$

THE AXIAL LOAD DUE TO AXIAL OVERTURNING AND MOMENT LOADS IS THEN:

$$f_a = \frac{M_1}{d_2 A} + \frac{t_3}{2A} + \frac{Mc'}{I} =$$

$$= 560 + 51.1 + \frac{196869(6.5/2)}{1111.33}$$

$$= 560 + 51.1 + 575.7 = 1187 \text{ \#/IN}$$

THE TOTAL COMBINED LOAD

$$f_t = (1187^2 + 341^2)^{1/2} = 1235 \text{ \#/IN}$$

ASSUMING A 5/16" WELD ON EACH SIDE OF THE PLATE THE RESULTING WELD STRESS IS THEN

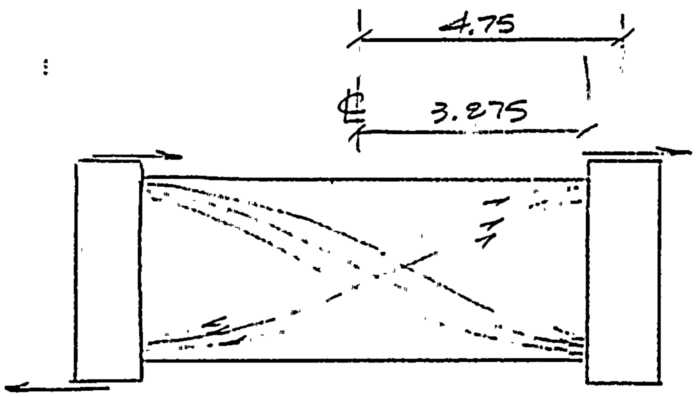
$$\tau_{WELD} = \frac{1235}{(.707)(.3125)\,2} = 2795 \text{ PSI} \leq 14000$$

CYGNA

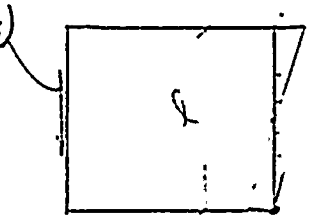
Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: M.A. Scott	Date: 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date: 6/15/83
System: CSP and CEP		Job No.: 82044	File No.: OS.01.F
~~Analysis No.~~ QID 361104	Rev. No.: 1	Sheet No.: 4.3.46	

THE MAXIMUM LOADS ON THE WELD OF THE OTHER PLATE ARE AS FOLLOWS. SINCE THE BASIC RESISTANCE TO DEFLECTION IS BY SHEAR RESISTANCE OF THE PLATE THE PLATE IS BASICALLY ACTING LIKE A DIAGONAL MEMBER AS SHOWN BELOW.



$$6461 = \frac{6138(5)}{4.75}$$



FROM THE ORIGINAL FREEBODY THE ℄ SHEAR WAS 6461# AND THE MOMENT WOULD BE $6461(3.875) = 25036$ IN LB. $S = \frac{t_w (4)^2}{6} = 2.67$

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~~Analysis No.~~ QID 361104	Rev. No. 1	Sheet No. 4.3.47	

THE RESULTING LOAD FROM THIS APPROACH

$$f_b = \frac{M}{S} = \frac{25036}{2.67} = 9377 \ \#/\text{IN}$$

THE RESULTING SHEAR LOAD WOULD BE

$$f_v = \frac{V}{A} = \frac{6461}{4} = 1615 \ \#/\text{IN}$$

THE COMBINED LOAD WOULD BE

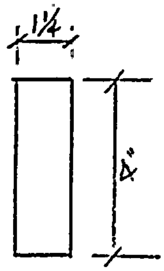
$$f_t = (9377^2 + 1615^2)^{1/2} = 9515$$

FOR A 5/16 WELDMENT ON EITHER SIDE THE RESULTING WELD STRESS WOULD THEN BE

$$\tau_{weld} = \frac{9515}{(.707)(.3125)(2)} = 21533 \ \text{LB/IN}^2$$

TOO HIGH

IF THIS WERE CHANGED TO A PL ON THE OUTSIDE OF THE EARS WITH A WELDMENT WITH THE FOLLOWING PROPORTIONS



$$A = 2(4+1.25) = 10.5 \ \text{IN}$$

$$J = \frac{(b+d)^3}{6} = \frac{(4+1.25)^3}{6} = 24.1$$

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Calculation Sheet

Project: WPPSS Mechanical Equipment Requalification		Prepared By: M.A. Scott	Date 6/15/83
Subject: 30" Cylinder Operated Butterfly Valves		Checked By: L.C. Fernandez	Date 6/15/83
System: CSP and CEP		Job No. 82044	File No. OS.01.F
~~Analysis No.~~ QID 361104	Rev. No. 1	Sheet No. 4.3.48	

THE MOMENT WOULD BE

$$.6461\left(3.875+\left(1.25/2\right)\right)=(4.5)(6461)=29075$$

THE HORIZONTAL SHEAR LOAD @ THE TOP WOULD BE

$$f_h=\frac{Mc_v}{J}=\frac{29075(2")}{24.1}=2413\ \#/IN$$

THE VERTICAL SHEAR LOAD @ ~~THE~~ TOP WOULD BE

$$f_v=\frac{Mc_h}{J}+\frac{V}{A}=\frac{29075(.625)}{24.1}+\frac{6461}{10.5}$$

$$=754+615=1369\ \#/IN$$

THE TOTAL LOAD ON THE WELD IS ~~THEN~~

$$f_{tot}=\left(2413^2+1369^2\right)^{1/2}=2774$$

THE RESULTING WELD STRESS IS THEN

$$\sigma_{WELD}=\frac{2774}{.707(.3125)}=12557\ PSI\ \leq 14000^{*}$$

* THIS LOAD IS SOMEWHAT HIGH BUT CONTAINS THE OPERATING LOADS SO THE ACTUAL FATIGUE RANGE IS LOWER. AND IS SO ACCEPTABLE

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: J.E. Rakowski	Date: 1/10/83
Subject: 30" Butterfly Valves		Checked By: L. C. Fernández	Date: 6/15/83
System: CSP and CEP		Job No.: 82044	File No: OS.01/F
Analysis No: 361104	Rev. No.: 1	Sheet No: 4.3.49	

Section 4.3.5 - Fatigue Analysis

Discussion

The operator and bracket assembly are not part of the pressure boundary, therefore, the fatigue analysis will be performed in accordance with Appendix B of the AISC Manual for Steel Construction. The following assumptions apply to the fatigue analysis.

1) Faulted stresses (based on piping-analysis accelerations) will be used. This is necessary to insure operability after a design basis event.

2) The actual stresses used will be the ones calculated in Section 4.3.

3) If the alternating portion of the stress has been calculated separately only this part will be used. If the operating loads (i.e. seating torque effects) are already included in the stress analysis it will be conservative to use the calculated stress value. As long as no failures occur, the operating stress does not need to be extracted.

4) The allowable stress will be based on Table B3 of Appendix B in the AISC Manual of Steel Construction.

5) A factor of 1.5 will be applied to the allowable because of the low number of cycles. (Per Section 1.7 of the Commentary on the AISC Manual).

6) The actual stress range is taken as 2 times the maximum stress for components subject to alternating tension and compression.

7) Bracket bolting is assumed to be properly tightened and will not be considered for fatigue per Section B3.1 of the AISC Manual.

The table on the following page gives the calculated stress range, stress category, and allowable for the critical components. The following page gives excerpts from Appendix B of the AISC Manual showing the descriptions of the relevent stress categories.

Calculation Sheet

Project WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date 1/10/83
Subject 30" Butterfly Valves	Checked By: L.C. Fernandez	Date 4/29/83
System CSP and CEP	Job No. 82044	File No. 0'S.01/F
Analysis No 361104 Rev. No. 1	Sheet No 4.3.51	

Fatigue Analysis (cont.)

ITEM	STRESS TYPE	STRESS (PSI)	STRESS RANGE (PSI)	STRESS CATEGORY	1.5 x ALLOW (FROM AISC)
TRUNNION PIN	τ	4108	8216	F (1)	22500
DRIVE ROD (MAX)	σ	- SEE TABLE 1.2 -		A	90000
SUPPORT EARS	σ	- SEE TABLE 1.2 -		A	90000
MAIN SHAFT	τ σ	9127 7158	18254 14316	A A	90000 90000

NOTES:

(1) Assume shear stress on nominal area of a stud type shear connection.

Note that this comparison includes all of the load combinations in one conservative comparison using the maximum stress and the total number of cycles (3 x 4500 + 2000 + 60 = 15560).

Calculation Sheet	Prepared By: [signature]	Date 11/19/82
Project SUPPLY SYSTEM	Checked By. L Pomer	Date 11/19/82
Subject 30" BUTTERFLY VALVE	Job No. 82044	File No. 05.01/F
System CSP & CEP	Sheet No.	
Analysis No. 361104 Rev. No 1	4.3.52	

FATIGUE ANALYSIS (CONT.)

THE TABLE BELOW HAS BEEN CONDENSED FROM APPENDIX B OF THE AISC MANUAL OF STEEL CONSTRUCTION. THE CASES USED ARE MARKED WITH AN ARROW.

General Condition	Situation	Kind of Stress*	Stress Category. (See Table B3)	
Plain material	Base metal with rolled or cleaned surfaces.	T or Rev.	A	← (90,000)
Built-up members	Base metal and weld metal in members, without attachments, built-up of plates or shapes connected by continuous full- or partial-penetration groove welds or continuous fillet welds parallel to the direction of applied stress.	T or Rev.	B	
	Calculated flexural stress, f_b, in base metal at toe of welds on girder webs or flanges adjacent to welded transverse stiffeners.	T or Rev.	C	
	Base metal at end of partial-length welded cover plates having square or tapered ends, with or without welds across the ends.	T or Rev.	E	
Mechanically fastened connections	Base metal at gross section of high-strength-bolted friction-type connections, except connections subject to stress reversal and axially loaded joints which induce out-of-plane bending in connected material.	T or Rev.	B	
	Base metal at net section of other mechanically fastened joints.	T or Rev.	D	
	Base metal at net section of high-strength bolted bearing connections.	T or Rev.	B	
Attachments	Shear stress on nominal area of stud-type shear connectors.	S	F	← (22,500)

1006 00

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification		Prepared By: J.E. Rakowski	Date: 3/25/83
Subject: 30" Butterfly Valve		Checked By: L.C. Fernandez	Date: 4/29/83
System: CSP and CEP		Job No. 82044	File No. OS.01/F
Analysis No. 361104	Rev. No. 1	Sheet No. 4.3.53	

4.4 REFERENCES

1) BIF Drawings

	Drawing #	Rev#	Description
a	A-206763	F	General Arrangement
b	CEP-625-10		From Reactor Nozzle X-3 to SGT-FU-1A, 1B
c	CEP-625-11.12	H	From Reactor Nozzle X-3 to SGT-FU-1A, 1B
d	C-26095		Model A-83B Cylinder
e	A-206767		Valve Assembly
f	DOC-D-220-0310-IR-66	O	Tube errection iso-metric
g	D-207110	F	Valve Data Sheet
h	M-144		General Arrangment plan mis level
k	CSP-807-3.4		Containment purge air supply system

CYGNA

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date: 3/25/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernandez	Date: 4/29/83	
System: CSP and CEP	Job No.: 82044	File No.: OS.01/F	
Analysis No.: 361104	Rev. No.: 1	Sheet No.: 4.3.54	

Reference cont'n

Formulas for Natural Frequency and Mode Shapes,
Robert D. Blevins
Van Nostrand Reinhold Company
1979 Edition

3) BIF Report TR-27234 and TR-27235, "Dynamic Torque Calculation of Butterfly Valve; Sizes 24 and 30 inch", dated November 10, 1982.

4) Report TR-74-8 by McPherson Assoc., Inc., "Design & Seismic Analysis 30" Cylinder operated Butterfly Valve". (Rev. 1) 12/31/75.

5) WPPSS letter to Cygna Energy Services, GE-02-RWH-018, 12/17/82.

6) WPPSS, WNP-2 SRM Equipment List Summary Sheets dated 2/10/83.

7) Cygna Energy Services, Equipment Qualification Walkdown Verification Form dated 7/14/82 and 7/19/82.

8) Cygna Energy Services, "Project Manual Design Criteria," DC-1, Rev. 1, 10/82.

9) Burns and Roe Revised Piping Analysis Loads for CSP-V-1 and 2 (dated 4/12/83) and CEP-V-1A and 1B (dated 11/15/82).

10) Communications Report, R. Ricappito of BIF and J. Rakowski of CES, "BIF Valve Dimensions", 2/11/83

APPENDIX A

COMPILED PROGRAMS AND RESULTS FOR

CSP-V-1

CSP-V-2

```
sbasic csp12
      tm
S-BASIC Compiler Version 5.4b

REM***** BIF VALVE AND AIR OPERATOR SEISMIC STRESS *****
REM*************** CSP-V/AO-1/2 ************************
REM*************** 10 INCH AO PARAMETERS ***************
REM
var i,j,k = integer
var lrod,lcg,x,phi,lave,ablt,l1,l2,e1,e2,e3,e4,e5 = real
var fst2, ca,ia,cb,ib,aa,ab,d1,d2,c1,i1,c2,i2=real
var lrodo,lcgo,ldr,d, abush, pbush=real
var fcof, fco, ma,mb, siga, sigb, fcdr, fcdrf,maf, mbf=real
var dear, fcear,fr, f11,f22,la, ci12,ci21,stt3,sem1=real
var sem2,set3,ses1,ses2,sr,tau11,tau22,tauear,aear=real
var btens, taublt, set3f,sem1f,sem2f,fcearf, frf,f11f=real
var f22f,stt3f,ses1f,ses2f,srf,tau1f,tau2f,taurf=real
var taubf,btf, dsr,dtaur,dtaub,dbten,dsa,dsb,dpb=real
var sdraf,sdrbf,pbushf,tau11f,tau22f=real
var wao,wbr,ftr1,watr1,s1,s1f,s2,s2f,m1,m1f,m2=real
var m2f,t3,t3f,tt3,tt3f,lbr,wtot=real
var bs1,bs2,bt3,bm1,bm2,btt3=real
dim real av(3)
dim real wa(3)
dim real wb(3)
REM
REM *** BURNS 7 ROE EAR FORCES ARE bs1 etc TURN ON WITH K=1***
REM
REM
dim real a(3,3)
dim real b(3)
dim real glc(3,3)
1   data 9.5, 10.5, .88, 3.94, 1.50,1.34
2   data 25,21.50,.488,48.,4.85,.627,1.75,3.0
3   data 1847.,.875,.46,.648,.138,2.41,1.4
4   data 593.,321.,5.25,8.5,28.5,15.,7.75
5   data 40.,16.25,26.5,43.,2.075
6   data 135.,90.,135.,90.,180.,90.
7   data 45.,90.,135.,90.,0.,90.
REM DATA 6&7 FOR VALVE/GLOBAL-G ORIENTATIONS AND WEIGHT VECTOR
restore
read d1,d2,c1,i1,c2,i2
restore 2
read lrod,lcg,x,phi,lave,ablt,l1,l2
restore 3
read fst2,ca,ia,cb,ib,aa,ab
restore 4
read wao,wbr,e1,e2,e3,e4,e5
restore 5
read lrodo,lcgo,ldr,d,abush
restore 6
read  a(1,1),a(2,1),a(3,1),a(1,2),a(2,2),a(3,2)
restore 7
read  a(1,3),a(2,3),a(3,3),av(1),av(2),av(3)
text 0,& INPUT GLOBAL ACCELERATIONS &
input b(1),b(2),b(3)
print
text 0,& INPUT DATA &
print
print "GLOBAL G-LEVELS        = ";b(1),b(2),b(3)
print "NORTH VECTOR ANGLES    = ";a(1,1),a(2,1),a(3,1)
print "VERTICAL VECTOR ANGLES= ";a(1,2),a(2,2),a(3,2)
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 4.3.A2

```
0059:00 print "EAST VECTOR ANGLES    = ";a(1,3),a(2,3),a(3,3)
0060:00 print "WEIGHT VECTOR ANGLES  = ";av(1),av(2),av(3)
0061:00 print
0062:00 for i=1 to 3
0063:01 for j=1 to 3
0064:02   a(j,i)=a(j,i)*2.*3.1416/360.
0065:02   glc(j,i)=b(i)*cos(a(j,i))
0066:02 next j
0067:01 next i
0068:00 for j=1 to 3
0069:01 av(j)=av(j)*2.*3.1416/360.
0070:01 next j
0071:00 print
0072:00 text 0,& LOCAL G-LEVELS &
0073:00 print
0074:00 print glc(1,1),glc(1,2),glc(1,3)
0075:00 print glc(2,1),glc(2,2),glc(2,3)
0076:00 print glc(3,1),glc(3,2),glc(3,3)
0077:00 REM WEIGHT COMPONENTS
0078:00 for j=1 to 3
0079:01 wa(j)=wao*cos(av(j))
0080:01 wb(j)=wbr*cos(av(j))
0081:01 next j
0082:00 phi=phi*2.*3.1416/360.
0083:00 la=lave/2
0084:00 ci12=c1/i2
0085:00 ci21=c2/i1
0086:00 aear=l1*l2
0087:00 REM CALCULATE EAR FORCES USE B&R LOADS AS OPTION LATER
0088:00 REM FIXED COMPONENTS ARE ALWAYS THERE
0089:00 lbr=lrod+lcg
0090:00 watr1=lbr*wa(1)/lrod
0091:00 s1f=wb(1)+watr1
0092:00 wtot=wao+wbr
0093:00 s2f=wb(2)+wa(2)+fst2
0094:00 t3f=wa(3)+wb(3)
0095:00 m1f=-(wa(2)+wb(2)+fst2)*e5-wa(3)*(e3+lcg)-wb(3)*e4
0096:00 m2f=(watr1+wb(1))*e5-wa(3)*e2-wb(3)*e1
0097:00 tt3f=watr1*e3+(wa(2)+fst2)*e2+wb(1)*e4+wb(2)*e1
0098:00 fcdrf=lcg*wa(1)/lrod
0099:00 maf=fcdrf*(lrod-13.5)
0100:00 mbf=fcdrf*7.125
0101:00 sdraf=fst2/aa+abs(maf*ca/ia)
0102:00 sdrbf=fst2/ab+abs(mbf*cb/ib)
0103:00 fcof=lcgo*wa(1)/lrodo
0104:00 pbushf=fcof*(ldr+d)/(d*abush)
0105:00 REM STRESSES FROM FIXED COMPONENTS
0106:00 dear=(d1*d1+d2*d2)**.5
0107:00 set3f=abs(t3f/(4*aear))
0108:00 sem1f=abs(m1f/(2*d2*aear))
0109:00 sem2f=abs(m2f/(2*d1*aear))
0110:00 fcearf=tt3f/(2*dear)
0111:00 frf=x*fcearf
0112:00 f11f=-(fcearf*sin(phi)-frf*cos(phi))
0113:00 f22f=fcearf*cos(phi)+frf*sin(phi)
0114:00 stt3f=abs(f11f*la*ci12)+abs(f22f*la*ci21)
0115:00 ses1f=abs(s1f*ci12*la/4.)
0116:00 ses2f=abs(s2f*ci21*la/4.)
0117:00 srf=set3f+sem1f+sem2f+ses1f+ses2f+stt3f
0118:00 REM EAR SHEAR
0119:00 tau11f=abs(s1f/(4*aear))+abs(f11f/aear)
0120:00 tau22f=abs(s2f/(4*aear))+abs(f22f/aear)
0121:00 taurf=(tau11f*tau11f+tau22f*tau22f)**.5
0122:00 taubf=taurf*aear/ablt
0123:00 REM EARBOLT TENSION
0124:00 btf=(set3f+sem1f+sem2f)*aear/ablt
0125:00 print
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 43.43

```
0126:00 print"OPERATING CYLINDER BRG PRESSURE ";pbushf
0127:00 print"OPERATING VALVE EAR TENSILE STR ";srf
0128:00 print"OPERATING VALVE EAR SHEAR STRES ";taurf
0129:00 print"OPERATING EAR BOLT SHEAR STRESS ";taubf
0130:00 print"OPERATING EAR BOLT TENSILE  STR ";btf
0131:00 print
0132:00 REM
0133:00 REM CALCULATE VARIABLE COMPONENTS
0134:00 REM
0135:00 dsr=0.
0136:00 dtaur=0.
0137:00 dtaub=0.
0138:00 dbten=0.
0139:00 dsa=0.
0140:00 dsb=0.
0141:00 dpb=0.
0142:00 for j=1 to 3
0143:01 fco=lcgo*wao*glc(1,j)/lrodo
0144:01 pbush=fco*(ldr+d)/(d*abush)
0145:01 ftr1=lbr*wao*glc(1,j)/lrod
0146:01 s1=ftr1+wbr*glc(1,j)
0147:01 s2=wtot*glc(2,j)
0148:01 t3=wtot*glc(3,j)
0149:01 m1=-wtot*glc(2,j)*e5-wao*glc(3,j)*(e3+lcg)-wbr*glc(3,j)*e4
0150:01 m2=(ftr1+wbr*glc(1,j))*e5-(wao*e2+wbr*e1)*glc(3,j)
0151:01 tt3=ftr1*e3+wbr*glc(1,j)*e4+glc(2,j)*(wao*e2+wbr*e1)
0152:01 fcdr=lcg*wao*glc(1,j)/lrod
0153:01 ma=fcdr*(lrod-13.5)
0154:01 mb=fcdr*7.125
0155:01 siga=ma*ca/ia
0156:01 sigb=mb*cb/ib
0157:01 REM CALCULATE EAR TENSION
0158:01 set3=abs(t3/(4*aear))
0159:01 sem1=abs(m1/(2*d2*aear))
0160:01 sem2=abs(m2/(2*d1*aear))
0161:01 fcear=tt3/(2*dear)
0162:01 fr=x*fcear
0163:01 f11=-(fcear*sin(phi)-fr*cos(phi))
0164:01 f22=fcear*cos(phi)+fr*sin(phi)
0165:01 stt3=abs(f11*la*ci12)+abs(f22*la*ci21)
0166:01 ses1=abs(s1*ci12*la/4.)
0167:01 ses2=abs(s2*ci21*la/4.)
0168:01 sr=set3+sem1+sem2+ses1+ses2+stt3
0169:01 REM EAR SHEAR
0170:01 tau11=abs(s1/(4.*aear))+abs(f11/aear)
0171:01 tau22=abs(s2/(4.*aear))+abs(f22/aear)
0172:01 tauear=(tau11*tau11+tau22*tau22)**.5
0173:01 taublt=tauear*aear/ablt
0174:01 REM EARBOLT TENSION
0175:01 btens=(set3+sem1+sem2)*aear/ablt
0176:01 dsa=dsa+siga*siga
0177:01 dsb=dsb+sigb*sigb
0178:01 dpb=dpb+pbush*pbush
0179:01 dsr=dsr+sr*sr
0180:01 dtaur=dtaur+tauear*tauear
0181:01 dtaub=dtaub+taublt*taublt
0182:01 dbten=dbten+btens*btens
0183:01 next j
0184:00 REM COMBINE STRESSES
0185:00 dsa=dsa**.5
0186:00 dsb=dsb**.5
0187:00 dpb=dpb**.5
0188:00 dsr=dsr**.5
0189:00 dtaur=dtaur**.5
0190:00 dtaub=dtaub**.5
0191:00 dbten=dbten**.5
```

```
print
text 0,& DYNAMIC COMPONENTS &
print
print "DRIVE ROD TENSILE STRESS AT A";dsa
print "DRIVE ROD TENSILE STRESS AT B";dsb
print "BUSHING PRESSURE                ";dpb
print "VALVE EAR TENSILE STRESS        ";dsr
print "VALVE EAR SHEAR STRESS          ";dtaur
print "EAR BOLT SHEAR STRESS           ";dtaub
print "EAR BOLT TENSILE STRESS         ";dbten
dsa=dsa+abs(sdraf)
dsb=dsb+abs(sdrbf)
dpb=dpb+abs(pbushf)
dsr=dsr+abs(srf)
dtaur=dtaur+abs(taurf)
dtaub=dtaub+abs(taubf)
dbten=dbten+abs(btf)
print
text 0,& FIXED PLUS DYNAMIC COMPONENTS &
print
print "DRIVE ROD TENSILE STRESS AT A";dsa
print "DRIVE ROD TENSILE STRESS AT B";dsb
print "PUSHING PRESSURE                ";dpb
print "VALVE EAR TENSILE STRESS        ";dsr
print "VALVE EAR SHEAR STRESS          ";dtaur
print "EAR BOLT SHEAR STRESS           ";dtaub
print "EAR BOLT TENSILE STRESS         ";dbten
end

        ****** End of program ******
```

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 4.3.A5

cspl

INPUT GLOBAL ACCELERATIONS

? 2.26,3.62,2.8

INPUT DATA

GLOBAL G-LEVELS	=	2.26	3.62	2.8
NORTH VECTOR ANGLES	=	135	90	135
VERTICAL VECTOR ANGLES	=	90	180	90
EAST VECTOR ANGLES	=	45	90	135
WEIGHT VECTOR ANGLES	=	90	0	90

LOCAL G-LEVELS

-1.59807	-1.38092E-5	1.97989
-8.62121E-6	-3.62	-1.06811E-5
-1.59807	-1.38092E-5	-1.97991

OPERATING DRIVE ROD STRESS AT A	766.432
OPERATING DRIVE ROD STRESS AT B	1319.35
OPERATING CYLINDER BRG PRESSURE	-7.15824E-4
OPERATING VALVE EAR TENSILE STR	2111.01
OPERATING VALVE EAR SHEAR STRES	293.896
OPERATING EAR BOLT SHEAR STRESS	2460.85
OPERATING EAR BOLT TENSILE STR	1625.1

DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	28384.4	
DRIVE ROD TENSILE STRESS AT B	43412.2	– reduced cross section close to thread [illegible]
BUSHING PRESSURE	477.447	
~~VALVE EAR TENSILE STRESS~~	~~8282.34~~	*SEE SHEETS 4.3.30 - 4.3.40 △1
~~VALVE EAR SHEAR STRESS~~	~~840.657~~	
EAR BOLT SHEAR STRESS	7039	
EAR BOLT TENSILE STRESS	10524.9	

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	29150.9	
DRIVE ROD TENSILE STRESS AT B	44731.6	
PUSHING PRESSURE	477.448	
~~VALVE EAR TENSILE STRESS~~	~~10393.3~~	*
~~VALVE EAR SHEAR STRESS~~	~~1134.55~~	
EAR BOLT SHEAR STRESS	9499.86	
EAR BOLT TENSILE STRESS	12150	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 4.3.A6

csp(1)2
PUT GLOBAL ACCELERATIONS
26,3.62,2.8

INPUT DATA

GLOBAL G-LEVELS	=	2.26	3.62	2.8
NORTH VECTOR ANGLES	=	135	90	135
VERTICAL VECTOR ANGLES	=	90	180	90
EAST VECTOR ANGLES	=	45	90	135
WEIGHT VECTOR ANGLES	=	90	0	90

LOCAL G-LEVELS

-1.59807	-1.38092E-5	1.97989
-8.62121E-6	-3.62	-1.06811E-5
-1.59807	-1.38092E-5	-1.97991

OPERATING DRIVE ROD STRESS AT A	766.432
OPERATING DRIVE ROD STRESS AT B	1319.35
OPERATING CYLINDER BRG PRESSURE	-7.15824E-4
OPERATING EAR WELD TENSILE STR	3090.43
OPERATING EAR WELD SHEAR STRES	735.124
OPERATING EAR BOLT SHEAR STRESS	2460.86
OPERATING EAR BOLT TENSILE STR	1625.1

MIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	28384.4
DRIVE ROD TENSILE STRESS AT B	43412.2
BUSHING PRESSURE	477.447
~~EAR WELD TENSILE STRESS~~	~~12091.7~~ * SEE SHEETS 4.3.30 - 4.3.38 △1
~~EAR WELD SHEAR STRESS~~	~~2102.74~~
EAR BOLT SHEAR STRESS	7039
EAR BOLT TENSILE STRESS	10524.9

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	29150.9
DRIVE ROD TENSILE STRESS AT B	44731.6
PUSHING PRESSURE	477.448
~~EAR WELD TENSILE STRESS~~	~~15182.1~~ *
~~EAR WELD SHEAR STRESS~~	~~2837.86~~
EAR BOLT SHEAR STRESS	9499.86
EAR BOLT TENSILE STRESS	12150

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 4.3.47

csp (2)
 INPUT GLOBAL ACCELERATIONS
? 1.44,3.54,1.9

 INPUT DATA

GLOBAL G-LEVELS	=	1.44	3.54	1.9
NORTH VECTOR ANGLES	=	135	90	135
VERTICAL VECTOR ANGLES	=	90	180	90
EAST VECTOR ANGLES	=	45	90	135
WEIGHT VECTOR ANGLES	=	90	0	90

 LOCAL G-LEVELS

-1.01824	-1.3504E-5	1.3435
-5.49316E-6	-3.54	-7.24792E-6
-1.01824	-1.3504E-5	-1.34351

OPERATING DRIVE ROD STRESS AT A	766.432
OPERATING DRIVE ROD STRESS AT B	1319.35
OPERATING CYLINDER BRG PRESSURE	-7.15824E-4
OPERATING VALVE EAR TENSILE STR	2111.01
OPERATING VALVE EAR SHEAR STRES	293.896
OPERATING EAR BOLT SHEAR STRESS	2460.85
OPERATING EAR BOLT TENSILE STR	1625.1

 DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	18806
DRIVE ROD TENSILE STRESS AT B	28762.8
BUSHING PRESSURE	316.332
~~VALVE EAR TENSILE STRESS~~	~~5755.57~~ * SEE SHEETS 4.3.32 - 4.3.48 ⚠
~~VALVE EAR SHEAR STRESS~~	~~606.452~~
EAR BOLT SHEAR STRESS	5077.94
EAR BOLT TENSILE STRESS	7164.63

 FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	19572.5
DRIVE ROD TENSILE STRESS AT B	30082.1
PUSHING PRESSURE	316.333
~~VALVE EAR TENSILE STRESS~~	~~7866.59~~ *
~~VALVE EAR SHEAR STRESS~~	~~900.348~~
EAR BOLT SHEAR STRESS	7538.79
EAR BOLT TENSILE STRESS	8789.72

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 4.3.A8

csp1(2)

PUT GLOBAL ACCELERATIONS

? 44,3.54,1.9

INPUT DATA

GLOBAL G-LEVELS	=	1.44	3.54	1.9
NORTH VECTOR ANGLES	=	135	90	135
VERTICAL VECTOR ANGLES	=	90	180	90
EAST VECTOR ANGLES	=	45	90	135
WEIGHT VECTOR ANGLES	=	90	0	90

LOCAL G-LEVELS

-1.01824	-1.3504E-5	1.3435
-5.49316E-6	-3.54	-7.24792E-6
-1.01824	-1.3504E-5	-1.34351

OPERATING DRIVE ROD STRESS AT A	766.432
OPERATING DRIVE ROD STRESS AT B	1319.35
OPERATING CYLINDER BRG PRESSURE	-7.15824E-4
OPERATING EAR WELD TENSILE STR	3090.43
OPERATING EAR WELD SHEAR STRES	735.124
OPERATING EAR BOLT SHEAR STRESS	2460.86
OPERATING EAR BOLT TENSILE STR	1625.1

MIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	18806
DRIVE ROD TENSILE STRESS AT B	28762.8
BUSHING PRESSURE	316.332
~~EAR WELD TENSILE STRESS~~	~~8415.88~~
~~EAR WELD SHEAR STRESS~~	~~1516.92~~
EAR BOLT SHEAR STRESS	5077.96
EAR BOLT TENSILE STRESS	7164.63

* SEE SHEETS 4.3.30 - 4.3.48 △

FIXED PLUS DYNAMIC COMPONENTS

DRIVE ROD TENSILE STRESS AT A	19572.5
DRIVE ROD TENSILE STRESS AT B	30082.1
PUSHING PRESSURE	316.333
~~EAR WELD TENSILE STRESS~~	~~11506.3~~ *
~~EAR WELD SHEAR STRESS~~	~~2252.04~~
EAR BOLT SHEAR STRESS	7538.81
EAR BOLT TENSILE STRESS	8789.72

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 4.3.49

APPENDIX B

VALVE/AIR OPERATOR MODEL FOR
FINAL PIPING RESPONSE G-LEVEL CALCULATION.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

CALCULATION CONTINUATION SHEET

CALC NO. 361104

REVISION INDICATIONS

APPENDICES B & C REMOVED.
IDENTICAL TO SAME APPENDICES
IN QID 361106 (24" VALVES)

CHECKED (INITIALS/DATE)

RWH

SECTION 5.0

APPENDICES

CONTENTS

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN CSP-V-1
QID# 361104

BLDG R	FLOOR EL 501	COORDS M.5/7.6
MFR BIF	COMPONENT EL 508	DSCRP BUTTERFLY VAL.
MODEL# 0657	SERIAL# N27236-1	MAT'L SA516 GR70
45 PSI @ 340 °F	ASME CLASS 2	LBS ___ SIZE 30

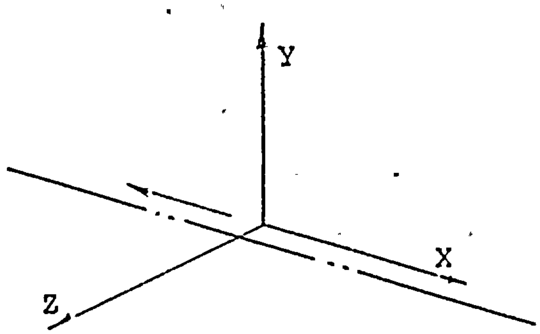
YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )
// TO AXIS OF PIPE ( ) N/A
YOKE LENGTH ___
(FLANGE TO FLANGE)

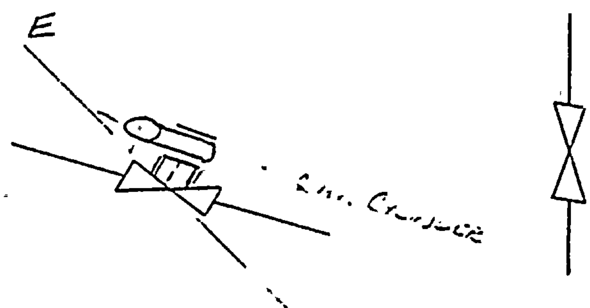
MOUNTING CONDITION

NO OF BOLTS ___
BOLT TYPE ___ BOLT Ø 1 1/4" (AS WRAPPED)
WELD TYPE & SIZE FLANGE CONNECTION
PIPE MOUNTED YES (X) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2")................YES ( ) NO (X)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (X) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (X)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN CSP-AO-1	MANUFACTURER MILLER FLUID POWER
MODEL NO (3)	SERIAL NO ___
TYPE ___ SIZE ___	ORDER NO ___

MOTOR EPN N/A	MANUFACTURER ___
MODEL NO ___	SERIAL NO ___
ID NO ___ INS CLASS ___	1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

TYPE OF CONDUIT CONNECTION: RIGID ( ) FLEX (X)

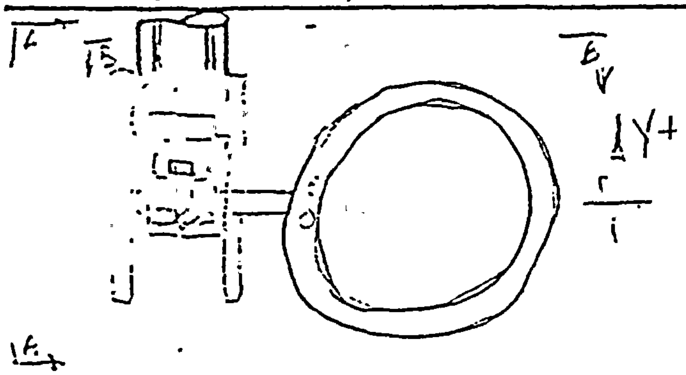
NOTES: 1. Definition (N/F = Not Found)
2. (2) NAMCO LIMIT SWITCHES SERIAL # CA176080100
3. THERE WERE NO AIR OPERATOR MFG MODEL/IDENTIFICATION TAGS FOUND

△2

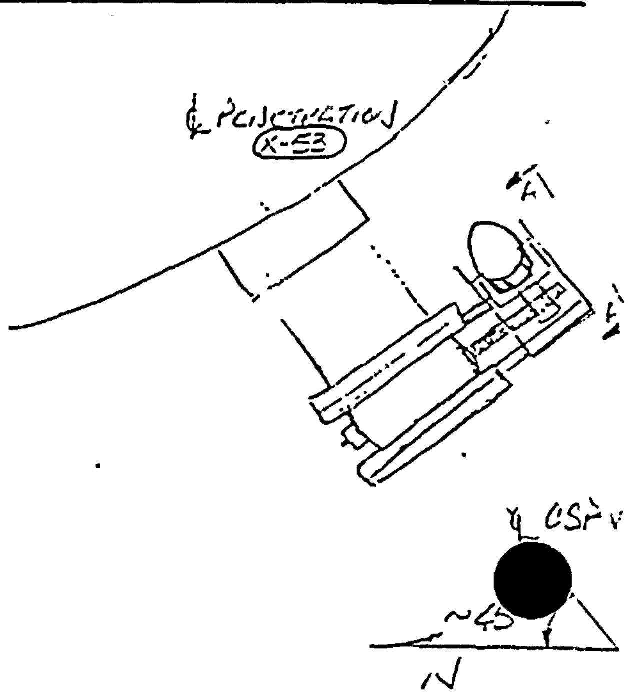
PREPARED BY [signature] DATE 6/16/83 REVIEWED BY L C Fernandez DATE 6/20/83
(SIGNATURE) (SIGNATURE)
DON SEARLE L C FERNANDEZ

Calculation Sheet

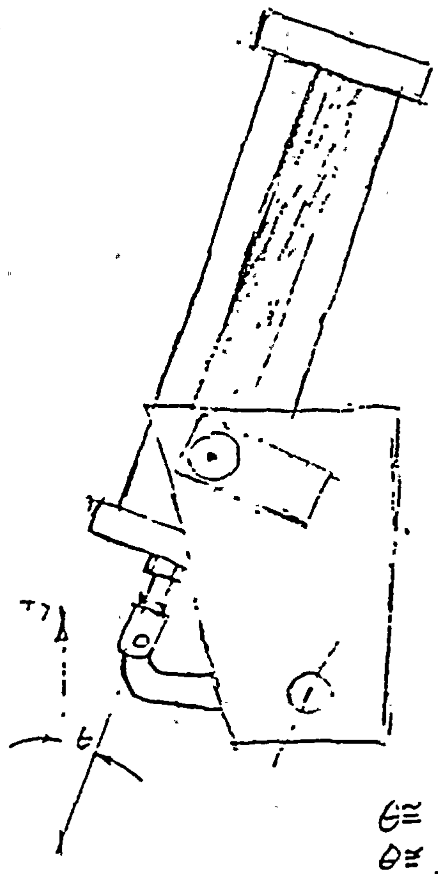
Project WNP #2		Prepared By [signature]	Date
Subject EQUIP. QUALIFICATION		Checked By [signature]	Date 1/4/83
System CSP-V-1		Job No. 82044	File No
Analysis No 01D36104	Rev No	Sheet No	2 OF 2



CSP-V-1,2 (TYP VIEW)



PLAN VIEW (B-B)



θ ≅ 7° — CSP-V-1
θ ≅ 6° — CSP-V-2

SECTION VIEW A-A

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION, ONLY)

EQUIPMENT QUALIFICATION
WALKDOWN VERIFICATION FORM

PAGE 1 OF 2

EPN CSP-V-2

QID# 361104

BLDG R	FLOOR EL 501	COORDS M.5/14
MFR B/F	COMPONENT EL 508	DSCRP BUTTERFLY VALV
MODEL# 6657	SERIAL# N-27234-2	MAT'L SA516 GR70
45 PSI @ 340 °F	ASME CLASS 2	LBS N/F SIZE 30

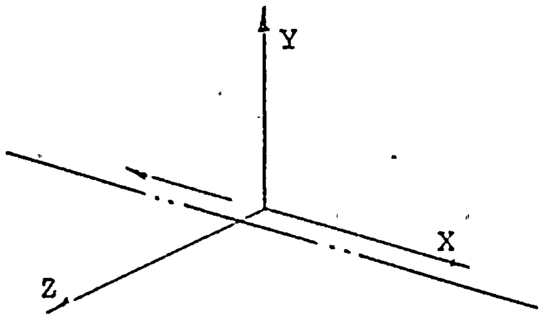
YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )
// TO AXIS OF PIPE ( ) N/A
YOKE LENGTH ______
(FLANGE TO FLANGE)

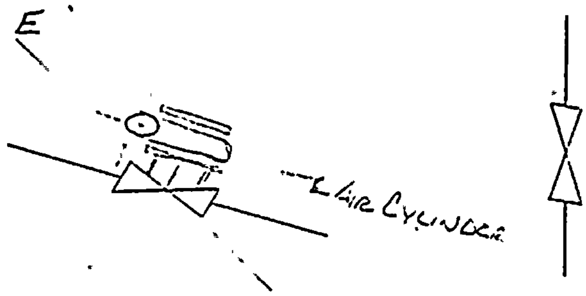
MOUNTING CONDITION

NO OF BOLTS ______
BOLT TYPE ______ BOLT Ø 1½ (As Measured)
WELD TYPE & SIZE LADISH 327
PIPE MOUNTED YES (X) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2")................YES ( ) NO (X)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (X) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (X)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN CSP-AO-2	MANUFACTURER MILLER FLUID POWER
MODEL NO ③	SERIAL NO ______
TYPE ______ SIZE ______	ORDER NO ______

MOTOR EPN N/A	MANUFACTURER ______
MODEL NO ______	SERIAL NO ______
ID NO ______ INS CLASS ______	1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

TYPE OF CONDUIT CONNECTION: RIGID ( ) FLEX (X)

NOTES: 1. Definition (N/F = Not Found)

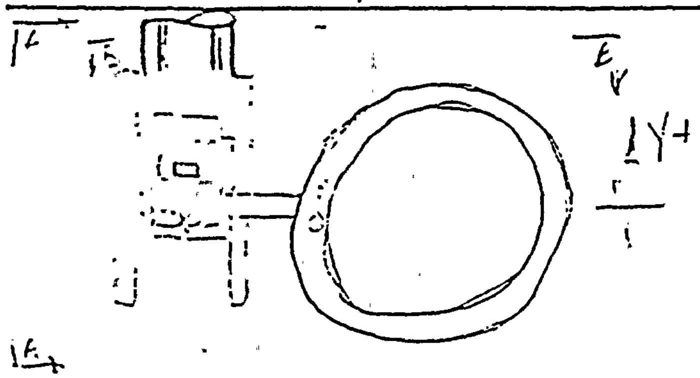
2. NAMCO LIMIT SWITCHES SERIAL # EA 74060100

3. THERE WERE NO AIR OPERATOR MFG MODEL/IDENTIFICATION TAGS FOUND

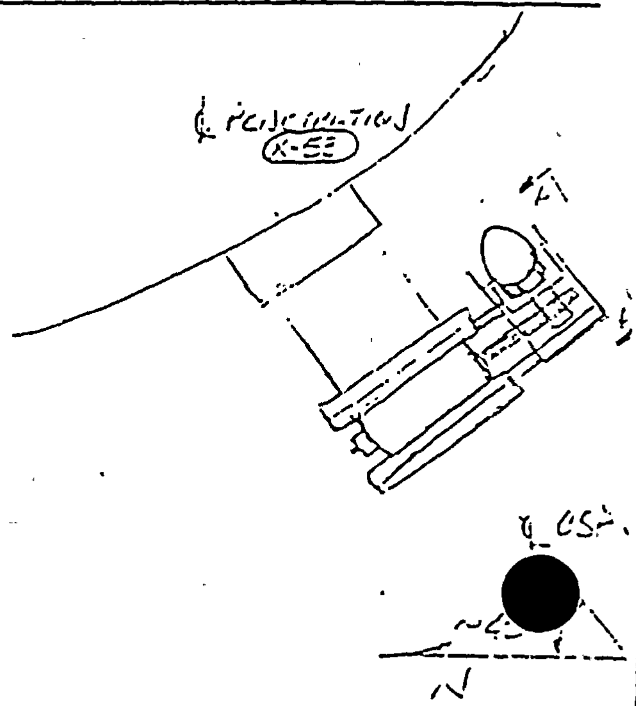
PREPARED BY [signature] (SIGNATURE) DON SEARLE DATE 6/16/83 REVIEWED BY L C Fernandez (SIGNATURE) L.C. FERNANDEZ DATE 6/20/83

Sheet

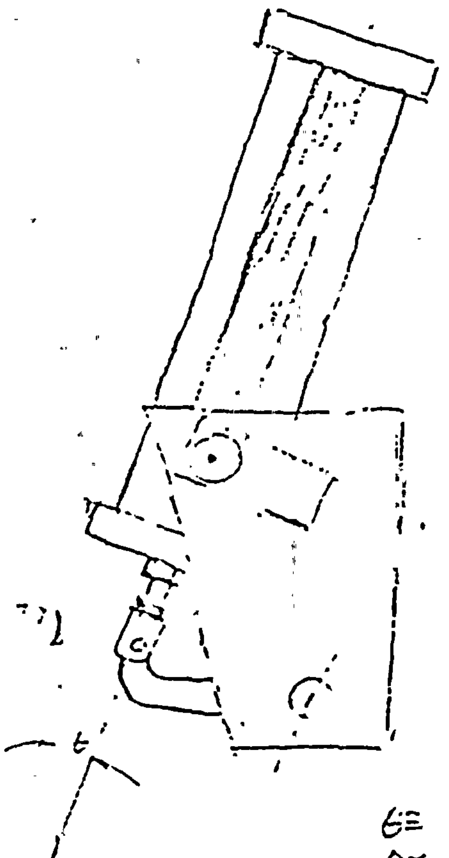
Project: NMP #2		Prepared By: [signature]	Date: 12/...
Subject: EQUIP. QUALIFICATION		Checked By: [signature]	Date: 1/4/83
System: CSP-V-2		Job No: 82044	File No:
Analysis No: OID536104	Rev. No:	Sheet No: 2 OF 2	



CSP-V-1,2 (TYP VIEW)



PLAN VIEW (B-B)



θ ≅ 7° — CSP-V-1
θ ≅ 6° — CSP-V-2

SECTION VIEW A-A

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION, ONLY)

EPN CSL-V-3

QID# 361106

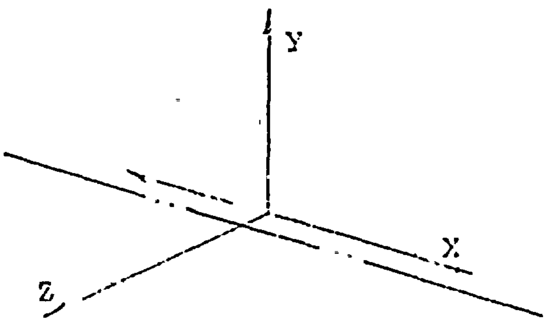
BLDG R	FLOOR EL 471	COORDS 7.6/M.6
MFR A/E	COMPONENT EL 478	DSCRP BUTTERFLY VALV
MODEL# 0657	SERIAL# 27235-1	MAT'L SA516-GE70
150 PSI @ 275 °F	ASME CLASS 2	LBS 150 SIZE 24

YOKE ORIENTATION	MOUNTING CONDITION
⊥ TO AXIS OF PIPE ( )	NO OF BOLTS 20
// TO AXIS OF PIPE ( ) N/A	BOLT TYPE ____ BOLT Ø 1½"
YOKE LENGTH ____ (FLANGE TO FLANGE)	WELD TYPE & SIZE 150# FLANGES
	PIPE MOUNTED YES (X) NO ( )

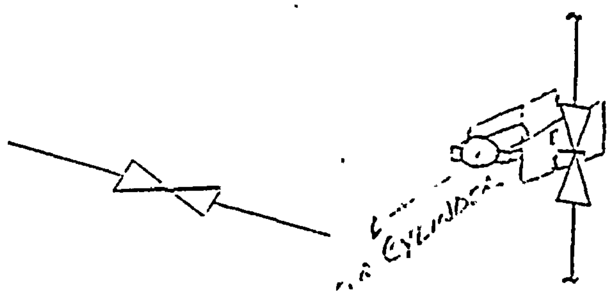
PERMANENT OBSTRUCTION (WITHIN 2")................YES ( ) NO (X)

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (X) NO ( )

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES (X) NO ( )



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN CSD-BO-3	MANUFACTURER MILLER FLUID POWER
MODEL NO ③	SERIAL NO
TYPE ____ SIZE ____	ORDER NO

MOTOR EPN N/A	MANUFACTURER
MODEL NO	SERIAL NO
ID NO ____ INS CLASS ____	1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

TYPE OF CONDUIT CONNECTION: RIGID ( ) FLEX ( )

NOTES: 1. Definition (N/F = Not Found)

2 (2) NAMCO LIMIT SWITCHES SERIAL # CA74060100

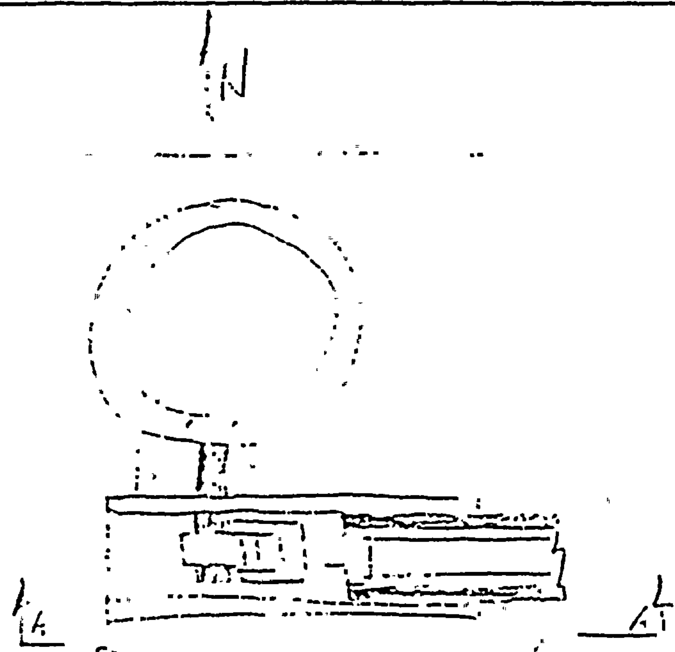
3. THERE WERE NO AIR OPERATOR MFG MODEL/IDENTIFICATION TAGS FOUND

△2

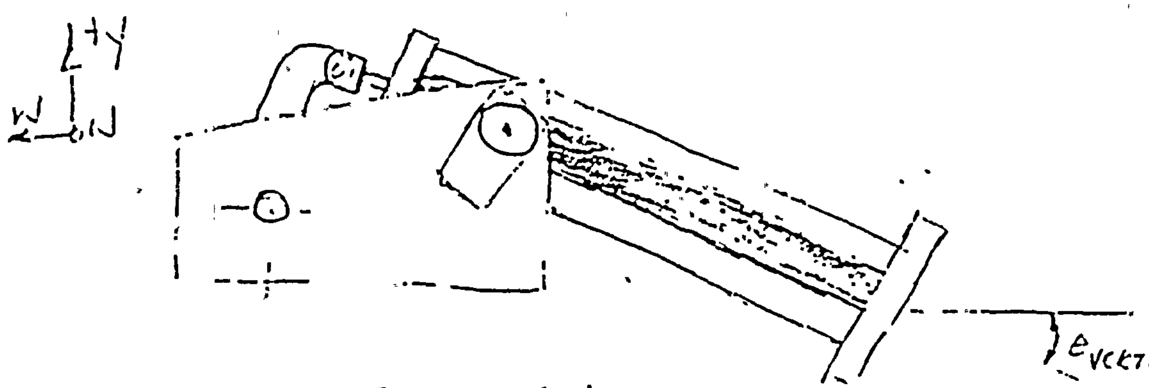
PREPARED BY Don Searle DATE 6/8/83 REVIEWED BY L.C. Fernandez DATE 6/20/83
(SIGNATURE) (SIGNATURE)
DON SEARLE L.C. FERNANDEZ

Sheet

Project WNP#2		Prepared By [illegible]	Date 12/[illegible]
Subject Equip Qualification		Checked By [illegible]	Date 1/4/83
System CCP/CSP — CSP-V-3 △2		Job No 82044	File No
Analysis No QID#361106	Rev No	Sheet No	2 OF 3



PLAN CSP-V-3,4 (TYP VIEW)



SECTION A-A

CSP-V-3 — θ ~ 7°
CSP-V-4 — θ ~ 6°

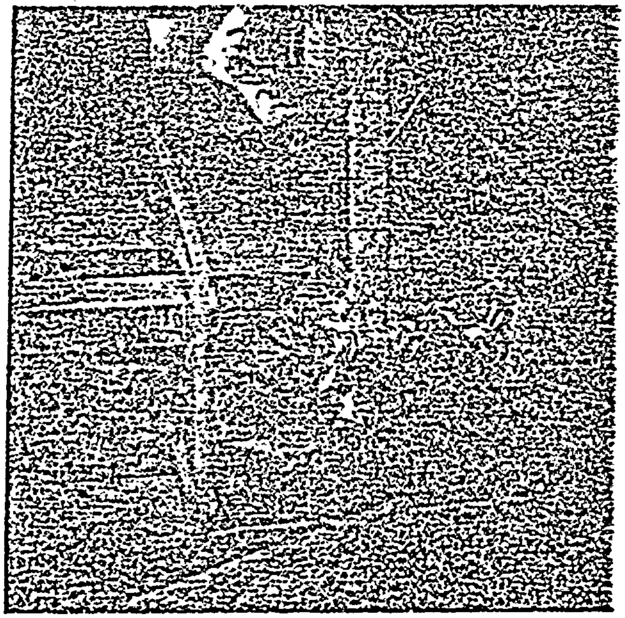
FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY)

Calculation Sheet

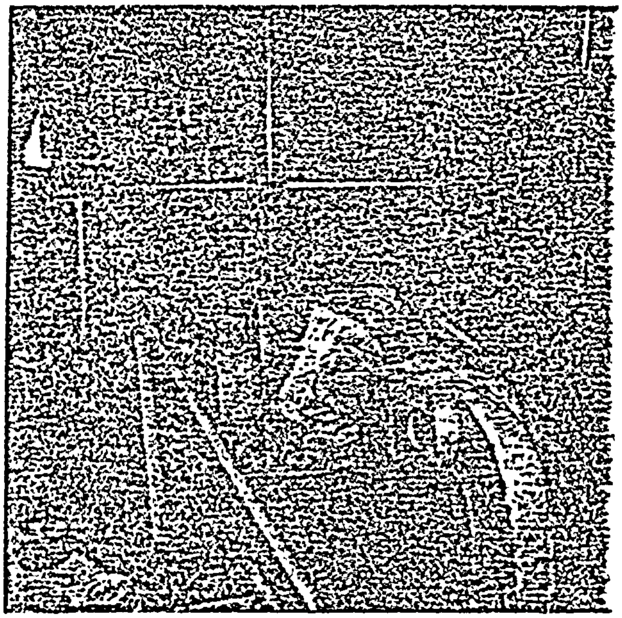
Project: WPPSS Mechanical Equipment Qualification	Prepared By	Date 1/10/83	
Subject: 24" Butterfly Valves	Checked By: [signature]	Date 3/22/83	
System: CSP and CEP	Job No 82044	File No OT.01/F	
Analysis No 361106	Rev. No.	Sheet No 3 of 3	

SUPPLEMENTAL INFORMATION: (AIR OPERATOR PICTURES)

CSP-AO-3



CSP-AO-3 (CLOSE-UP)
SUPPORT BRACKET & DRIVE LEVER



CSP-AO-3 (MILLER OPERATOR)
VIEW LOOKING SOUTH-EAST

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN CSP-V-4
QID# 361106

BLDG R
MFR B/E
MODEL# 0657
150 PSI @ 275 °F

FLOOR EL 471
COMPONENT EL 477
SERIAL# 27235-2
ASME CLASS 2

COORDS 7.6/M.6
DSCRP BUTTE[illegible]ALV
MAT'L SA516-GE70
LBS 150 SIZE 24

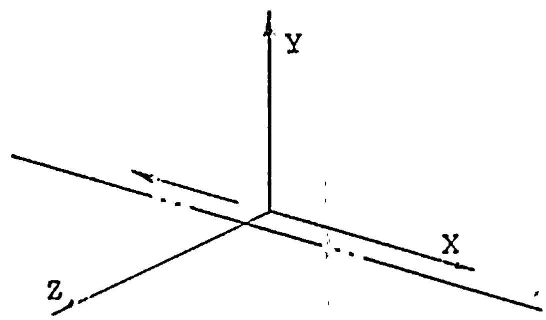
YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )
// TO AXIS OF PIPE ( ) N/A
YOKE LENGTH ______
(FLANGE TO FLANGE)

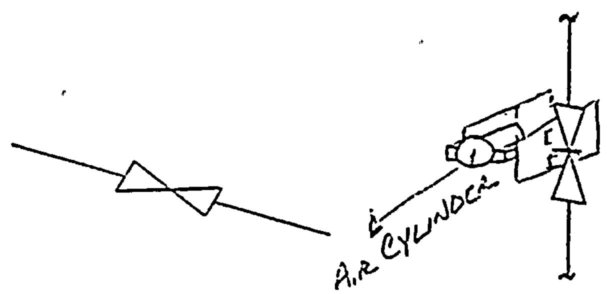
MOUNTING CONDITION

NO OF BOLTS 20
BOLT TYPE ______ BOLT Ø 1 1/2"
WELD TYPE & SIZE 150# FLANGES
PIPE MOUNTED YES (X) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2")................YES ( ) NO (X)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (X) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES (X) NO ( )



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN CSP-AO-4
MODEL NO ③
TYPE ______ SIZE ______
MANUFACTURER MILLER FLUID POWER
SERIAL NO ______
ORDER NO ______

MOTOR EPN N/A
MODEL NO ______
ID NO ______ INS CLASS ______
MANUFACTURER ______
SERIAL NO ______
1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

TYPE OF CONDUIT CONNECTION: RIGID ( ) FLEX ( )

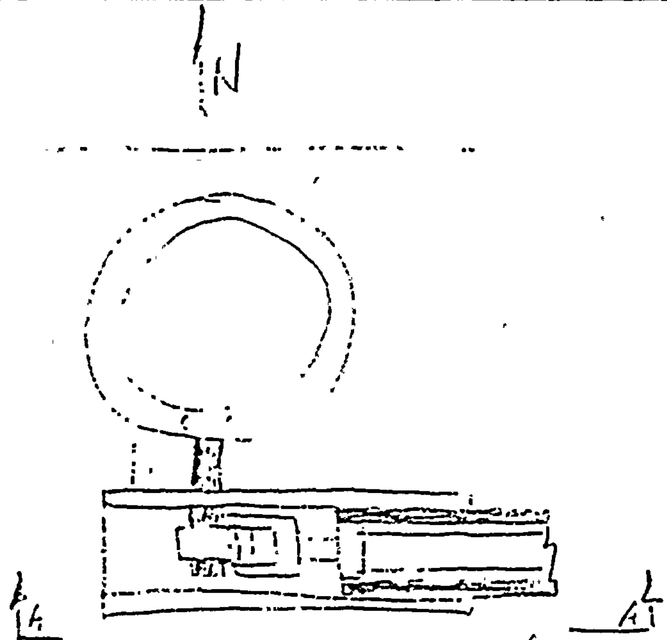
NOTES: 1. Definition (N/F = Not Found)
2. (2) NAMCO LIMIT SWITCHES SERIAL# EA74080100
3. THERE WERE NO AIR OPERATOR MFG MODEL/IDENTIFICATION TAGS FOUND

△2

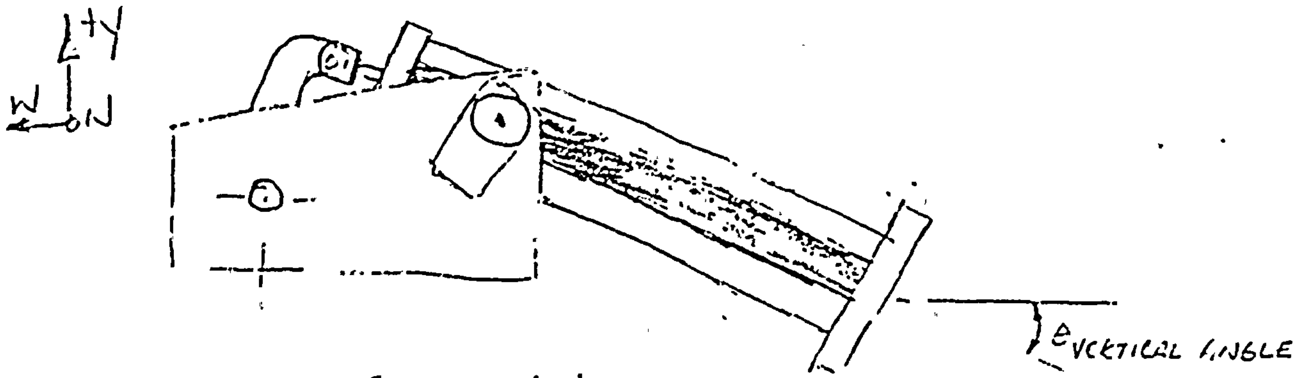
PREPARED BY [signature] DATE 6/16/83 REVIEWED BY [signature] DATE 6/20/83
(SIGNATURE) (SIGNATURE)
DON SEARLE L.C. FERNANDEZ

Calculation Sheet

Project	WNP#2	Prepared By	[illegible signature]	Date	12/22/82
Subject	EQUIP QUALIFICATION	Checked By	E Kalinowski	Date	1/4/83
System	CEP/CSP - / CSP-V-4 (2)	Job No	82044	File No	
Analysis No	QID#361106	Rev No		Sheet No	2 OF 2



PLAN CSP-V-3,4 (TYP VIEW)



SECTION A-A

CSP-V-3 — θ ~ 7°
CSP-V-4 — θ ~ 6°

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY)

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN CSP-V-5

QID# 361106

BLDG R	FLOOR EL 471	COORDS M.7/8.3
MFR BIF	COMPONENT EL 475	DSCRP BUTTERF[illegible]VE
MODEL# 0657	SERIAL# 27236-1	MAT'L SA516 GR70
150 PSI @ 275 °F	ASME CLASS 2	LBS 150 SIZE 24"

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( ) N/A

YOKE LENGTH ____
(FLANGE TO FLANGE)

MOUNTING CONDITION

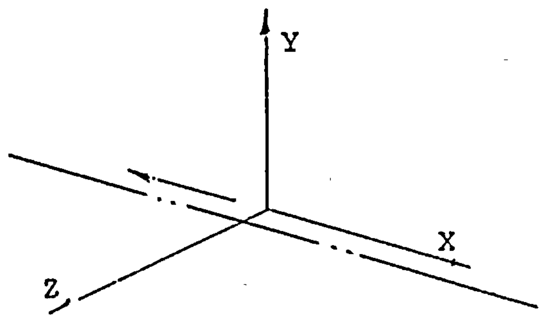
NO OF BOLTS 20

BOLT TYPE ____ BOLT Ø 1 1/4"

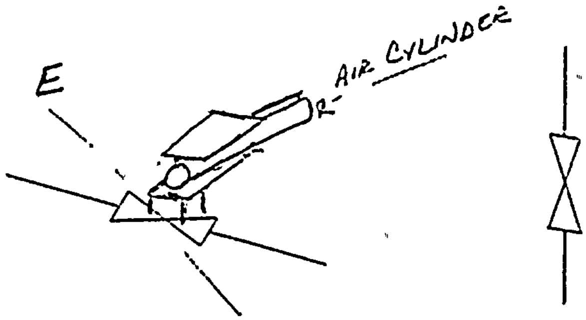
WELD TYPE & SIZE 150# ANSI FLANGES

PIPE MOUNTED YES (X) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2")................YES ( ) NO (X)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (X) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES (X) NO ( )



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN CSRAO-5	MANUFACTURER MILLER FLUID POWER
MODEL NO ③	SERIAL NO
TYPE ____ SIZE ____	ORDER NO

MOTOR EPN N/A	MANUFACTURER
MODEL NO	SERIAL NO
ID NO ____ INS CLASS ____	1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

TYPE OF CONDUIT CONNECTION: RIGID ( ) FLEX (X)

NOTES: 1. Definition (N/F = Not Found)
2. (2) NAMCO LIMIT SWITCHES SERIAL #CA74080100
3. THERE WERE NO AIR OPERATOR MFG MODEL/IDENTIFICATION TAGS FOUND

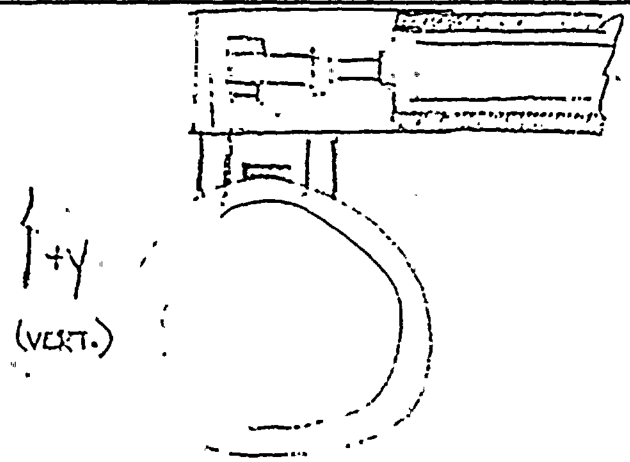
△2

PREPARED BY [signature] (SIGNATURE) DON SCARLE DATE 6/18/83

REVIEWED BY L.C. Fernandez (SIGNATURE) L.C. FERNANDEZ DATE 6/20/83

Calculation Sheet

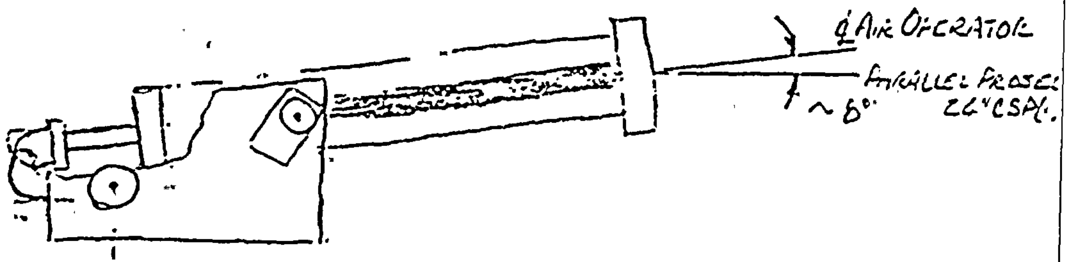
Project:	NMP #2	Prepared By: [signature]	Date: 12/22/82
Subject:	EQUIP. QUALIFICATION	Checked By: [signature]	Date: 1/4/83
System:	CSP-V-5	Job No: 82066	File No:
Analysis No:	QID 26-1106	Rev No.:	Sheet No: 2 OF 2



CSP-V-5

47in N

24"CSP(1)-1 ℄



PLAN VIEW

FIELD SKETCH (FOR THE PURPOSE OF SHOWING OPERATOR ORIENTATION)

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN CSP-V-6

QID# 361106

BLDG R

FLOOR EL 471

COORDS H.5/5.3

MFR BIF

COMPONENT EL 480

DSCRP BUTTER[illegible]LVE

MODEL# 0657

SERIAL# 27236-2

MAT'L SA516 GR70

150 PSI @ 275 °F

ASME CLASS 2

LBS 150 SIZE 24

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( ) N/A

YOKE LENGTH (FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS 20

BOLT TYPE ____ BOLT Ø 1 1/4"

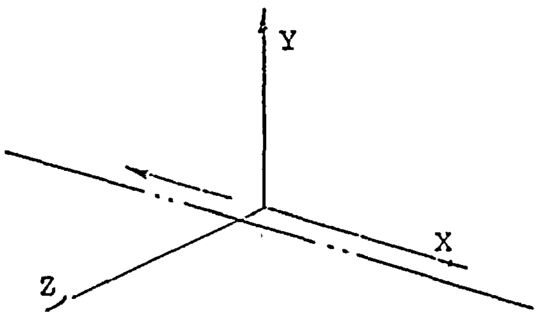
WELD TYPE & SIZE FLANGED ENDS

PIPE MOUNTED YES (x) NO ( )

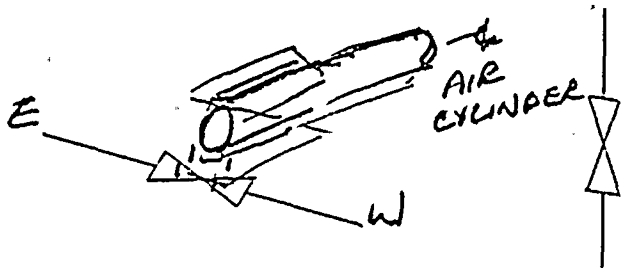
PERMANENT OBSTRUCTION (WITHIN 2")................YES ( ) NO (X)

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (X) NO ( )

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES (X) NO ( )



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN CSP-AO-6

MANUFACTURER MILLER FLUID POWER

MODEL NO (3)

SERIAL NO

TYPE ____ SIZE ____

ORDER NO

MOTOR EPN N/A

MANUFACTURER

MODEL NO

SERIAL NO

ID NO ____ INS CLASS ____

1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

TYPE OF CONDUIT CONNECTION: RIGID ( ) FLEX (X)

NOTES: 1. Definition (N/F = Not Found)

2. (2) NAMCO LIMIT SWITCHES SERIAL # 74080100

3. THERE WERE NO AIR OPERATOR MFG MODEL/IDENTIFICATION TAGS FOUND.

△2

PREPARED BY Don Searle (SIGNATURE) DATE 6/18/83

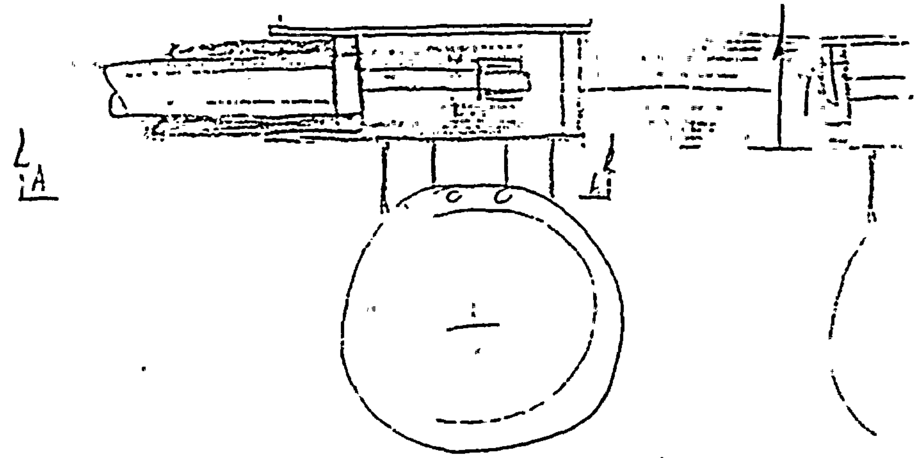
DON SEARLE

REVIEWED BY L.C. Fernandez (SIGNATURE) DATE 6/20/83

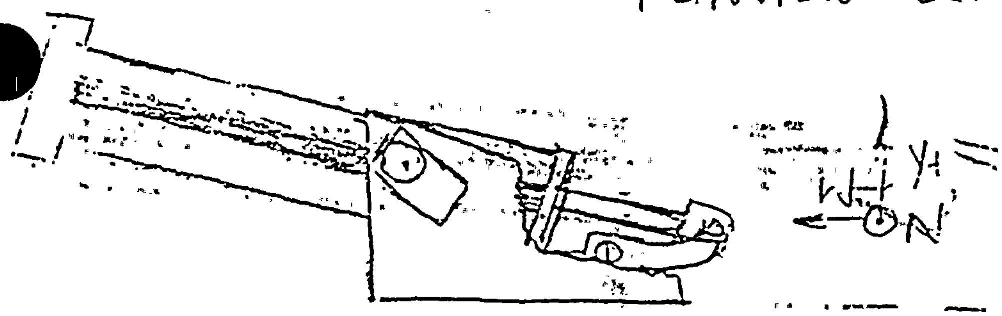
L.C. FERNANDEZ

Sheet

Project: WNP 2		Prepared By: [illegible]	Date: 12/22/82
Subject: EQUIP QUALIFICATION		Checked By: E Pod[illegible]	Date: 1/4/83
System: CEP/CES / CSP-V-6		Job No: 0082044	File No:
Analysis No: OID # 361106	Rev No:	Sheet No: 2 OF 2	



PLANVIEW CSP-V-6



SECTION A-A

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY)

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN CSP-V-9

QID# 361106

BLDG R	FLOOR EL 471	COORDS M.9/5.[illegible]
MFR BIF	COMPONENT EL 490	DSCRP BUTTERF[illegible]LV
MODEL# 0657	SERIAL# N27236-3	MAT'L
150 PSI @ 275 °F	ASME CLASS 2	LBS SIZE 24"

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( ) N/A

YOKE LENGTH (FLANGE TO FLANGE)

MOUNTING CONDITION

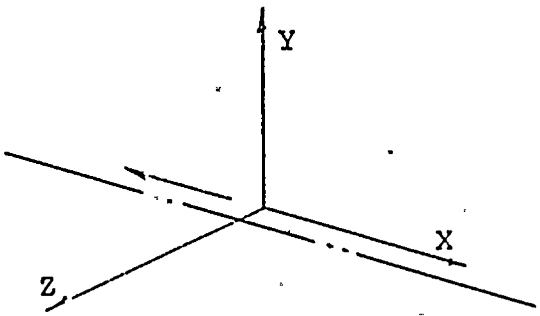
NO OF BOLTS 20

BOLT TYPE BOLT Ø

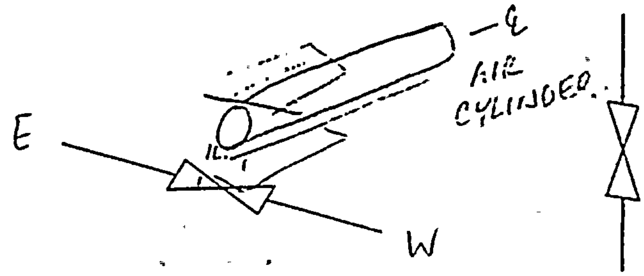
WELD TYPE & SIZE FLANGED ENDS

PIPE MOUNTED YES (X) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2")..............YES ( ) NO (X)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (X) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (X)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN CSP-AO-9	MANUFACTURER MILLER FLUID POWER
MODEL NO (3)	SERIAL NO
TYPE SIZE	ORDER NO

MOTOR EPN N/A	MANUFACTURER
MODEL NO	SERIAL NO
ID NO INS CLASS	1-PHASE ( ) 3-PHASE ( ) AC DC

TYPE OF CONDUIT CONNECTION: RIGID ( ) FLEX (X)

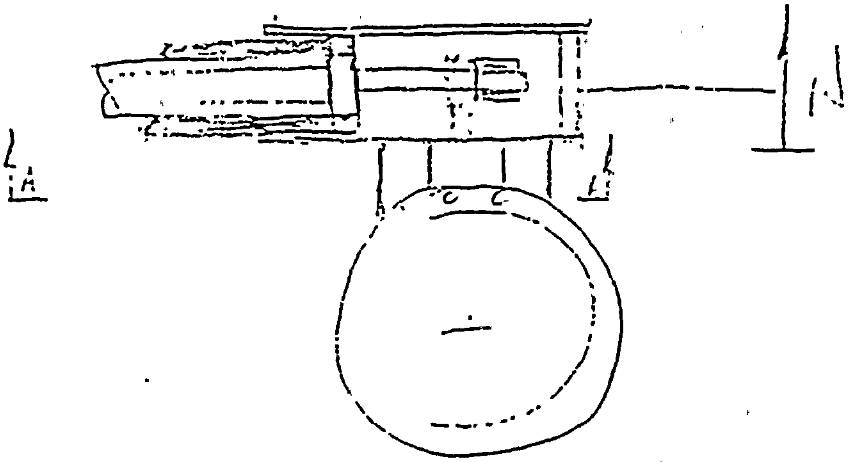
NOTES: 1. Definition (N/F = Not Found)
2. (2) NAMCO LIMIT SWITCHES SERIAL # 74080100
3. THERE WERE NO AIR OPERATOR MFG. MODEL/IDENTIFICATION TAGS FOUND

PREPARED BY Don Searle (SIGNATURE) DATE 6/18/83 REVIEWED BY L.C. Fernandez (SIGNATURE) DATE 6/20/83

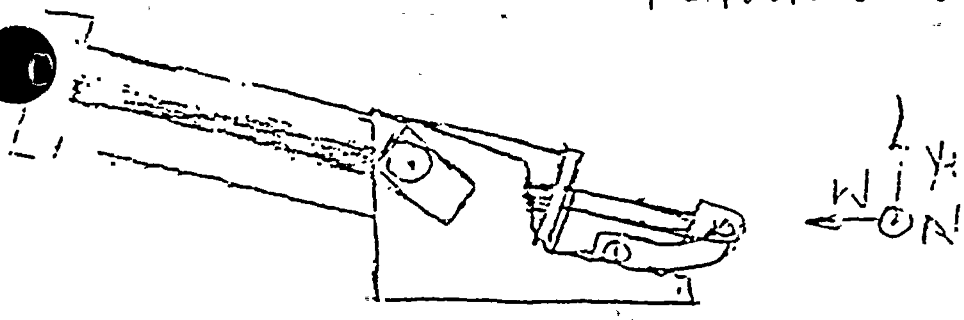
DON SEARLE L.C. FERNANDEZ

Sheet

Project: WNP#2		Prepared By: [illegible]	Date: 12/22/82
Subject: EQUIP QUALIFICATION		Checked By: [illegible]	Date: 1/4/83
System: CCP/CES / CSP-V-6		Job No: 82044	File No:
Analysis No: W/D# 361106	Rev. No.:	Sheet No: 2 OF 2	



PLAN VIEW CSP-V-6



SECTION A-A

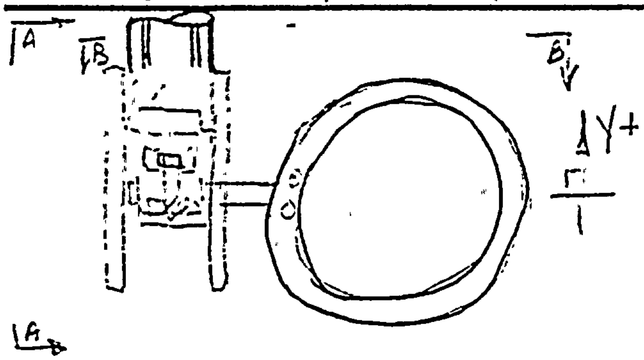
FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY

1006 0:

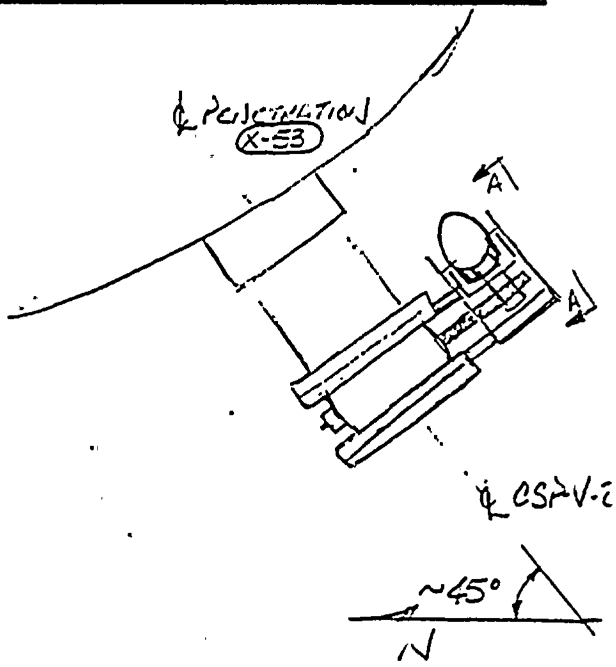
Calculation Sheet

CYGNA

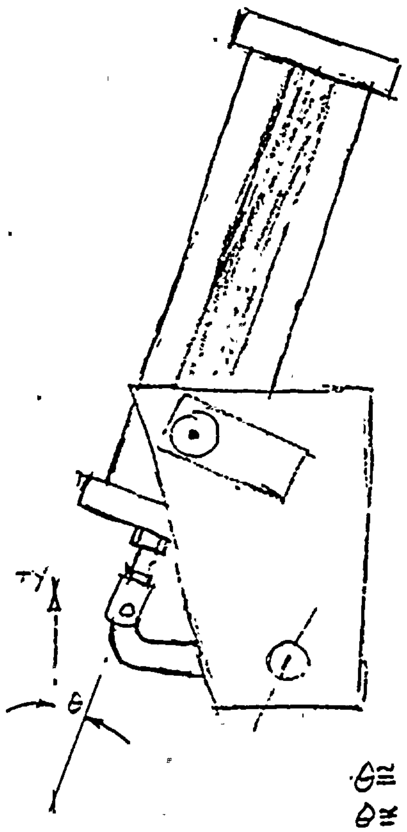
Project: WNP #2		Prepared By: [illegible signature]	Date: 12/22/82
Subject: EQUIP. QUALIFICATION		Checked By: L E Robinson [signature]	Date: 1/4/83
System:		Job No.: 82044	File No.:
Analysis No.: QID#361104	Rev. No.:	Sheet No.: 2 OF 2	



CSP-V-1,2 (TYP VIEW)



PLAN VIEW (B-B)



θ ≅ 7° — CSP-V-1

θ ≅ 6° — CSP-V-2

SECTION VIEW A-A

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 5.2.4

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION, ONLY)

PAGE 1 OF 1

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CEP-V-1A

QID# 361104

BLDG R | FLOOR EL 548 | COORDS J4/5.4

MFR BIF | COMPONENT EL 558 | DSCRP 30" Butterfly

MOD# A-206763 | SERIAL# 27234-3 | MAT'L SA-516-GR70

45 PSI @ 340 °F | LBS N/F | SIZE 30

ASME CLASS 2

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( ) N/A

// TO AXIS OF PIPE ( )

YOKE LENGTH N/A
(FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

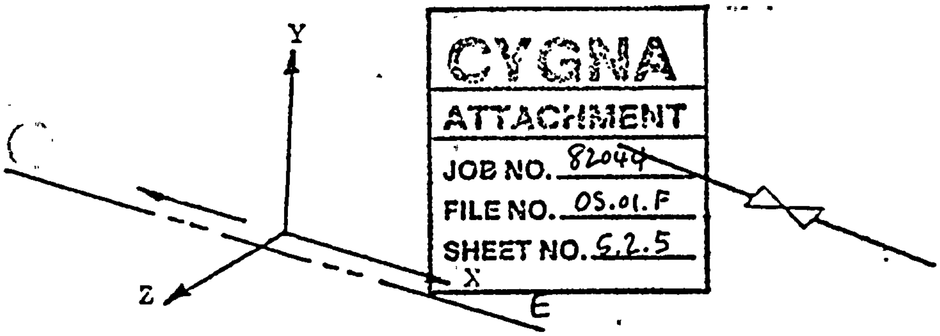
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( ) bolted flanges

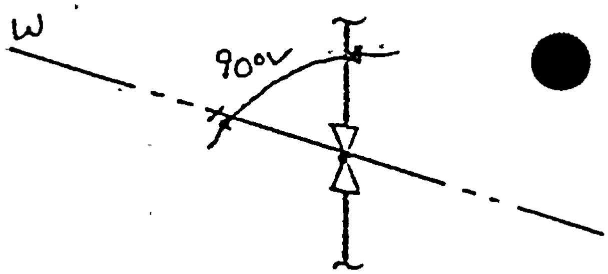
PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

IS COMP BETWEEN CONT & 1ST ANC. (FULL 6 WAY ANC) YES (✓) NO ( )

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 5.2.5



GLOBAL CO-ORDINATE SYSTEM

VALVE STEM ORIENTATION

OPERATOR EPN N/A | MANUFACTURER
MODEL NO | SERIAL NO
TYPE | SIZE | ORDER NO

MOTOR EPN N/A | MANUFACTURER
MODEL NO | SERIAL NO
ID NO | INS CLASS | 1-PHASE ( ) 3-PHASE ( ) AC DC

COMMENTS: 2 Limit Switches Found EPN's: not known
Model: 1703100 Manufacturer: Namco Controls
EA74080100

PREPARED BY [signature] DATE 7/14/82 REVIEWED BY William Cunha DATE 7/14/82
(SIGNATURE) (SIGNATURE)
David Tr... WILLIAM CUNHA

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CEP-V-2A

OID# 361104

BLDG R

FLOOR EL 548

COORDS J.4/5.4

MFR BIF

COMPONENT EL 558

DSCRP 30" Butterfly

MOD# 0657

SERIAL# 27234-4

MAT'L SA-516-GR 70

45 PSI @ 340 °F

LBS N/F SIZE 30

ASME CLASS 2

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( ) N/A

YOKE LENGTH N/A
(FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

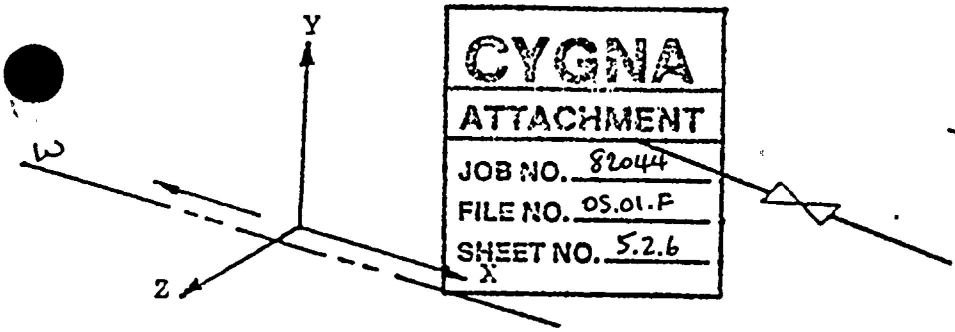
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( ) bolted flanges

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

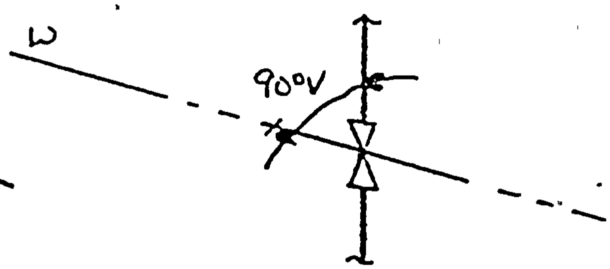
IS COMP BETWEEN CONT & 1ST ANC. (FULL 6 WAY ANC) YES (✓) NO ( )

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 5.2.6

GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN N/A

MANUFACTURER

MODEL NO N/A

SERIAL NO

TYPE ____ SIZE ____

ORDER NO

MOTOR EPN N/A

MANUFACTURER

MODEL NO

SERIAL NO

ID NO ____ INS CLASS ____

1-PHASE ( ) 3-PHASE ( ) AC ____ DC ____

COMMENTS: 2 Limit Switches found Manufacturer: Namco Controls

Model #: 1703100 EPN: CEP-LMS-2A

#: EA 74080100

PREPARED BY Doug [signature] for Dan Doyel (SIGNATURE) DATE 7/14/82 REVIEWED BY William [signature] (SIGNATURE) DATE 7/14/82

5.3 Valve Local Coordinate Systems

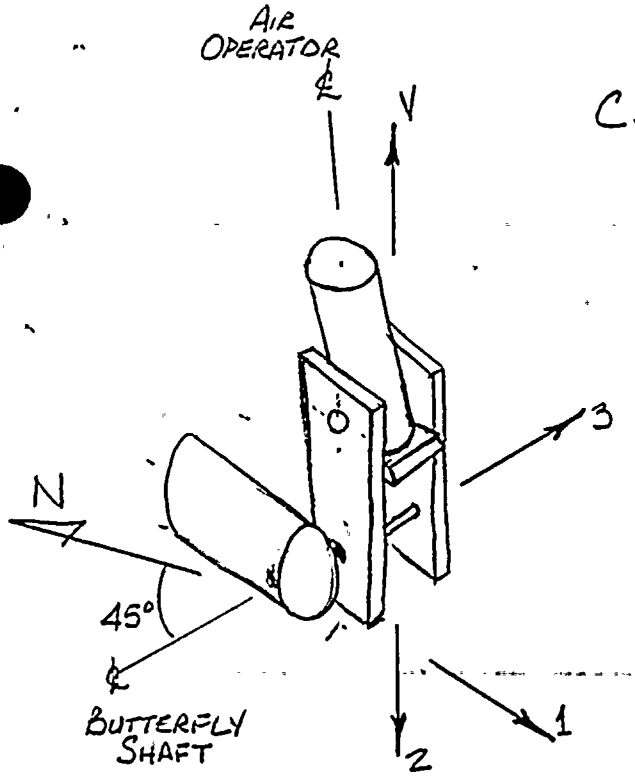
CSP-V-1

CSP-V-2

CSP-V-1,2

REFERENCE CSP-V-1,2 FIELD WALKDOWN SHEETS

PREPARED BY [signature] 2/11/83
REVIEWED BY: [signature] 2/11/83

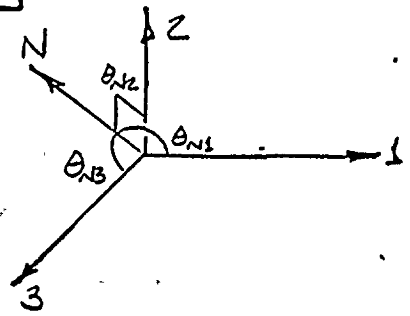


CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 5.3.1

$\theta_{N1} = 135°$ $\quad \cos\theta_{N1} = -0.707$

$\theta_{N2} = 90°$ $\quad \cos\theta_{N2} = 0$

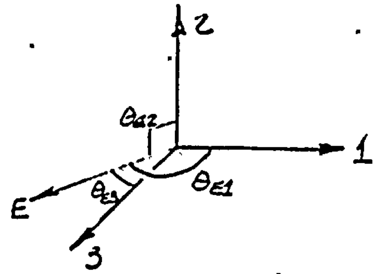
$\theta_{N3} = 135°$ $\quad \cos\theta_{N3} = -0.707$



$\theta_{E1} = 45°$ $\quad \cos\theta_{E1} = 0.707$

$\theta_{E2} = 90°$ $\quad \cos\theta_{E2} = 0$

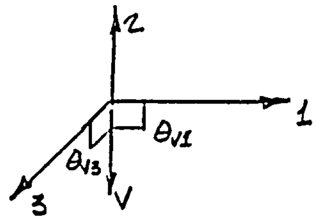
$\theta_{E3} = 135°$ $\quad \cos\theta_{E3} = -0.707$



$\theta_{V1} = 90°$ $\quad \cos\theta_{V1} = 0$

$\theta_{V2} = 180°$ $\quad \cos\theta_{V2} = -1$

$\theta_{V3} = 90°$ $\quad \cos\theta_{V3} = 0$



5.5 REVISED BURNS & ROE PIPING ANALYSIS ACCELERATIONS

MAY 11 1983

RECEIVED

MAY 31 1983

CYGNA-RICHLAND

Subject: W. O. 3900/4000
Washington Public Power Supply System
WNP-2
Qualification of Mechanical Pipe
Mounted Equipment; Forwarding of
Information

April 29, 1983
BRWP-83-078

Mr. L. T. Harrold
Assistant Director
Washington Public Power Supply System
3000 George Washington Way
Richland, Washington 99352

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 5.5.1

Attention: Mr. B. A. Holmberg

References: (a) WPBR-83-17, dated 3/16/83.
(b) WPBR-83-28, dated 4/12/83.
(c) WPBR-83-29, dated 4/12/83.
(d) Telecopy, B. A. Holmberg to J. J. Verderber, dated 4/4/83.

Gentlemen:

In response to the request of references (a), (b), (c) and (d), this letter is forwarding refined valve accelerations. The valve acceleration sheets for the five (5) CSP valves represent the second iteration of the refinement task. Valve sheets for the other four (4) valves represent the first iteration of the refinement task. Please inform the Woodbury Office if efforts should be made to reduce accelerations further.

Very truly yours,

ORIGINAL SIGNED BY J. J. VERDERBER

John J. Verderber
Project Engineering Manager

JJV/BPM/es
Att.

CC: Mr. W. S. Chin - BPA - 1 w/1
Mr. J. R. Rhodes - WPPSS - 1 w/1
Mr. P. Buck - WPPSS - 1 w/1 Mail Drop 575

ATTACHMENT

Data forwarded with BRWP-83-078, dated April 29, 1983

Valve #	Anchor Group	Calc. No.
CSP-V-1	125	8.14.129
CSP-V-2	125	8.14.129
CSP-V-3	125	8.14.129
CSP-V-4	125	8.14.129
CSP-V-5	125	8.14.129
RCIC-V-31	107	8.14.112A
RHR-V-17B	31	8.14.121
RHR-V-53A	29	8.14.62C
RHR-V-53B	31	8.14.121B

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 5.5.2

BURNS AND ROE, INC.
W.O. No. 3900-10 Date 4/12/83 Book No. 8/14/129 Page No.
Drawing No. M200 Iso 172 Rev. 3 Calc. No. 8/14/129 Sheet of
By J.S. Checked Approved
Title WNP-2 Status As-Built Verification of Piping Calculations

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 5.5.3

CSP-V-1 Valve Qualification

B&R File No. Dwg. 68-00-0008 Operation I.D. No. ______

B&R M200 Iso No. 172 Anchor Group 125

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelerations (g) X	Y	Z	Comments
Valve Operator (Bracket)	25	321	Upset	0.65	1.27	0.65	
			Emergency	0.88	1.58	1.87	
			Faulted	1.31	2.69	2.13	
Valve Operator (Cylinder)	33	593	Upset	0.76	1.41	0.88	
			Emergency	1.07	2.95	1.40	
			Faulted	1.46	3.67	1.74	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 5.5.5

B&R File No. 68-00-0308

B&R N200 Iso No. 171 REV 2A

Operation I.D. No. CEP-V-1A

Anchor Group 123

Calc. No. 8.14.125

Valve Acceleration

CEP-V-1A

Location	Nodal Pt. No.	Mass Wt. M (lb.)	Conditions	Loads (lb.) FX	Loads (lb.) FY	Loads (lb.) FZ	Acceleration (g) Horizontal $\frac{(FX^2+FZ^2)^{1/2}}{M}$	Acceleration (g) Vertical $\frac{FY}{M}$	Comments
Valve Body	53	1876	Upset	1970	3018	2040	1.51	1.61	
			Emergency	1975	3027	2044	1.52	1.62	
			Faulted	2383 1.27	3322 1.77	2313 1.23	1.77	1.77	SLSS = 2.50
Valve Operator	555	1352	Upset	2148	2752	2219	2.28	2.04	
			Emergency	2157	2759	2229	2.3	2.04	
			Faulted	2[illegible]3 [illegible]	3009 2.23	2496 1.85	2.67	2.23	SLSS = 3.[illegible]

W.O. No. 3900-10 Date 11/15/1982 Book No. 8.14.125 Page No.
Drawing No. N200-SH.171/REV2A Calc. No. Sheet Cont. on Sheet
By R.M. Checked RR Approved
Title STRESS ANALYSIS OF SH N200-SH.171/REV. 2A

BURNS AND ROE, INC.

W.O. No. 3900-10 Date 4/12/83 Book No. 8.14.129 Page No. ___
Drawing No. M200 Sh. 172 Rev 2.1 Calc. No. 8.14.129 Sheet ___ of ___
By P.S. ... Checked ___ Approved ___
Title WNP-2 Status As-Built Verification of Piping Calculation

CSP-V-2 Valve Qualification

B&R File No. Dwg. 68-00-0008 Operation I.D. No. ______

B&R M200 Iso No. 172 Anchor Group 125

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelerations (g) X	Y	Z	Comments
Valve Operator (Bracket)	8	321	Upset	0.61	1.27	0.64	
			Emergency	0.81	1.51	1.56	
			Faulted	1.26	2.65	1.86	
Valve Operator (Cylinder)	17	593	Upset	0.66	1.33	0.79	
			Emergency	1.06	2.82	1.61	
			Faulted	1.44	3.57	1.90	

B&R File No. 68-00-0008
B&R M200 Iso No. 171 REV 2A

Operation I.D. No. CEP-V-2A
Anchor Group 123
Calc. No. 8.14.125

Valve Acceleration

CEP-V-2A

Location	Nodal Pt. No.	Mass Wt. M (lb.)	Conditions	Loads (lb.) FX	Loads (lb.) FY	Loads (lb.) FZ	Acceleration (g) Horizontal $\frac{(FX^2+FZ^2)^{1/2}}{M}$	Acceleration (g) Vertical $\frac{FY}{M}$	Comments
Valve Body	661	1870	Upset	1246	3012	1588	1.08	1.61	
			Emergency	1277	3020	1623	1.1	1.61	
			Faulted	1464 0.79	3315 1.77	1918 1.02	1.29	1.77	SRSS = 2.19
Valve Operator	664	1352	Upset	1112	2600	1282	1.26	1.92	
			Emergency	1176	2608	1361	1.33	1.93	
			Faulted	1300 [illegible]	2856 [illegible]	1562 [illegible]	1.50	2.11	SRSS = 2.59

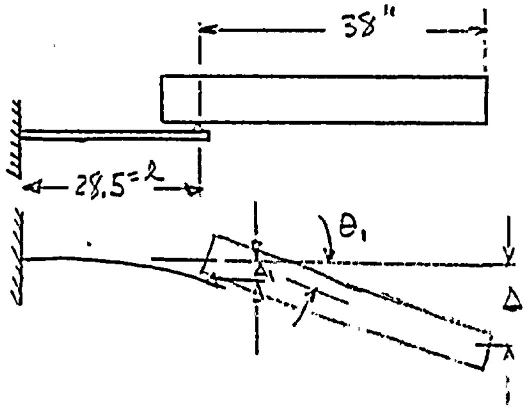
W.O. No. 35900-1 | Drawing No. M200-SII-171-2A | Date 11/15/1982 | Book No. 8.14.125 | Page No.
By J.M. | Checked RR | Calc. No. 8.14.125 | Sheet | Cont. on Sheet
Title: STRESS ANALYSIS OF ISO M200-SII-171 REV. 2A | Approval

Calculation Sheet

Project WPPSS-EO		Prepared By: J E Rakowski	Date 3/24/83
Subject B/F Valve/Actuator Model Summary		Checked By: [illegible]	Date 3/24/83
System CSP		Job No. 82044	File No. OT.01/F
Analysis No. 361104 & 361106	Rev. No. 0	Sheet No. 361106-4.3-E9	

AVERAGE FLEXIBILITY = $1.27(10)^{-3}$ in/lb

CALCULATE EFFECTIVE MOMENT OF INERTIA OF A CANTILEVER BEAM USED TO REPRESENT THE BRACKET. USE THE FOLLOWING DIMENSIONS



$\Delta = \Delta_1 + 38\theta_1 = 150^{\#} * .00127 \text{ in}/\# = 0.190$ (use 150# or = F)

$$\Delta_1 = \frac{F\ell^3}{3EI} + \frac{(38F)\ell^2}{2EI} = \frac{F\ell^2}{EI}\left(\frac{\ell}{3} + 19\right) = \frac{F\ell^2}{EI}\left(\frac{28.5}{3} + 19\right)$$

$$\frac{F\ell^2}{EI} = \frac{150 * (28.5)^2}{2.9(10)^7 I_{zz}} = \frac{4.2(10)^4 (10)^{-7}}{I_{zz}} = \frac{.0042}{I_{zz}}$$

$$\Delta_1 = \frac{.0042}{I_{zz}} * \left(\frac{28.5}{3} + 19\right) = \frac{.120}{I_{zz}} \text{ in}$$

$$\Delta = \frac{.120}{I_{zz}} + 38\theta_1$$

1005 00

CYGNA

Calculation Sheet

Project: WPPSS-EQ	Prepared By: J E Rakowski	Date: 3/24/83	
Subject: B/F Valve/Actuator Model Summary	Checked By: [illegible]	Date: 3.24.83	
System: CSP	Job No. 82044	File No. 07.01/F	
Analysis No. 361104 & 361106	Rev. No. 0	Sheet No. 361106-4.3-B10	

$\theta_1 = \theta_1$ due to $F + \theta_1$ due to $M = 38F$

$$= \frac{F\ell^2}{2EI} + \frac{(38F)\ell}{EI} = \frac{F\ell}{EI_{zz}}\left(\frac{\ell}{2} + 38\right)$$

$$\theta_1 = \frac{150\,(28.5)}{2.9(10)^7\, I_{zz}}\left(\frac{28.5}{2} + 38\right) = \frac{7.7(10)^4 \times 10^{-7}}{I_{zz}} = \frac{7.7(10)^{-3}}{I_{zz}}$$

$$38\,\theta_1 = \frac{.293}{I_{zz}}$$

$$\therefore\ \Delta = \frac{.122}{I_{zz}} + \frac{.293}{I_{zz}} = .19$$

$$\frac{.415}{I_{zz}} = .19$$

$$\boxed{I_{zz} = 2.16\ \text{IN}^4}\quad 8''\ \text{A/O}$$

FOR THE 10" CYLINDER, RATIO UP INERTIA, I.E.

$$I_{zz}\Big|_{10} = I_{zz}\Big|_8 \times \frac{(5/8)^3}{(1/2)^3} = I_{zz}\Big|_8 \times 1.95$$

$$\boxed{I_{zz}\Big|_{10''} = 4.22\ \text{IN}^4}$$

BRACKET TORSIONAL RESISTANCE : SET TO A HIGH VALUE SINCE BENDING + TORSION BOTH REPRESENTED IN ABOVE FLEXIBILITY. (1000 IN⁴)

CYGNA

Calculation Sheet

Project: WPPSS-EO	Prepared By: J E Rokowski	Date: 3/24/83	
Subject: B/F Valve/Actuator Model Summary	Checked By: [signature]	Date: 3/24/83	
System: CSP	Job No. 82044	File No. 0T.01/F	
Analysis No. 361104 & 361106	Rev. No. 0	Sheet No. 361106-4.3-B15	

FOR THE BRACKET ELEMENT:

(MAKE $\rho = 0$ & PUT 277# 15" DOWN) <(321#)>

LENGTH	= 28.5 (15 + 13.5)	<✓28.5>
WEIGHT	= 277 LB	<321 #>
$A_x = A_y = A_z$	= 6.84 IN^2	<10.6 IN^2>
C_z	= 6.84 IN	<8.5 IN>
C_x	= .25 IN	<.313 IN>
I_{xx}	= 102 IN^4 (BELOW)	<255 IN^4>
I_{yy}	= 1000 IN^4 (PAGE 7/13)	<1000 IN^4>
I_{zz}	= 2.16 IN^4 (PAGE 7/13)	<4.22 IN^4>

IN PLANE BENDING INERTIA OF BRACKET PLATE:

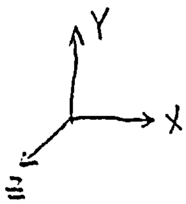
$$I_{xx} = \frac{1}{12} b \ell^3 = \frac{1}{12} (0.5)(13.5)^3 = 102 \ IN^4$$

<.625 17> <255>

CYGNA

Calculation Sheet

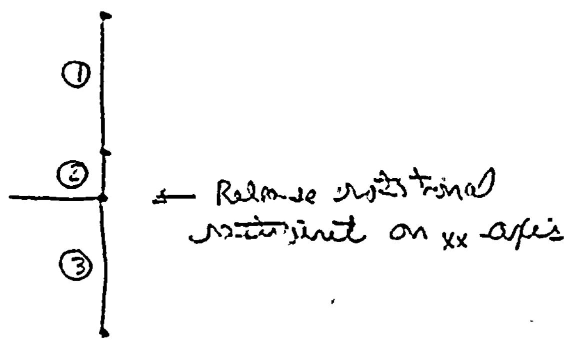
Project: WPPSS EQ		Prepared By: [signature]	Date: 1/3/83
Subject: BIF VALVE/ACTUATOR MODEL SUMMARY		Checked By: [signature]	Date: 3/24/83
System: CSP		Job No. 82044	File No. 0T.01/F
Analysis No. 361104 #106	Rev. No. 0	Sheet No. 361106-4.3-B16	

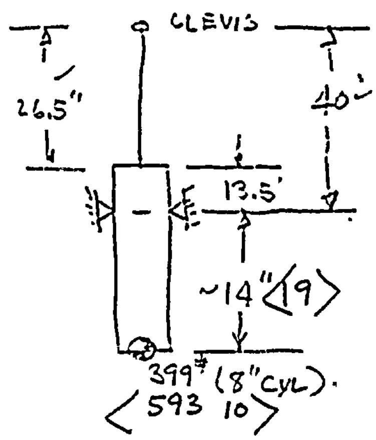


DRIVE ROD & CYLINDER:

IMPORTANT DISTANCES ARE:

MODEL:





①: DRIVE ROD:

$L = 26.5"$ ✓

$A = \pi/4\ D^2 = 2.41\ IN^2$ ✓

$C = .875"$ ✓

$I = .46\ IN^4 = I_{xx} = I_{zz}$ ✓

$I_{yy} = \sqrt{2} * I_{xx} = .92\ IN^4$ ✓ ⟨0.92 for 10"⟩

② ③ 8" ⟨10⟩ CYL: (Say ρ = 0 AND PUT 399# ⟨593#⟩ AT CG)

$L_{②} = 13.5$ ✓

$L_{③} = 14.0$ ⟨19⟩

$I_{yy} = \quad = 74\ IN^4$ ⟨180⟩

$I_{xx} = I_{zz} \quad = 52.2\ IN^4$ (longer ⟨(1.25)^4⟩ = ⟨127⟩)

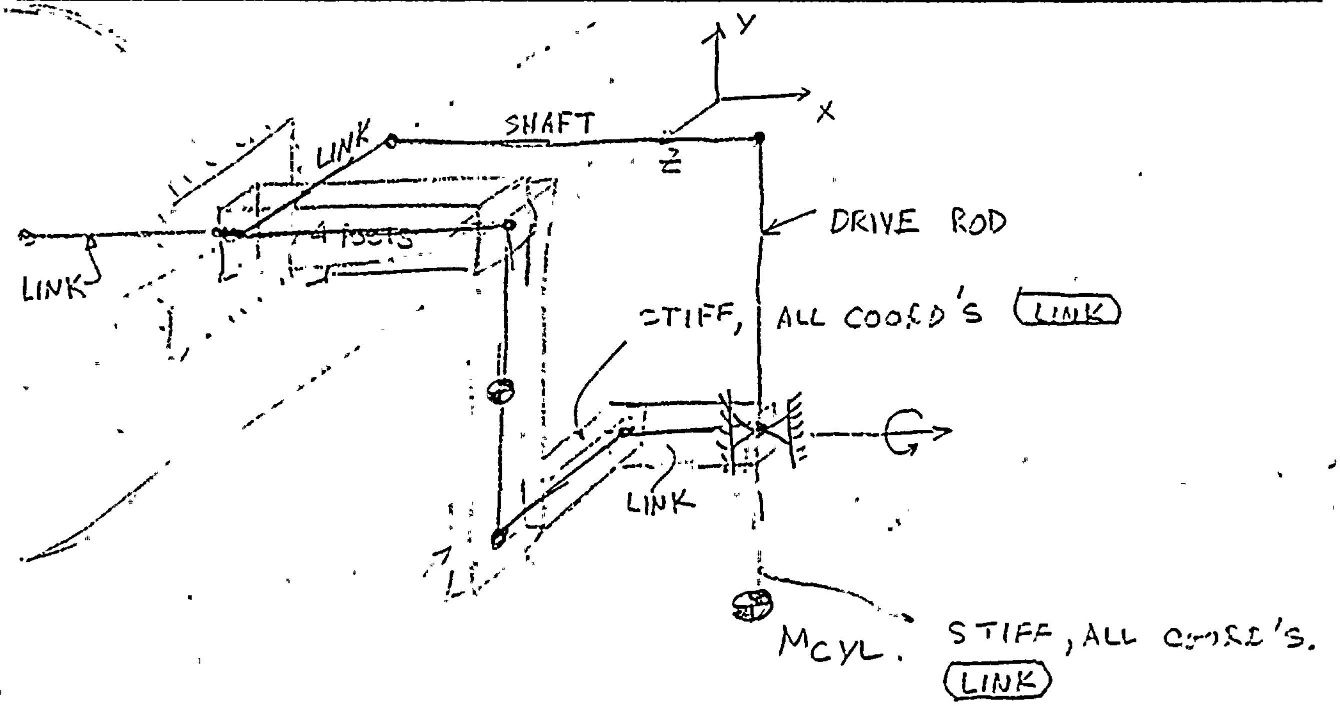
$A = \pi/4\ 8^2 = 50.3\ IN^2$ ⟨78⟩

$C = 4"$ ⟨5⟩

CYGNA

Calculation Sheet

Project: WPPS3 - EQ		Prepared By: [signature]	Date: 1/3/83
Subject: RIF VALVE/ACTUATOR MODEL SUMMARY		Checked By: [signature]	Date: 3/24/83
System: CSP		Job No. 82044	File No. OT.01/F
Analysis No. 361104 & 106	Rev. No. 0	Sheet No. 361106-4.3-B11	



ZZ Bending, Flex calc.'d.
XX - Stiff
I_{yy} - TORSIONAL STIFFNESS

PICK I's & A's for proper STIFFNESS, THEN SO OTHERS.

GO TO 4- PAGES

1008 CO

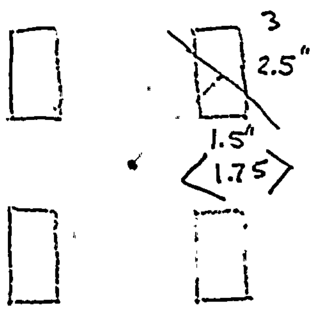
CYGNA

Calculation Sheet

Project: WPPSS - EQ	Prepared By: [illegible signature]	Date: 1/3/83	
Subject: KTF VALVE/ACTUATOR MODEL SUMMARY	Checked By: [illegible signature]	Date: 3/24/83	
System: CSP	Job No. 82044	File No. OT.01/F	
Analysis No. 361104.2 106	Rev. No. 0	Sheet No. 361106-4.3-B12	

(1) EARS:

< > = VALUES FOR 10" OPERATORS



$A_x = 1.5 \times 2.5 \times 4 = \overset{21}{15}\ in^2$

INERTIAS:

$I_{xx} = J$

Define I_{xx} for program $\phi = \dfrac{Tl}{G I_x}$

$I_{xx} = \dfrac{Tl}{\phi G}$

from page 5: $\langle 1.565(10)^9 \rangle$

$K_{\theta_x\theta_x} = 1.72(10)^8$ in·# / rad $= \dfrac{T}{\phi}$

$\therefore\ I_{xx} = \dfrac{l}{G} K_{\theta_x\theta_x} = \dfrac{7.125 \ \langle 4.85 \rangle}{.4(10)^6 \times 29} * 1.72(10)^8 \ \langle 1.565(10)^9 \ 15.65(10)^8 \rangle$

UNITS: $\dfrac{F \times L \times L}{F/L^2} = L^4$ OK

$I_{xx} = 1.06 * 10^2\ in^4 = 106\ IN^4$

$\left\langle 106 * \dfrac{15.65}{1.72} * \dfrac{4.85}{7.125} = \underline{657\ IN^4} \right\rangle$

1006 00

CYGNA

Calculation Sheet

Project: WPPSS EQ		Prepared By: [illegible signature]	Date: 1/3/83
Subject: BIF VALVE / ACTUATOR MODEL SUMMARY		Checked By: [illegible signature]	Date: 3/24/83
System: CSP		Job No. 82044	File No. 07.01/F
Analysis No. 361104 & 106	Rev. No. 0	Sheet No. 361106-4-3-B13	

△3 [illegible signature] 6/3/83 J.C. Fernandez 5/9/83

$I_z = 4 * I_{MAX}$ (1.95) ⟨3.94⟩

$I_z = 7.80 \text{ in}^4$ ⟨15.76 IN^4⟩

$I_y = 4 \; I_{min}$ (0.70) ⟨1.34⟩ $= 2.80 \text{ IN}^4$ ⟨5.36 IN^4⟩

$C_z = 3.75 \text{ IN}$ ⟨4.75⟩ , $C_y = 5.00 \text{ IN}$ ⟨5.25⟩

$E = 29 * 10^6 \text{ PSI}$, $G = E_S = 11.6 * 10^6 \text{ PSI}$

BECAUSE OF BENDING OF EARS IN MODE BELOW, ADJUST I_y & I_z TO ACCOUNT. (THIS WAS DONE IN ANALYSIS FOR $K_{\theta_x \theta_x}$):

NOTE: SEE PAGE 4.3-53 REV 3 △3

$Y_{max} = \frac{-w}{12EI} \ell^3$ FOR EARS:

$Y_{max} = \frac{-w}{6EI} (2\ell^3)$ for

$\therefore Y_{max-ear} = \frac{1}{4} Y_{max}$ (model beam)

Since $Y_{max} \propto \frac{1}{I}$, multiply $I_{model\ beam}$ by 4.

$I_z = 7.8$ ⟨15.76⟩ $* 4 = 31.2 \text{ IN}^4$ ⟨63⟩

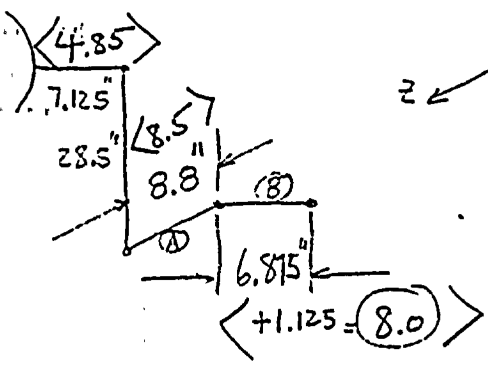
$I_y = 2.8$ ⟨5.36⟩ $* 4 = 11.2 \text{ IN}^4$ ⟨21.4⟩

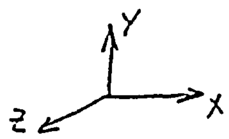
Calculation Sheet

CYGNA

Project: WPPSS EQ		Prepared By: [signature]	Date: 1/3/83
Subject: BTF VALVE / ACTUATOR MODEL SUMMARY		Checked By: [signature]	Date: 3/22/83
System: ??P		Job No.: 02044	File No.: 0T.01/F
Analysis No.: 361104 & 106	Rev. No.: 0	Sheet No.: 361106-4.3-B14	

BRACKET OFFSETS





(A) & (B) ARE MASSLESS, RIGID LINKS

SHAFT

$\langle 2.50 \rangle$ $\langle (30") \rangle$

DIA = 2.25" (from McPherson, 24" valve):

$C = 1.125"$ $\langle 1.25 \rangle$

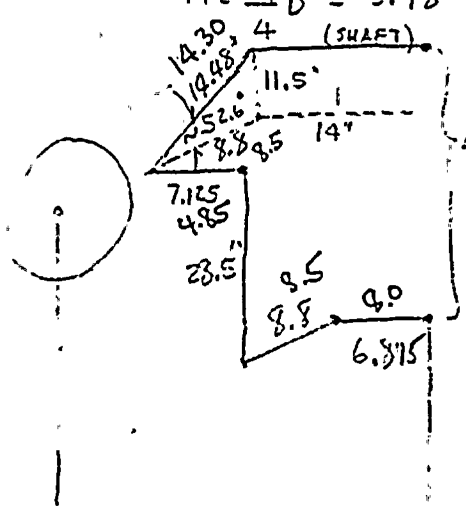
$I = 1.26\ IN^4 = I_{yy}$ $\langle 1.92 \rangle$

$I_{xx} = \sqrt{2}\ I_{yy} = 2.52\ IN^4$ $\langle 3.84 \rangle$

$A = \pi D^2 = 3.98\ IN^2$ $\langle 4.91 \rangle$

$\langle 4.85 \rangle \langle 8 \rangle = \langle 12.85" \rangle$

$L = 7.125 + 6.875 = 14"$



SHAFT TO BE SOFT FOR Y-DEFLECTION & STIFF FOR Z-DEFLECTION (L NOT IMPORTANT.) (NO STRESS) THERE FORE; SINCE SHAFT IS MODELED HERE OF GREATER THAN ACTUAL LENGTH, USE:

$I_{XX} = 1.78\ IN^4$ $\langle 2.72 \rangle$

$I_{YY} = 3 * I_{ZZ} \cong 4\ IN^4$ $\langle 5.75 \rangle$

$I_{ZZ} = 1.26\ IN^4$ $\langle .92 \rangle$

APPENDIX C

SAMPLE HAND CALCULATIONS
TO CHECK PROGRAM
CEP-V-3A

```
nbif CEP-V-3A
 INPUT GLOBAL ACCELERATIONS
? 13.89,1.66,1.04
 INPUT ANGLES OF NORTH VECTOR
? 90,90,0
 INPUT ANGLES OF VERTICAL VECTOR
? 90,0,90
 INPUT ANGLES OF EAST VECTOR
? 0,90,90
```

Calculation Sheet

Prepared By: E Rabzewski Date: 3/25/83
Checked By: A E Searle Date: 3/30/83
Job No. 82044 File No. 0T.01/F

361106-C-1

```
 INPUT DATA

GLOBAL G-LEVELS          =  13.89        1.66        1.04
NORTH VECTOR ANGLES      =  90           90          0
VERTICAL VECTOR ANGLES=     90           0           90
EAST VECTOR ANGLES       = 0    90       90

 INPUT ANGLES OF WEIGHT VECTOR
? 90,180,90

 LOCAL G-LEVELS

-5.29861E-5   -6.33239E-6    1.04
-5.29861E-5    1.66         -3.96728E-6
 13.89        -6.33239E-6   -3.96728E-6

OPERATING DRIVE ROD STRESS AT A   477.198
OPERATING DRIVE ROD STRESS AT B   821.458
OPERATING CYLINDER BRG PRESSURE -3.75613E-4
OPERATING VALVE EAR TENSILE STR  [1136.52]
OPERATING VALVE EAR SHEAR STRES   89.1706
OPERATING EAR BOLT SHEAR STRESS   1078.68
OPERATING EAR BOLT TENSILE  STR   525.595

glc(1,j)= j=-5.29861E-5 ✓    1
fcdr=        -1.22282E-2
siga= -.267492
sigb= -.409114
Fc due to T3=-5.71181E-2
f11= 2.73638E-2
f22=-5.85968E-2
dsa= .071552
dsr= 3.3257E+7
dbten= 4.86604E+9
glc(1,j)= j=-6.33239E-6      2
fcdr=        -1.4614E-3
siga= -3.19681E-2
sigb= -4.88934E-2
Fc due to T3= [321.752]
f11=[-154.143]
f22=[330.082]          (NEXT PAGE)
dsa= .072574
dsr= 3.7607E+7
dbten= 4.86759E+9
glc(1,j)= j= 1.04            3
fcdr=           240.013
siga=  5250.28
sigb=  8029.99
Fc due to T3= [919.516]
f11=-440.516
f22= 943.322
dsa= 2.75454E+7
```

SAMPLE CHECK CALC'S.

EAR TENSILE STRESS

$T_{3F} = (F_{ST} - W_{AO}) * 8.5 - 277 * 5.25$

$= (1150 - 399) * 8.5 - 277 * 5.25$

$T_{3F} = 4939$, $F_c = \frac{4939}{25} = 198\overset{+}{\mathord{}}$

$F_{11} = -.48 * T_{3F} = -95$

$F_{22} = +1.03 * T_{3F} = 203$

$S_{EEIS} = \left|-95 * \frac{7.125}{2} * \frac{.75}{.70}\right| + \left|203 * \frac{7.125}{2} * \frac{1.25}{1.95}\right|$

$= 826$ PSI

M_1 due to dwd bending $= (W_{AO} + W_{BR} - F_{ST2}) * e_5$

$\sigma_{M1} = M_1 / 2 d_2 * l_1 l_2 = \frac{3259}{2*10*1.5*2.5} = 44$ PSI

σ due to dwd shear $= \frac{(W_{AO} + W_{BR} - F_{ST2})}{4} * \frac{C_2}{I_1} * \frac{l_{aw}}{2}$

σ due to shear $= \frac{474}{4} * \frac{1.25}{1.95} * \frac{7.125}{2} = 271$ PSI

TOTAL DWD EAR TENSILE STRESS =

$826 + 44 + 271 = 1141$ VS ~1137 (OK)

CHECK Fc'

$F_{TR1} = \frac{(25 + 14.46)}{25} * 399 * 1.04 = 655$ #

$T_3 = (655 * 28.5 + 277 * 1.04 * 15)/25 = 919.25$ in-# (OK)

CYGNA

Calculation Sheet

Project: WPPSS-EQUIPMENT QUALIFICATION		Prepared By: E.R. [signature]	Date: 3/25/83
Subject: 24" B/F BUTTERFLY VALVES		Checked By: D.E. Searle	Date: 3/30/83
System: CEP & CSP		Job No. 82044	File No. 0T.01/F
Analysis No. 361106	Rev. No. 0	Sheet No. 361106-C-2	

CHECK EAR TENSILE STRESS CALCS:

$\frac{f_{11}}{f_c} = \frac{-154}{322} = -.48$ ✓ $\frac{+330}{322} = +1.03$ ✓ (OK)

SIGNS (OK)

$T_3 = 2D\,F_c = 2 * 12.5 * 322 = 8050$ "#

CHECK:

$T_3 = F_{TL1} * 28.5 + \bar{W}_{BR} * g_1 * 15 + \bar{W}_{AO} * g_2 * 8.5 + \bar{W}_{BR} * g_2 * 5.25$

$= \sim 0 \; (\text{i.e. } g_{1,2} \approx 0) \quad + 399 * 1.66 * 8.5 + 277 * 1.66 * 5.25$

$T_3 = 8044$ "# VS 8050 "# (OK)

CONCLUSIONS OF CHECK CASE CEP-V-3A:

1. FIXED STRESSES ON EARS CHECK
2. NEW VALUE FOR BENDING STRESS COMPONENTS CHECK
3. BEARING PRESSURE CHECKS (NOT SHOWN)
4. DRIVE ROD STRESS CHECKS (NOT SHOWN)
5. BOLT TENSION CHECKS (NOT SHOWN)

SECTION 5.0

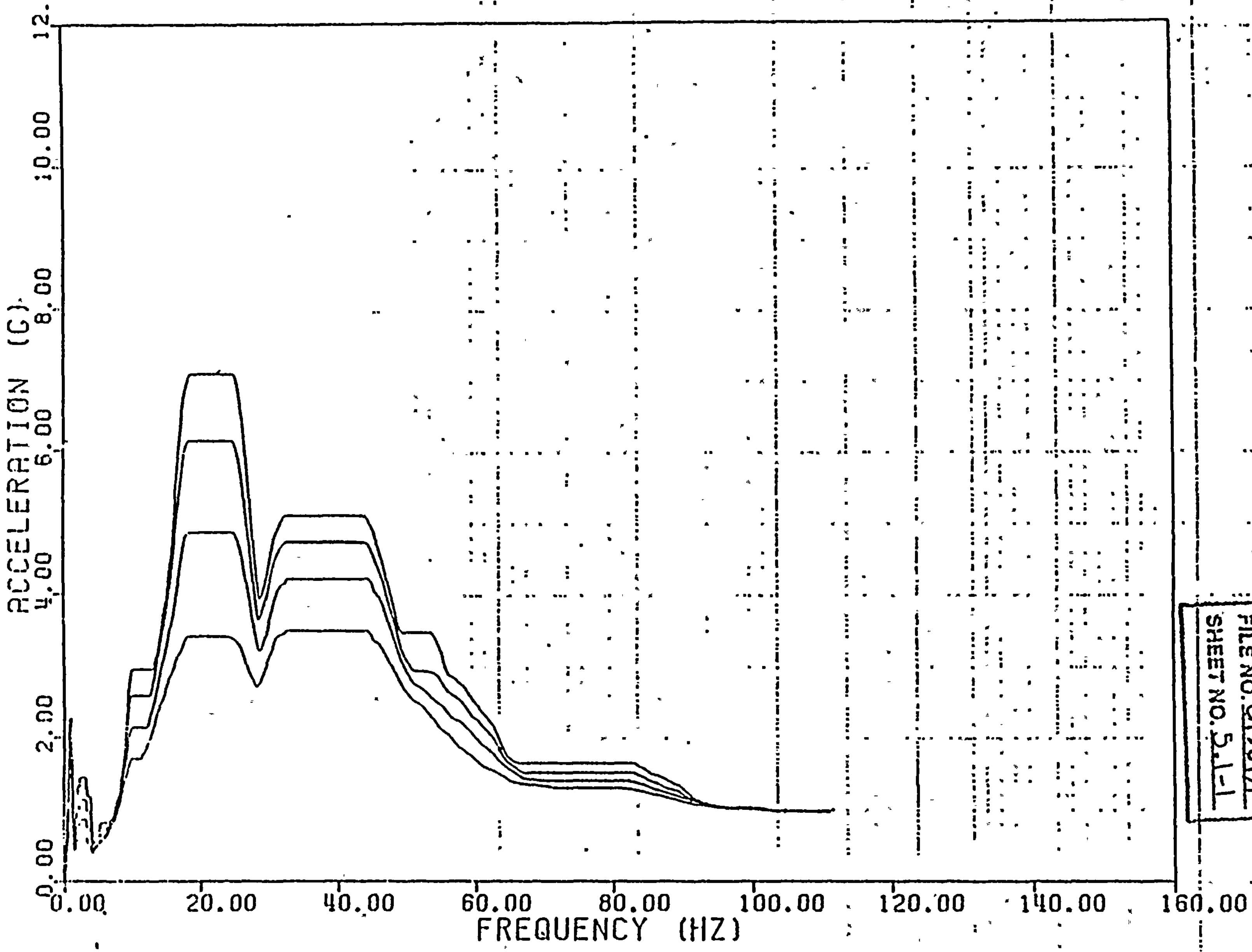
QID# 361106

APPENDICES

CONTENTS

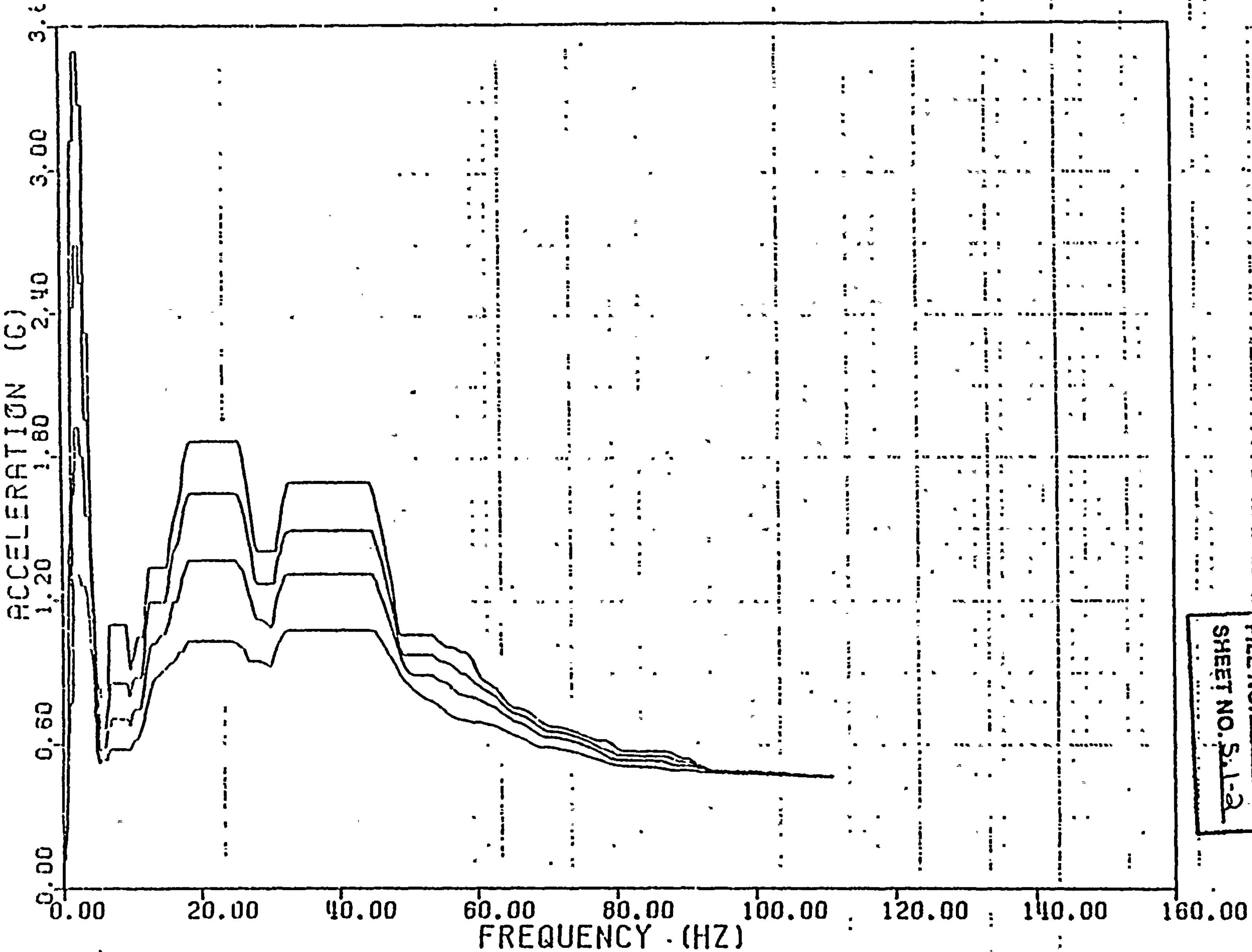
Revision 3

5.1 Response Spectra



WPPSS REACTOR BLDG. SRSS OF SRV SSE AP/CHUG.
MASS NO. 182 EL. 500 FT. HORIZ. TRANSLATION
CONTAINMENT VESSEL DAMPING= .005,.01,.02,.04

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. GT.01/F
SHEET NO. 5.1-1



WPPSS REACTOR BLDG. SRSS OF SRV SSE AP/CHUG.
MASS NO. 182 EL. 500 FT. VERT. TRANSLATION
CONTAINMENT VESSEL DAMPING= .005, .01, .02, .04

5.2 Walkdown Sheets

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

⚠

EPN: CSP-V-3

QID: [illegible]

BLDG R | FLOOR EL 501 | COORDS M.1/7.6

MFR BTF 0657 | COMPONENT EL 481 | DSCRP 24" BFLY Cont Isol Valve

MOD# ~~BWG-A26764~~ | SERIAL# N27235-1 | MAT'L SA-516-GR-70

150 PSI @ 275 °F | LBS N/F | SIZE 24"

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH 0'-4 1/2"
(FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

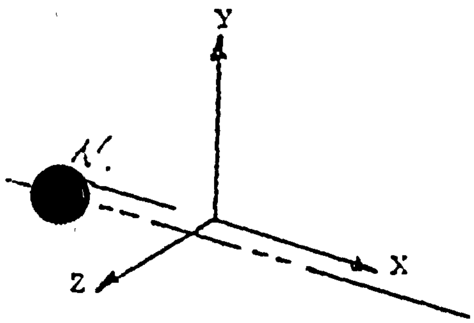
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( )

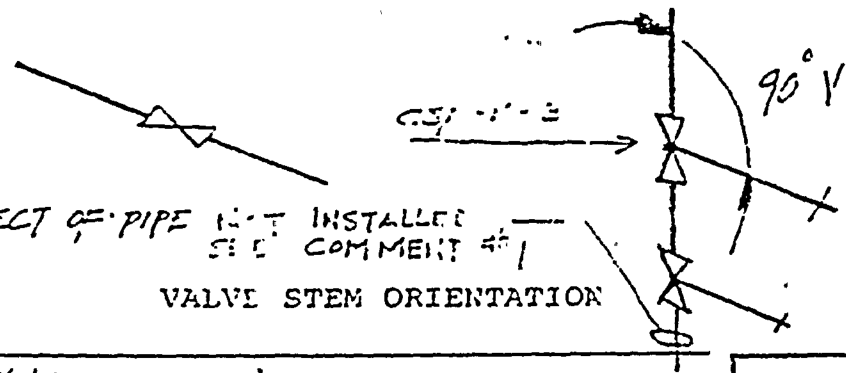
PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( ) N/F

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( ) N/F



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN COVERED W/ PLASTIC | MANUFACTURER
MODEL NO | SERIAL NO
TYPE | SIZE | ORDER NO

MOTOR EPN N/A NOT MOTOR OPERATED | MANUFACTURER
MODEL NO | SERIAL NO
S NO | INS CLASS | 1-PHASE ( ) 3-PHASE ( ) AC DC

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. QE.01/F
SHEET NO. 5.2-1

COMMENTS: Definition (N/F = Not Found)

CSP-LMS-3

1. LENGTH OF PIPE HAS NOT BEEN INSTALLED FROM VALVE TO CONTAINMENT.

PREPARED BY William Cunha (SIGNATURE) DATE 7/21/82 REVIEWED BY Doug True (SIGNATURE) DATE 7/21/82

William Cunha

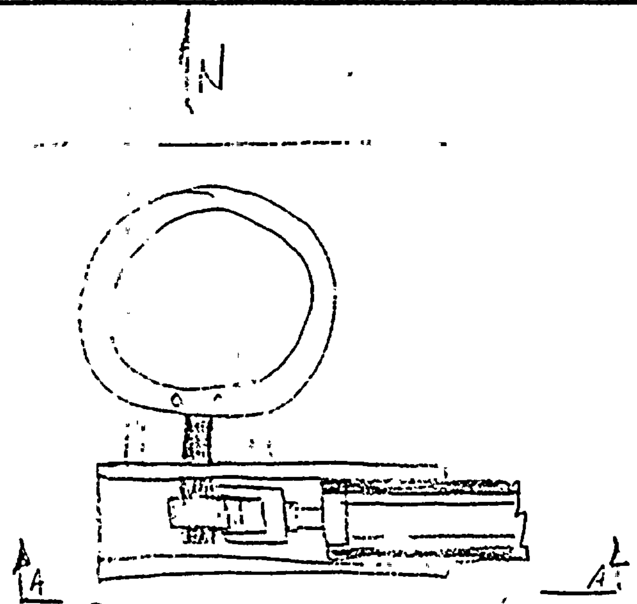
Doug True

⚠ H. Searle 1/5/83

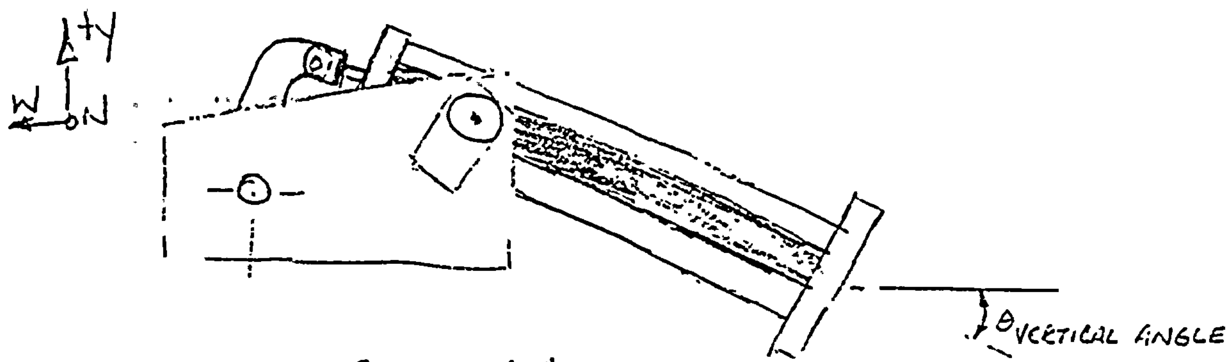
CYGNA

Calculation Sheet

Project WNP#2		Prepared By [signature]	Date 12-22-82
Subject EQUIP. QUALIFICATION		Checked By [signature]	Date 1/4/83
System CEP/CSP		Job No. 82044	File No.
Analysis No OID#361106	Rev. No.	Sheet No.	



PLAN CSP-V-3,4 (TYP VIEW)



SECTION A-A

CSP-V-3 — θ ~ 7°
CSP-V-4 — θ ~ 6°

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY)

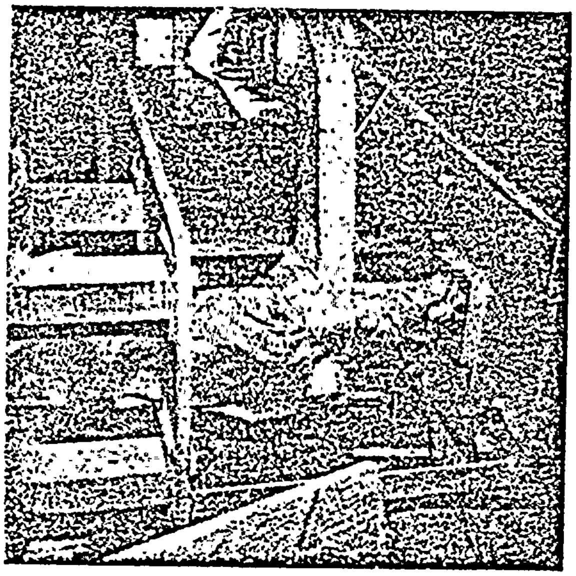
CYGNA

Calculation Sheet

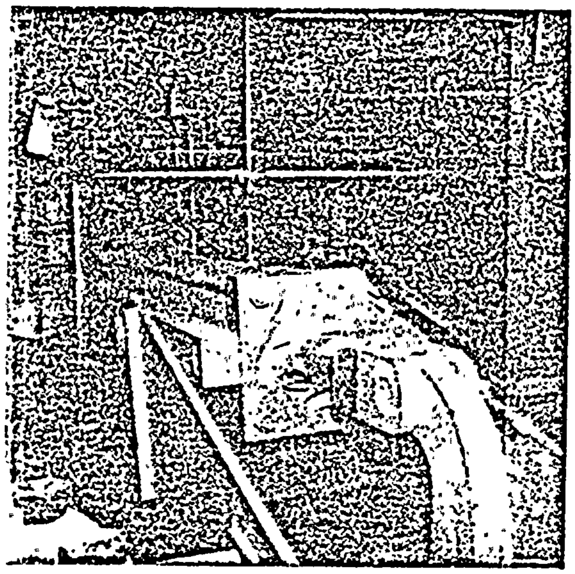
Project: WPPSS Mechanical Equipment Qualification	Prepared By:	Date: 1/10/83	
Subject: 24" Butterfly Valves	Checked By: [signature]	Date: 3/22/83	
System: CSP and CEP	Job No: 82044	File No.: OT.01/F	
Analysis No.: 361106	Rev. No.:	Sheet No.:	

SUPPLEMENTAL INFORMATION: (AIR OPERATOR [illegible])

CSP-AO-3



CSP-AO-3 (CLOSE-UP)
SUPPORT BRACKET [illegible]



CSP-AO-3 (MILLER OPERATOR)
VIEW LOOKING SOUTH-EAST

CYGNA ATTACHMENT	
JOB NO.	82044
FILE NO.	OT.01/F
SHEET NO.	5.2-3

EQUIPMENT QUALIFICATION
WALKDOWN VERIFICATION FORM

EPN# CSP-V-4

QID# 361106

BLDG R | FLOOR EL 47' | COORDS 7.6/M.1

MFR BIF | COMPONENT EL 478 | DSCRP 24" BFLY CNT. ISOL VALVE

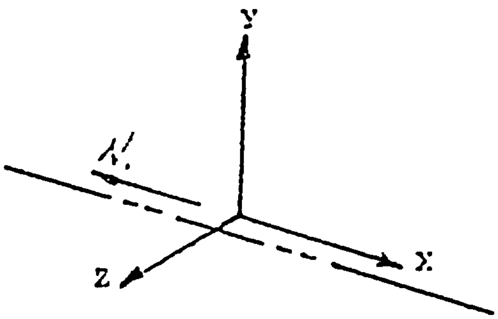
MOD# C657 | SERIAL# 772-39-1 | MAT'L SA-516-GR-70

150 PSI @ 125 °F | LBS N/F | SIZE 24"

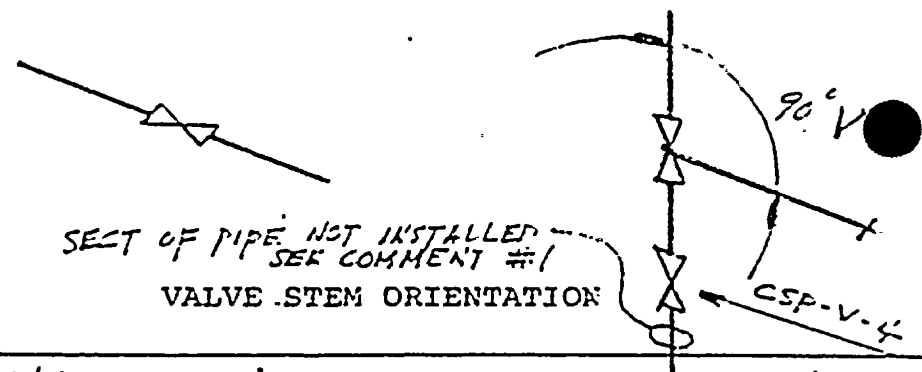
ASME CLASS N/F

YOKE ORIENTATION	MOUNTING CONDITION
⊥ TO AXIS OF PIPE (✓)	NO OF BOLTS N/A
// TO AXIS OF PIPE (✓)	BOLT TYPE N/A BOLT Ø N/A
YOKE LENGTH 6'-4 1/2" (FLANGE TO FLANGE)	WELD TYPE & SIZE N/A
	PIPE MOUNTED YES (✓) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( ) N/F
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( ) N/F



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN COVERED W/ PLASTIC | MANUFACTURER
MODEL NO | SERIAL NO
TYPE | SIZE | ORDER NO

MOTOR EPN N/A NOT MOTOR OPERATED | MANUFACTURER
MODEL NO | SERIAL NO
ID NO | INS CLASS | 1-PHASE ( ) 3-PHASE ( )

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. QT.01/F
SHEET NO. 5.2-4

COMMENTS: Definition (N/F = Not Found)
1. LENGTH OF PIPE HAS NOT BEEN INSTALLED FROM VALUE TO CONTAINMENT.

PREPARED BY [signature] (SIGNATURE) DATE 7/21/82 REVIEWED BY [signature] (SIGNATURE) DATE 7/21/82

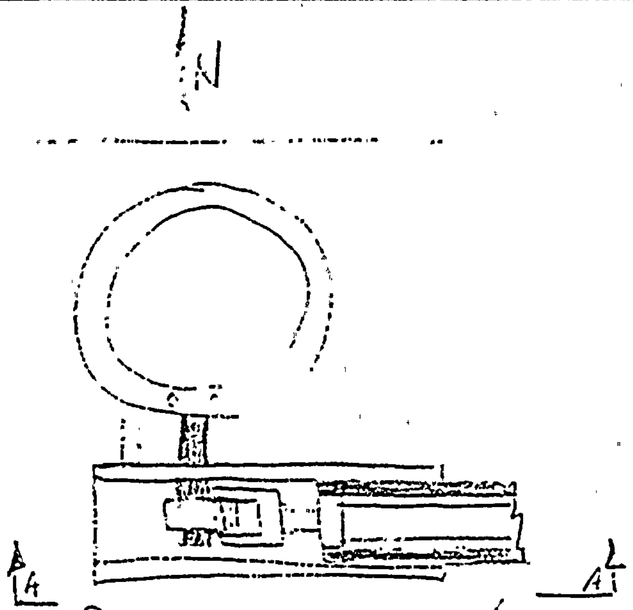
[signature] 1/5/83

Doug True

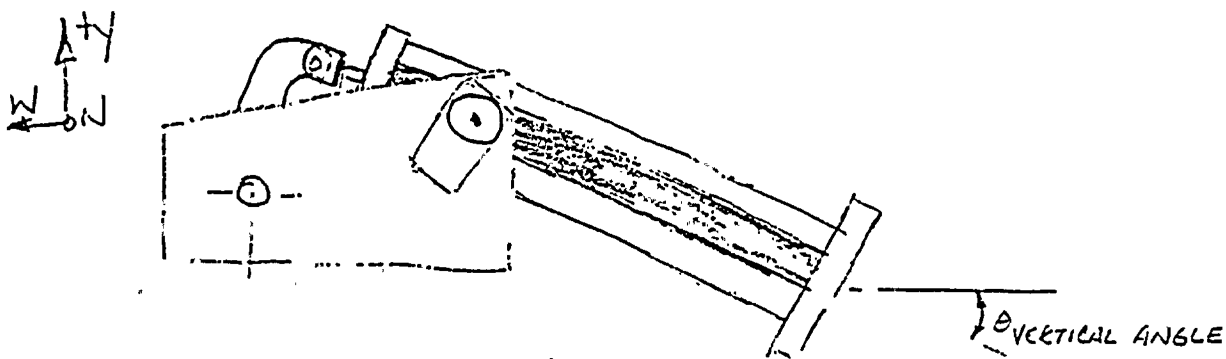
Calculation Sheet

Project WNP#2		Prepared By [signature]	Date 12/22/82
Subject Equip. Qualification		Checked By: [signature]	Date 1/4/83
System CEP/CSP		Job No. 82044	File No.
Analysis No. QID#361106	Rev. No.	Sheet No.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. QT.01/F
SHEET NO. 5.2-5



PLAN CSP-V-3,4 (TYP VIEW)



SECTION A-A

CSP-V-3 — θ ~ 7°
CSP-V-4 — θ ~ 6°

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY)

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CSF-Y-5

QID# 361106

BLDG R

FLOOR EL 471

COORDS M.7 / 8.3

MFR BIF

COMPONENT EL 475

DSCRP 24" BFLY

MOD# DWG A20765

SERIAL# 27236-1

MAT'L ______

______ PSI @ ______ °F

LBS ______ SIZE ______

ASME CLASS ______

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( )

YOKE LENGTH ______
(FLANGE TO FLANGE)

MOUNTING CONDITION

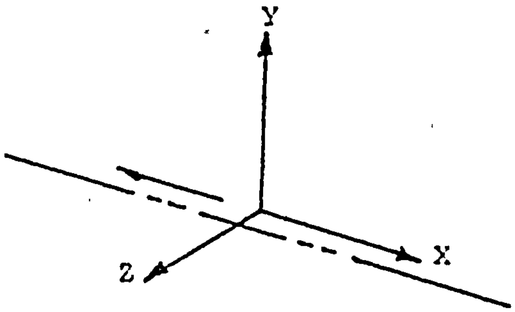
NO OF BOLTS ______

BOLT TYPE ______ BOLT Ø ______

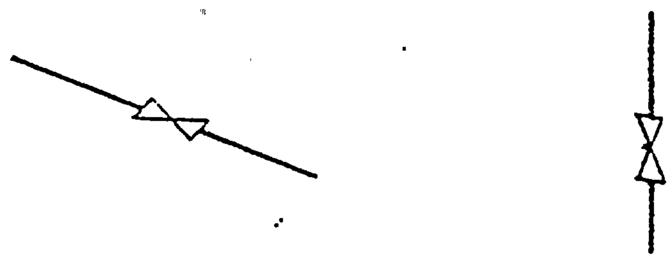
WELD TYPE & SIZE ______

PIPE MOUNTED YES( ) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO ( )
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( )



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN ______ MANUFACTURER ______
MODEL NO ______ SERIAL NO ______
TYPE ______ SIZE ______ ORDER NO ______

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. QT.01/F
SHEET NO. 5.2-6

MOTOR EPN ______ MANUFACTURER ______
MODEL NO ______ SERIAL NO ______
ID NO ______ INS CLASS ______ 1-PHASE ( ) 3-PHASE ( ) AC ______ DC ______

△ VISUAL INSPECTION MADE 12/22/82 & IT WAS NOTED VALVE INSTALLED SEE SHEET 2 OF 2

COMMENTS: Definition (N/F = Not Found)

Valve not installed as of 7/21/82

PREPARED BY William [signature] (SIGNATURE) DATE 7/21/82 REVIEWED BY Doug True (SIGNATURE) DATE 7/21/82

William [signature]

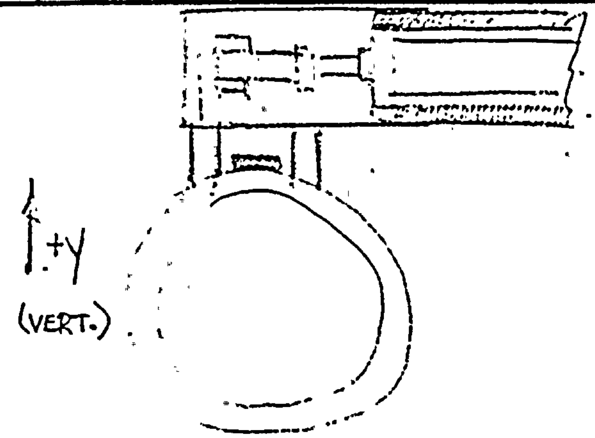
△ H. Searle 1/5/83

Doug True

CYGNA

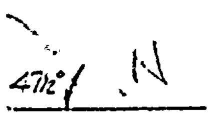
Calculation Sheet

Project WNP #2		Prepared By: [signature]	Date 12/22/82
Subject EQUIP QUALIFICATION		Checked By: [signature]	Date 1/4/83
System		Job No. 82044	File No.
Analysis No OID #26-1106	Rev No.	Sheet No. 2 OF 2	

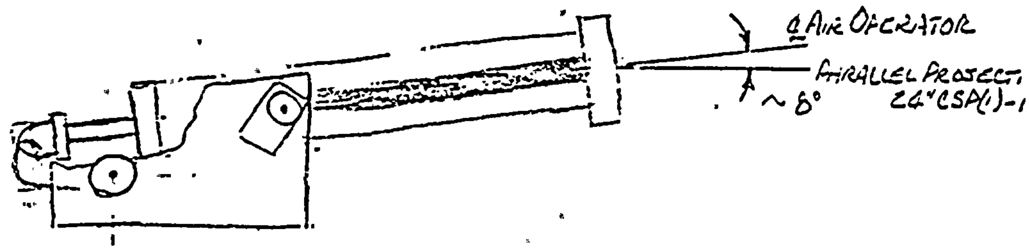


CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT-01/F
SHEET NO. 5.2-7

CSP-V-5



24"CSP(1)-1 ℄



PLAN VIEW

FIELD SKETCH (FOR THE PURPOSE OF SHOWING OPERATOR ORIENTATION ONLY)

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN: CSP-V-6

QID: 361106

BLDG: R — FLOOR EL: 471 — COORDS: N.5/7.7

MFR: BIF — COMPONENT EL: 480 — DSCRP: 24" BFLY

MOD#: A-206765 — SERIAL#: ____ — MAT'L: ____

____ PSI @ ____ °F — LBS ____ SIZE ____

ASME CLASS ____

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( )

YOKE LENGTH ____ (FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS ____

BOLT TYPE ____ BOLT Ø ____

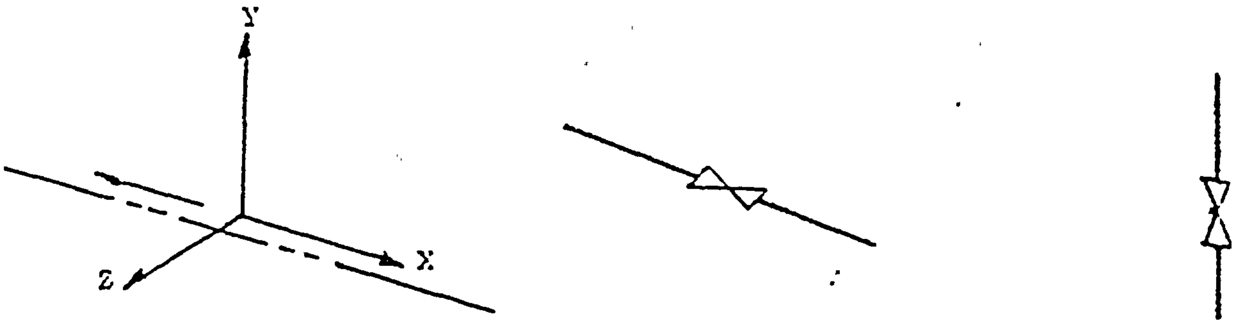
WELD TYPE & SIZE ____

PIPE MOUNTED YES ( ) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO ( )

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( )

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( )



GLOBAL CO-ORDINATE SYSTEM — VALVE STEM ORIENTATION

OPERATOR EPN ____	MANUFACTURER ____
MODEL NO ____	SERIAL NO ____
TYPE ____ SIZE ____	ORDER NO ____

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. 5.2-8

MOTOR EPN ____	MANUFACTURER ____
MODEL NO ____	SERIAL NO ____
ID NO ____ INS CLASS ____	1-PHASE ( ) 3-PHASE ( ) AC ____ DC ____

COMMENTS: Definition (N/F = Not Found)

X CSP-LMS-6 — 1. Not installed as of 7/21/82

△ VISUAL INSPECTION MADE 12/22/82 & IT WAS NOTED VALVE INSTALLED

SEE SHEET 2 OF 2

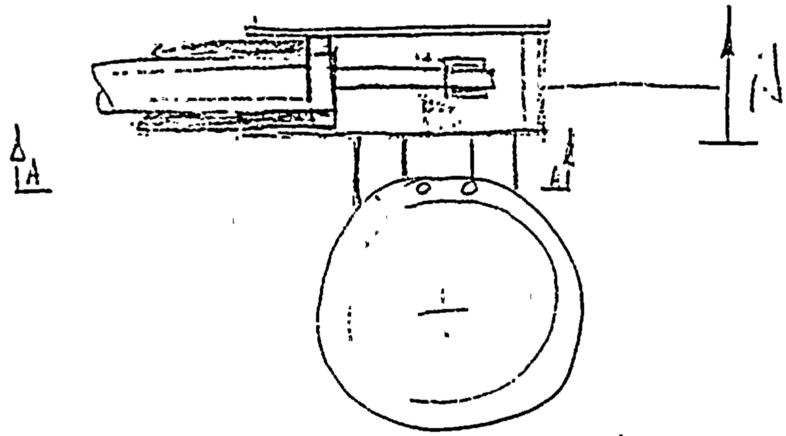
PREPARED BY [signature] (SIGNATURE) DATE 7/21/82 REVIEWED BY [signature] (SIGNATURE) DATE 7/21/82

WILLIAM CURLEE △ [signature] 1/5/83 — Doug True

CYGNA

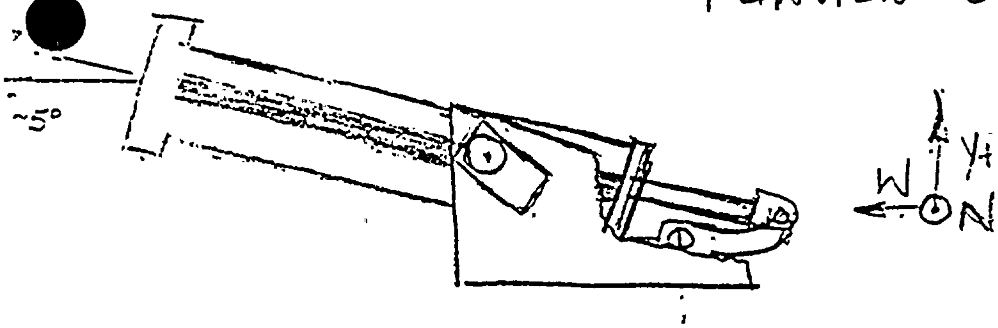
Calculation Sheet

Project: WNP#2		Prepared By: [illegible]	Date: 12.22.82
Subject: EQUIP QUALIFICATION		Checked By: E P O'Donnell	Date: 1/4/83
System: CEP/CES		Job No. 82044	File No.
Analysis No: QID#361106	Rev. No.	Sheet No. 2 OF 2	



CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. 5.2-9

PLANVIEW CEP-V-6



SECTION A-A

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY)

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# ~~CSF-V-9~~

QID# 361106

BLDG R FLOOR EL 471 COORDS M9/5.1

MFR BIF COMPONENT EL 490 DSCRP 24" BFLY

MOD# A20765 SERIAL# ____ MAT'L ____

____ PSI @ ____ °F LBS ____ SIZE ____

ASME CLASS ____

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( )

YOKE LENGTH ____
(FLANGE TO FLANGE)

MOUNTING CONDITION

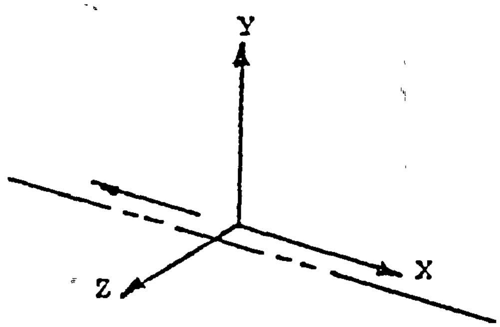
NO OF BOLTS ____

BOLT TYPE ____ BOLT Ø ____

WELD TYPE & SIZE ____

PIPE MOUNTED YES ( ) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO ( )
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( )



GLOBAL CO-ORDINATE SYSTEM

VALVE STEM ORIENTATION

OPERATOR EPN ____ MANUFACTURER ____
MODEL NO ____ SERIAL NO ____
TYPE ____ SIZE ____ ORDER NO ____

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. 5.2-10

MOTOR EPN ____ MANUFACTURER ____
MODEL NO ____ SERIAL NO ____
ID NO ____ INS CLASS ____ 1-PHASE ( ) 3-PHASE ( ) AC ____ DC ____

COMMENTS: Definition (N/F = Not Found)

Note: not installed as of 7/21/82

PREPARED BY [signature] DATE 7/21/82 REVIEWED BY [signature] DATE 7/21/82
(SIGNATURE) (SIGNATURE)

William Cunthe

Doug True

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN: [illegible]

QID: [illegible]

BLDG: K
FLOOR EL: 471
COORDS: H.5/5.4

MFR: BTF
COMPONENT EL: 495
DSCRP: 24. BTFY Supp Chamber Exhaust

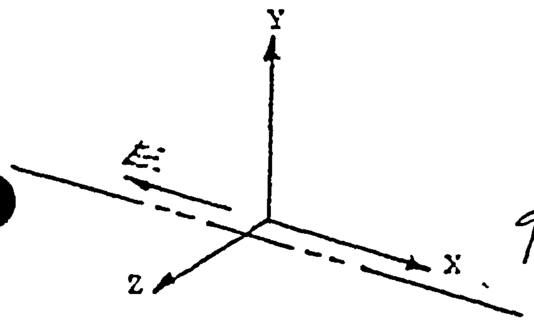
MOD#: ~~DWG A-[illegible]~~ 0657
SERIAL#: N272353
MAT'L: [illegible]

150 PSI @ 275 °F
LBS: N/F
SIZE: 24"

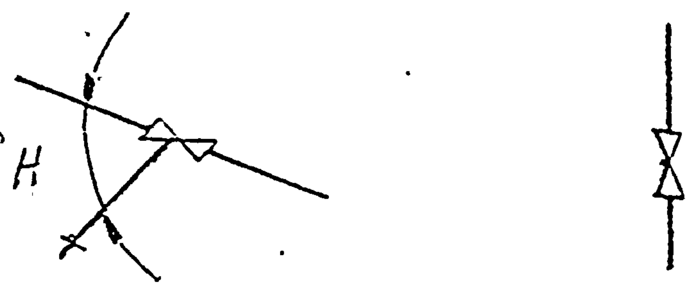
ASME CLASS: N/F

YOKE ORIENTATION	MOUNTING CONDITION
⊥ TO AXIS OF PIPE (✓)	NO OF BOLTS: N/A
// TO AXIS OF PIPE (✓)	BOLT TYPE: N/A BOLT Ø: N/A
YOKE LENGTH: 0'-4½" (FLANGE TO FLANGE)	WELD TYPE & SIZE: N/A
	PIPE MOUNTED YES (✓) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (✓) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN: N/A
MANUFACTURER:
MODEL NO:
SERIAL NO:
TYPE:
SIZE:
ORDER NO:

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. 5.2-11

MOTOR EPN: N/A
MANUFACTURER:
MODEL NO:
SERIAL NO:
ID NO:
INS CLASS:
1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

COMMENTS: Definition (N/F = Not Found)

* CERLMS-3A

△ SEE SHEET 2 OF 2 FOR OPERATOR ORIENTATION

PREPARED BY: William [illegible] (SIGNATURE) DATE: 7/21/82 REVIEWED BY: [signature] (SIGNATURE) DATE: 7/21/82

William [illegible] Doug True

△ [illegible] 1/5/83

CYGNA

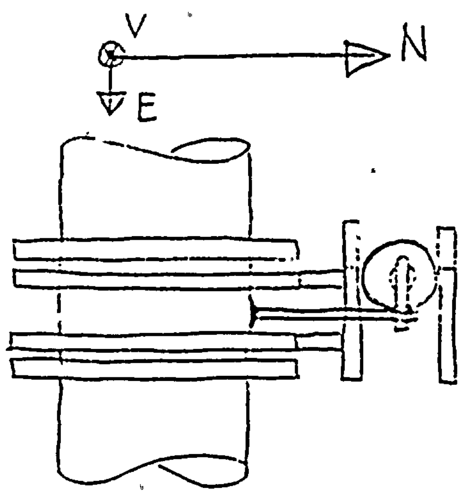
Calculation Sheet

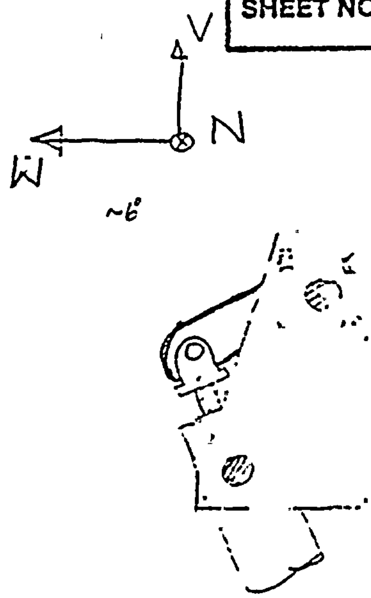
Project: WPPS MECH. E.Q.		Prepared By: J E Rakowski	Date: 12/18/82
Subject: BIF VALVE & AO		Checked By: [illegible]	Date: 12/20/82
System: CSP / CEP		Job No: 82044	File No.
Analysis No	Rev No	Sheet No: 2/2	

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. 5.2-12

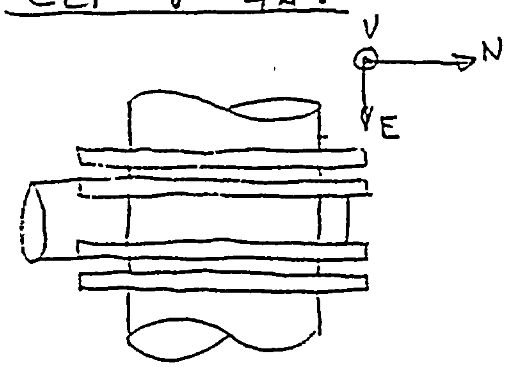
WALKDOWN
VALVE & OPERATOR ORIENTATIONS
CEP-V-3A & 4A

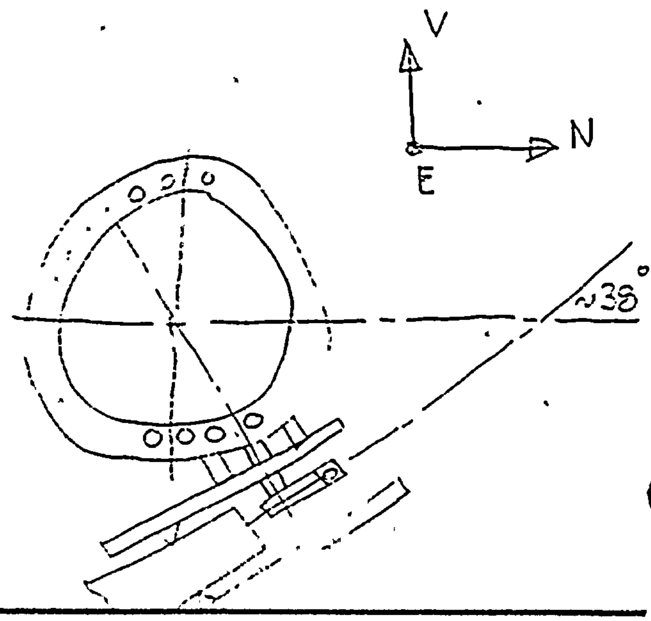
CEP-V-3A:





CEP-V-4A:





1006 03

EQUIPMENT QUALIFICATION
WALKDOWN VERIFICATION FORM

△

EPN CEP-V-4A

CID 361106

BLDG R

FLOOR EL 471

COORDS H.5/5.4

MFR BIF

COMPONENT EL 495

DSCRP 24" BFLY

MOD# ~~DWG A 306314~~ 0657

SERIAL# N27235-4

MAT'L SA-516 GR-70

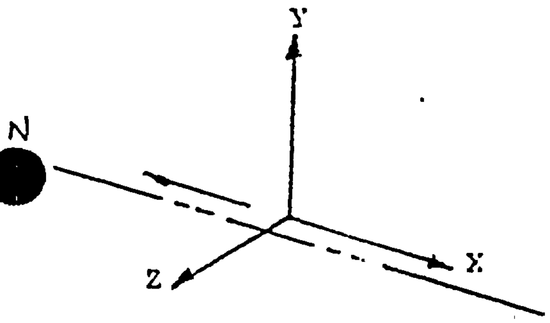
150 PSI @ 275 °F

LBS N/F   SIZE 24"

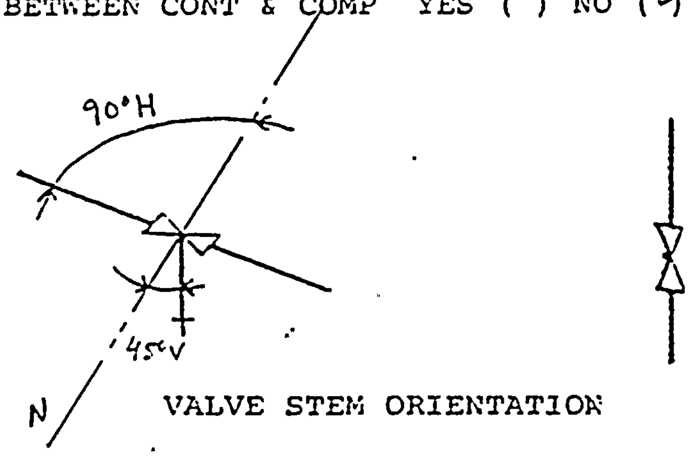
ASME CLASS N/F

YOKE ORIENTATION	MOUNTING CONDITION
⊥ TO AXIS OF PIPE (✓)	NO OF BOLTS N/A
// TO AXIS OF PIPE (✓)	BOLT TYPE N/A BOLT Ø N/A
YOKE LENGTH 0'-4½"	WELD TYPE & SIZE N/A
(FLANGE TO FLANGE)	PIPE MOUNTED YES (✓) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (✓) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN N/A		MANUFACTURER	
MODEL NO		SERIAL NO	
TYPE	SIZE	ORDER NO	
MOTOR EPN N/A		MANUFACTURER	
MODEL NO		SERIAL NO	
ID NO	INS CLASS	1-PHASE ( ) 3-PHASE ( )	AC ___ DC ___

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. S.2-13

COMMENTS: Definition (N/F = Not Found)

* CEP-LMS-4A not found

△ SEE SHEET 2 OF 2 FOR OPERATOR ORIENTATION

PREPARED BY [signature] (SIGNATURE) DATE 7/-/82 REVIEWED BY [signature] (SIGNATURE) DATE 7/21/82

[signature] △ [signature] 1/5/83 Doug True

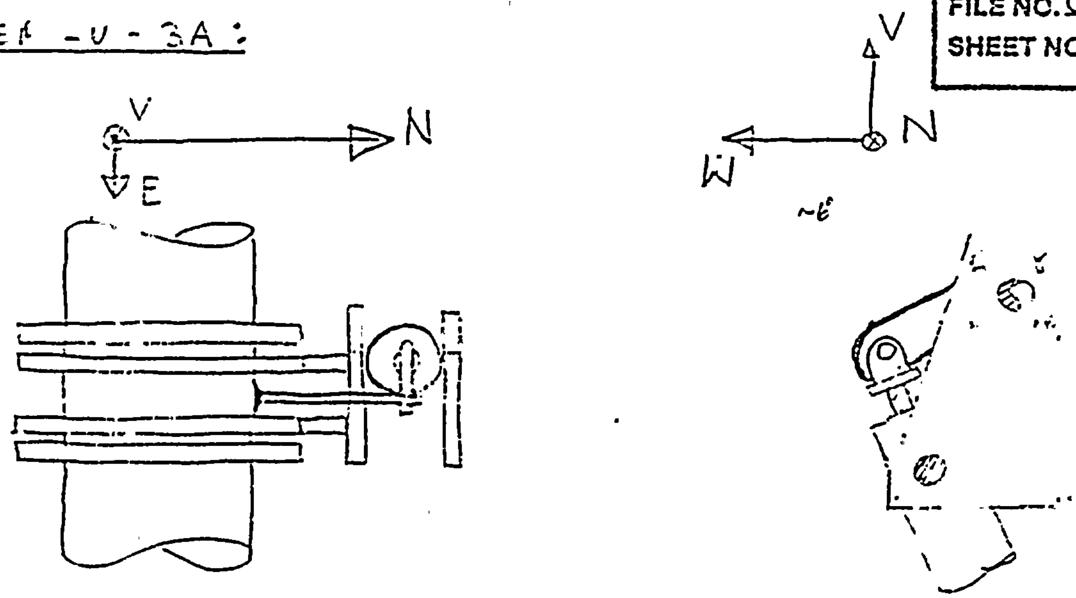
Calculation Sheet

Project: WPPS MECH. E.Q.		Prepared By: J E Rukowski	Date: 12/18/82
Subject: B/F VALVE & AO		Checked By: R. E. Serrels	Date: 12/20/82
System: CSP / CEP		Job No: 82044	File No:
Analysis No:	Rev No:	Sheet No.: 2/2	

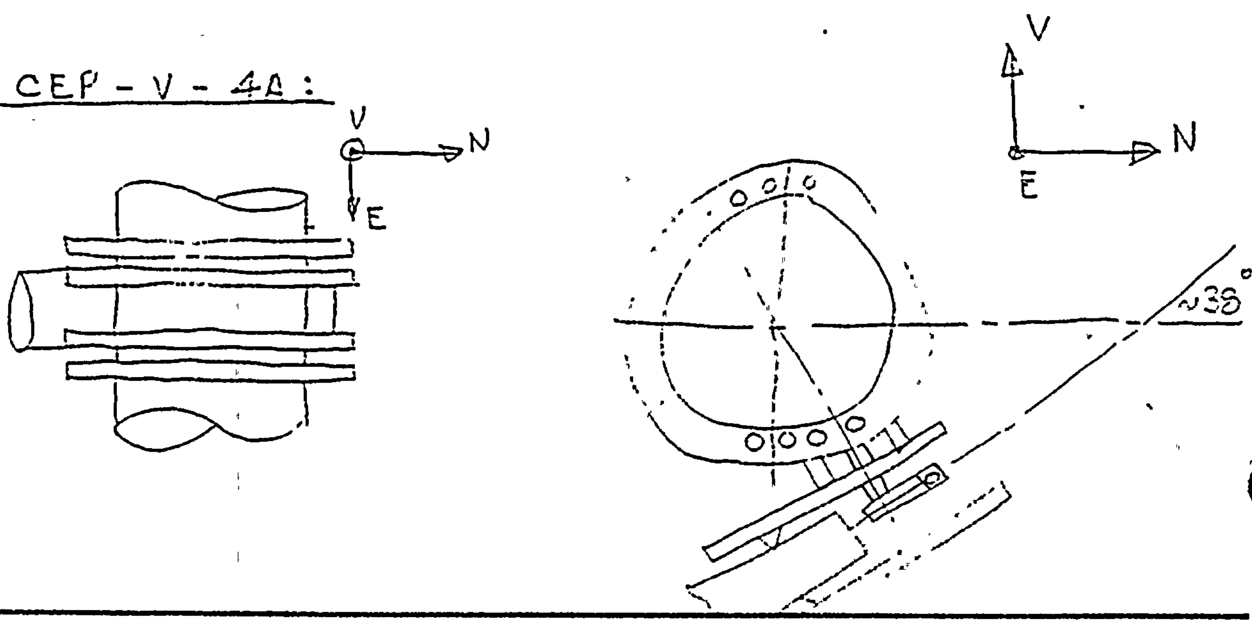
CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. CT.01/F
SHEET NO. 5.2-14

WALKDOWN
VALVE & OPERATOR ORIENTATIONS
CEP-V-3A & 4A

CEP-V-3A:



CEP-V-4A:



5.3 Valve Local Coordinate Systems

CSP-V-3

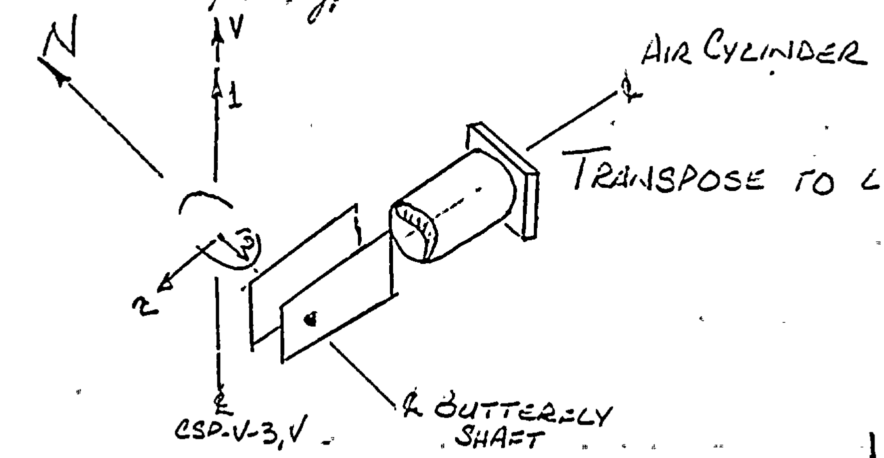
CSP-V-4

CSP-V-5

CSP-V-6

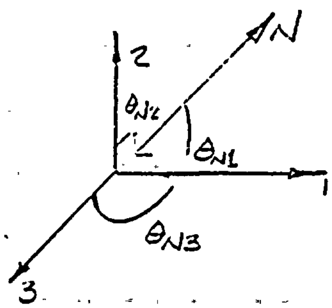
PREPARED BY: [signature]
REVIEWED BY: [signature] 2/11/83

CSP-V-3, 4 (typical)

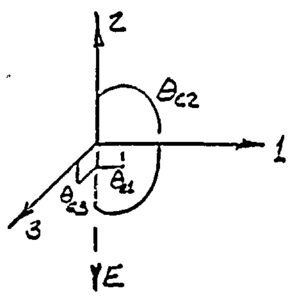


TRANSPOSE TO LOCAL COORDINATE SYSTEM

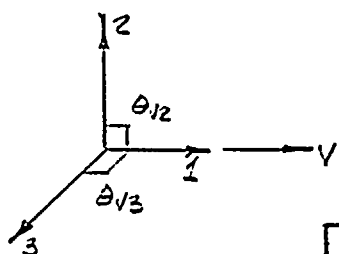
$\theta_{N1} = 90°$ ✓ $\cos\theta_{N1} = 0$ ✓
$\theta_{N2} = 90°$ ✓ $\cos\theta_{N2} = 0$ ✓
$\theta_{N3} = 180°$ ✓ $\cos\theta_{N3} = -1$



$\theta_{E1} = 90°$ $\cos\theta_{E1} = 0$
$\theta_{E2} = 180°$ $\cos\theta_{E2} = -1$
$\theta_{E3} = 90°$ $\cos\theta_{E3} = 0$

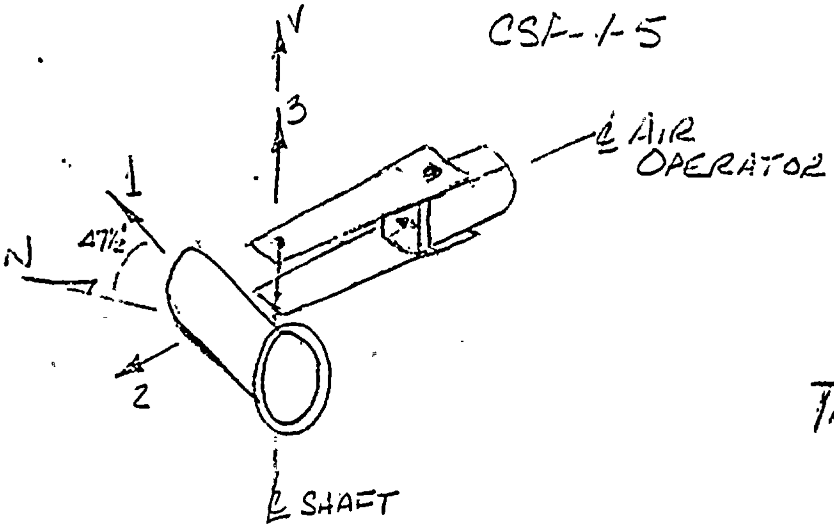


$\theta_{V1} = 0°$ $\cos\theta_{V1} = 1$
$\theta_{V2} = 90°$ $\cos\theta_{V2} = 0$
$\theta_{V3} = 90°$ $\cos\theta_{V3} = 0$

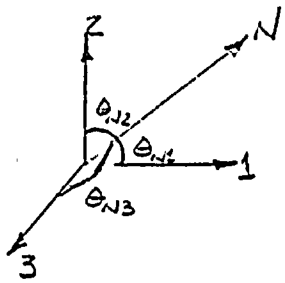


CSF-1-5

PREPARED BY: [illegible]
REVIEWED BY: [illegible] 2/11/83



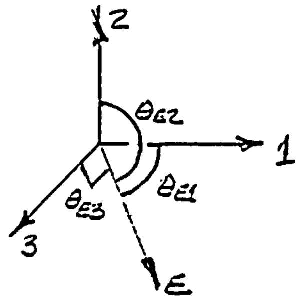
TRANSPOSE TO LOCAL COORDINATE SYSTEM



$\theta_{N1} = 42½°$ $\cos\theta_{N1} = 0.737$

$\theta_{N2} = 47½°$ $\cos\theta_{N2} = 0.676$

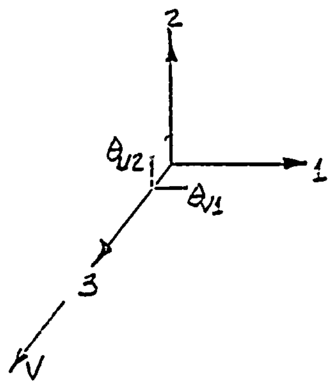
$\theta_{N3} = 90°$ $\cos\theta_{N3} = 0$



$\theta_{E1} = 47½°$ $\cos\theta_{E1} = 0.676$

$\theta_{E2} = 137½°$ $\cos\theta_{E2} = -0.737$

$\theta_{E3} = 90°$ $\cos\theta_{E3} = 0$



$\theta_{V1} = 90°$ $\cos\theta_{V1} = 0$

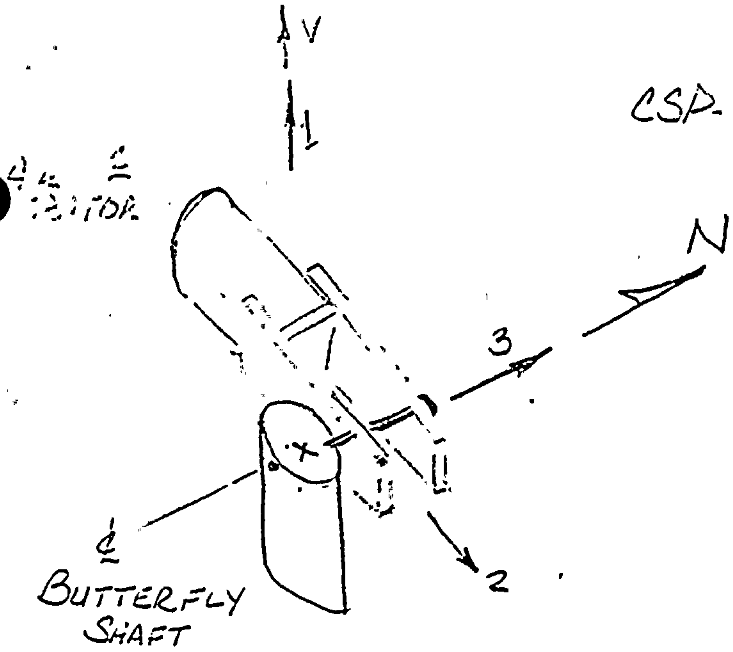
$\theta_{V2} = 90°$ $\cos\theta_{V2} = 0$

$\theta_{V3} = 0°$ $\cos\theta_{V3} = 1$

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. 5.3-2

CSP-V-6

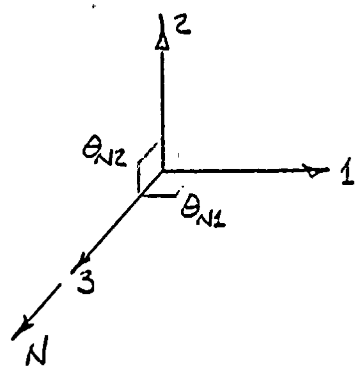
PREPARED BY: [illegible] 2/11/83
REVIEWED BY: [illegible] 2/11/83



$\theta_{N1} = 90^\circ$ $\cos\theta_{N1} = 0$

$\theta_{N2} = 90^\circ$ $\cos\theta_{N2} = 0$

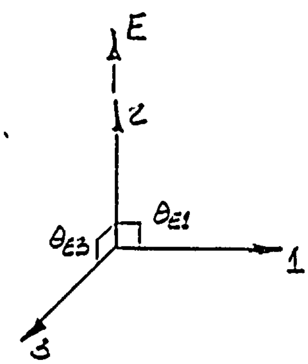
$\theta_{N3} = 0^\circ$ $\cos\theta_{N3} = 1$



$\theta_{E1} = 90^\circ$ $\cos\theta_{E1} = 0.$

$\theta_{E2} = 0^\circ$ $\cos\theta_{E2} = 1$

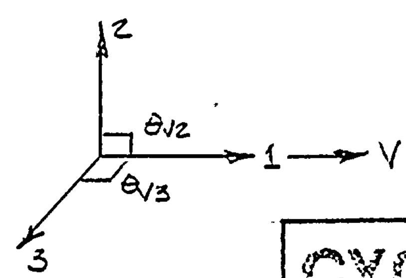
$\theta_{E3} = 90^\circ$ $\cos\theta_{E3} = 0$



$\theta_{V1} = 0^\circ$ $\cos\theta_{V1} = 1$

$\theta_{V2} = 90^\circ$ $\cos\theta_{V2} = 0$

$\theta_{V3} = 90^\circ$ $\cos\theta_{V3} = 0$

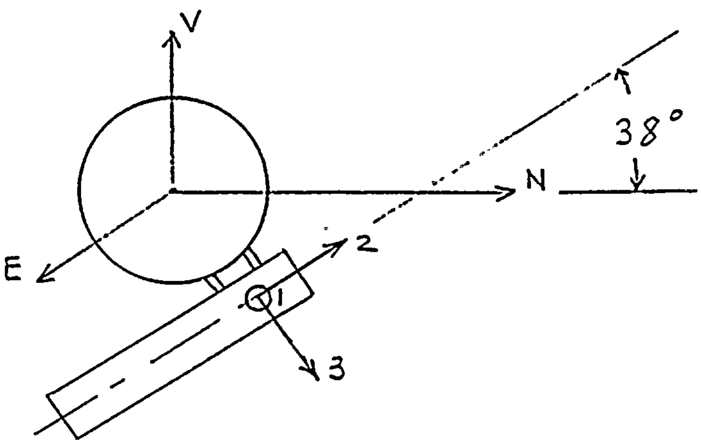


CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. 5.3-3

Calculation Sheet

Project: WPPSS EQ		Prepared By: [illegible]	Date: 2/15/83
Subject: BIF VALUES / MILLER A/O		Checked By: [illegible]	Date: [illegible]
System: CEP		Job No. 82044	File No. OT.01/F
Analysis No. 361106	Rev. No. 0	Sheet No.	

CEP-V-4A



ANGLES

	(1-AXIS)	(2-AXIS)	(3-AXIS)
NORTH	90	-38	52
VERTICAL	90	52	142
EAST	180	90	90
WEIGHT	90	-128	-38

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01/F
SHEET NO. 5.3-4

5.5 Final Pipe-Mounted Equipment Response G-Levels

MAY 11 1983

RECEIVED

MAY 31 1983

CYGNA-RICHLAND

Subject: W. O. 3900/4000
Washington Public Power Supply System
WNP-2
Qualification of Mechanical Pipe
Mounted Equipment; Forwarding of
Information

April 29, 1983
BRWP-83-078

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. S.S.1

Mr. L. T. Harrold
Assistant Director
Washington Public Power Supply System
3000 George Washington Way
Richland, Washington 99352

Attention: Mr. B. A. Holmberg

References: (a) WPBR-83-17, dated 3/16/83.
(b) WPBR-83-28, dated 4/12/83.
(c) WPBR-83-29, dated 4/12/83.
(d) Telecopy, B. A. Holmberg to J. J. Verderber, dated 4/4/83.

Gentlemen:

In response to the request of references (a), (b), (c) and (d), this letter is forwarding refined valve accelerations. The valve acceleration sheets for the five (5) CSP valves represent the second iteration of the refinement task. Valve sheets for the other four (4) valves represent the first iteration of the refinement task. Please inform the Woodbury Office if efforts should be made to reduce accelerations further.

Very truly yours,

ORIGINAL SIGNED BY J. J. VERDERBER

John J. Verderber
Project Engineering Manager

JJV/BPM/es
Att.

CC: Mr. W. S. Chin - BPA - 1 w/1
Mr. J. E. Rhodes - WPPSS - 1 w/1
Mr. F. Buck - WPPSS - 1 w/1 Mail Drop 575

ATTACHMENT

Data forwarded with BRWP-83-078, dated April 29, 1983

Valve #	Anchor Group	Calc. No.
CSP-V-1	125	8.14.129
CSP-V-2	125	8.14.129
CSP-V-3	125	8.14.129
CSP-V-4	125	8.14.129
CSP-V-5	125	8.14.129
RCIC-V-31	107	8.14.112A
RHR-V-17B	31	8.14.121
RHR-V-53A	29	8.14.62C
RHR-V-53B	31	8.14.121B

BURNS AND ROE, INC.

W.O. No. 3900-10 Date 4/12/83 Book No. 8.14.129 Page No. ____
Drawing No. M200 Sh. 172 Rev 3A Calc. No. [illegible] Sheet ____ of ____
By P.S. Checked [illegible] Approved [illegible]
Title WNP-2 Status As-Built Verification of Piping Calculations

CYGNA
ATTACHMENT
JOB NO. [illegible]
FILE NO. [illegible]
SHEET NO. [illegible]

CSP-V-5 Valve Qualification

B&R File No. Dwg 68-00-0010 Operation I.D. No. ____

B&R M200 Iso No. 172 Anchor Group 125

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelerations (g)			Comments
				X	Y	Z	
Valve Operator (Bracket)	128	277	Upset	0.95	1.31	1.71	
			Emergency	2.80	1.82	5.32	
			Faulted	2.96	2.84	5.42	
Valve Operator (Cylinder)	132	399	Upset	0.97	1.54	1.60	
			Emergency	1.29	2.77	2.34	
			Faulted	1.62	3.52	2.55	

BURNS AND ROE, INC.

W.O. No. 3900-10 Date 3/31/83 Book No. 8.14.125 Page No. ___ Sheet ___ of ___
Drawing No. M200 Sh. 168 Rev 2A Calc. No. 2.14.125
By RS Checked CT Approved
Title WNP-2 Status As-Built Verification of Piping Calculation

CSP-V-6 Valve Qualification

B&R File No. ______ Operation I.D. No. ______

B&R M200 Iso No. 168 Anchor Group V23

CYGNA ATTACHMENT
JOB NO. 8204
FILE NO. 1.2.01.F
SHEET NO. 5.5.6

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelarations X	Y	Z	Comments
Valve Operator (Bracket)	74	277	Upset	2.69	1.24	0.38	
			Emergency	11.37	1.50	0.55	
			Faulted	11.39	1.78	0.75	
Valve Operator (Cylinder)	71	399	Upset	2.33	3.09	1.48	
			Emergency	2.49	3.18	5.83	
			Faulted	2.55	3.33	5.85	

Form BR 8002-2

QID# 361106

7.0 TRANSMITTAL, PRIOR CALCULATIONS AND REPORTS

CONTENTS

*NOTE 1
See Cygna Energy Services Project File; "Equipment Seismic and Hydrodynamic for 24" Cylinder Operated Butterfly Valves", File No. 0T.01.F, QID# 361106, Revision 3, June, 1983 for complete report.

Revision 3

6.0 Drawings

QID# 361106

DRAWINGS SUBMITTED TO SUPPLY SYSTEM
IN ORIGINAL PACKAGE

Johnson Controls	
D-220-0310-IR-64	Rev 0
Flick-Reedy Corp	
C-26096	Rev 0
BIF	
D-207110-H	Rev B
D-207110-G	Rev A
A-206767	Rev C
Bovee & Crail	
CSP-807-8.10	Rev 4
CSP-809-1.2	Rev 4
CEP-625-3.4	Rev 6
CEP-625-1.2	Rev 3

CSP-V-4. Valve Qualification

B&R File No. Dwg. 68-00-0009 Operation I.D. No. ____

B&R M200 Iso No. 172 Anchor Group 125

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelerations (g) X	Y	Z	Comments
Valve Operator (Bracket)	103	277	Upset	1.01	1.40	0.85	
			Emergency	3.10	1.97	1.71	
			Faulted	3.25	2.94	1.99	
Valve Operator (Cylinder)	111	399	Upset	1.14	1.49	1.50	
			Emergency	1.60	1.87	4.07	
			Faulted	1.87	2.87	4.19	

W.O. No. 3900-10 Date 4/12/83 Book No. 8.14.129 Page No. ___ Sheet ___ of ___
Drawing No. M200 Sh. 172 Rev 3A Calc. No. ___
By PG Checked ___ Approved ___
Title WNP-2 Status As-Built Verification of Piping Calculation

ATTACHMENT
JOB NO. 8200L
FILE NO. 07.01.F
SHEET NO. 553

CSP-V-3 Valve Qualification

B&R File No. Dwg 68-00-0009 Operation I.D. No. ______

B&R M200 Iso No. 172 Anchor Group 125

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelerations (g) X	Y	Z	Comments
Valve Operator (Bracket)	86	277	Upset	0.72	1.37	0.70	
			Emergency	2.48	1.77	1.14	
			Faulted	2.66	2.81	1.53	
Valve Operator (Cylinder)	95	399	Upset	1.23	1.86	0.96	
			Emergency	1.80	2.30	3.62	
			Faulted	2.04	3.17	3.76	

CEP-V-4A Valve Qualification

B&R File No. ________ Operation I.D. No. ________

B&R M200 Iso No. 168 Anchor Group 12.3

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelarations (g) X	Y	Z	Comments
Valve Body	31	847	Upset	1.05	0.84	0.51	
			Emergency	3.66	0.90	0.73	
			Faulted	3.71	1.33	0.89	
Valve Operator	34	626	Upset	0.94	0.89	0.40	
			Emergency	3.31	0.93	0.69	
			Faulted	3.35	1.34	0.86	

BURNS AND ROE, INC.

W.O. No. 3900-10 Date 3/31/83 Book No. 2.14.125 Page No. ____ Sheet ____ of ____

Drawing No. M200 Iso 168 Rev 2A Calc. No. 2.14.125

By ____ Checked cT Approved ____

Title WNP-2 Status As-Built Verification of Piping Calculation

Form BR 8002-2

BURNS AND ROE, INC.

W.O. No. 3900-10 Date 3/31/23 Book No. 8.14.125 Page No. ___ of ___
Drawing No. M20C Sh. 168 Rev 2A Calc. No. 8.14.125 Sheet ___
By c1 Checked ___ Approved ___
Title WNP-2 Status As-Built Verification of Piping Calculation

CEP-V-3A Valve Qualification

B&R File No. ________ Operation I.D. No. ________

B&R M200 Iso No. 168 Anchor Group 123

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelarations (g)			Comments
				X	Y	Z	
Valve Body	21	847	Upset	0.90	0.70	0.51	
			Emergency	3.06	0.78	0.74	
			Faulted	3.10	1.25	0.90	
Valve Operator	24	626	Upset	1.20	0.74	0.41	
			Emergency	4.54	0.81	0.69	
			Faulted	4.57	1.26	0.86	

QID# 361106

7.1 Communication Reports & Correspondence

Communications Report

CYGNA

Company: CES	☒ Telecon		☐ Conference Report
Project: WPPSS EQ		Job No.	
		Date:	Below
		Time:	Below
Subject: BIF VALVE DIMENSIONS		Place:	RBO

Participants:

Jim Foley	of CES - BAO
Rick Riccoppito 401-885-1000	of BIF
Jim Rohowski	of CES - RBO

Item	Comments	Req'd Action By
	2/10/83 – J. Foley / J. Rohowski	
	BIF VALVE FLANGE DIMENSIONS	
	24": thickness 1.78" · 30": 2.125"	
	i.d. 25" · 31"	
	o.d. 32" · 38.75"	
	BOLTS: 1 3/8" (20) · 1 3/8" (28)	
	2/11/83 – Rick Riccoppito / J. Rohowski	
	Radial Clearance of 24" & 30" valves.	
	— approx 1/8 inch —	

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 7.1.1

Signed: Page of

Distribution:

1020.00

Washington Public Power Supply System
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

December 17, 1982
GE-02-RWH-82-018

Cygna Energy Services
141 Battery Street
Suite 400
San Francisco, CA 94111

Attention: Mr. T. Wittig, Project Manager

Subject: NUCLEAR PROJECT 2
CONTRACT C-0892

Investigation of the CSB and CEB systems shows that during a dynamic event the systems are not degraded in any way by the butterfly valves fluttering. Therefore, all work on Work Release Nos. 14 and 17 which address valve stability should be terminated.

RWHickman

R. W. Hickman - 575
Senior Engineer,
Equipment Qualification

RWH/sms

cc: F. Khanachet, Cygna Richland

RECEIVED
DEC 22 1982
CYGNA-RICHLAND

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. 7.1.2

CYGNA

H Srih

Communications Report

CR-030

Company: CES	☒ Telecon	☐ Conference Report
Project: WPPSS		Job No. 82044
		Date: 7/29/82
Subject: QID 361110 - 18" BUTTERFLY VALVE		Time: 9:40 A.M.
		Place: SDAO

Participants:

Dick Hickman of Supply System

Hal Reeser of CES, SDAO

of

Item	Comments	Req'd Action By
	I called Dick re. dynamic instability of BIF valve while in open position. I also requested permission to contact GE re. use of faulted or upset allowables for RHR valves.	
	o Dick said we should complete the requalification analysis of the valves and flag the dynamic instability issue as a separate subject that will require Supply System action for resolution.	
	o Supply System has granted a contract to BIF for operability studies on their valves. The contract admistrator at BIF is John McDonald (401/885-1000). Our action should be to determine the scope of the BIF study and to make certain that we do not overlap our efforts with theirs. Also we should attempt to assure that our work does not conflict with the BIF effort.	H. Abolhoda
	o Dick said we may contact GE direct. Our contact at GE for the decision on faulted or upset allowables is: Arlan DeVault (408/925-2208).	M. Rajan*
	*ACTION: Rajan, this resolution should be documented via revised criteria in our Project Manual.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. DT.01.F
SHEET NO. 7.1.3

HR/sak

HR

Signed: H. Reeser

Distribution: T. Wittig, H. Abolhoda, F. Khanachet, P. Guglielmo, B. Schlafer, M. Rajan, J. Minichiello, P. Patel, Project Files (SD), (SF), (RB)

1020.00

CYGNA

Communications Report

CR-027

Company: CES	☒ Telecon		☐ Conference Report
Project: WPPSS		Job No.	82046
		Date:	7/20/82
Subject: APPLICABILITY OF HYDRODYNAMIC LOADS		Time:	P.M.
		Place:	SDAO

Participants:

W. Schlafer of CES, SDAO

H. Reeser of CES, RBO

of

Item	Comments	Req'd Action By
1.	The Hydrodynamic Load Column in the WPPSS SRM list is known to have errors. A "no" listing is not to be trusted.	
2.	For packages in analysis Cygna will trace down the P & ID to determine the applicability of hydrodynamic loads to line mounted equipment.	
3.	To accomplish this, Cygna will: a. Check the line routing to see if it penetrates the primary containment. If not, hydrodynamic loads do not apply. b. If the line penetrates the primary containment, hydrodynamic loads will apply unless: 1. An anchor point appears first in that line, or 2. The line first connects with floor mounted equipment outside the primary containment and it is sufficiently sturdy to eliminate the propagation of pipe line hydrodynamic loads beyond it.	
4.	If a line mounted equipment fails to qualify due to hydrodynamic loads, estimate it's fragility level. This information will be used by WPPSS when they receive the B & R final piping analysis and examine actual pipe accelerations.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. 7.1.4

WS/sak

Signed: W. Schlafer HReese

Page 1 of 2

Distribution: L. Kammerzell, J. Read, P. Guglielmino, J. Minichiello, P. Patel, M. Rajan, H. Abolhoda, [redacted] P. Curry, H. Reeser, T. Wittig, F. Khanachet

1020.00

CYGNA

Communications Report

CR-027

Company: CES	☒ Telecon	☐ Conference Report
Project: WPPSS		Job No.
		Date:
Subject: APPLICABILITY OF HYDRODYNAMIC LOADS		Time:
		Place:

Participants:

_____ of _____

_____ of _____

_____ of _____

Item	Comments	Req'd Action By
5.	For packages whose analysis is complete and where hydrodynamic loads were not considered because the SRM said "No": a. Review the line as in 3 (first page of this telecon). b. If we feel hydrodynamic loads really do apply, send a memo to the S. S. indicating the package may need rework. c. Send memo to F. Khanachet requesting supply system concurrence that hydro loads do apply and added analysis is required.	

Signed: W. Schlafer | Page 2 of 2

Distribution:

102000

CYGNA

Communications Report

CR-023

Company: CES ☒ Telecon ☐ Conference Report

Project: WPPSS

Job No. 82046

Date: July 20, 1982

Subject: Hydrodynamic Loads

Time: 9 A.M.

Place: San Diego

Participants:

J. Minnachiello of SFAO

P. K. Patel of SDAO

of

Item	Comments	Req'd Action By
	During the conversation we discussed the following:	
1.	If attenuation data on hydrodynamic loads are not available, one does not have any choice but to take into account hydrodynamic loads on all line mounted equipments.	
2.	One should use 1.5X peak acceleration unless the system frequency (line plus equipment) indicates otherwise.	
3.	If the equipment satisfies the allowable stress limits, then one should perform fatigue analysis using the fatigue design curves given for Class 1 components. To calculate the fatigue damage for normal operation (excluding all dynamic events) one might take a conservative approach by assuming the calculated stresses are equal to the allowable stress limits.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 7.1.6

Signed: P. K. Patel

Page 1 of 1

Distribution: H. Reeser, R. Hsieh, Rajan, H. Abolhoda, P. Curry

1020 00

COPY

BIF

July 7, 1982

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 1.1.1

RECEIVED
JUL 13 1982
CYGNA - SAN DIEGO

Sygna Energy Service
225 Stevens Street
Solana Beach, CA 92075

Attention: Mr. "Bill" Schlafer

Subject: Butterfly Valves for Nuclear Applications with IEEE Qualification Requirements

Dear Sir:

This information is provided in response to your recent phone call.

1. Enclosed please find some catalog information describing BIF's line of butterfly valves, including our current models as well as our new Model 0668 design (which will shortly replace our 0652 and 0658 models).

2. The following are our best estimates for budget purposes only of what it would cost to replace the valves and operators originally furnished to WPPSS in the 1970's (which did not require IEEE qualifications) with valves and operators that are fully qualified to IEEE-382-1972, IEEE-323-1971 and IEEE-344-1975.

   It is almost impossible to obtain prices from IEEE qualified actuator vendors without a detailed specification showing exactly what is required; therefore, these are our best guestimates of what the replacements would cost. They could be high or low by 10 to 20%, depending upon the wording used in the engineer's resultant specification.

   Replacements for Valves Furnished Originally on N-27232

14 - 18" BV's with electric operators (See NODS - 11/1/79)	$40,000 ea. if qty. = 1 or $25,000 ea. if qty. = 14

   Replacements for Valves Furnished Originally on N-27233

2 - 18" BV's with spring to open cylinder operators	$60,000 ea. if qty. = 1 or $45,000 ea. if qty. = 2

Replacements for Valves Furnished Originally on N-27234

4	- 30" BV's with spring to close cylinder operators	$75,000 ea. if qty. = 1 or $60,000 ea. if qty. = 4

Replacements for Valves Furnished Originally on N-27235

4	- 24" BV's with spring to close cylinder operators	$60,000 ea. if qty. = 1 or $50,000 ea. if qty. = 4

Replacements for Valves Furnished Originally on N-27236

3	- 24" BV's with spring to open cylinder operators	$60,000 ea. if qty. = 1 or $50,000 ea. if qty. = 3

We trust that this information will be of some help to you, and are sorry that our prices cannot be more precise.

Sincerely,

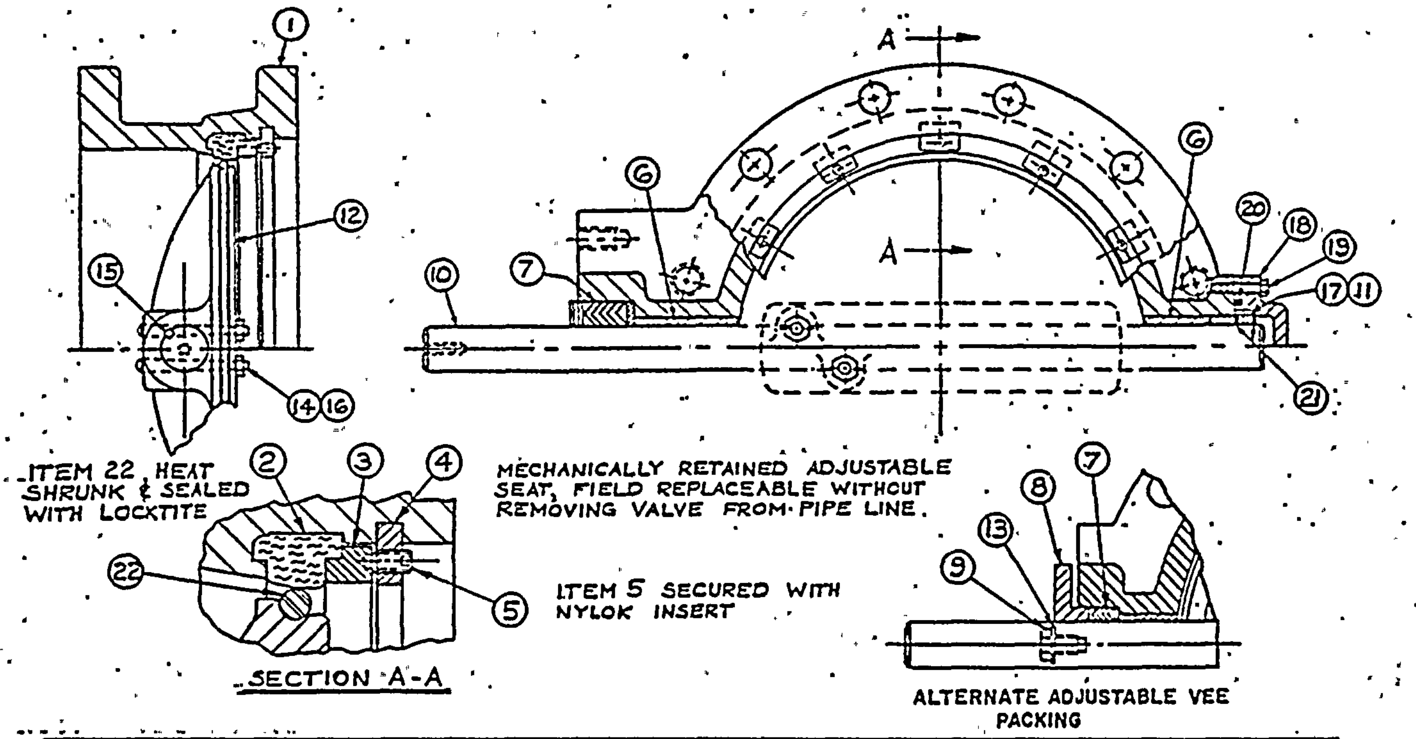
George E. Sayer

George E. Sayer
BV Sales Applications Engineer

Enclosures: 650.20-4
BPD-668-45-1
BPD-668-1
NODS-11/1/79

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 7.1.8

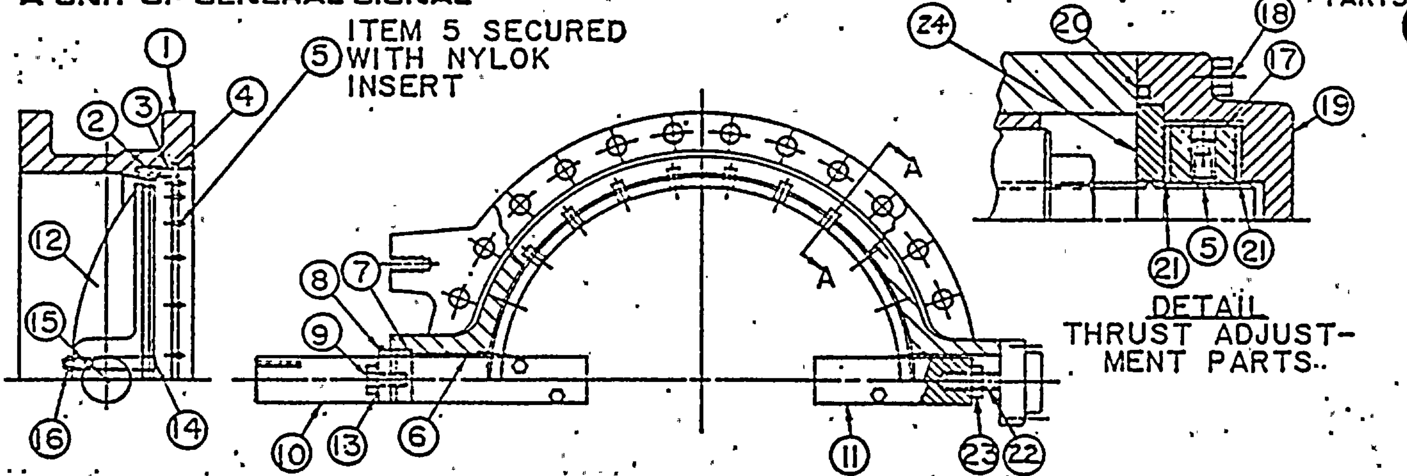
BUTTERFLY VALVES, MODEL 668
12"-24" THRU SHAFT
PARTS

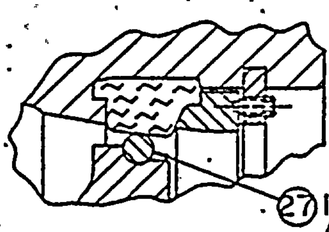


ITEM	MATERIAL	MATERIAL
1	VALVE BODY	CAST IRON ASTM A126 CL B
2	RUBBER SEAT	BUNA-N ASTM D2000
3	CLAMPING RING	TYPE 304 ST. ST'L
4	CLAMPING RING LOCK	TYPE 304 ST. ST'L
5	HALF DOG POINT SET SCREW	TYPE 304 ST. ST'L
6	SHAFT BEARING	REINFORCED TEFLON BRZ OR PHENOLIC BACKED
7	STUFFING BOX PACKING	VEE PACKING, BUNA-N
8	STUFFING BOX GLAND	CAST BRONZE ASTM B62
9	HEX HEAD CAP SCREW	TYPE 304 ST. ST'L
10	OPERATOR SHAFT	TYPE 304 ST. ST'L
11	HALF DOG POINT SET SCREW	TYPE 304 ST. ST'L
12	VALVE DISC	CAST IRON ASTM A48 CL40 OR DUCTILE IRON ASTM A536 GR. 65-45-12
13	WASHER	TYPE 18-8 ST.ST'L
14	DISC PIN	TYPE 304 ST.ST'L
15	KEY	ST'L
16	HEX NUT	TYPE 304 ST. ST'L
17	THRUST COLLAR	TYPE 303 ST. ST'L
18	THRUST BEARING COVER	CAST IRON ASTM A126 CL B
19	HEX HEAD CAP SCREW	TYPE 304 ST. ST'L
20	O-RING	BUNA-N
21	THRUST BEARING	REINFORCED TEFLON, ~~PHENOLIC BACKED~~
22	DISC SEATING RING	TYPE 316 ST. ST'L

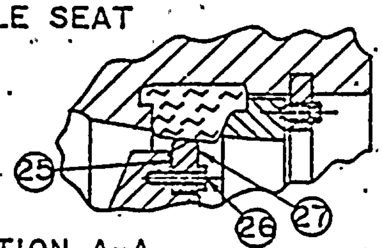
CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. DT-01F
SHEET NO. 7.1.9

AWWA BUTTERFLY VALVES
MODEL 0668 30" THRU 120"
PARTS





MECHANICALLY RETAINED ADJUSTABLE SEAT FIELD REPLACEABLE WITHOUT REMOVING VALVE FROM PIPE LINE

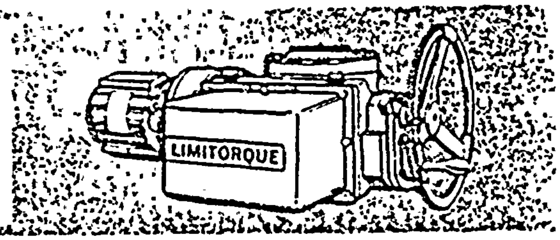


SECTION A-A (FOR 30" THRU 48" B.V)

SECTION A-A (FOR 54" THRU 120" B.V.)

ITEM	MATERIAL	MATERIAL
1	VALVE BODY	CAST IRON ASTM A126 CL B
2	RUBBER SEAT	BUNA-N ASTM D2000
3	CLAMPING RING	TYPE 304 ST. ST'L
4	CLAMPING RING LOCK	TYPE 304 ST. ST'L
5	HALF DOG POINT SET SCREW	TYPE 304 ST. ST'L
6	SHAFT BEARING	REINFORCED TEFLON BRZ OR PHENOLIC BACKED
7	STUFFING BOX PACKING	VEE PACKING , BUNA-N
8	STUFFING BOX GLAND	CAST BRONZE ASTM B62
9	HEX HEAD CAP SCREW	TYPE 304 ST. ST'L
10	OPERATOR SHAFT	TYPE 304 ST. ST'L
11	STUB SHAFT	TYPE 304 ST. ST'L
12	VALVE DISC	CAST IRON ASTM A48 CL40 OR DUCTILE IRON ASTM A536 GR. 65-45-12
13	WASHER	TYPE 18-8 ST.ST'L
14	DISC PIN	TYPE 304 ST.ST'L
15	KEY	ST'L
16	HEX NUT	TYPE 304 ST. ST'L
17	THRUST COLLAR	TYPE 303 ST. ST'L
18	THRUST BEARING COVER	CAST IRON ASTM A126 CL B
19	HEX HEAD CAP SCREW	TYPE 304 ST. ST'L
20	O-RING	BUNA-N
21	THRUST BEARING	REINFORCED TEFLON, PHENOLIC BACKED
22	THRUST ADJUSTING SCREW	TYPE 304 ST. ST'L
23	JAM NUT	TYPE 304 ST. ST'L
24	THRUST BEARING PLATE	STEEL ASTM A36
25	SEAL	SILICONE RUBBER
26	HEX HEAD CAP SCREW	TYPE 304 ST. ST'L
27	SEATING EDGE	TYPE 316 ST.ST'L

LIMITORQUE VALVE CONTROLS



LIMITORQUE CORPORATION • P. O. BOX 11318 • LYNCHBURG, VIRGINIA 24506

IEEE 323 (1974) and IEEE 382 (1972)
NUCLEAR QUALIFICATION DATA
FOR SAFETY RELATED SERVICE

	THREE PHASE ONLY		D.C.
	Nuclear Containment (See Option 8 Price Adders)	Outside Containment (Standard Prices)††	Containment—Inside or Outside (See Option 8 Price Adders)
Design Life	40 years (2000 cycles)*	40 years (2000 cycles)*	40 years (2000 cycles)*
Ambient Temperature (Continuous)	140°F	120°F	120°F
Ambient Humidity	60-100%	30-100%	30-100%
Aging	Motor Stator only 180°C for 100 hours	Entire Unit 165°F for 200 hours at 100% relative humidity	Motor Armature, Field Coils, & Brush Box only 180°C for 100 hours
Total Radiation (40 yrs. integrated)	2.04×10^8 rads	2×10^7 rads	1.0×10^7 rads
Seismic Ref: IEEE344	**6.0 g's (SMB/SB) ***3.0 g's (SMB/HBC) ****6.0 g's (SMB/HBC)	** 6.0 g's (SMB/SB) *** 3.0 g's (SMB/HBC) **** 6.0 g's (SMB/HBC)	†6.0 g's (SMB/SB) ***3.0 g's (SMB/HBC) ****6.0 g's (SMB/HBC)
Number of transients	2	2	1
Transient Temperature	340°F (BWR) 300°F (PWR)	250°F	340°F
Test Humidity	100% (saturated)	100% (saturated)	100% (saturated)
Profile	PWR/IEEE382-73, Page 12, Table 1 BWR/IEEE382-73, Page 12, Table 2	ANSI (yet to be published)	Special
Length of Test	30 Days	15 Days	25 Hours
Completed Test Date	PWR—September 1974 (600456) BWR—September 1972 (6000376)	February 1975 (600461)	October 31, 1975 (B0009)

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 7.1.11

*During BWR test, 500 cycles were used as a design life per IEEE382.

During PWR test, 2000 cycles were used as a design life of which 500 were incorporated prior to test and 1500 after test.

During test for outside containment, 200 cycles were incorporated while the actuators were being aged, and 1800 were added prior to irradiating.

During D.C. test, all 2000 cycles were incorporated prior to irradiating.

**As of 7/26/75, seismic tests were completed to IEEE344-1975 for both SMB and SB units to 6.0 g's vertical and 3.2 g's horizontal. Since no cross coupling was noted between axes, the test qualifies the SMB/SB to 6.0 g's in both vertical and horizontal axis. Maximum g-level dwells in each of the three axes qualify the units for any mounting position. (Seismic Qualification Report No. B0021). Qualification extends through 35 Hz.

††Standard Class "B" insulated motors only.

**Standard units without spur attachments.

****Standard units with seismic support bracket and without spur attachments.

NOTE: SMC-04 and SMC-05 actuators are qualified for "Outside Containment" service per above levels based on their similarity to the SMB actuator.

Communications Report

CYGNA

Company: CES	☒ Telecon	☐ Conference Report

Project: WPPSS

Job No. 82046/CR-019

Date: 7/1/82

Subject: Hydrodynamic Loads for Line Mounted Equipment

Time: 11:20 a.m.

Place: SDAO

Participants:

Bruce Linderman & Don Harkness of Bechtel, Norwalk, CA

W. Schlafer of CES, SDAO

of

Item	Comments	Req'd Action By
1.	Called the Seismic Qualification Working Group to determine their current criteria for line mounted equipment subjected to hydrodynamic loads.	
2.	Their current test requirements for in line equipment subjected to hydrodynamic loads are:	
	a) One SSE + SRV Event: Required Input Motion (RIM) of sine beat testing at 1/3 Octave Intervals from 1 to 200 Hertz, each for 15 seconds, at 6.0 g.	
	b) Two OBE + SRV Events: Required Input Motion (RIM) of two sine sweeps at 1 Octave/Minute from 2 to 200 to 2 Hertz at 2/3*6.0 g = 4.0 g.	
	c) In-Plant Vibration: Required Input Motion of sine sweep testing at 2 Octaves/Minute from 5 to 200 to 5 Hertz for 90 minutes at .75 g.	
3.	This type of environment is distinctly more severe and more correct than that proposed in the WPPSS interim dynamics criteria memo # 856. Eventually WPPSS will need to be informed of current industry practice such as this.	

WS:lgn

Signed: W. Schlafer WJS

Page 1 of 1

Distribution: Messrs. Kammerzell, Read, Reeser, Wittig, Minichiello, Guglielmino, Bosch, Hsieh, Patel, Rajan, Abolhoda, Curry

1020.00

Communications Report

Company:	CES	☒ Telecon	☐ Conference Report
Project:	WPPSS	Job No.	82046/CR-018
		Date:	6/29/82
Subject:	EQ of BIF Butterfly Valves QID 361104, 361106	Time:	12:05 p.m.
		Place:	SDAO

Participants:

Bill Schlafer of CES, SDAO

John Henry of John Henry Associates

of

Item	Comments	Req'd Action By
1.	Called John Henry because he was the engineer who approved the original seismic calculations for BIF Butterfly Valves.	
2.	His recollection of these analyses was vague but did mention they, as consulting engineers, never tried to assure operability. Operability was the manufacturer's responsibility.	
3.	He recommended testing a similar valve.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. 7.1.13

BS:lgn

Signed: Bill Schlafer BS

Page 1 of 1

Distribution: L. Kammerzell, J. Read, H. Abolhoda, ~~R. Hsieh~~ P. Patel, P. Curry

1020.00

Communications Report

Company:	CES	☒ Telecon	☐ Conference Report
Project:	WPPSS	Job No.	82046/CR017
		Date:	6/29/82
Subject:	EQ of BIF Butterfly Valves QID 361104, 361106	Time:	a.m.
		Place:	SDAO

Participants:

Bill Schlafer	of	CES, SDAO
George Sayer	of	BIF, 401-885-1000
	of	

Item	Comments	Req'd Action By
1.	Called George Sayer, the BIF sales agent to get a budget price for BIF 18", 24", 30" air-operated butterfly valves and an 18" motor actuated butterfly valve. These valves are similar to ones in WPPSS QID files but do not use the same air-actuators. The original BIF valve serial numbers (for reference) are N-27234-F, N-27235-F, N-27236-F and N-27232-1.	
2.	He required a few days to work out a price and will also send descriptive brochures.	

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. 7.1.14

BS:lgn

Signed: Bill Schlafer BS   Page 1 of 1

Distribution: L. Kammerzell, J. Read, H. Abolhoda, ~~R. Hsieh~~, P. Patel, P. Curry

1020 00

CYGNA

Communications Report

Company: CES ☒ Telecon ☐ Conference Report

Project: WPPSS

Job No. 82046/CR016

Date: 6/29/82

Subject: EQ of BIF Butterfly Valves QID 761104, 361106

Time: a.m.

Place: SDAO

Participants: Bill Schlafer of CES, SDAO

Allan Berger of BIF 401-885-1000

Item	Comments	Req'd Action By
1.	Called Allan Berger, a BIF engineer, to get technical drawings for the 18", 24" and 30" air-operated butterfly valve actuators.	
2.	Requested drawings of Miller air cylinders showing details of a) Cylinder dimensions b) Piston dimensions c) Rod/piston connections	
3.	Conversation indicated a) There is a bearing and seal around the piston rod where it exits the cylinder b) The piston rod fits through a clearance hole in the piston and is bolted on. c) No seismic functional tests have been done on the Miller air cylinder d) For dimensional data to verify functional operability of the motor actuated valve, contact Limitorque in Lynchburg, Virginia.	

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. DT.01.F
SHEET NO. 7.1.15

BS:lgn

Signed: Bill Schlafer BS

Page 1 of 1

Distribution: L. Kammerzell, J. Read, H. Abolhoda, ~~R. Hsieh~~, P. Patel, P. Curr

1020 00

CYGNA

Memorandum

PROJECT MEMO: SDCM-002
T.001

To: H. Reesin.

Date: 6/17/82

From: R. Hzrich

Job No: 82046
WPPSS

Subject: MISSING DATA REQUEST
(QID # 361106, Pkg # T)

Copies:
Project File

1. DRAWING A-208293 (CYL. SUPPT. BRACKE
2. DRAWING D-206661 (MILLER CYL.)
3. SPEC # 2808-68
4. DRAWING B-211830 (DRIVE LEVER)
5 DRAWING B-211832-1 (CLEVIS)

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 7.1.16

NOTE: Please sign and return the attached copy of this memorandum as acknowledgement of receipt of this memo. THANK YOU.

Received by: ______________

Date Received: ______________

Memorandum

CYGNA

To: P. Guglielmino
J. Minichiello

Date: June 17, 1982

From: W. Schlafer, PK. Patel
W/S

Job No: 82046/SDM-003

Subject: Analysis for Operability

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. 7.1.17

Copies: L. Kammerzell
J. Read
H. Reeser
G. Shipway (Wyle)
T. Wittig
Project File

In order to assess operability by analysis of mechanical equipment which can be modelled to correctly predict its stress and deformation responses relevant to operation, the following criteria are to be considered in conjunction with Section 3.E.1 of the Design Criteria.

If an equipment in Group II is expected to perform during the seismic and/or hydrodynamic event then the following requirements shall be met:

(1) Elastic displacement calculations shall be performed to assure non-interference between mating parts, and

(2) The calculated stresses shall be within the allowable stress limits.

If the calculated stresses for any service loading are such that permanent deformations might have occurred due to high allowable stress limits, a displacement analysis as in (3) shall be performed.

(3) A comprehensive elastic-plastic analysis should be conducted in these cases to assure non-interference between between mating parts.

For an equipment in Group I which is expected to operate after the seismic and/or hydrodynamic event then the following requirements shall be met:

(4) Total stresses in the part must be limited to a yield strength of the material, OR

(5) Satisfy the requirements of Group II equipment.

WS:lgn

Communications Report

CYGNA

Company:	CES	☒ Telecon	☐ Conference Report
Project:	WPPSS	Job No.	82046/CR-014
		Date:	6/16/82
Subject:	Wyle Data Bank	Time:	a.m.
		Place:	SDAO
Participants:	W. Schlafer	of	CES, SDAO
	G. Shipway	of	Wyle, Norco
		of	

Item	Comments	Req'd Action By
1.	Asked George to initiate a search in their testing data bank for seismic or seismic/hydrodynamic tests on BIF 18", 24" & 30" Butterfly Valves.	G. Shipway
2.	These valves are in QID files 361106 and 361104.	
3.	George is skeptical test data exists for those butterfly valves experiencing the extended frequency range of the hydrodynamic event.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. DT.01.F
SHEET NO. 7.1.18

WS:lgn

Signed: W.Schlafer WS Page 1 of 1

Distribution: L. Kammerzell, J. Read, H. Abolhoda, R. Hsieh, Project File

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JUN 28 1982
CYGNA - SAN DIEGO

COPY

Communications Report

Group Leader

Company: Cygna/Wyle | ☒ Telecon | ☐ Conference Report

Project: Equipment Seismic/Hydrodynamic Requalification

Job No. 82044

Date 6/15/82

Subject: Interim Dynamic Loads Criteria and Fatigue Criteria

Time 11:00

Place: Richland Office

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 71.19

Participants:

Joe Braverman of Burns & Roe

Jim Foreman of Wyle Laboratories

Item	Comments	Req'd Action By
	Joe Braverman of Burns and Roe was contacted by telephone on June 15, 1982 to get a clarification on the subject criteria for use in the Requalification of Equipment for Seismic and Hydrodynamic effects. Joe concurred that the acceleration values shown in the table of the attachment to the conference notes were intended to be used for rigid line mounted components only and not for flexible components. i.e., those having natural frequencies below the cutoff frequency. To be consistent with B&R recommendation for qualification of line mounted components by test would indicate that for the analysis of flexible line mounted components a static load would be applied at the C.G. of the extended structure equal to the amplification factor for sinsusoidal motion at a justifiable damping value. For example, for an SSE condition the amplification at 3% damping would be 50 divided by 3 = 16.7. This loading may be in some cases present a very conservative loading on the line mounted components. A somewhat more realistic input motion would be	

Signed: KAF

Page 1 of 3

Distribution: Standard Distribution, Hsieh, Patel, Abolhoda, Raju, Curry

Communications Report

Company: Cygna/Wyle	☒ Telecon	☐ Conference Report	
Project: Equipment Seismic/Hydrodynamic Requalification		Job No.	82044
		Date:	6/15/82
Subject: Interim Dynamic Loads Criteria and Fatigue Criteria		Time:	11:00
		Place:	Richland Office

Participants:

Joe Braverman of Burns and Roe

Jim Foreman of Wyle Laboratories

of

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 01.01.F
SHEET NO. 7.1.20

Item	Comments	Req'd Action By
	continuous sine beats of 12-15 ocsillations per beat as recommended by the IEEE-382 draft "American Standard of Safety Related Valve Actuators". The amplification for a 15 oscillation sine beat at resonance for 3% damping is approximately 11.5. If the static loadings given above show an overstressed condition or deflections which would cause operational malfunction, the alternative to develop a more realistic approach would be to perform in situ testing from which the data could be used to develop response spectra at valve locations. The in-situ tests would allow the determination of the natural frequencies and mode shapes of a sufficient part of the piping system along with the valve and extended structure to validate the mathematical models used to generate response spectra at the valve location and/or component locations on the extended structure. The response spectra at component locations allow direct comparisons with component test data. It is felt that a combined test and analysis would be a feasible and cost effective approach.	

Signed: JWF

Distribution: Standard Distribution

1020 00

Communications Report

CYGNA

Company: Cygna/Wyle	☒ Telecon	☐ Conference Report
Project: Equipment Seismic/Hydrodynamic Requalification		Job No. 82044
		Date: 6/15/82
Subject: Interim Dynamic Loads Criteria and Fatigue Criteria		Time: 11:00
		Place: Richland Office

Participants:

Joe Braverman	of	Burns and Roe
Jim Foreman	of	Wyle Laboratories
	of	

Item	Comments	Req'd Action By
	Burns and Roe is checking to see if fatigue criteria have been developed for WNP-2 and will notify Cygna/Wyle not later than June 17, 1982 if such criteria exists.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 7.1.21

Signed: JWF

Page 3 of 3

Distribution: Standard Distribution

1020 00

6/25/82 Wilchlafer

Why In-situ Testing By G. Shipway

1. Verify analytical model
2. Verify rigidity
3. Reduce stress analysis conservatism
4. Demonstrate operability
5. Include piping influences into modeling

Considerations

1. Must be closely coupled with analytical work.
2. Previous in-situ programs will be reviewed for possible guidance.
3. Assume site accessibility is no problem.

Which items

First estimate attached

Refine 1st guess with walk down inspection

Refine again with similarity review

Refine again with review of analytical work

Methods

Select desired scenario depending on objective + items.

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OTi01.F
SHEET NO. 7.1.22

WYLE LABORATORIES

In-situ Scenario's

1. Static equivalent pull test for operability.

   a. From analytical analysis, compute static equivalent load to be applied to actuator c.g., and the direction of the load.

   c. Determine location of, and access to, the item in question.

   d. Consider potential synergisms of pressure, temperature, flow, etc.

   e. If the absence of any of the potential synergistic parameters cannot be justified, the effect of that parameter must be accounted for.

   f. Apply required static load.

   g. Monitor operation of item as required to verify acceptable operation.

   b. Determine acceptance criteria for operation of the item.

4. Caution - a static pull test must be run; cause permanent [illegible] [illegible] [illegible] [illegible].

In-situ Scenarios

2. Resonance frequency determination
[To be used to verify rigidity, i.e. the absence of resonances at low frequencies.]

a. Determine location of, and access to, the item in question.

b. Determine the mounting arrangement and any other interfaces for the item.

c. Compare the in-situ mounting + interfaces with that used in the analytical model

d. Consider the probability of the item having no low frequency resonances. (If the probability of rigidity is not high this technique may not be the best choice).

e. Using an appropriate size of hammer and a rubber pad, impact excite the item at the location(s) most likely to produce resonance responses.

f. Monitor the response of the item with an accelerometer and the micro FFT analyzer to determine the lowest frequency of amplified response motion.

g. Care must be used to insure the excitation of the lowest response frequency by proper use of the hammer and the location of the impact.

In-situ Scenarios

3. Modal Survey

a. Determine location of, and access to, the item in question.

b. Determine the mounting arrangement and any other interfaces for the item.

c. Compare the in-situ mounting and interface with that used in the analytical model.

d. Determine the mode shapes and frequencies predicted by the analytical work, and use this information as a guide for the experimental work.

f. If the item is relatively simple, and has low impedance, use an instrumented hammer for excitation. Otherwise, use a 30 to 50 lb shaker for excitation.

e. Determine the frequency range of interest, i.e. with, or without, hydrodynamic loads.

g. Using the HP 5423, monitor the item response at selected locations to gather experimental modal data for comparison with the analytical data.

h. Iterate analytical and experimental results to achieve convergence.

Prepared by HPR Date 24 June 82 Subject
WPPSS WNP-2 Safety Related Mechanical ~~Equipment~~

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 7.1.26

Potential In Situ Test Items

QID No	DESCRIPTION	EQUIPMENT NO	LOCATION	TEST
118002	Engine/P.P. Elect	DSA-ENG. 1A2	D441, P.2/7.0	F
		1B2	D443, P.7/6.7	
128002	Filter/Electro Motive	DLO-F-1A1	D441, P.3/6.0	F
	DG-ENG. 1A	DLO-F-1A2	D441, R.5/6.0	
	1B	DLO-F-1B1	D441, P.3/8.0	
	Lube Oil Filter	DLO-F-1B2	D441, R.5/8.0	3 F
	Inlet Filter	DLO-F-2A1	D441, P.3/6.0	
	Turbo Charger Supply	F-2A2	" R.5/6.2	
	Filter Intake	F-2B1	" P.3/8.0	
		F-2B2	" R.5/8.0	
		F-3A1	" P.3/6.2	
		F-3A2	" R.5/6.0	
		F-3B1	" P.3/8.0	
		F-3B2	" R.5/8.0	F
133001	FC Valve/Fischer	CAC-FCV-1A	R575 M2/5.2	F, S
	Flow Control X-99	-1B	R564 J.6/6.7	3 F
	2.5" Flow Control	-3A	R495 M.8/4.7	18 F
		-3B	R496 J.0/7.4	1 S
		-4A	R495 N.4/6.0	
		-4B	R495 N.4/6.0	F, S
133002	FC Valve/Fisher	RHR-FCV-64B	R443 H.0/9.1	F, S 2 F
	3.0" MO Globe	-64C	R443 J.0/4.9	F, S
	RHR Min Flow			

Prepared by ______ Date ______ Subject ______

QID No.	DESCRIPTION	EQUIPMENT NO	LOCATION	TEST
133004	FC Valves/Fisher Flow Control (2.5")	CAC-FCV-2A	R560 M.1/7.7	F, S 2 F
		-2B	R558 M.5/6.6	F, S 1 S
193001	Valve/Fisher Line from Heat Exch. 2.5" Globe Line	RHR-LCV-65A	R481 7.9/K	F, S 2 F
		-65B	R475 L3/8.1	F, S 1 S
236004	PC Valve/Fisher ECONTV PIC Sonic Flow	RHR-PCV-51A	R578 J/9.3	F, S 2 F
		-51B	R575 M.8/9.3	F, S 1 S
361103	Valve/BIF 18" MO BFLY	SGT-V-1A	R583 H8/5.3	F, S
		SGT-V-1B	R583 J3/5.3	2 F
		SGT-V-3A1	R576 H8/7.7	2 F
		3A2	R576 J.0/7.7	2.3
		3B1	R576 J3/6.8	
		3B2	R576 J3/7.4	
		4A1	R587 H8/7.1	
		4A2	R587 J.0/7.0	
		4B1	R585 J2/5.1	
		4B2	R585 J6/7.1	
		5A1	R587 H.6/7.0	
		5A2	R587 J/7.1	
		5B1	R587 J2/7	
		5B2	R585 J6/7	F, S
361104	Valve/BIF 30" BFLY	CEP-V-1A	R558 J.4/5.4	F, S 1 F
		CEP-V-2A	R558 J.4/5.4	F, S 2 F
		CSP-V-1	R508 M.5/7.6	F, S 1 S
		CSP-V-2	R508 M.5/7.4	F, S

Prepared by ______ Date ______ Subject ______

QID No.	DESCRIPTION	EQUIPMENT NO.	LOCATION	TEST
361106	Valve / BIF 24" BFLY	CEP-V-3A	R495 H.5/5.4	F,S
		-4A	R495 H.5/5.4	4 Fl
		CSP-V-3	R481 M.6/7.6	1 S
		-4	R478 7.6/M.6	
		-5	R475 M.7/8.3	
		-6	R480 N.5/7.7	
		-9	R490 M.9/57.1	F,S
361110	Valve / BIF	SGT-V-2A	R580 H7/5.3	F,S 2 Fr.
		-2B	J3/5.3	F,S 1S

Communications Report

CYGNA

Company:	CES	X Telecon	☐ Conference Report
Project:	WPPSS	Job No.	82046/CR-008
		Date:	6/11/82
Subject:	Qualification of Line Mounted Equip.	Time:	a.m.
		Place:	SDAO
Participants:	H. Reeser	of	CES, Richland
	W. Schlafer	of	CES, SDAO
		of	

Item	Comments	Req'd Action By
1.	The new work authorization had not yet been released. Use the Initial Analysis EQ-12-3000 number for the week-ending Friday 6/11/82.	
2.	Hal recommends that as a result of using our best engineering judgment in the qualification of line mounted equipment, it is more prudent to fail a few items first before presenting WPPSS with our concern for a more well defined position on line mounted equipment qualification. At that time, we can present a planned approach for additional analytical and/or in-situ testing to be conducted which will yield data needed for a more accurate definition of the dynamic input to line mounted equipment.	
3.	An examination of the preliminary horizontal OBE and SSE response spectra outside the containment building for a frequency of 8Hz, indicate that the g levels from Attachment 1 (of the Interim Dynamic Loads Criteria) to be used in the static analysis of line mounted equipment not affected by hydrodynamic loads, may already have a multiplicative factor incorporated in them. This factor may not yet still address the issue of a possible resonance condition of the line mounted equipment which would result in even higher g levels for use in analysis.	

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.5
SHEET NO. 7.1.29

WS:lgn

Signed: W. Schlafer W/S

Page 1 ~~of 1~~

Distribution: L. Kammerzell, J. Read, H. Reeser, J. Minichiello, P. Guglielmino, P.K. Patel, ~~B. Hsieh~~, M.K.S. Rajan, A. Abolhoda, P. Curry, Project

1020.00

CYGNA

Communications Report

Company: CES ☒ Telecon ☐ Conference Report

Project: WPPSS Equipment Qualification

Job No. 82046/CR-005

Date: June 8, 1982

Subject: Response Spectra & WPPSS E.Q. Documents

Time: pm

Place: SDAO

Participants:

H. Reeser of CES, Richland

J. Forman of Wyle (CES, Richland)

W. Schlafer of CES, SDAO

Item	Comments	Req'd Action By
1.	Hal has asked Jim Forman to help Cygna obtain the following information form WPPSS or from similar data available within Wyle: a) Separate SRV Response Spectra for use in fatugue stress analysis. b) Time histories used in deriving the SRV response spectra for use in determining the number of significant stress cycles and duration of an SRV loading. c) The number of SRV events. d) The number of significant stress cycles and duration of the hydrodynamic loads (AP/Chugging) associated with the LOCA event.	
2.	The large compilation of Response Spectra for OBE, SSE and combined hydrodynamic events recently received by the BAO, SDAO and the SFAO are to be considered preliminary. Hal will update and transmit an official copy of response spectra to be used for analysis/testing.	
3.	Hal is also sending the WPPSS a) FSAR Section 3.10 and Appendices b) The 2/12/82 submittal to the NRC concerning Equipment qualification.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. 7.1.30

Signed: W. Schlafer

Page 1 of 1

Distribution: Kammerzell, Read, Patel, Hsieh, Rajan, Abolhoda, Curry, Minichiello, Guglielmino Reeser, PROJECT FILE

1020.00

CYGNA

Communications Report

Company: CES ☒ Telecon ☐ Conference Report

Project: WPPSS Equipment Qualification

Job No. 82046/CR-004

Date: June 8, 1982

Subject: QID File Review

Time: am

Place: SDAO

Participants:

P. Guglielmino of BAO

W. Schlafer of SDAO

of

Item	Comments	Req'd Action By
1.	In the review of a QID file, if errors in other than seismic analysis are discovered which adversly affect the equipment's qualification, these too must be noted and corrected or justified.	
2.	If the error is such that the equipment can still be qualified, note the error and the fact it does not adversly affect qualification, but avoid the expense of altering that portion of the analysis.	
3.	Both Peter and myself feel that a better defensible position needs to be investigated for the loads used in the analysis of line mounted equipment.	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. 7.1.31

Signed: W. Schlafer Page 1 of 1

Distribution: Kammerzell, Read, Patel, Hsieh, Rajan, Abolhoda, Curry, Minichiello, Reeser

102000 PROJECT FILE

Communications Report

CYGNA

Company: CES ☒ Telecon ☐ Conference Report

Project: WPPSS Equipment Qualification

Job No. 82046/CR-003

Date: June 3, 1982

Subject:

Time: pm

Place:

Participants:

H. Reeser of CES, Richland

W. Schlafer of CES, San Diego

of

Item	Comments	Req'd Action By
1.	Hal questioned his immediate contact at WPPSS, Dennis Armstrong, about the number of SRV events and number of cycles. Their reply was "we don't know".	
2.	Hal has suggested that Cygna investigate these issues, formulate a position, and then get WPPSS concurrence. Since WPPSS has generated combined response spectra for seismic and SRV events, I suggested to Hal he obtain separate SRV response spectra and time histories from which they were derived. This will help in determining the length an SRV event and the number of significant cycles. The number of SRV events is more difficult to determine and possibly needs a more thorough understanding of the BWR's systems.	HGR
3.	Hal will be our contact in Richland to submit our Action Plan and cost estimates for approval.	

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. 7.1.32

Signed: W. Schlafer WJS Page 1 of 1

Distribution: Kammerzell, Read, Patel, ~~Hsieh~~, Rajan, Abolhoda, Curry, Guglielmino, Minichiello, Reeser, PROJECT FILE

WS:ib

1020 00

Communications Report

Company	CES	☒ Telecon	☐ Conference Report
Project	WNP-2 Equipment Qualification	Job No.	82044
		Date.	4/28/83
Subject.	Weld size at Valve Flange/Ear Interface	Time	2:00 p.m.
		Place	Richland
Participants	Don Searle	of	CES/RBO
	Rick Ricappito	of	BIF 401-885-1000
		of	

Item	Comments	Req'd Action By
	Requested and received information concerning the attachment of the rectangular shaped "ears" to the valve body flanges. Rick informed me that all of these items were affixed to the valve flange by means of welding. a) 0.31" fillet weld three sides b) 0.31" "J"/Groove weld on side flush with flange face Reference: BIF Order No: PN27234, PN27235 BIF Assembly Drawing: A-206767	

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. 7.1.33

Signed D. Searle

Page 1 of 1

Distribution: T. Wittig, F. Khanachet, D. Armstrong, M. Scott, R. Hickman, Project File, D. Searle, Office File

July 16, 1974

Conference Notes No. 258

RECEIVED
JUN 17 1982

RECEIVED
JUL 23 1974

CYGNA-RICHLAND

Subject: W.O. 2808
Washington Public Power Supply System
WPPSS Nuclear Project No. 2
Contract No. 68
"HVAC - Isolation Valves"

Date: July 5, 1974

Place: B.I.F.
Providence, Rhode Island

Purpose: Review of B&R Comments on Seismic Calculations and General Review Meeting

Present: B.I.F

J.P. Cunningham - Product Engr-Butterfly Valves
*T. Masse - Engr. Product Mgr. - Butterfly Valves
*G.F. MacDonald - Director Nuclear Q.A.
*T. Wolfe - Marketing Manager - Butterfly Valves

Burns and Roe

D. Sheikh
J. V. Zalavadia

* Part Time

WNP NO. 2 | K HALE | W VAUGHAN | DE THARP | GE DEEGAN

Distribution: MZizza, JJByrnes, JJVerderber, TAHendrickson, FJPatti, HSechster, JHodsky, JRoberts, PPerry, MHroncich, DMurphy, HReh, CVesy (PT&O), RLuken, RECamp, JHagan, HDoon, RWoodward, JBlas (2), HSybil, JO'Donnell, AWChamos, MGoodman, SFox, JVZalavadia, DSheikh, BBedrosian, RBaldwin, EFerrari (6), MKahn, pf, db, pc

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 7.1.34

Notes: 1. Documents to BIF

Burns and Roe Comments on Q.A. Manual-Burns and Roe letter BRBIF-68-74-011, dated March 19, 1974.

2. Seismic Calculations - B&R Comments

Burns and Roe pointed out the following items and BIF agreed to revise their seismic calculations accordingly:

a. Change the material ASTM A-126 & A-48 which are Cast Iron and not allowed per Contract Specification.

b. Submit the proof that the valves will fail open or close, as mentioned in the specification.

c. Submit the calculations for the detail of seating torque value, used in design calculations

d. Submit stress and fatigue analysis for the spring which is in the cylinder.

e. Consideration of relatively higher temperature when using ASTM materials.

f. Submit proof that there would be no loss of function during and after the prescribed seismic disturbance as mentioned in paragraph 3.3 of the specification. The seismic calculations include stress analysis only. The analysis for strain/deformation is also required as a proof that there will be no loss of function.

g. Submit analysis or proof that radiation will not adversly affect the yield point of the material.

h. Submit analysis and design for 72" and 84" valves considering normal load with the combination of ½ SSE stresses shall be maintained within the normal allowable working stress limit as mentioned in paragraph 3.3.1.1 of specification.

3. Mandatory Testing for Seismic Qualifications

Burns and Roe asked BIF to submit dynamic or shake table tests for motor, switches etc, as mentioned in 3.3.4 of the specification. BIF replied that they have already tested the same type of equipment for greater accelerations than Burns and Roe specified and that they will submit the test data for Burns and Roe review and approval.

4. Stardyne Model used in Seismic Calculations

BIF clarified satisfactorily Burns and Roe comments the Stardyne Model used for 84" and 72" valves.

5. Closing Time

Burns and Roe asked for proof that the valves will open or close in specified time, as mentioned in the specification. BIF replied that they cannot analytically prove this, but they will test prove at the time of leakage test in the presence of Burns and Roe inspector to meet the Contract Specification requirements.

6. Double Eccentricity of Cylinder

Burns and Roe pointed out that they should consider double eccentricity of the cylinder while designing trunnion pin, instead of the single eccentricity considered in 30", 24" valves. BIF agreed to look into the problem.

7. Natural Frequencies of 18", 24", and 30" Valves

Burns and Roe asked BIF to submit the natural fundamental frequency of 18", 24", and 30" valves. BIF replied that since this is beyond the scope of contract, they will inform Burns and Roe regarding additional cost for this work. Burns and Roe stated that after reviewing their quotation and after WPPSS's approval Burns and Roe will notify BIF if additional work is authorized. (BIF informed Mr. D. Sh[illegible] on July 9, 1974 by telephone that the cost of additional work will be $300.00).

8. General-BIF Comments

BIF indicated as follows:

a. If operation or accidental temperature is high, the rubber seal should be on valve disc, correctly specified by Burns and Roe, instead of valve body. Rubber seal if on valve body, is fixed by glue, which cannot resist high temperature. Rubber seal on valve disc is fixed in-between metal pieces.

b. If water or any other fluid is supposed to flow in the pipe, the shaft in the valve should be vertical. The vertical shaft would mean C.G. of pressure due to fluid will be on the axis and hence much less driving force is required to operate the valves. But in case of air or steam it makes no difference.

9. Quality Assurance Manual

Burns and Roe stated that Burns and Roe comments on BIF Quality Assurance Manual was mailed to BIF on March 19, 1974 (BRBIF-68-74-011) and was classified "Not Approved". The response to these comments has not been received as of this date. BIF stated that the BIF Plant is on vacation for 2 weeks (July 1 thru July 12). Mr. MacDonald will start updating QA Manual on July 15 and he expects to complete by July 19, 1974. BIF will revise their Q.A. Manual and/or provide necessary supplements to the manual as per Burns and Roe comments. Burns and Roe comments were discussed. Mr. MacDonald will call Mr. Sheldon Paige of Burns and Roe on July 15, for the clarification of the following Burns and Roe comments:

a. Corrective action
b. Audit of Purchase Reqs./P.O.'s/change orders
c. Compliance to supplier Quality Control Program
d. Compliance to Lower Tier Procurement
e. Welding Process Sheet Form N-152 (BIF) and the forms of Contract Specification 17A-30 and 17A-31

10. Inservice Inspection Requirements

Burns and Roe questioned regarding the requirements of "calibration blocks" in accordance with the draft of the 1974 Edition of ASME Section XI, Article I-3000 "Preparation for Calibration" for Inservice Inspection. BIF stated that the special calibration blocks are not required. They will submit detailed method of Inservice Inspection with Standard Calibration blocks.

11. Item Owed to BIF by B&R

Decision on BIF quotation on calculations on natural frequencies of 18", 24" and 30" valves (Item No. 7).

12. Item Owed to B&R by BIF

a. Submission of revised seismic calculations as per Item No.'s 2, 3, and 6 above.

b. Submission of revised Q.A. Manual (Item No. 9)

c. Inservice Inspection Requirements (Item No. 10)

David Smith

JJV/JVZ/dcw

Prepared by J. V. Zalawadia

Submitted by J. J. Verderber

cc: Mr. J. E. Woolsey - WPPSS -3
Mr. P. C. Otness - BPA -1

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 05.01.F
SHEET NO. 7.1.37

CYGNA

QID# 361106

7.3 BIF Report

B I F A UNIT OF GENERAL SIGNAL
1600 DIVISION ROAD
WEST WARWICK, R.I. 02893

QUALIFICATION OF PRIMARY CONTAINMENT BUTTERFLY ISOLATION VALVES UNDER LOCA CONDITION.

DYNAMIC TORQUE CALCULATION OF BUTTERFLY VALVE

PREPARED FOR:

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

VALVE SIZES 30", and 24"
WPPSS CONTRACT NO. 68
BIF ORDER NO.: PN27234 & PN27235
WPPSS IDENTIFICATION NO. CSP-V-1 & 2, and
CSP-V-3 & 4

Prepared by: Debendra K. Das *Debendra K. Das*
Date: *Nov. 10, 1982*
Checked by: Dezso Szilagyi *Dezso Szilagyi*
Date: *Nov. 10. 1982*

REPORT NO. TR-27234 And
TR-27235

CYGNA
ATTACHMENT
JOB NO. *82044*
FILE NO. *OT.01.F*
SHEET NO. *A-1*

TABLE OF CONTENTS

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-2

SUMMARY

This report contains the dynamic torque analysis of two butterfly valves of sizes 30, and 24 inch. The analysis is performed for LOCA (loss of Coolant Accident) per WPPSS Specification, reference 1 on page six of this report. The analytical procedure and the assumptions are outlined in the section beginning on page seven. Dynamic torque calculations have been performed for two media, namely, air and saturated steam for various angles of opening of these valves.

The results of the analysis tabulated on page two through five of the report indicate that the dynamic torques developed under the specified flow conditions are less than the design torques used in the original Seismic and Stress analysis of these valves. Therefore the valves are safe against the action of dynamic torque in the event of a LOCA.

SUMMARY OF RESULTS

Table - 1, 30 Inch Valve, airflow

Time s	Angle α deg.	Dynamic Torque in-lb
1.0	90 (Full open)	11020
1.5	78.75	23098
2.0	67.50	18138
2.5	56.25	14747
3.0	45.00	12428
3.5	33.75	10780
4.0	22.50	8014
4.5	11.25	3972
5.0	9.0 (Full closed)	0.0 *

T_{Net} = 22174 in-lb

* At full closed position the dynamic torque is zero and the net torque is due to seating and bearing friction.

NOTE: The design torque used in the Seismic analysis report No. TR-74-8 by McPherson Associates for this valve is 27800 in-lb. Therefore the design is safe.

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-4

SUMMARY OF RESULTS

Table - 2, 30 Inch Valve Steam flow

Time s	Angle α deg.	Dynamic Torque in-lb
1.0	90 (Full open)	11032
1.5	78.75	23175
2.0	67.50	18142
2.5	56.25	14668
3.0	45.00	12424
3.5	33.75	10580
4.0	22.50	7809
4.5	11.25	3867
5.0	9.0 (Full closed)	0.0 *

T_{Net} = 22174 in-lb

* At full closed position the dynamic torque is zero and the net torque is due to seating and bearing friction.

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-5.

SUMMARY OF RESULTS

Table - 3, 24 Inch Valve, Air flow

Time s	Angle α deg.	Dynamic Torque in-lb
1.0	90 (Full open)	5525
1.5	78.75	11692
2.0	67.50	9095
2.5	56.25	7428
3.0	45.00	6239
3.5	33.75	5430
4.0	22.50	4043
4.5	11.25	2020
5.0	9.0 (Full closed)	0.0 *

T_{Net} = 13808 in-lb

* At full closed position the dynamic torque is zero and the net torque is due to seating and bearing friction.

Note: The design torque used in the Seismic analysis report No. TR-74-7 by McPherson Associate for this valve is 17000 in-lb. Therefore the deisgn is safe.

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-6

SUMMARY OF RESULTS

Table - 4, 24 Inch Valve, Steam flow

Time s	Angle α deg.	Dynamic Torque in-lb
1.0	90 (Full open)	5425
1.5	78.75	11394
2.0	67.50	8921
2.5	56.25	7213
3.0	45.00	6109
3.5	33.75	5202
4.0	22.50	3842
4.5	11.25	1902
5.0	9.0 (Full closed)	0.0 *

T_{Net} = 13808 in-lb

* At full closed position the dynamic torque is zero and the net torque is due to seating and bearing friction.

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. A-7

REFERENCES

1. WPPSS Specification 2808-68, Calc. No. ME-02-83-08-0, Sheets 1 thru 9, dated 10/8/82.

   LOCA Temperature Curve Fig. 6.2-2.
   LOCA Pressure Curve Fig. 6.2-3.

2. ANSI/AWWA C504-80, AWWA Standard for Rubber-Seated Butterfly Valves. American Water Works ASsociation,Colo.

3. Beard,C., Final Control Elements, Valves and Actuators, First Edition, Rimbach Publications, 1969.

4. Hutchison, J. W., ISA Handbook of Control Valves, 2nd Edition.

5. Torque and Sizing Calculation for BIF Butterfly Valves, No. D-214590, dated 1/9/75 for WPPSS Contract #68.

6. B I F Test Report for Dynamic Torque and Head Loss Tests of Cast Iron Streamline Disc versus Fabricated Flat Plate Disc dated May 13, 1974.

7. B I F Test Report #TR-0650-43, Hydrodynamic and Headloss Test of 12" - 150 Lb. Butterfly Valve with directly connected short radius elbow upstream, dated 2/24/82.

8. B I F Drawings: 30 inch Valve General Arrangement Drawing A-206763
   24 inch Valve General Arrangement Drawing A-206764

QID# 361106

7.4 McPherson Associates Analysis

23.2401.0127

BIF A UNIT OF GENERAL SIGNAL
1600 DIVISION ROAD
WEST WARWICK, R.I. 02893

DESIGN AND SEISMIC ANALYSIS OF 24" CYLINDER OPERATED BUTTERFLY VALVE FOR WASHINGTON PUBLIC POWER SUPPLY SYSTEM AND BURNS AND ROE

CUSTOMER P.O. CONTRACT 68

BIF SHOP ORDER NO'S PN27235-U-0708
PN27236-U-0808

BIF SERIAL NO'S PN27235-1 thru 4
PN27236-1 thru 3

NUCLEAR

REPORT NO. TR-74-7
PREPARED BY McPHERSON ASSOCIATES, INC.

APPROVED BY: [signature] 3/7/74

REAPPROVED: [signature] 1/5/76 (REV 1)

B&R FILE NUMBER 68 00 0050

DESIGN AND SEISMIC ANALYSIS OF 24" CYLINDER OPERATED BUTTERFLY VALVE A-206765

22 February 1974

Prepared For:

BIF
A Unit of General Signal Corporation

Prepared By:

Thomas M. Riley
John R. Henry

BIF
A Unit of General Signal Corporation
Purchase Order No. 84908-63

McPherson Associates, Inc.
Report No. TR-74-7 - REV. 1 12/31/75

McPherson Associates, Inc.
400 Totten Pond Road
Waltham, Massachusetts 02154

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. B-2

NUCLEAR

DESIGN AND
SEISMIC ANALYSIS
OF
24" CYLINDER OPERATED
BUTTERFLY VALVE
A-206765

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. B-3

BIF
A Unit of General Signal Corporation
Purchase Order No. 84908-63

NUCLEAR

McPherson Associates, Inc.
Report No. TR-74-7 - REV. 1 12/31/75

FOR 24" VALVES

BIF Contract No.	BIF S.O. No.	Valve Tag No's
68	N 27235-F N 27236-F	CSP-V-3 CSP-V-4 CEP-V-3A CEP-V-4A CSP-V-5 CSP-V-6

REVISION RECORD

HUS REPORT TR-74-7

REVISION 1 12/31/75

Page 3
a) Mat'l was ASTM A-126 & A-48
b) Allowable Stress Value corrected

Page 5
a) Drive Lever was B-184005-6
b) Clevis was D-146578

Page 9
a) Mat'l was ASTM A-126, Class C
b) Corrected yield stress allowable
c) Deleted ASTM A-48

Page 32
a) Ref. drawings were B-184005-6 & D-14578

Pages 33, 35, 36 & 37
a) Mat'l was ASTM A-126
b) Corrected Stress Allowable

NUCLEAR

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. B-4

Section 1.0

INTRODUCTION

The purpose of this report is to determine the structural adequacy of a 24" Butterfly Valve Assembly when subjected to seismic accelerations as described in Reference 1 and to insure the valve design is in accordance with Reference 5 of this report.

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. B-7

The seismic plus operating analysis is performed in accordance with Washington Public Power Supply System Specification No. 2808-68, Reference 1, and all applicable information as described in Section 4.0 of this report.

NUCLEAR

Section 2.0

SUMMARY OF RESULTS

BY. JAE	DATE 2-21-74	SUBJECT 24" B.F.V.	SHEET NO. 201 OF
CHKD. BY JH	DATE 2-21-74	- SUMMARY -	JOB NO.

COMPONENT	PAGE	STRESS COMPARISON (PSI) & MATERIAL
TRUNNION PINS	19	$\tau = 1919 < .6 S_y = 11100$ (SA-276,304)
CYL. OPERATOR DRIVE ROD	22	$\tau = 52113 < S_y = 90000$ (AISI-4140)
CYL. SUPPORT BRACKET	28	$\tau = 1319 < S_y = 36000$ (ASTM A-36)
CLEVIS	33	$\tau = 1233 < .6 S_y = 36,000$ (ASTM A395) ①
CLEVIS PIN	33	$\tau = 1136 < .6 S_y = 9900$ (SA-2[illegible])
DRIVE LEVER	37	$\tau = 40449 < S_y = 45000$ (AS[illegible])
VALVE BODY "EARS"	42	$\tau = 18761 < S_y = 22000$. (S[illegible])
HARDWARE	45	$\tau = 12927 < S_y = 23333$ (SA-[illegible])
SHAFT	50	$S.I. = 18337 < 1.8 S_m = 27160$ (SA-479)
DISC	51	$S.I. = 3871 < S_m = 15000$ (SA-516, GR-[illegible])
TAPER PINS	53	$\tau_{max} = 10753 < .8 S_m = 12000$ (SA-276)
VALVE BODY	65	$S.I. = 7330 < 1.2 S_m = 19000$ (SA-516, GR60)
GLAND FOLLOWER	67	THICKNESS CHECK ONLY
THRUST BEARING COVER	69	THICKNESS CHECK ONLY

THE TERM "S.I." REFERS TO STRESS INTENSITY

1) [illegible]

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. B-9

NUCLEAR

Section 3.0

CONCLUSIONS

McPherson Associates, Inc. concludes that all components for the 24" Butterfly Valve, as analyzed in this report, meet the requirements of all governing specifications for seismic and operating considerations as defined in References 1, and 3 of this report.

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. B-10

NUCLEAR

TABLE OF CONTENTS

Certification

McPherson Associates, Inc. certifies that the 24" Butterfly Valve, A-206765, as shown on the customer drawings was analyzed in accordance with Washington Public Power Supply System Specification No. 2808-68 and to the best of our knowledge and belief, meets the requirements of Paragraphs 3.2, 3.3, and 3.5.2.4 of this document and Reference 3 of Section 4.0 of this report.

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 07.01.F
SHEET NO. B-6

NUCLEAR

John R. Henry
Registered Professional Engineer
Mass. Registration No. 25929

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. OT.01.F
SHEET NO. B-11

Section 4.0

REFERENCES

1. Washington Public Power Supply System Specification No. 2808-68.

2. BIF Drawings

Drawing No.	Revision	Description
A-206765	B	24" Butterfly Valve-General Arrangements
A-900523	-	Body, Fabricated
A-900524	-	Body, Machining
A-900339	-	Disc, Fabricated
A-900340	-	Disc, Machined
A-208293	-	Cylinder Support Bracket
B-900521,B-900522	-	Operator Shafts
B-211830	-	Drive Lever
D-211837-1	-	Clevis
D-206661	-	Miller Cylinder

3. Section III, Nuclear Power Plant Components, ASME Boiler and Pressure Vessel Code, 1971 with Addenda.

4. Virgil Moring Faires, Design of Machine Elements, 4th Edition, The MacMillan Co., N.Y., 1965.

5. Raymond J. Roark, Formulas for Stress and Strain, 4th Edition, McGraw Hill Book Co., 1965.

6. Laddish Catalog No. 55.

7. Grinnel, Piping and Engineering, 3rd Edition, 1971.

8. 1963 Supplement to Screw Thread Standards for Federal Services.

9. Baumeister & Marks, Standard Handbook for Mechanical Engineers, 7th Edition, McGraw Hill Book Company.

‹ent, Mechanical Engineers Handbook.

\.S.T.M. Standards - Part 2.

\.S.M. Metals Handbook.

imoshenko and Goodier, Theory of Elasticity, 3rd Edition, cGraw Hill Book Co., 1970.

eely and Smith, Advanced Mechanics of Materials, nd Edition, John Wiley & Son, Inc., 1966.

achinery's Handbook, 17th Edition, The Industrial Press, 964.

ction VIII, Pressure Vessels, Division 2 - Alternative les, A.S.M.E. Boiler and Pressure Vessel Code, 1971.

emical Rubber Publishing Co., Standard Mathematics bles, Twelfth Edition.

erican National Standards Institute - Document B16.5 tled "Steel Pipe Flanges and Flanged Fittings."

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

SUPPLIER TRANSMITTAL FORM

(AREA WITHIN HEAVY BORDER TO BE COMPLETED BY SUPPLIER)

TO THE ATTENTION OF: Dennis Armstrong,
(COGNIZANT PURCHASE AGENT/BUYER/CONTRACT ADMIN.)
ADDRESS: 3000 George Washington Way, Richland, WA
SUBJECT: Equipment Seismic/Hydrodynamic Requal
FROM: Cygna Energy Services
ADDRESS: 1200 Jadwin, Suite 565, Richland, WA
THE FOLLOWING PUBLICATIONS/DRAWINGS ARE SUBMITTED FOR:
[XX] APPROVAL [ ] REVIEW [ ] INFORMATION [ ] DISTRIBUTION
NO. OF PRINTS ____ OF EACH NO. OF REPRODUCIBLES ____ OF EACH
SUBMITTED BY: Fawaz Khanacher
TITLE: Assistant Project Manager
SUBVENDOR: ____ CONT./P.O. NO.: ____

PAGE 1 OF 1
TRANSMITTAL NO. 101
[XX] NEW [ ] RE-SUBMITTAL
DATE SUBMITTED: 6/15/83
REQUESTED DATE OF RETURN: ____
CONTRACT NO: C-0892
P.O. NO: ____
WORK ORDER NO: ____
SPEC. NO: ____
SPEC. SECT. NO: ____

ITEM NO.	PUBLICATION OR DRAWING NO.	REV. NO.	PUBLICATION OR DRAWING TITLE	MANUFACTURER	WPPSS ACTION
1	361104	1	Orig. Requal. Rpt. for QID 361104		A
2	T-646RB		Cygna Transmittal #646RB		

COMMENTS: (USE ADDITIONAL SHEET, IF REQUIRED)

· TO BE REVIEWED BY ·

RECEIVED BY: (PURCHASING ONLY)
NAME ____ DATE ____

TRANSMITTED BY: (PURCHASING ONLY)
NAME ____ DATE ____

APPROVED BY: Dennis A. Armstrong TITLE Program Leader DATE 6/15/83

ACTION LEGEND:
A = APPROVED FOR PUBLICATION
AN = APPROVED AS NOTED FOR FABRICATION
I = INFORMATION ONLY
NA = NOT APPROVED

Final Qualification Report

PROJECT: Equipment Seismic and Hydrodynamic Requalification

JOB NO: 82044

CALC NO: OS.01.F

CLIENT: Washington Public Power Supply System

QID NO: 361104

TITLE: Equipment Seismic and Hydrodynamic Requalification of 30" Cylinder Operated Butterfly Valves:

CSP-V-1 and 2
CEP-V-1A and 2A

PREPARED BY: M.A. Scott [signature] 6/15/83 DATE

REVIEWED BY: L.C. Fernandez [signature] 6/15/83 DATE

APPROVED BY: F. Khanachet [signature] 6/15/83 DATE

SUPPLY SYSTEM: RW Heckman 6/15/83

REVISION: 1

QID# 361104

REVISION STATUS LOG

Rev. No.	Date	Prepared by / Reviewed by	Approved by Cygna Energy Services	Approved by WPPSS	Description
0	2/16/83	R. Hsieh H. Abolhoda J. Rakowski L. Fernandez			Original Issue
1	6/15/83	M. Scott L. Fernandez			Revised to incorporate addition of shear plates

Revision 1 1.1

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

REQUALIFICATION CERTIFICATE

WNP- 2

QID 361104

COMPONENT NO: CSP-V-1, CSP-V-2, CEP-V-1A, and CEP-V-2A

COMPONENT DESCRIPTION: 30" Cylinder Operated Butterfly Valves

MANUFACTURER: BIF MODEL NO: A-206763

EQUIPMENT CLASSIFICATION: [X] ACTIVE [ ] PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:
Cygna Energy Services, "Equipment Seismic and Hydrodynamic Requalification of 30" Cylinder Operated Butterfly Valves," File No. OS.01.F, QID No. 361104, Revision 1, June, 1983.

[redacted]

REQUIRED ACTION: 1) Replace A-307 Ear Bolts with A-325 bolts.
2) Addition of shear plates, see sheets 4.3.30 to 4.3.48 for additional details.

THE ABOVE SEISMIC [redacted] QUALIFICATION REPORTS HAVE BEEN REEVALUATED IN ACCORDANCE WITH THE CURRENT NRC SEISMIC [redacted] CRITERIA:

1. IEEE STANDARDS 344 (1975)
2. USNRC REGULATORY GUIDES 1.92, 1.100
3. STANDARD REVIEW PLANS 3.9.2, 3.10, [redacted]
4. NUREG-0588

This equipment is qualified as a assembly when the air cylinders are completely qualified addressed in QID #018001.

THE ABOVE COMPONENT HAS BEEN FOUND ACCEPTABLE FOR PERFORMING ITS INTENDED SAFETY RELATED FUNCTION WHEN SUBJECTED TO THE PLANT SPECIFIC VIBRATORY [redacted] LOADS.

PREPARED BY J.E. Rakowski 1 6/14/83	DATE 3/25/83
REVIEWED BY 6/15/83	DATE 5/16/83
APPROVED BY 6/15/83	DATE

968-12576

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

Qualification Summary of Equipment

QID# 361104

Ref. No.

I. PLANT NAME: WNP-2

TYPE

PWR ______

1. NSSS: GE 2. A/E: Burns & Roe BWR 5, Mark II

II. COMPONENT NAME: 30" Cylinder Operated Butterfly V. COMPONENT NO. CSP-V-1 & 2 CEP-V-1A & 2A △1

1. SCOPE: ☐ NSSS ☒ BOP

2. MODEL NUMBER: A-206763 QUANTITY: 2

3. VENDOR: BIF

4. IF THE COMPONENT IS A CABINET OR PANEL, NAME AND MODEL NO. OF THE DEVICES INCLUDED:

N/A

5. PHYSICAL DESCRIPTION: a. APPEARANCE: Butterfly Valve with 10" Cyl Operator

b. DIMENSIONS: 30" Nominal Diameters

c. WEIGHT: 1208 - Valve Assy; 914 - Operator & Bracket

6. LOCATION: BUILDING: Reactor

ELEVATION: 508' (CSP) and 588' (CEP)

7. FIELD MOUNTING CONDITIONS: ☒ BOLT (NO. ______ SIZE ______)

☐ WELD (LENGTH ______)

☐ ______

8. a. SYSTEM IN WHICH LOCATED: Containment Supply Purge Systems (CSP) Containment Exhaust Purge Systems (CEP)

b. FUNCTIONAL DESCRIPTION: Primary Containment isolation, prevention of of the release of radioactive material to the environment.

c. IS THE EQUIPMENT REQUIRED FOR: ☐ HOT STANDBY ☐ COLD SHUTDOWN

☒ BOTH ☐ NEITHER

9. PERTINENT REFERENCE DESIGN SPECIFICATION: WPPSS Spec. 2808-68

III. IS EQUIPMENT AVAILABLE FOR INSPECTION IN THE PLANT: ☒ YES ☐ NO

Qualification Summary of Equipment (Continued)

QID# 361104

Ref. No.

IV. EQUIPMENT QUALIFICATION METHOD:

☐ TEST ☒ ANALYSIS ☐ COMBINATION OF TEST & ANALYSIS

QUALIFICATION REPORT: Equipment Seismic and Hydrodynamic Requalification of 30" Cylinder Operated Butterfly Valve*

(NO., TITLE & DATE): File No. OS.01.F, June, 1983

COMPANY THAT PREPARED REPORT: Cygna Energy Services

COMPANY THAT REVIEWED REPORT: Washington Public Power Supply Systems

*Plus original valve analysis 1

V. VIBRATION INPUT:

1. LOADS CONSIDERED: a. ☐ SEISMIC ONLY

   b. ☐ HYDRODYNAMIC ONLY

   c. ☒ COMBINATON OF (a) AND (b)

2. METHOD OF COMBINING RRS: ☐ ABSOLUTE SUM ☒ SRSS ☐ OTHER (SPECIFY) ______

3. REQUIRED RESPONSE SPECTRA (ATTACH THE GRAPHS): Section 5.1 of QID 361104

4. DAMPING CORRESPONDING TO RSS: ☐ OBE ______ ☒ SSE 3%

5. REQUIRED ACCELERATION IN EACH DIRECTION: ☐ ZPA ☒ OTHER (SPECIFY) Section 5.5

   OBE S/S = Attached F/B = ______ V = ______

   SSE S/S = Attached F/B = ______ V = ______

6. WERE FATIGUE EFFECTS OR OTHER VIBRATION LOADS CONSIDERED?

   ☒ YES ☐ NO

IF YES, DESCRIBE LOADS CONSIDERED AND HOW THEY WERE TREATED IN OVERALL QUALIFICATION PROGRAM:

The calculated stress ranges were compared to the AISC allowables, as the structures analyzed were not part of the pressure boundary.

*NOTE: IF MORE THAN ONE REPORT, COMPLETE ITEMS IV THROUGH VII FOR EACH REPORT

Qualification Summary of Equipment (Continued)

QID# 361104

Ref. No.

VI. IF QUALIFICATION BY TEST, THEN COMPLETE*: N/A

1. ☐ SINGLE FREQUENCY ☐ MULTI-FREQUENCY ☐ RANDOM

2. ☐ SINGLE AXIS ☐ MULTI-AXIS ☐ SINE BEAT ☐ ________

3. NO. OF QUALIFICATION TESTS: OBE ________ SSE ________ OTHER (SPECIFY) ________

4. FREQUENCY RANGE: ________

5. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL):

   S/S = ________ F/B = ________ V = ________

6. METHOD OF DETERMINING NATURAL FREQUENCIES:

   ☐ LAB TEST ☐ IN SITU TEST ☐ ANALYSIS

7. TRS ENVELOPING RRS USING MULTI-FREQUENCY TEST: ☐ YES (ATTACH TRS & RRS GRAPHS) ☐ NO

8. INPUT g-LEVEL TEST: OBE S/S = ________ F/B = ________ V = ________

   SSE S/S = ________ F/B = ________ V = ________

9. LABORATORY MOUNTING:

   ☐ BOLT (NO. ________, SIZE ________) ☐ WELD (LENGTH ________) ☐ ________

10. FUNCTIONAL OPERABILITY VERIFIED: ☐ YES ☐ NO ☐ NOT APPLICABLE

11. TEST REULTS INCLUDING MODIFICATIONS MADE:

____

____

____

12. OTHER TEST PERFORMED (SUCH AS AGING OR FRAGILITY TEST, INCLUDING RESULTS):

____

____

____

____

*NOTE: IF QUALIFICATION BY A COMBINTATION OF TEST AND ANALYSIS, ALSO COMPLETE ITEM VII.

Qualification Summary of Equipment (Continued)

QID# 361104

Ref. No.

VII. IF QUALIFICATION BY ANALYSIS, THEN COMPLETE:

1. METHOD OF ANALYSIS:

[ ] STATIC ANALYSIS [X] EQUIVALENT STATIC ANALYSIS

[ ] DYNAMIC ANALYSIS [ ] TIME-HISTORY [ ] RESPONSE SPECTRUM

2. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL):

S/S = 13.0 Hz F/B = 11.45 Hz V = >100 Hz

3. MODEL TYPE:

[ ] 3D [ ] 2D [ ] 1D [ ] FINITE ELEMENT [X] BEAM [ ] CLOSED FORM SOLUTION

4. [ ] COMPUTER CODES: ______

FREQUENCY RANGE AND NO. OF MODES CONSIDERED: ______

[X] HAND CALCULATIONS

5. METHOD OF COMBINING DYNAMIC RESPONSES: [ ] ABSOULTE SUM [ ] SRSS [X] OTHER (SPECIFY) ______

6. DAMPING: OBE ______ SSE ______ BASIS FOR THE DAMPING USED: N/A*

7. SUPPORT CONSIDERATIONS IN THE MODEL: pipe-mounted

8. CRITICAL STRUCTURAL ELEMENTS:

A.

IDENTIFICATION	LOCATION	GOVERNING LOAD OR RESPONSE COMBINATION	SEISMIC STRESS	TOTAL STRESS	STRESS ALLOWABLE
Operator Drive Rod	Cylinder on CSP-V-1	Fatigue Stress		86,826	90,000
	CSP-V-2	Range		57,526	90,000
Ear Weld	Support Ear CSP-V-1	Fatigue Stress Range		26,554	28,000

B.

MAX. CRITICAL DEFLECTION	LOCATION	MAXIMUM ALLOWABLE DEFLECTION TO ASSURE FUNCTIONAL OPERABILITY
< 0.01"	Valve disk radial deflection	approx 1/8" radial clearance

NOTE: Calculations based on accelerations for CSP-V-1 and 2 will provide an envelope for CEP-V-1A and 2A. See Table 1.1 of Section 4.3 for relative required accelerations for CSP and CEP valve operators.

*Based on calculation using Revised Burns and Roe Piping Analysis Accelerations, April, 1983.

Qualification Summary of Equipment (Continued)

VIII. REFERENCES

1) BIF Drawings

	Drawing #	Rev#	Description
a	A-206763	F	General Arrangement
b	CEP-625-10		From Reactor Nozzle X-3 to SGT-FU-1A, 1B
c	CEP-625-11.12	H	From Reactor Nozzle X-3 to SGT-FU-1A, 1B
d	C-26095		Model A-83B Cylinder
e	A-206767		Valve Assembly
f	DOC-D-220-0310-IR-66	O	Tube errection iso-metric
g	D-207110	F	Valve Data Sheet
h	M-144		General Arrangment plan mis level
k	CSP-807-3.4		Containment purge air supply system

References continued on page 2.6

Completed By	J E Rakowski 1 [illegible] 6/1/85	Date	3/25/83
Reviewed By	[illegible] [illegible]	Date	5/16/83

THIS PAGE NOT USED.

Calculation Sheet

Project: WPPSS Mechanical Equipment Qualification	Prepared By: J.E. Rakowski	Date: 3/25/83	
Subject: 30" Butterfly Valves	Checked By: L.C. Fernández	Date: 4/29/83	
System: CSP and CEP	Job No. 82044	File No. OS.01/F	
Analysis No. 361104	Rev. No. 1	Sheet No. 2.6	

Reference cont'n

2) Formulas for Natural Frequency and Mode Shapes,
Robert D. Blevins
Van Nostrand Reinhold Company
1979 Edition

3) BIF Report TR-27234 and TR-27235, "Dynamic Torque Calculation of Butterfly Valve; Sizes 24 and 30 inch", dated November 10, 1982.

4) Report TR-74-8 by McPherson Assoc., Inc., "Design & Seismic Analysis 30" Cylinder operated Butterfly Valve". (Rev. 1) 12/31/75.

5) WPPSS letter to Cygna Energy Services, GE-02-RWH-018, 12/17/82.

6) WPPSS, WNP-2 SRM Equipment List Summary Sheets dated 2/10/83.

7) Cygna Energy Services, Equipment Qualification Walkdown Verification Form dated 7/14/82 and 7/19/82.

8) Cygna Energy Services, "Project Manual Design Criteria," DC-1, Rev. 1, 10/82.

9) Burns & Roe Revised Piping Analysis Loads for CSP-V-1 and 2 (received 4/13/83) and CEP-V-1A and 1B (dated 11/15/82).

10) Communications Report, R. Ricappito of BIF and J. Rakowski of CES, "BIF Valve Dimensions", 2/11/83

11) Cygna Energy Services, "Equipment Seismic and Hydrodynamic Requalification Calculation No. OS.01.F", QID No. 361104, Revision 1, May, 1983.

Calculation Sheet

Project: WPPSS, WNP-2 Seismic/Hydrodynamic Mechanical Equipment Requalification		Prepared By: L.C.Fernandez	Date: 4/29/83
Subject: 30"Butterfly Valves		Checked By: [signature]	Date: 4/30/83
System: CEP and CSP		Job No: 82044	File No: OS.01.F
Analysis No: 361104	Rev. No: 1	Sheet No: 2.7	

UPSET CONDITION G-LEVELS

EPN	N	V	E
CSP- V -1	0.76	1.36	0.88
CSP- V-2	0.66	1.33	0.79

FAULTED CONDITION G-LEVELS (REQUIRED)
8 AND 10 INCH AIR CYLINDER OPERATORS

EPN	HYDR LDS	ELEV 'R'	G'S N	V	E
CSP-V -1	Y	508.00	2.26	3.62	2.80
CSP- V -2	Y	508.00	1.44	3.54	1.90
CEP- V -1A	Y	588.00	1.93	2.23	1.85
CEP- V -2A	Y	588.00	0.96	2.11	1.16

From Revised Burns and Roe Piping Accelerations, see Section 5.5.

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QID# 361104

Revision 1

CYGNA

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CON'T

QID# 361104

*Note: Excerpts from report included in specified section. For complete report see Cygna Energy Services File No. OS.01.F, QID 361104, "Equipment Seismic and Hydrodynamic Requalification of 30" Cylinder Operated Butterfly Valves," Revision 1, June, 1983.

Revision 1

Calculation Cover Sheet

CYGNA

Project	Equipment Seismic and Hydrodynamic Requalification	Job No.	82044
		File No.	0S.01.F
Client	Washington Public Power Supply System	Calc. Set No.	1
		No. of Sheets	83

Subject

BIF 30" Cylinder Operated Butterfly Valves,
QID# 361104
EPNS: CSP-V-1, 2
CEP-V-1A, 2A

Statement of Problem

Seismic and Hydrodynamic Requalification of CSP-V-1, CSP-V-2, CEP-V-1A, CEP-V-2A to Burns and Roe Piping Analysis Loads.

Sources of Data

See References pages 4.3.53 and 54.

Sources of Formulae & References

See References pages 4.3.53 and 54.

Remarks The equipment requalification was performed based on calculations using Revised Burns and Roe Piping Analysis Accelerations, April, 1983. (See Section 5.5)

Originators	Checkers	Distribution	Revision No. 1
JE Rakowski	LC Fernandez	Supply System-2	Supersedes Calculation Set No.
H. Abolhoda	MA Scott	Project File-1	Revision 0, 7/23/82
R. Hsieh	DE Searle		Approved By: [signature] Date: 6/5/83

1005.00

Calculation Sheet

Project		Prepared By	Date
Subject		Checked By	Date
System		Job No.	File No.
Analysis No.	Rev No.	Sheet No	

CONTENTS

CYGNA

Calculation Sheet

Project		Prepared By:	Date
Subject		Checked By.	Date
System		Job No.	File No.
Analysis No	Rev. No.	Sheet No	

SECTION 4.1

CONCLUSIONS

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

SUPPLIER TRANSMITTAL FORM

(AREA WITHIN HEAVY BORDER TO BE COMPLETED BY SUPPLIER)

TO THE ATTENTION OF: Dennis Armstrong
(COGNIZANT PURCHASE AGENT/BUYER/CONTRACT ADMIN.)
ADDRESS: 3000 George Washington Way, Richland, WA
SUBJECT: Equip. Seismic/Hydrodynamic Requalification
FROM: Cygna Energy Services
ADDRESS: 1200 Jadwin, Suite 565, Richland, WA

THE FOLLOWING PUBLICATIONS/DRAWINGS ARE SUBMITTED FOR:
[x] APPROVAL [ ] REVIEW [ ] INFORMATION [ ] DISTRIBUTION
NO. OF PRINTS ____ OF EACH NO. OF REPRODUCIBLES ____ OF EACH
SUBMITTED BY: Fawaz Khanachet [signature]
TITLE: Assistant Project Manager
SUBVENDOR: ____ CONT./P.O. NO.: ____

PAGE 1 OF 1
TRANSMITTAL NO. 094
[X] NEW [ ] RE-SUBMITTAL
DATE SUBMITTED: 5/20/83
REQUESTED DATE OF RETURN: ____
CONTRACT NO: C-0892
P.O. NO: ____
WORK ORDER NO: ____
SPEC. NO: ____
SPEC. SECT. NO: ____

ITEM NO.	PUBLICATION OR DRAWING NO.	REV. NO.	PUBLICATION OR DRAWING TITLE	MANUFACTURER	WPPSS ACTION
1	133001	1	Orig. & 1 copy of Final Requal. Report		
2	T-639RB		Cygna Transmittal #639RB		
3	018001	0	Original for QID 018001		A

COMMENTS: (USE ADDITIONAL SHEET, IF REQUIRED)

TO BE REVIEWED BY

RECEIVED BY: (PURCHASING ONLY) NAME ____ DATE ____

TRANSMITTED BY: (PURCHASING ONLY) NAME ____ DATE ____

APPROVED BY: Dennis Armstrong TITLE: Program Leader DATE: 5/24/83

ACTION LEGEND:
A = APPROVED FOR PUBLICATION
AN = APPROVED AS NOTED FOR FABRICATION
I = INFORMATION ONLY
NA = NOT APPROVED

CYGNA

FINAL
QUALIFICATION
REPORT

PROJECT: Equipment Seismic & Hydrodynamic Requalification

JOB NO.: 82044

CALC. NO.: 1P.01/F

CLIENT: Washington Public Power Supply System

QID NO.: 018001

TITLE: Equipment Seismic & Hydrodynamic Requalification
8", 10" and 12" Bore Air Cylinder Operator
EPN #CEP-AO-1A, 2A
CEP-AO-3A, 4A
CSP-AO-1, 2
CSP-AO-3, 4, 5, 6, 9
REA-AO-1, 2
ROA-AO-1, 2

PREPARED BY: [signature] / J E Rakowski — 12/3/82 / 2/19/83 4/25/83

REVIEWED BY: Ronald P Carassa / [signature] — 12-8-82 4/27/83

APPROVED BY: [signature] / [signature] — 12-8-82 5/20/83

SUPPLY SYSTEM RW Holeman 5/24/83

REVISION: 0

REVISION STATUS LOG

Rev. No.	Date	Prepared by / Reviewed by	Approved by Cygna Energy Services	Approved by WPPSS	Description
0	12/8/82	L.K. / ER / DEJ / RPC	9m7 for P Guglielmino		

1.0 REQUALIFICATION CERTIFICATION

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

REQUALIFICATION CERTIFICATE

WNP-2 QID 018001

COMPONENT NO: CSP-AO-3&4

COMPONENT DESCRIPTION: 8" Bore Air Cylinder Operators

MANUFACTURER: Miller Fluid Power Corp. MODEL NO: A83

EQUIPMENT CLASSIFICATION: [X] ACTIVE [ ] PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:

Cygna Report 1P.01/F, QID 018001
WPPSS Seismic Qualification of 8" and 10" Bore Miller Air Operator.

ENVIRONMENTAL QUALIFICATION REPORT REFERENCE:

Remarks 1: Parts of the air operators such as the drive rod, trunnion pins, brackets and clevis were evaluated as part of the respective valve QID packages.

Remarks 2: These operators do not qualify until the operability demonstration described in Section 4.3.2 has been performed.

THE ABOVE SEISMIC AND [redacted] QUALIFICATION REPORTS HAVE BEEN REEVALUATED IN ACCORDANCE WITH THE CURRENT NRC SEISMIC AND [redacted] CRITERIA:

1. IEEE STANDARDS 344 (1975)
2. USNRC REGULATORY GUIDES 1.92, 1.100
3. STANDARD REVIEW PLANS-3.9.2, 3.10, [redacted]
4. [redacted]

This certificate applies only to the operator which was evaluated as part of the valve assembly. Following completion of the valve requalification (QID 361106), the certification will be revised to address the entire assembly.

THE ABOVE COMPONENT HAS BEEN FOUND ACCEPTABLE FOR PERFORMING ITS INTENDED SAFETY RELATED FUNCTION WHEN SUBJECTED TO THE PLANT SPECIFIC VIBRATORY LOADS, subject to the above remarks.

PREPARED BY	J. E. Rakowski (signed in absentia by [illegible])	DATE 4/27/83
REVIEWED BY	[signature]	DATE 4/27/83
APPROVED BY	[illegible]	DATE 5/2[illegible]/83

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

REQUALIFICATION CERTIFICATE

WNP- 2 QID 018001

COMPONENT NO: CSP-AO-1&2

COMPONENT DESCRIPTION: 10" Bore Air Cylinder Operators

MANUFACTURER: Miller Fluid Power Corp. MODEL NO: A83

EQUIPMENT CLASSIFICATION: [X] ACTIVE [ ] PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:

Cygna Energy Services Report 1P.01/F, QID 018001
WPPSS Seismic Qualification of 8" and 10" Bore Miller Air Operator.

ENVIRONMENTAL QUALIFICATION REPORT REFERENCE:

Remarks 1: Parts of the air operators such as the drive rod, trunnion pins, brackets and clevis were evaluated as part of the respective valve QID packages.

Remarks 2: CSP-AO-1,2 are not qualified until the operability demonstration described in Section 4.3.2 has been performed.

THE ABOVE SEISMIC AND [redacted] QUALIFICATION REPORTS HAVE BEEN REEVALUATED IN ACCORDANCE WITH THE CURRENT NRC SEISMIC AND [redacted] CRITERIA:

1. IEEE STANDARDS 344 (1975)
2. USNRC REGULATORY GUIDES 1.92, 1.100
3. STANDARD REVIEW PLANS 3.9.2, 3.10, ~~3.11~~
4. ~~NUREG-0588~~

This certificate applies only to the operator which was evaluated as part of the valve assembly. Following completion of the valve requalification (QID 361104), the certification will be revised to address the entire assembly.

THE ABOVE COMPONENT HAS BEEN FOUND ACCEPTABLE FOR PERFORMING ITS INTENDED SAFETY RELATED FUNCTION WHEN SUBJECTED TO THE PLANT SPECIFIC VIBRATORY LOADS, subject to the above remarks.

PREPARED BY J.E RAKOWSKI (SIGNED IN ABSENTIA BY [illegible])	DATE 4/27/93
REVIEWED BY [signature]	DATE 4/27/93
APPROVED BY [signature]	DATE 5/[illegible]/93

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

REQUALIFICATION CERTIFICATE

WNP- 2 QID 018001

COMPONENT NO: CSP-AO-5,6&9

COMPONENT DESCRIPTION: 8" Bore Air Cylinder Operators

MANUFACTURER: Miller Fluid Power Corp. **MODEL NO:** A83

EQUIPMENT CLASSIFICATION: [X] ACTIVE [ ] PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:

Cygna Report 1P.01/F, QID 018001
WPPSS Seismic Qualification of 8" and 10" Bore Miller Air Operator.

ENVIRONMENTAL QUALIFICATION REPORT REFERENCE:

Remarks 1: Parts of the air operators such as the drive rod, trunnion pins, brackets and clevis were evaluated as part of the respective valve QID packages.

THE ABOVE SEISMIC AND [redacted] QUALIFICATION REPORTS HAVE BEEN REEVALUATED IN ACCORDANCE WITH THE CURRENT NRC SEISMIC AND [redacted] CRITERIA:

1. IEEE STANDARDS 344 (1975)
2. USNRC REGULATORY GUIDES 1.92, 1.100
3. STANDARD REVIEW PLANS 3.9.2, 3.10, ~~3.11~~
4. ~~NUREG-0588~~

This certificate applies only to the operator which was evaluated as part of the valve assembly. Following completion of the valve requalification (QID 361106), the certification will be revised to address the entire assembly.

THE ABOVE COMPONENT HAS BEEN FOUND ACCEPTABLE FOR PERFORMING ITS INTENDED SAFETY RELATED FUNCTION WHEN SUBJECTED TO THE PLANT SPECIFIC VIBRATORY LOADS.

PREPARED BY J E RAKOWSKI (SIGNED IN ABSENTIA BY [signature])	DATE 4/27/83
REVIEWED BY [signature]	DATE 4/27/83
APPROVED BY [signature]	DATE [illegible]/83

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

REQUALIFICATION CERTIFICATE

WNP-2 QID 018001

COMPONENT NO: CEP-AO-1A & 2A

COMPONENT DESCRIPTION: 10" Bore Air Cylinder Operators

MANUFACTURER: Miller Fluid Power Corp. MODEL NO: A83 (2A), A83B (1A)

EQUIPMENT CLASSIFICATION: [X] ACTIVE [ ] PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:

Cygna Report 1P.01/F, QID 018001
WPPSS Seismic Qaulification of 8" and 10" Bore Miller Air Operator.

ENVIRONMENTAL QUALIFICATION REPORT REFERENCE:

Remarks: Parts of the air operators such as the drive rod, trunnion pins, brackets and clevis were evaluated as part of the respective valve QID packages.

THE ABOVE SEISMIC AND [redacted]L QUALIFICATION REPORTS HAVE BEEN REEVALUATED IN ACCORDANCE WITH THE CURRENT NRC SEISMIC AND [redacted]RITERIA:

1. IEEE STANDARDS 344 (1975)
2. USNRC REGULATORY GUIDES 1.92, 1.100
3. STANDARD REVIEW PLANS 3.9.2, 3.10, [redacted]
4. [redacted]

This certificate applies only to the operator which was evaluated as part of the valve assembly. Following completion of the valve requalification (QID 361104), the certification will be revised to address the entire assembly.

THE ABOVE COMPONENT HAS BEEN FOUND ACCEPTABLE FOR PERFORMING ITS INTENDED SAFETY RELATED FUNCTION WHEN SUBJECTED TO THE PLANT SPECIFIC VIBRATORY LOADS.

PREPARED BY JE RAKOWSKI (SIGNED IN ABSENTIA BY [signature])	DATE 4/27/93
REVIEWED BY [signature]	DATE 4/27/93
APPROVED BY [signature]	DATE [illegible]

968-12576

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

REQUALIFICATION CERTIFICATE

WNP- 2 QID 018001

COMPONENT NO: CEP-AO-3A & 4A

COMPONENT DESCRIPTION: 8" Bore Air Cylinder Operators

MANUFACTURER: Miller Fluid Power Corp. MODEL NO: A83(4A), A83B(3A)

EQUIPMENT CLASSIFICATION: [X] ACTIVE [ ] PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:

Cygna Report 1P.01/F, QID 018001
WPPSS Seismic Qualification of 8" and 10" Bore Miller Air Operator.

ENVIRONMENTAL QUALIFICATION REPORT REFERENCE:

Remarks: Parts of the air operators such as the drive rod, trunnion pins, brackets and clevis were evaluated as part of the respective valve QID packages.

THE ABOVE SEISMIC AND [redacted] QUALIFICATION REPORTS HAVE BEEN REEVALUATED IN ACCORDANCE WITH THE CURRENT NRC SEISMIC AND [redacted] CRITERIA:

1. IEEE STANDARDS 344 (1975)
2. USNRC REGULATORY GUIDES 1.92, 1.100
3. STANDARD REVIEW PLANS 3.9.2, 3.10, ~~3.11~~
4. ~~NUREG-0588~~

This certificate applies only to the operator which was evaluated as part of the valve assembly. Following completion of the valve requalification (QID 361106), the certification will be revised to address the entire assembly.

THE ABOVE COMPONENT HAS BEEN FOUND ACCEPTABLE FOR PERFORMING ITS INTENDED SAFETY RELATED FUNCTION WHEN SUBJECTED TO THE PLANT SPECIFIC VIBRATORY LOADS.

PREPARED BY J. E. RAKOWSKI (SIGNED IN ABSENTIA BY [signature])	DATE 4/27/83
REVIEWED BY [signature]	DATE 4/27/83
APPROVED BY [signature]	DATE [illegible]

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

REQUALIFICATION CERTIFICATE

WNP-2 QID 018001

COMPONENT NO: REA-AO-1&2, ROA-AO-1&2

COMPONENT DESCRIPTION: 12" Bore Air Cylinder Operators

MANUFACTURER: Miller Fluid Power Corp. MODEL NO: A83

EQUIPMENT CLASSIFICATION: [X] ACTIVE [ ] PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:

Cygna Report 1P.01/F, QID 018001

WPPSS Seismic Qualification of 8" and 10" Bore Miller Air Operator.

ENVIRONMENTAL QUALIFICATION REPORT REFERENCE:

N/A

THE ABOVE SEISMIC AND [redacted] QUALIFICATION REPORTS HAVE BEEN REEVALUATED IN ACCORDANCE WITH THE CURRENT NRC SEISMIC AND [redacted] CRITERIA:

1. IEEE STANDARDS 344 (1975)
2. USNRC REGULATORY GUIDES 1.92, 1.100
3. STANDARD REVIEW PLANS 3.9.2, 3.10, [redacted]
4. [redacted]

THE ABOVE COMPONENT HAS BEEN FOUND ACCEPTABLE FOR PERFORMING ITS INTENDED SAFETY RELATED FUNCTION WHEN SUBJECTED TO THE PLANT SPECIFIC VIBRATORY LOADS.

PREPARED BY J.E. RAKOWSKI (SIGNED IN ABSENTIA BY [signature])	DATE 4/27/83
REVIEWED BY [signature]	DATE 4/27/83
APPROVED BY [signature]	DATE [illegible]

968-12576

2.0 SQRT FORM(S) AND REFERENCES

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

Qualification Summary of Equipment

QID 018001

Ref. No.

I. PLANT NAME: WNP-2 TYPE

PWR ____

1. NSSS: GE 2. A/E: Burns & Roe BWR 5-Mark II

II. COMPONENT NAME: 8" Bore Air Cylinder COMPONENT NO. CEP-AO-3A, 4A CSP-AO-3,4,5,6,9

1. SCOPE: ☐ NSSS ☒ BOP

2. MODEL NUMBER: A83B QUANTITY: 7

3. VENDOR: BIF

4. IF THE COMPONENT IS A CABINET OR PANEL, NAME AND MODEL NO. OF THE DEVICES INCLUDED:

N/A

5. PHYSICAL DESCRIPTION: a. APPEARANCE: Cylindrical 13

b. DIMENSIONS: 8" Dia. x 51.5" long (excludes the drive rod) 13

c. WEIGHT: 399 lbs. - cylinder, 277 lb. - bracket 13

6. LOCATION: BUILDING: Reactor Building 4

ELEVATION: 475' - 497' 4

7. FIELD MOUNTING CONDITIONS: ☒ BOLT (NO. ____ SIZE ____)

☐ WELD (LENGTH ____)

☐ ____

8. a. SYSTEM IN WHICH LOCATED: CEP; Containment Exhaust Purge System 4
CSP; Containment Supply Purge System

b. FUNCTIONAL DESCRIPTION: Primary Containment Isolation and Prevention of the release of radioactive material to the environment 4

c. IS THE EQUIPMENT REQUIRED FOR: ☐ HOT STANDBY ☐ COLD SHUTDOWN

☒ BOTH ☐ NEITHER 4

9. PERTINENT REFERENCE DESIGN SPECIFICATION: 68

III. IS EQUIPMENT AVAILABLE FOR INSPECTION IN THE PLANT: ☒ YES ☐ NO
(see walkdown)

Qualification Summary of Equipment (Continued)

QID 018001

Ref. No.

VI. IF QUALIFICATION BY TEST, THEN COMPLETE*: N/A

1. ☐ SINGLE FREQUENCY ☐ MULTI-FREQUENCY ☐ RANDOM

2. ☐ SINGLE AXIS ☐ MULTI-AXIS ☐ SINE BEAT ☐ ______

3. NO. OF QUALIFICATION TESTS: OBE ______ SSE ______ OTHER (SPECIFY) ______

4. FREQUENCY RANGE: ______

5. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL):

   S/S = ______ F/B = ______ V = ______

6. METHOD OF DETERMINING NATURAL FREQUENCIES:

   ☐ LAB TEST ☐ IN SITU TEST ☐ ANALYSIS

7. TRS ENVELOPING RRS USING MULTI-FREQUENCY TEST: ☐ YES (ATTACH TRS & RRS GRAPHS) ☐ NO

8. INPUT g-LEVEL TEST: OBE S/S = ______ F/B = ______ V = ______

   SSE S/S = ______ F/B = ______ V = ______

9. LABORATORY MOUNTING:

   ☐ BOLT (NO. ______, SIZE ______) ☐ WELD (LENGTH ______) ☐ ______

10. FUNCTIONAL OPERABILITY VERIFIED: ☐ YES ☐ NO ☐ NOT APPLICABLE

11. TEST REULTS INCLUDING MODIFICATIONS MADE:

______

______

______

12. OTHER TEST PERFORMED (SUCH AS AGING OR FRAGILITY TEST, INCLUDING RESULTS):

______

______

______

______

*NOTE: IF QUALIFICATION BY A COMBINTATION OF TEST AND ANALYSIS, ALSO COMPLETE ITEM VII.

FAULTED CONDITION G-LEVELS*
8 AND 10 INCH AIR CYLINDER OPERATORS

EPN	HYDR LDS	ELEV 'R'	G'S N	G'S V	G'S E	N ***	V ***	E ***
CSP-AO-1	Y	508.00	4.40	6.51	4.89 **	2.26	3.62	2.80
CSP-AO-2	Y	508.00	4.95	6.45	3.72 **	1.44	3.54	1.90
CSP-AO-3	Y	481.00	5.72	3.82	7.45 **	2.66	2.99	3.76
CSP-AO-4	Y	478.00	4.65	4.06	6.57 **	2.96	3.17	4.19
CSP-AO-5	Y	475.00	9.35	5.75	7.72	2.96	3.44	5.42
CSP-AO-6	Y	480.00	9.35	5.57	1.46	11.39	3.33	5.85
CSP-AO-9	Y	490.00	2.57	1.73	2.67	NC	NC	NC
EP-AO-1	Y	588.00	1.27	1.77	1.23	NC	NC	NC
EP-AO-2	Y	588.00	0.78	1.77	1.02	NC	NC	NC
CEP-AO-3A	Y	495.00	13.89	1.66	1.04	4.57	1.26	0.86
CEP-AO-4A	Y	495.00	10.95	1.50	1.10	3.35	1.34	0.86

*Transmitted from the final piping analysis, see Section 5.5.
**These valves are required to fail-closed during a DBE, change Use Code to "1,3".

*** THESE ACCELERATIONS REPRESENT REVISED PIPING ANALYSIS BURNS & ROE INC WOODBURY, TELECOPIED TRANSMITTAL P. SCHUENZEL TO D. ARMSTRONG (WPPSS). SEE SEC. 5.5/Q.I.D 018001

[signature] 4/21/8[illegible]
[signature] 4/27/8[illegible]

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

Qualification Summary of Equipment

QID 018001

		Ref. No.
I. PLANT NAME: WNP-2	TYPE	
	PWR ______	
1. NSSS: GE 2. A/E: Burns & Roe	BWR 5 - Mark II	
II. COMPONENT NAME: 10" Bore Air Cylinder	COMPONENT NO. CEP-AO-1A, 2A CSP-AO-1, 2	4
1. SCOPE: ☐ NSSS ☒ BOP		
2. MODEL NUMBER: A83B	QUANTITY: 4	
3. VENDOR: BIF		
4. IF THE COMPONENT IS A CABINET OR PANEL, NAME AND MODEL NO. OF THE DEVICES INCLUDED: N/A		
5. PHYSICAL DESCRIPTION: a. APPEARANCE: Cylindrical		13
b. DIMENSIONS: 10" dia. x 64" long (excludes the drive rod)		13
c. WEIGHT: 593 lbs. - cylinder, 321 lb. - bracket		13
6. LOCATION: BUILDING: Reactor Building		4
ELEVATION: 508' to 560'		4
7. FIELD MOUNTING CONDITIONS: ☒ BOLT (NO. ______ SIZE ______) ☐ WELD (LENGTH ______) ☐ ______		
8. a. SYSTEM IN WHICH LOCATED: CEP; Containment Exhaust Purge System CSP; Containment Supply Purge System		4
b. FUNCTIONAL DESCRIPTION: Primary Containment Isolation and Prevention of the release of radioactive material to the environment.		4
c. IS THE EQUIPMENT REQUIRED FOR: ☐ HOT STANDBY ☐ COLD SHUTDOWN ☒ BOTH ☐ NEITHER		4
9. PERTINENT REFERENCE DESIGN SPECIFICATION: 68		
III. IS EQUIPMENT AVAILABLE FOR INSPECTION IN THE PLANT: ☒ YES (See Walkdown) ☐ NO		

Qualification Summary of Equipment (Continued)

QID 018001

	Ref. No.
EQUIPMENT QUALIFICATION METHOD:	
☐ TEST ☒ ANALYSIS ☐ COMBINATION OF TEST & ANALYSIS	4
QUALIFICATION REPORT: Requalification Analysis of QID 018001	
(NO., TITLE & DATE): OP.01/F, February 1983	
COMPANY THAT PREPARED REPORT: Cygna Energy Services	
COMPANY THAT REVIEWED REPORT: Washington Public Power Supply System	
V. **VIBRATION INPUT:**	
1. LOADS CONSIDERED: a. ☐ SEISMIC ONLY	
b. ☐ HYDRODYNAMIC ONLY	
c. ☒ COMBINATON OF (a) AND (b)	4
2. METHOD OF COMBINING RRS: ☐ ABSOLUTE SUM ☒ SRSS ☐ OTHER (SPECIFY) ______	
3. REQUIRED RESPONSE SPECTRA (ATTACH THE GRAPHS): Section 5.1	
4. DAMPING CORRESPONDING TO RSS: ☐ OBE ______ ☒ SSE 2%	
5. REQUIRED ACCELERATION IN EACH DIRECTION: ☐ ZPA ☒ OTHER (SPECIFY) Sec. 5.4	
OBE S/S = Attached F/B = ______ V = ______	
SSE S/S = Attached F/B = ______ V = ______	
6. WERE FATIGUE EFFECTS OR OTHER VIBRATION LOADS CONSIDERED?	
☒ YES ☐ NO	13
IF YES, DESCRIBE LOADS CONSIDERED AND HOW THEY WERE TREATED IN OVERALL QUALIFICATION PROGRAM:	
For those EPN's which are subjected to hydrodynamic loadings, the fatigue analysis on critical locations will be performed to comply with the requirements of AISC, Section 5, Appendix B. Total number of hydrodynamic stress cycles is equal to 15560.0 cycles (10 x 6 (OBE/SSE) + 3 x 4500 (SRV) + 2000.0 cycles (chugging).	1
*NOTE: IF MORE THAN ONE REPORT, COMPLETE ITEMS IV THROUGH VII FOR EACH REPORT	

Qualification Summary of Equipment (Continued)

QID 018001

Ref. No.

VI. IF QUALIFICATION BY TEST, THEN COMPLETE*: N/A

1. ☐ SINGLE FREQUENCY ☐ MULTI-FREQUENCY ☐ RANDOM

2. ☐ SINGLE AXIS ☐ MULTI-AXIS ☐ SINE BEAT ☐ ______

3. NO. OF QUALIFICATION TESTS: OBE ______ SSE ______ OTHER (SPECIFY) ______

4. FREQUENCY RANGE: ______

5. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL):

S/S = ______ F/B = ______ V = ______

6. METHOD OF DETERMINING NATURAL FREQUENCIES:

☐ LAB TEST ☐ IN SITU TEST ☐ ANALYSIS

7. TRS ENVELOPING RRS USING MULTI-FREQUENCY TEST: ☐ YES (ATTACH TRS & RRS GRAPHS) ☐ NO

8. INPUT g-LEVEL TEST: OBE S/S = ______ F/B = ______ V = ______

SSE S/S = ______ F/B = ______ V = ______

9. LABORATORY MOUNTING:

☐ BOLT (NO. ______, SIZE ______) ☐ WELD (LENGTH ______) ☐ ______

10. FUNCTIONAL OPERABILITY VERIFIED: ☐ YES ☐ NO ☐ NOT APPLICABLE

11. TEST REULTS INCLUDING MODIFICATIONS MADE:

______

______

______

12. OTHER TEST PERFORMED (SUCH AS AGING OR FRAGILITY TEST, INCLUDING RESULTS):

______

______

______

______

*NOTE: IF QUALIFICATION BY A COMBINTATION OF TEST AND ANALYSIS, ALSO COMPLETE ITEM VII.

Qualification Summary of Equipment (Continued)

QID 018001

Ref. No.

IF QUALIFICATION BY ANALYSIS, THEN COMPLETE:

1. METHOD OF ANALYSIS: — 13

[ ] STATIC ANALYSIS [X] EQUIVALENT STATIC ANALYSIS

[ ] DYNAMIC ANALYSIS [ ] TIME-HISTORY [ ] RESPONSE SPECTRUM

2. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL): — 10

S/S = 13.0 Hz F/B = 11.45 Hz V = 100 Hz

3. MODEL TYPE:

[ ] 3D [ ] 2D [ ] 1D [ ] FINITE ELEMENT [X] BEAM [ ] CLOSED FORM SOLUTION

4. [ ] COMPUTER CODES: None

FREQUENCY RANGE AND NO. OF MODES CONSIDERED: N/A

[X] HAND CALCULATIONS — 13

5. METHOD OF COMBINING DYNAMIC RESPONSES: [ ] ABSOULTE SUM [ ] SRSS [X] OTHER (SPECIFY) ______

6. DAMPING: OBE ______ SSE ______ BASIS FOR THE DAMPING USED: N/A*

7. SUPPORT CONSIDERATIONS IN THE MODEL: Pipe-Mounted — 10

8. CRITICAL STRUCTURAL ELEMENTS:

A.

IDENTIFICATION	LOCATION	GOVERNING LOAD OR RESPONSE COMBINATION	SEISMIC STRESS	TOTAL STRESS	STRESS ALLOWABLE	Ref. No.
Drive Rod	Operator CSP-V-1	Fatigue/Faulted	(Range) 86824		90,000 PSI	11

B.

MAX. CRITICAL DEFLECTION	LOCATION	MAXIMUM ALLOWABLE DEFLECTION TO ASSURE FUNCTIONAL OPERABILITY

Operability to be demonstrated by test for CSP-AO-1 & 2.

**Air Operator bushing stress > 200psi

* Final Response accelerations from piping analysis were used.

FAULTED CONDITION G-LEVELS*
8 AND 10 INCH AIR CYLINDER OPERATORS

EPN	HYDR LDS	ELEV 'R'	G'S N	G'S V	G'S E		N ***	V ***	E ***
CSP-AO-1	Y	508.00	4.40	6.51	4.89	**	2.26	3.62	2.80
CSP-AO-2	Y	508.00	4.95	6.45	3.72	**	1.44	3.54	1.90
CSP-AO-3	Y	481.00	5.72	3.82	7.45	**	2.66	2.99	3.76
CSP-AO-4	Y	478.00	4.65	4.06	6.57	**	2.96	3.17	4.19
CSP-AO-5	Y	475.00	9.35	5.75	7.72		2.96	3.44	5.42
CSP-AO-6	Y	480.00	9.35	5.57	1.46		11.39	3.33	5.85
CSP-AO-9	Y	490.00	2.57	1.73	2.67		NC	NC	NC
CEP-AO-1	Y	588.00	1.27	1.77	1.23		NC	NC	NC
EP-AO-2	Y	588.00	0.78	1.77	1.02		NC	NC	NC
CEP-AO-3A	Y	495.00	13.89	1.66	1.04		4.57	1.26	0.86
CEP-AO-4A	Y	495.00	10.95	1.50	1.10		3.35	1.34	0.86

*Transmitted from the final piping analysis, see Section 5.5.
**These valves are required to fail-closed during a DBE, change Use Code to "1,3".

*** THESE ACCELERATIONS REPRESENT REVISED PIPING ANALYSIS BURNS & ROE INC, WOODBURY, ~~TELECOPIED~~ TRANSMITTAL P. SCHUENZEL TO D. ARMSTRONG (WPPSS). SEE SEC. 5.5 / QID 018001

[signature] 4/21/83
[signature] 4/27/83

CYGNA

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

Qualification Summary of Equipment

QID 018001

	Ref. No.
I. PLANT NAME: WNP-2 TYPE	
PWR ______	
1. NSSS: GE 2. A/E: Burns & Roe BWR 5 - Mark II	
II. COMPONENT NAME: 12" Bore Air Cylinder COMPONENT NO. REA-AO-1, 2 ROA-AO-1, 2	4
1. SCOPE: ☐ NSSS ☒ BOP	
2. MODEL NUMBER: A83B QUANTITY: 4	
3. VENDOR: BIF	
4. IF THE COMPONENT IS A CABINET OR PANEL, NAME AND MODEL NO. OF THE DEVICES INCLUDED: N/A	
5. PHYSICAL DESCRIPTION: a. APPEARANCE: Cylindrical	13
b. DIMENSIONS: 12" dia. x 46.83" long (excludes the drive rod)	13
c. WEIGHT: 583 lbs. - cylinder, 586 lb. - bracket	13
6. LOCATION: BUILDING: Reactor Building	4
ELEVATION: 578' to 597'	4
7. FIELD MOUNTING CONDITIONS: ☒ BOLT (NO. ____ SIZE ____) ☐ WELD (LENGTH ____) ☐ ____	
8. a. SYSTEM IN WHICH LOCATED: REA; Reactor Building Exhaust Air (HVAC) System ROA; Reactor Building Outside Air (HVAC) System	4
b. FUNCTIONAL DESCRIPTION: Reactor Building, Containment Atmosphere Control, and prevention of the release of radioactive material to the environment.	4
c. IS THE EQUIPMENT REQUIRED FOR: ☐ HOT STANDBY ☐ COLD SHUTDOWN ☒ BOTH (REA) ☒ NEITHER (ROA)	4
9. PERTINENT REFERENCE DESIGN SPECIFICATION: 68	
III. IS EQUIPMENT AVAILABLE FOR INSPECTION IN THE PLANT: ☒ YES (See Walkdown) ☐ NO	

Qualification Summary of Equipment (Continued)

QID 018001

	Ref. No.
EQUIPMENT QUALIFICATION METHOD:	
[ ] TEST [X] ANALYSIS [ ] COMBINATION OF TEST & ANALYSIS	4
QUALIFICATION REPORT: Requalification Analysis of QID 018001	
(NO., TITLE & DATE): OP.01/F, February 1983	
COMPANY THAT PREPARED REPORT: Cygna Energy Services	
COMPANY THAT REVIEWED REPORT: Washington Public Power Supply System	

V. VIBRATION INPUT:

1. LOADS CONSIDERED: a. [ ] SEISMIC ONLY
   b. [ ] HYDRODYNAMIC ONLY
   c. [X] COMBINATON OF (a) AND (b)
2. METHOD OF COMBINING RRS: [ ] ABSOLUTE SUM [X] SRSS [ ] OTHER (SPECIFY) ______
3. REQUIRED RESPONSE SPECTRA (ATTACH THE GRAPHS): Section 5.1
4. DAMPING CORRESPONDING TO RSS: [ ] OBE ______ [X] SSE 2%
5. REQUIRED ACCELERATION IN EACH DIRECTION: [ ] ZPA [X] OTHER (SPECIFY) Sect. 5.4

	S/S =	F/B =	V =
OBE	1.0	1.0	0.6
SSE	1.0	1.0	0.6

6. WERE FATIGUE EFFECTS OR OTHER VIBRATION LOADS CONSIDERED?

[X] YES [ ] NO — Ref. No. 13

IF YES, DESCRIBE LOADS CONSIDERED AND HOW THEY WERE TREATED IN OVERALL QUALIFICATION PROGRAM:

For those EPN's which are subjected to hydrodynamic loadings, the fatigue analysis on critical loacations will be performed to comply with the requirements of AISC, Section 5, Appendix B. Total number of hydrodynamic stress cycles is equal to 15560.0 cycles (10x6 (OBE/SSE) + 3x4500 (SRV) + 2000.0 cycles (chugging). — Ref. No. 1

*NOTE: IF MORE THAN ONE REPORT, COMPLETE ITEMS IV THROUGH VII FOR EACH REPORT

Qualification Summary of Equipment (Continued) QID 018001

Ref. No.

VI. IF QUALIFICATION BY TEST, THEN COMPLETE*: N/A

1. ☐ SINGLE FREQUENCY ☐ MULTI-FREQUENCY ☐ RANDOM

2. ☐ SINGLE AXIS ☐ MULTI-AXIS ☐ SINE BEAT ☐ ______

3. NO. OF QUALIFICATION TESTS: OBE ______ SSE ______ OTHER (SPECIFY) ______

4. FREQUENCY RANGE: ______

5. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL):

S/S = ______ F/B = ______ V = ______

6. METHOD OF DETERMINING NATURAL FREQUENCIES:

☐ LAB TEST ☐ IN SITU TEST ☐ ANALYSIS

7. TRS ENVELOPING RRS USING MULTI-FREQUENCY TEST: ☐ YES (ATTACH TRS & RRS GRAPHS) ☐ NO

8. INPUT g-LEVEL TEST: OBE S/S = ______ F/B = ______ V = ______

SSE S/S = ______ F/B = ______ V = ______

9. LABORATORY MOUNTING:

☐ BOLT (NO. ______, SIZE ______) ☐ WELD (LENGTH ______) ☐ ______

10. FUNCTIONAL OPERABILITY VERIFIED: ☐ YES ☐ NO ☐ NOT APPLICABLE

11. TEST REULTS INCLUDING MODIFICATIONS MADE:

______

______

______

12. OTHER TEST PERFORMED (SUCH AS AGING OR FRAGILITY TEST, INCLUDING RESULTS):

______

______

______

______

*NOTE: IF QUALIFICATION BY A COMBINTATION OF TEST AND ANALYSIS, ALSO COMPLETE ITEM VII.

Qualification Summary of Equipment (Continued)

QID 018001

Ref. No.

IF QUALIFICATION BY ANALYSIS, THEN COMPLETE:

1. METHOD OF ANALYSIS:

[ ] STATIC ANALYSIS [X] EQUIVALENT STATIC ANALYSIS 13

[ ] DYNAMIC ANALYSIS [ ] TIME-HISTORY [ ] RESPONSE SPECTRUM

2. NATURAL FREQUENCIES IN EACH DIRECTION (SIDE/SIDE, FRONT/BACK, VERTICAL):

S/S = 10.81 F/B = 52.0 V = 100

3. MODEL TYPE:

[ ] 3D [ ] 2D [ ] 1D [ ] FINITE ELEMENT [X] BEAM [ ] CLOSED FORM SOLUTION

4. [ ] COMPUTER CODES: None

FREQUENCY RANGE AND NO. OF MODES CONSIDERED: N/A

[X] HAND CALCULATIONS

5. METHOD OF COMBINING DYNAMIC RESPONSES: [ ] ABSOULTE SUM [X] SRSS [ ] OTHER (SPECIFY) ______ 13

6. DAMPING: OBE ______ SSE ______ BASIS FOR THE DAMPING USED: N/A*

7. SUPPORT CONSIDERATIONS IN THE MODEL: Pipe-Mounted

8. CRITICAL STRUCTURAL ELEMENTS:

A.

IDENTIFICATION	LOCATION	GOVERNING LOAD OR RESPONSE COMBINATION	SEISMIC STRESS	TOTAL STRESS	STRESS ALLOWABLE	Ref. No.
Tie Rods		Operating		13681psi	20000 psi	13
Drive Rods	threaded end	faulted		31,172 psi	86,400 psi	

B.

MAX. CRITICAL DEFLECTION	LOCATION	MAXIMUM ALLOWABLE DEFLECTION TO ASSURE FUNCTIONAL OPERABILITY

* Final response accelerations from piping analysis were used.

Qualification Summary of Equipment (Continued) QID 018001

VIII. REFERENCES

1. "ASME Boiler and Pressure Vessel Code", American Society of Mechanical Engineers 1974 Edition with Winter 1974 Addenda. Section III, Division 1, Subsections NC and Appendicies.
2. U.S. Atomic Energy Commission Regulatory Guide No. 1.61, October 1973.
3. Response Spectra Plots. From Design Input Document No. 82045 DID 001.
4. WNP-2 Safety Related Mechanical Equipment List, SRM02. Dated 9/9/82, Section 5.4.
5. "Project Manual for WPPSS Equipment Seismic and Hydrodynamic Requalification", Cygna Energy Services, Rev. 0, Dated 6/8/82. Including Design Criteria DC-1.
6. Cygna Energy Services Project Memorandum, 82044/027SF, dated 9/9/82.
7. WPPSS WNP-2, FSAR Table 3-7.1.
8. Cygna Energy Services Equipment Qualification Walkdown Verification Forms for EPN's CEP-AO-1A, CEP-AO-2A, CEP-V-3A, CEP-V-4A, CSP-V-1, CSP-V-2, CSP-V-3, CSP-V-4, CSP-V-5, CSP-V-6, CSP-V-9.
9. American Institute of Steel Construction, "Manual of Steel Construction", 8th Edition, AISC, New York, NY.
10. Equipment Seismic & Hydrodynamic Requalification, QID #361104. File OS.01/F.
11. Equipment Seismic & Hydrodynamic Requalification, QID #361106, File OT.01/F.
12. Equipment Seismic & Hydrodynamic Requalification, QID #361102,
13. Cygna Calculation, Equipment Requalification, QID 018001, File 1P.01.F.

Completed By L Kam /J.E. Rakowski	Date 12/3/82
Reviewed By R.P. Cassoo / h.e. Smith 4/25/83	Date 12-8-82

3.0 TABLE OF CONTENTS

TABLE OF CONTENTS QID 018001

SECTION 4.0

REQUALIFICATION ANALYSIS

Calculation Cover Sheet

QID 018001

Project Equipment Seismic/Hydrodynamic Requalification	**Job No.** 82044
	File No. OP.01/F
Client Washington Public Power Supply System	**Calc. Set No.** 1
	No. of Sheets 51

Subject
Dynamic Qualification of 8, 10 and 12 inch Bore Air Cylinder Operators.

Statement of Problem

The equipment qualification was performed based on calculations using the air operator response g-levels transmitted by the A/E, current to 12/31/82.

Sources of Data

References, Section 4.4

Sources of Formulae & References

Cygna Design Criteria DC-1, Rev. 0

Remarks

None

Originators	Checkers	Distribution	Revision No. 0
L. Kaner	R. Casassa		Supersedes Calculation Set No.
J. Foley	D. Searle		
J. Rakowski			Approved By: [signature] Date: 5/20/83

1005.00

CYGNA

Calculation Sheet

QID 018001

Project		Prepared By:	Date
Subject		Checked By:	Date
System		Job No.	File No.
Analysis No.	Rev. No.	Sheet No.	

CONTENTS

CYGNA

Calculation Sheet

Project		Prepared By:	Date
Subject		Checked By:	Date
System		Job No.	File No.
Analysis No.	Rev. No.	Sheet No.	

SECTION 4.1

CONCLUSIONS

CYGNA

Calculation Sheet

Project: WPPSS Equip. Seismic/Hydrodynamic Requal.		Prepared By: J.E. Rakowski	Date: 4/22/83
Subject: Requalification		Checked By: D. Searle	Date: 4/25/83
System: BIF Air Operators		Job No.: 82044	File No.: 1P.01/F
Analysis No.: 018001.	Rev. No.: 0	Sheet No.: 018001	

CONCLUSIONS

This QID demonstrates seismic and hydrodynamic qualification of the 8, 10 and 12 inch bore diameter cylinder operators identified in Section 4.2.

Summary Table 4.2.2 presents these comparisons and shows requirements for the bolting material in the 8 and 10 inch cylinders.

1. Cylinders CSP-AO-1,2,3 & 4 must be qualified for an active function and require a representitive operability demonstration as described in Section 4.3.2 of this report.

This should be performed using the values of air operator loads in QID 361104 and 361106.

QID packages 361101 and 361102 document qualification of the valves associated with the 12 inch air cylinder in this report for the seismic loads which they experience. No fatigue analysis is required for these cylinders because no hydrodynamic vibration is experienced. These cylinders were shown to qualify with A307 bracket bolting for the actual response g-levels calculated in the piping analysis.

This qualification package will be complete when a satisfactory operability test is performed and documented herein. It has been concluded in this report that the standard A307 "earbolts" should be replaced with A325 material type bolts on the 8" and 10" air cylinders only.

CYGNA

Calculation Sheet

Project: WPPSS Equip. Seismic/Hydrodynamic Requal		Prepared By: J.E. Rakowski	Date: 4/22/83
Subject: Requalification		Checked By:	Date:
System: BIF Air Operators		Job No.: 82044	File No.: 1P.01/F
Analysis No.: 018001	Rev. No.: 0	Sheet No.: 018001	

SECTION 4.2

SUMMARY OF RESULTS

CYGNA

Calculation Sheet

Project: WPPSS Equipment Seismic/Hydro. Requal.		Prepared By: J.E. Rakowski	Date: 4/22/83
Subject: Requalification		Checked By: D.E. Searle	Date: 4/25/83
System: BIF Air Operators		Job No. 82044	File No. 1P.01/F
Analysis No. 018001	Rev. No. 0	Sheet No. 018001 - 4.2.1.	

4.2 SUMMARY OF RESULTS

Summary tables in this section present calculated stresses in comparison to allowables for the 8, 10 and 12 inch air cylinder operators. Trunnion pin, drive rod and bracket bolt calculated stresses for the 8 and 10 inch air cylinders were taken from QID 361106 and 361104, respectively. These calculations were performed on the valve/operator assembly using the SRSS method and the actual piping response g-levels to eliminate unnecessary conservatism in the higher-stressed components. The air operator components addressed in this report are not highly stressed and were analyzed using simpler techniques with generally higher envelope loads having greater margin. See Section 4.3.1 for more information.

The following summary tables note corresponding g-levels and operator components.

CYGNA

Calculation Sheet

Project: WPPSS Equip. Seismic/Hydrodynamic Requal.	Prepared By: J.E. Rakowski	Date: 4/22/83	
Subject: Requalification	Checked By: [signature]	Date: 4/22/83	
System: BIF Air Operators	Job No. 82044	File No. 1P.01/F	
Analysis No. 018001	Rev. No. 0	Sheet No. 018001 - 4.2.2	

TABLE 4.2.1

AIR CYLINDER REQUIRED G-LEVELS

SIZE	EPN	ELEVATION	REQ'D G'S - GLOBAL* X(N)	Y(VERT)	Z(E)
8	CSP-AO-3	481	2.66	2.99	3.76
8	CSP-AO-4	478	2.96	3.17	4.19
8	CSP-AO-5	475	2.96	3.44	5.42
8	CSP-AO-6	480	11.39	3.33	5.85
8	CSP-AO-9	490	2.57	1.73	2.67
8	CEP-AO-3A	497	4.57	1.26	0.86
8	CEP-AO-4A	497	3.35	1.34	0.86
10	CSP-AO-1	500	2.26	3.62	2.80
10	CSP-AO-2	500	1.44	3.54	1.90
10	CEP-AO-1A	500	1.93	2.23	1.85
10	CEP-AO-2A	500	0.96	2.11	1.16
12	REA-AO-1	597	1.00	0.60	1.00
12	REA-AO-2	597	1.00	0.60	1.00
12	ROA-AO-1	578	1.00	0.60	1.00
12	ROA-AO-2	578	1.00	0.60	1.00

* Refer to final piping G-levels in Section 5.5 and QID 361104 and 361106.

NOTE: ALL STRESSES LISTED IN PSI

SUMMARY TABLE 4.2.2

EPN'S QUALIFIED TO REQUIRED PIPING RESPONSE G'S **

VALVE EPN'S

FAULTED

MEMBER	MAT'L	STRESS TYPE	CSP-3	CSP-4	CSP-5	CSP-6	CEP-3A	CEP-4A	CSP1	CSP2
TR PINS	SA 276	SHEAR	4108 MAX	(ALLOW 11840) →						
DR ROD	A-4140	NORMAL	31629	33019	40634	33433	7462	7462	44732	30082
SUMMARY		(NORMAL ALLOWABLE)	86400 →							
EAR BOLTS	A-325	TENSILE	16845	18393	20848	58883	23525	23525	12150	8790
		SHEAR	14670	15475	19482	17564	4538	4538	9500	7540
SUMMARY		SHEAR ALLOWABLE	26250 →							
		NORMAL ALLOWABLE	66000 →							

FATIGUE RESULTS

MEMBER	MAT'L	STRESS TYPE	CSP-3	CSP-4	CSP-5	CSP-6	CEP-3A	CEP-4A	CSP1	CSP2
TR PINS	SA-276	SHEAR	8216 MAX →							
DR ROD	A-4140	NORMAL	46172	48952	65826	66866	13280	13280	86824	57526
SUMMARY		(NORMAL ALLOWABLE)	90000 →							

*CSP-AO-9 ENVELOPED BY CSP-AO-4 BY WIDE MARGIN
*CEP-AO-1A, & 2A QUALIFIED BY CEP-AO-4A.
** SEE TABLE 4.2.1

Calculation Sheet

Project: WPPSS - EQUIPMENT SEISMIC/HYDRO REQUAL
Subject: B/F VALVES W/ MILLER OPERATORS
System: 8", 10", 12" AIR CYLINDERS
Analysis No. 010 01/001
Rev. No. 0
Prepared By: [signature] Date 4/25/83
Checked By: [signature] Date 4/27/83
Job No. 82044
File No. 1P.01/E
Sheet No. 010001-4.2.3

TABLE 4.2.2
(continued)

Remaining 8" Bore Air Operator Components $g_h=14$ $g_v=6$:

Cylinder:

SI_{max} = 12,056 psi < 18,000 psi ∴ O.K.

Tie Rods:

f_t = 6099 psi < 20,000 psi ∴ O.K.

Support Bracket (Bearing):

F_p = 2299 psi < 32400 psi ∴ O.K.

Total Stress:

= 7492 psi < 21,600 psi ∴ O.K.

Shear Stress:

691 psi < 14,400 psi ∴ O.K.

Weld:

f = 789 psi < 21,000 psi ∴ O.K.

Fatigue:

f_r = 1579 psi < 45,000 psi ∴ O.K.

Remaining 10" Bore Air Operator Components $g_h=6$ $g_v=5$:

Cylinder:

SI_{max} = 9293 psi 18,000 ∴ O.K.

Tie Rods:

f_t = 6614 psi 10,000 psi ∴ O.K.

Support Bracket (Bearing):

f_p =2287 psi 32,400 psi ∴ O.K.

CYGNA

Calculation Sheet

Project: WPPSS Equip. Seismic/Hydrodynamic Requal.	Prepared By: J.E. Rakowski	Date: 4/22/83	
Subject: Requalification	Checked By: D.E. Stark	Date: 4/25/83	
System: BIF Air Operators	Job No.: 82044	File No.: 1P.01/F	
Analysis No.: 018001	Rev. No.: 0	Sheet No.: 018001-4.2.5	

TABLE 4.2.2
(continued)

Total Stress:
= 4830 psi 21,600 psi O.K.

SUMMARY OF RESULTS

Shear Stress:	τ = 346 psi < 14,400 psi	O.K.
Weld:	f 832 psi < 21,000 psi	O.K.
Fatigue:	N/A (Allowable stress range = 45 ksi for welds).	

12" Bore Air Operators Components

Cylinder:	SI_{max} = 3439 psi < 18,000 psi	O.K.
Tie Rods:	f_t = 13681 psi < 20,000 psi	O.K.
Support Bracket:(Bearing):	f_p = 1775 psi < 32,400 psi	O.K.
Total Stress:	σ = 4267 psi < 21,600 psi	O.K.
Shear Stress:	τ = 283 psi < 14,400 psi	O.K.
Weld:	f = 3445 psi < 21,000 psi	O.K.
Drive Rod (Tensile):	σ = 31,172 psi < 86,400 psi	O.K.
Trunnion Pins (Shear):	τ = 2,515 psi < 11,840 psi	O.K.

Support Bracket Bolts (A307): $g_h = g_v = 1.54$: (1.55)

Tensile: 12,598 psi < 30,000 psi O.K.

Shear: 6,339 psi < 15,000 psi O.K.

SUMMARY TABLE 1.3

ALLOWABLE STRESSES

Since operability is required, the stresses for the faulted condition will be kept in the elastic range. The table below is based on AISC criteria and the yield stresses at temperature (340°F) from PG. 9 of REF. 4 for conservatism.

MATERIAL	YIELD STRS (PSI)	LEVEL A & B: .6 Fy BENDING ALLOW.	LEVEL A & B: .4 Fy SHEAR ALLOW.	LEVEL D: 1.6×.6 Fy = 0.96 Fy BENDING ALLOW.	LEVEL D: 1.6×.4·Fy 0.64 Fy SHEAR ALLOW.
AISI-4140 HEAT TREATED	90,000	54,000	36,000	86,400	57,600
SA-276, GR 304	18,500	11,100	7,400	17,760	11,840
ASTM A-395-60-45-15	45,000	27,000	18,000	43,200	28,800
SA-307	23,300	13,980	9,320	22,370	14,900
AISI-1018 (MIN YIELD)	35,000	21,000	14,000	33,600	22,400
SA-193, GR B3, 304SS	31,000	18,600	12,400	29,760	19,840
SA-479, 304SS	22,650	13,590	9,060	21,744	14,500
SA-516, GR 60	28,000	16,800	11,200	26,880	17,920

* BRACKET BOLT ALLOWABLES TAKEN FROM AISC, 8TH ED., SEC. 1.5.2.2

CYGNA

Calculation Sheet

Project: WPPSS Equip. Seismic/Hydrodynamic Requal.		Prepared By: J.E. Rakowski	Date: 4/22/83
Subject: Requalification		Checked By:	Date:
System: BIF Air Operators		Job No.: 82044	File No.: 1P.01/F
Analysis No.: 018001	Rev. No.: 0	Sheet No.: 018001	

Section 4.3

REQUALIFICATION ANALYSIS

4.3.1 INTRODUCTION

The analyses herein address specific parts of the 8, 10 and 12 inch diameter Miller Air Products air cylinder operators identified in Section 1.0 of this QID. The remaining structural components of the operators were addressed in the associated* valve dynamic qualification pakcages. Refer to Table 4.3.1.

The analyses in this QID were performed with enveloping g-levels. Table 4.2.1 summarizes the required g-levels from the piping analysis. The air operator mass-stiffness model incorporated in the piping analysis to calculate response g-levels on the more severely loaded 8 and 10 inch operators is given in Appendix A of this calculation.

4.3.2 CYLINDER OPERABILITY

The cylinders designated as EPN CSP-AO-1,2,3,4 must operate during an DBE from open to fail-closed. While seating the valve disk during a DBE, the air cylinders must have sufficient capacity to overcome the seating torque of the valve plus the frictional forces in the bushing and cylinder. The following table compares the required seating torque forces and minimum cylinder spring preloads given in QID 361106 and 361104 for the 8 and 10 inch cylinders.

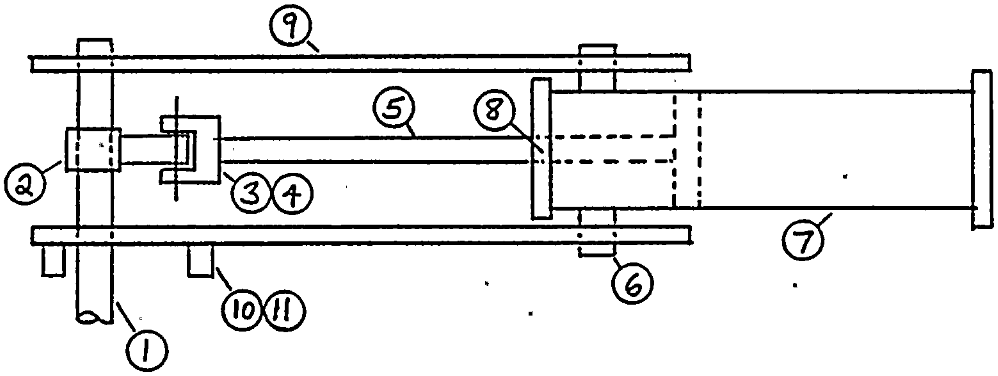
size	Required Seating Force	Spring Preload	Residual Capacity To Overcome Friction
8"	1150 lb.	1500 lb.	350 lb.
10"	1847 lb.	2900 lb.	1053 lb.

* QID's 361106, 361104 and (361101 & 361102) for the 8, 10 and 12 which operators respectively.

Calculation Sheet	Prepared By: J.M. Foley	Date 1/4/83
	Checked By: [signature]	Date 4/22/83
Project WPPSS	Job No. 82044	File No. 1P.01/F
Subject Air Operator ReQual		
System BIF Air Operators	Sheet No. 018001-4.3.2.1	
Analysis No. 018001 Rev. No.		

TABLE 4.3.1

AIR OPERATOR QUALIFICATION



ITEM #	DESCRIPTION	REPORT	AREAS ANALYZED
1	Main Shaft	Valve	Bending, shear, Keyway bearing.
2	Drive Lever	Valve	Tension, Bending, Bearing, Punch Shear, Keyway Bearing
3	Clevis	Valve	Tension, Bearing, Punch Shear
4	Clevis Pin	Valve	Shear.
5	Drive Rod*	Valve	Tension, Bending
6	Trunnion Pins*	Valve	Shear
7	Air Cylinder	Operator	Tension (applied), Pressure (with tie rods)
8	Bushings	Operator	Operability.

	Calculation Sheet	Prepared By: J.M. Foley	Date 1/4/83
		Checked By: D. Stark	Date 4/22/83
	Project WPPSS	Job No. 82044	File No. 1P.01/F
	Subject Air Operator ReQual.		
	System BIF Air Operator	Sheet No. 018001-4.3.2	
	Analysis No. 018001 Rev. No. 0		

TABLE 4.3.1 CONTINUED

ITEM #	DESCRIPTION	REPORT	AREAS ANALYZED
9	Support Bracket	Operator	Bearing, Bending, Shear, Weld Shear
10	Support Ears.	Valve	Tension, Bending, Shear
11	Support Bracket* Bolts	Valve	Tension, Shear

* Included herein for the 12-inch operator.

1006.00

4.3.2 CYLINDER OPERABILITY (CON'D)

Ability of the spring to fully close the valve depends on the coefficient of friction between the sliding surfaces of the cylinder, namely the drive rod and bushing, and the piston and cylinder.

Although upper limit bushing pressures due to load reaction were given by Miller Air Products for consideration of shaft wear, (Section 7.0, Ref. 5a and 5b) this alone is not a sufficient criterion because piston friction in the cylinder is not accounted for.

Therefore, it is recommended that one 8" air operator (CSP-AO-3 or 4) be field tested to verify operability since this size has approximately only 25 percent the residual capacity of a 10 inch operator. Dynamic plus static bushing pressures for these operators are calculated in QID's 361106 and 361104 and these may be used as a guide to specify the simulated test g-level on the end of the air cylinder by consideration of the bushing reaction equation in Appendix B of this calculation. The test load should be applied in the direction which tends to rotate the cylinder about the trunnion pin axis. Bushing pressures for both the 8 and 10 inch operators must be considered in comparison to the relative residual capacity of the 8 and 10 inch cylinders so that both sizes are covered by this test.

4.3.3 ANALYSIS

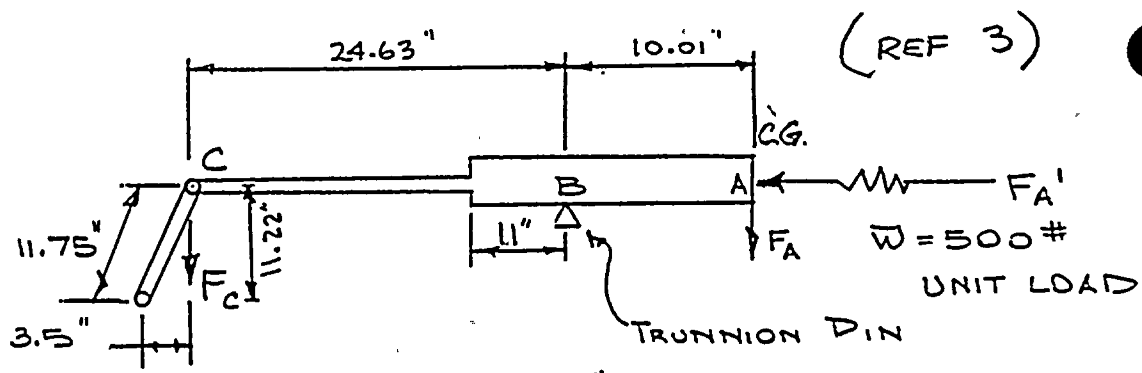
4.3.3.1 12 inch operator assembly frequency*.

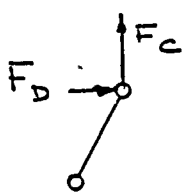
* Similar calculation for the 8 and 10 inch assemblies are given in QID 361106 and 361104.

Calculation Sheet	Prepared By: L Kaner	Date 11/30/82
Project: WPPSS Seismic	Checked By: RP [illegible]	Date 12/3/82
Subject: Requalification	Job No. 82044	File No. 1P.01/F
System: R&F Air Operators	Sheet No. 018001-4.33.1	
Analysis No. 018001 Rev. No. 0		

4.33.1 12" OPERATOR ASSEMBLY FREQUENCY

CALCULATE THE NATURAL FREQUENCY OF THE 12" CYLINDER OPERATOR DUE TO THE BENDING STIFFNESS OF THE DRIVE ROD AND THE CYLINDER OPERATOR.





$$F_C = 500^{\#}\left(\frac{10.01"}{24.63"}\right) = 203.2^{\#}$$

$$F_D = 203.2^{\#}\left(\frac{3.5"}{11.22"}\right) = 63.4^{\#}$$

TO OVERCOME THE SEATING TORQUE:

$$\text{SEATING TORQUE} = \frac{17000 \text{ IN}\#}{11.5 \text{ IN}} = 1478^{\#} \quad \text{(PER REF. 4 p18)}$$

$$F_A' = 500^{\#}\left(\frac{1478^{\#}}{69.88}\right) = 10557^{\#}$$

$$\text{ACCELERATION} = \frac{F_A'}{W_{ASSEMBLY}} = \frac{10557^{\#}}{399^{\#}} = 26.5$$

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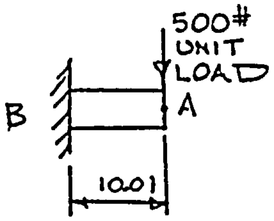
1006 00

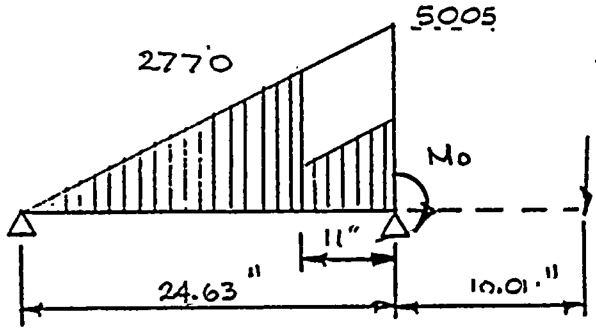
Calculation Sheet	Prepared By: L Kanes	Date 11/30/82
Project: WPPSS Seismic	Checked By: R P Cassara	Date 12/7/82
Subject: Requalification	Job No. 82044	File No. 1P.01/F
System: BIF Air Operators	Sheet No.	
Analysis No. 818001 Rev. No. 0	018001 — 4.3.3.2	

CALCULATION OF f_n:

$$\delta_A = \frac{P l^3}{3EI} = \frac{500^{\#}\,(10.01^3)}{3(29\times10^6)(229.2)} = .000025''$$



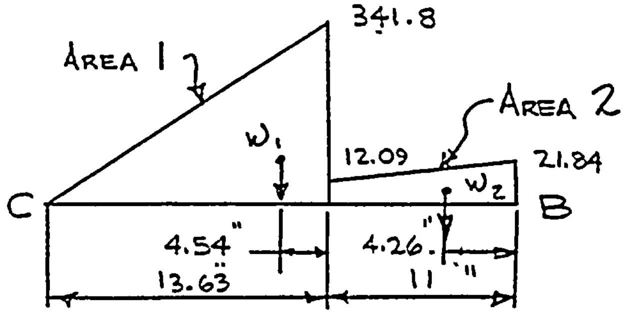
ROTATION AT "B" DUE TO Mo OF M/I DIAGRAM



$\therefore M_o = 500(10.01)$
$= 5005$ in#

$$\frac{5005}{229.2} = 21.84 \qquad \frac{2770}{229.2} = 12.09 \qquad \frac{2770}{0.79} = 3506.3$$

$$W_1 = 3506.3\left(\frac{13.6}{2}\right) = 23843 \qquad W_2 = \left(\frac{21.84+12.09}{2}\right)(11) = 186.6$$



AREA 1

$CG_{AREA_1} = \frac{1}{3}(13.63) = 4.54$ in

AREA 2

RECTANGLE:

$CG_R = \frac{1}{2}(11) = 5.5$

$A_R = (11)(12.09) = 133$

TRIANGLE:

$CG_T = \frac{2}{3}(11) = 7.33$

$A_T = \frac{1}{2}(11)(21.84-12.09) = 53.63$

$$CG_{AREA_2} = \frac{(CG_R)(A_R) + (CG_T)(A_T)}{A_R + A_T}$$

$$= \frac{(5.5)(133) + (7.33)(53.63)}{133 + 53.63}$$

$$= 6.03$$

$11 - 6.03 = 4.97$

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	Calculation Sheet	Prepared By: L Kamen	Date 11/30/82
CYGNA	Project WPPSS Seismic	Checked By: RP Casasca	Date 12/7/82
	Subject Requalification	Job No. 82044	File No. 1P.01/F
	System BIF Air Operators	Sheet No.	
	Analysis No. 018001 Rev. No. 0	018001-4.3.3.3	

JE Rakowski
A. Searle 4/22/83

$$R_B = 23843\left(\frac{9.09}{24.63}\right) + 186.6\left(\frac{17.89}{24.63}\right) =$$

$$R_B = 8749.5 + 271.1 = 8935$$

$$\Theta_B = \frac{8935}{29 \times 10^6} = .000308 \text{ RAD}$$

DEFLECTION @ POINT "A"

δ_A' DUE TO Θ_B

$$\delta_A' = .000308\ (10.01) = .003083 \text{ IN}$$

$$\text{TOTAL } \delta_A = .000025 + .003083 = .003108''$$

$$K = \frac{P}{\delta} = \frac{500}{.003108} = 160871 \ \#/\text{IN}$$

$$f_N = \frac{1}{2\pi}\sqrt{\frac{160871\ (386.4)}{583}} = \underline{\underline{51.97}} \text{ Hz}$$

f_n PARALLEL TO TRUNNION PINS AND DRIVE ROD:

IN REFERENCE TO QID 361104 & 361106, THE CYLINDER ASSY IS STIFF PARALLEL TO THE DRIVE ROD. USE THE FLEXIBLE 8" CYLINDER FREQUENCY FOR THE MODE PARALLEL TO THE TRUNNION PINS.

Calculation Sheet	Prepared By: L Kan	Date 11/30/82
	Checked By: R P [illegible]	Date 12/7/82
Project WPPSS-SEISMIC	Job No. 82044	File No. 1P.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No. 018001-4.3.3.4	
Analysis No. 018001 Rev. No. 0		

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A. Szark 4/22/83

4.3.3.2 ANALYSIS OF THE 8" OPERATOR

CYLINDER

USING WEIGHT AND C.G. FOR CYLINDER & ROD FROM QID 361106.

C.G. OF CYLINDER FROM SHAFT = 43 IN

W = 399#

OD = 8.45" ID = 7.97" t = .24 IN

$$A = \frac{\pi(8.45^2 - 7.97^2)}{4} = 6.19 \text{ IN}^2$$

$$I = \frac{\pi(8.45^4 - 7.97^4)}{64} = 52.2 \text{ IN}^4$$

MOMENT ARM = DISTANCE FROM TRUNION TO C.G.

MOMENT ARM = 51.5" - (13.5 + 23.54) = 14.46"

$M_{@TRUNION}$ = (MOMENT ARM)(WEIGHT)(g)

= (14.46)(399)(14) = 80,773.6 "#

1006 00

CYGNA	Calculation Sheet	Prepared By: L Korner	Date 11/30/82
	Project WPPSS - SEISMIC	Checked By: R Casassa	Date 12/7/82
	Subject REQUALIFICATION	Job No. 82044	File No. IP.01/F
	System BIF AIR OPERATORS	Sheet No.	
	Analysis No. 018001 Rev. No. 0	018001-4.3.3.5	

JE RAKOWSKI BY [illegible]
A. Sark 4/22/83

8" ANALYSIS (CONT)

BENDING STRESSES (X & Z)

$$\sigma_{x,z} = \frac{My}{I} = \frac{80773.6\left(\frac{8.45}{2}\right)}{52.2} = 6538 \text{ PSI}$$

AXIAL STRESSES (Y)

$$\sigma_y = \frac{W(g)}{A} = \frac{399(7)}{6.19} = 452 \text{ psi}$$

STRESSES FROM PRESSURE

AXIAL: $\sigma_{AXIAL} = \frac{Pr}{2t} = \frac{150(7.97)}{2(.24)} = 2491 \text{ psi}$

HOOP: $\sigma_{HOOP} = \frac{Pr}{t} = \frac{150(7.97)}{.24} = 4981 \text{ psi}$

RADIAL: $\sigma_{RADIAL} = \frac{-150}{2} = -75 \text{ psi}$

SHEAR STRESS

$$\tau = \frac{Wg}{A} = \frac{399(14)}{6.19} = 902 \text{ psi}$$

Calculation Sheet	Prepared By: L Kane	Date 11/30/82
Project WPPSS - SEISMIC	Checked By: R Plasassa	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. IP.01/F
System BIF AIR OPERATORS	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001 - 4.3.3.6	

JE RAKOWSKI 84 mld
D. Searle 4/22/83

8" ANALYSIS (CONT)

DETERMINATION OF PRINCIPAL STRESSES

STRESS	X	Z	Y	OPER	SRSS	OPER +SRSS	OPER -SRSS
σ (PSI)	6538	6538	452	2491	9257	11,748	-6766
τ (PSI)	902	902	–	–	1275	1275	-1275

PRINCIPAL STRESSES:

$$\sigma_{1,2} = \frac{\sigma_A + \sigma_{HOOP}}{2} \pm \sqrt{\left(\frac{\sigma_A - \sigma_{HOOP}}{2}\right)^2 + \tau^2}$$

OPER + SRSS: $\sigma_1 = 11,981$ psi $\sigma_2 = 4748$ psi

OPER - SRSS: $\sigma_1 = 4225$ psi $\sigma_2 = -7795$ psi

STRESS INTENSITIES: $\sigma_3 = \sigma_{RADIAL} = -75$ psi

	OP + SRSS	OP - SRSS
$\sigma_1 - \sigma_2$	7233	12,020
$\sigma_2 - \sigma_3$	4823	-7720
$\sigma_3 - \sigma_1$	-12,056	-4300

Calculation Sheet	Prepared By: L Kam	Date 11/20/82
	Checked By: R Plascasa	Date 12/2/82
Project WPPSS-SEISMIC	Job No. 82044	File No. IP.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATORS	Sheet No. 018001-4.3.3.7	
Analysis No. 018001 Rev. No. 0		

CYGNA

J.E. Rakowski By D. Jarde 4/22/83

8" ANALYSIS (CONT)

$SI_{mx} = 12{,}056$ psi

. CYLINDER MATERIAL IS A519 STEEL.

∴ USE $S_u = 30{,}000$ psi (WHICH IS MINIMUM YIELD)

∴ ALLOWABLE = .6 Su = 18,000 psi

∴ $SI_{mx} = 12{,}056 < 18000$ psi

∴ CYLINDER IS ACCEPTABLE

TIE RODS:

LOAD = (INSIDE AREA) X (PRESSURE)

$$= \frac{\pi (7.97)^2}{4}(150) = 7483^{\#}$$

$$\text{LOAD PER BOLT} = \frac{7483}{4} = 1871^{\#}$$

TIE ROD DIAMETER = 5/8"

$$A_{ROD} = \frac{\pi d^2}{4} = \frac{\pi (5/8)^2}{4} = .31 \text{ IN}^2$$

$$\sigma_{ROD} = \frac{1871}{.31} = 6099 \text{ psi} < 20 \text{ ksi}$$ (ASSUME A307 THREADED ROD)

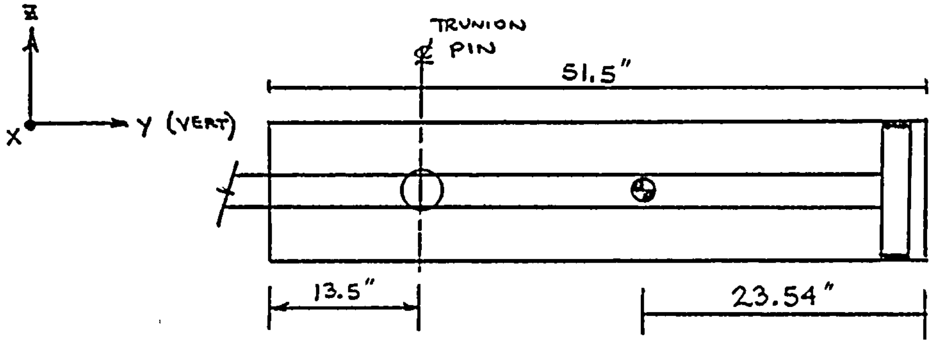
∴ TIE RODS ARE ADEQUATE

Calculation Sheet	Prepared By: L. Koman	Date 11/30/81
	Checked By: R.P. Gasaca	Date 12/3/82
Project WPPSS-SEISMIC	Job No. 82044	File No. 1P.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.8	

J.E. Rakowski
D. Searle 4/22/83

8" ANALYSIS (CONT)

OPERATOR SUPPORT BRACKET



W=399#

FORCES @ TRUNION PIN.

OVERTURNING

$M = gWL = 5.0\,(399)\,(51.5-(13.5+23.54))$

$M = 80773.6''\#$

$\text{depth} = 13.25 + \frac{2(.5)}{2} = 13.75$ (REF DWG A-208293)

$F_1 = \frac{80773.6}{13.75} = 5874\#$

VERTICAL

$F_2 = g(W_{TOTAL})$ $W_{TOTAL} = W_{CYLINDER}$

$W_{CYLINDER} = 399\#$

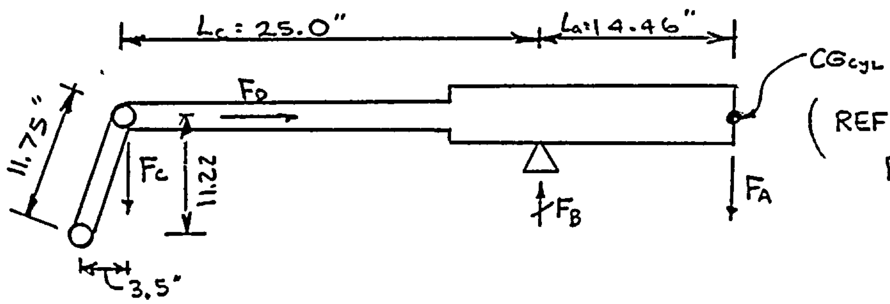
$F_2 = \frac{(\cdot)(399)}{2} = 1396\ \#/_{END\ OF\ PIN}$

1006 00

Calculation Sheet	Prepared By: L Kxxxx	Date 11/30/82
	Checked By: RP Casaca	Date 12/3/82
Project WPPSS-SEISMIC	Job No. 82044	File No. 1R.01/F
Subject REQUALIFICATION	Sheet No.	
System B1F AIR OPERATORS	018001-4.3.3.9	
Analysis No. 018001 Rev. No. 0		

JE RAKOWSKI BY
D. Searle 4/22/83

8" ANALYSIS (CONT)



FORCE DUE TO CLEVIS RESTRAINT (Z-DIRECTION)

$$F_B = F_A + F_C$$

F_A = WT OF CYLINDER = 399

$$L_a F_a = F_c L_c \quad \therefore \quad F_c = \frac{F_a L_a}{L_c}$$

$$F_c = \frac{399\,(14.46)}{(25.0)} = 231^{\#}$$

$$F_B = (231 + 399)/2 = 315^{\#}/\text{PER END OF PIN}$$

FORCE DUE TO CLEVIS RESTRAINT (Y-DIRECTION)

$$\frac{F_D}{3.5} = \frac{F_C}{11.22}$$

$$F_D = \frac{231}{11.22}(3.5) = 72.1^{\#}$$

$$F_D = 36.0^{\#}/\text{PER END OF PIN}$$

1006 00

Calculation Sheet	Prepared By: L Kamen	Date 11/30/82
Project WPPSS - SEISMIC	Checked By: R Plassca	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.10	

JE RAKOWSKI BY
A. Lisrk 4/22/83

8" ANALYSIS (CONT)

F_0 = SEATING TORQUE = 601 (QID 361/06, CYGNA CALC'S.)

$$\text{TOTAL LOAD} = F_D + \sqrt{F_1^2 + F_2^2 + F_8^2 + F_0^2}$$

$$= 601 + \sqrt{5874^2 + 1396^2 + 315^2 + 36^2} = 6046\#$$

BEARING ON SUPPORT @ TRUNION PIN

BEARING AREA = $A_B = LD$

WHERE L = THE THICKNESS OF PLATE
D = DIAMETER OF PIN

L = 1.5" D = 1.75" (REF DWG A208293)

$A_B = 1.5(1.75) = 2.63 \text{ in}^2$

$$\sigma_{BEARING} = \frac{F}{A_B} = \frac{6046}{2.63} = 2299 \text{ psi}$$

ASSUME A-36 MATERIAL: ALLOWABLE = .9 S_y = 32.4 ksi

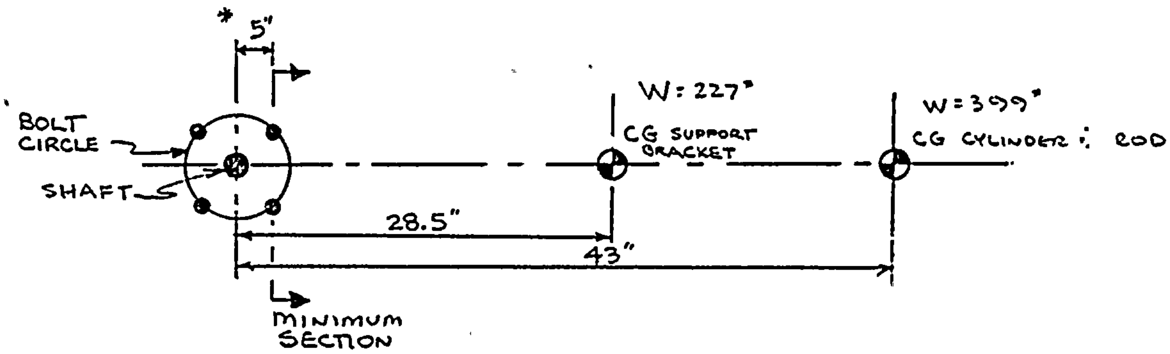
$\therefore \sigma_{BEARING} = 2299 \text{ psi} < 32.4 \text{ ksi} \therefore OK$

Calculation Sheet	Prepared By: L. Kam	Date 11/30/82
Project WPPSS-SEISMIC	Checked By: R.P. Caracca	Date 12/3/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.11	

J.E. Rakowski 4/22/83

8" ANALYSIS (CONT)

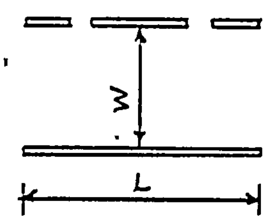
CHECK BRACKET FOR BENDING



SECTION PROPERTIES

FROM P.29 OF REF 4

$L = 13.5"$ $L_{max} = 22.0"$ $W = 13.25"$



THICKNESS = .5"

(WEB DOES NOT EXIST @ MINIMUM SECTION)

$$\bar{y} = \frac{13.5(.5)(.25) + (13.5 - 1.62)(.5)(14)}{13.5(.5) + (13.5 - 1.62)(.5)}$$

$\bar{y} = 6.69"$ FROM BOTTOM

$$I = \frac{13.5(.5)^3}{12} + \frac{(13.5 - 1.62)(.5)^3}{12} + 13.5(.5)(6.69 - .25)^2 + (13.5 - 1.62)(.5)(14 - 6.69)^2$$

$I = 597.6 \text{ IN}^4$

Calculation Sheet	Prepared By: L Em	Date 11/30/82
Project WPPSS - SEISMIC	Checked By: RP Casasa	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001 - 4.3.3.12	

JERAKOWSKI BY mD
A. Siurak 4/22/83

8" ANALYSIS (CONT)

BENDING STRESS:

$$M = [227(28.5-5) + 399(43-5)]\,14.0 = 286950.''^{\#}$$

$$\sigma_B = \frac{[286950(14-6.69)]}{597.6} = 3510 \text{ psi}$$

AXIAL STRESS

$$A_{T_{MIN}} = (13.5 - 1.62)(.5) = 5.94 \text{ in}^2$$

$$F_{AXIAL} = F_{OVERTURNING} + F^{*}_{VERTICAL} + F^{*}_{SEATING}$$

$$F_{AXIAL} = \frac{286950}{13.25} + 1396. + 601. = 23654\ ^{\#}$$

$$\sigma_A = \frac{23,654}{5.94} = 3982 \text{ PSI}$$

* PREVIOUSLY CALCULATED

1006 00

Calculation Sheet	Prepared By: L Kan	Date 11/30/82
Project WPPSS - SEISMIC	Checked By: RP Casacca	Date 12/1/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.13	

JE RAKOWSKI BY AND
D. Karle 4/22/83

8" ANALYSIS (CONT)

SHEAR STRESS

$$V = 14.0(W_{CYLINDER} + W_{BRACKET})$$

$$= 14.0(227 + 399) = 8764$$

$$AREA = 5.94 + 13.5(.5) = 12.69$$

$$\tau = \frac{3130}{12.96} = 691 \text{ psi}$$

COMBINING AXIAL & BENDING STRESSES:

$$\sigma_{TOTAL} = 3510 + 3982 = 7492 \text{ psi}$$

ALLOWABLE BENDING = .6 S_u = 21,600 psi

$\sigma_{TOTAL} < .6 S_u$ ∴ OK

ALLOWABLE SHEAR = .4 S_u = 14,400 psi

$\tau < .4 S_u$ ∴ OK

1006 00

Calculation Sheet	Prepared By: L Kan	Date 11/30/82
	Checked By: R P Casasa	Date 12/3/82
Project WPPSS - SEISMIC	Job No. 82044	File No. 1P.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No. 018001 - 4.3.3.14	
Analysis No. 018001 Rev. No. 0		

J E RAKOWSKI BY A. Searle 4/22/83

8" ANALYSIS (CONT)

CHECK WELDS OF BRACKET

LOAD ON WELD = 6046# *

AREA OF WELD = 2(.707)(.31) = .44 IN²/IN

LENGTH OF WELD = 17.5" (NEGLECTING 6" SCH 40 STEEL PIPE)

∴ TOTAL AREA = 17.5(.44) = 7.66 IN²

$\sigma = \frac{6046}{7.66} = 789$ psi < 21,000 psi ∴ OK

FATIGUE ON WELDS (PER AISC (8TH ED.) SECTION 5 APPENDIX B)

ASSUME LOADING CONDITION 1 - *CYCLES = 20,000-100,000 (B1)

FOR A BUILT-UP SECTION, USE CATEGORY B. (B2)

∴ FOR THE ALLOWABLE RANGE OF STRESSES : F_{sr} = 45 ksi

STRESS RANGE = 2(6046) = 12,092 *

$\sigma = \frac{12,092}{7.66} = 1579$ psi < 45,000 psi ∴ OK

∴ OPERATOR SUPPORT BRACKET IS ACCEPTABLE

* PREVIOUSLY CALCULATED

JE RACKOWSKI BY [signature]
D. Searle 4/22/83

4.3.3.3 ANALYSIS OF THE 10" OPERATOR

CYLINDER

USING WEIGHT AND C.G. FOR CYLINDER AND ROD FROM QID 361106.

C.G OF CYLINDER FROM SHAFT = 59.5 IN
WEIGHT = 593 #
O.D = 10.425 IN
I.D = 9.960 IN
t = 0.233 IN

$$A = \frac{\pi (10.425^2 - 9.96^2)}{4} = 7.44 \text{ IN}^2$$

$$I = \frac{\pi (10.425^4 - 9.96^4)}{64} = 96.73 \text{ IN}^4$$

MOMENT ARM = DIST. FROM TRUNNION TO C.G.
MOMENT ARM = 64" − (13.25" + 29.25") = 21.5 IN

$M_{@TRUNNION}$ = (MOMENT ARM)(WEIGHT)(g)
= (21.5)(593)(6) = 76497.0 in-lb

BENDING STRESSES (X AND Z)

$$\sigma_{x,z} = \frac{My}{I} = \frac{76497 \left(\frac{10.425}{2}\right)}{96.73} = 4122.20 \text{ psi}$$

AXIAL STRESSES (Y)

$$\sigma_Y = \frac{W \cdot (g)}{A} = \frac{593(6)}{7.44} = 478.23 \text{ psi}$$

Calculation Sheet	Prepared By: M. Kuntz	Date 11/15/82
	Checked By: [illegible]	Date 12/6/82
Project WPPSS - SEISMIC	Job No. 32044	File No. 1P.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No. 018001-4.3.3.16	
Analysis No. 018001 Rev. No. 0		

JE Rakowski [illegible]
H. Searle 4/22/83

STRESSES FROM PRESSURE

AXIAL: $\sigma_{AXIAL} = \frac{Pr}{2t} = \frac{150(9.96)}{2(.233)} = 3206$ psi

HOOP: $\sigma_{HOOP} = \frac{Pr}{t} = \frac{150(9.96)}{(.233)} = 6412$ psi

RADIAL: $\sigma_{RADIAL} = -\frac{150}{2} = -75$ psi

SHEAR STRESS

$\tau = \frac{Wa}{A} = \frac{593(6)}{7.44} = 478.23$ psi

DETERMINATION OF PRINCIPAL STRESSES

STRESS	X	Z	Y	OPER	SRSS	OPER + SRSS	OPER − SRSS
$\sigma_{(psi)}$	4122	4122	478	3206	5849	9055	-2643
$\tau_{(psi)}$	478	478	—	—	676	676	-676

PRINCIPAL STRESSES:

$$\sigma_{1,2} = \frac{\sigma_{AXIAL} + \sigma_{HOOP}}{2} \pm \sqrt{\left(\frac{\sigma_{AXIAL} - \sigma_{HOOP}}{2}\right)^2 + \tau^2}$$

OPER + SRSS: $\sigma_1 = 9218$ psi $\sigma_2 = 6249$ psi

OPER − SRSS: $\sigma_1 = 6462$ psi $\sigma_2 = -2693$ psi

STRESS INTENSITIES: $\sigma_3 = \sigma_{RADIAL} = -75$ psi

	OP + SRSS	OP − SRSS
$\sigma_1 - \sigma_2$	2969 psi	9155 psi
$\sigma_2 - \sigma_3$	6324 psi	-2768 psi
$\sigma_3 - \sigma_1$	-9293 psi	-6537 psi

Calculation Sheet	Prepared By: M. Kuntz	Date 11/17/82
	Checked By: [illegible]	Date 12/1/82
Project WPPSS-SEISMIC	Job No. 82044	File No. 1P.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.17	

CYGNA

J E RAKOWSKI BY [illegible]
D. Searle 4/22/83

SI_{MAX} = 9293 psi

ASSUME CYLINDER MATERIAL IS A-36 STEEL
∵ ALLOWABLE = .6 Su = 21600 psi
∵ SI_{MAX} = 9293. < 21600 psi
∴ CYLINDER IS ACCEPTABLE

TIE RODS:

LOAD = (INSIDE AREA) × (PRESSURE)

$$= \frac{\pi (9.96)^2}{4} (150) = 11687^{\#}$$

$$\text{LOAD PER BOLT} = \frac{11687}{4} = 2922^{\#}$$

TIE ROD DIAMETER = 3/4"

$$A_{ROD} = \frac{\pi d^2}{4} = \frac{\pi (3/4)^2}{4} = .442 \text{ IN}^2$$

$$\sigma/_{ROD} = 2922/.442 = 6614 \text{ psi} < 20 \text{ ksi}$$

(ASSUME A307 THREADED ROD)

∴ TIE RODS ARE ADEQUATE

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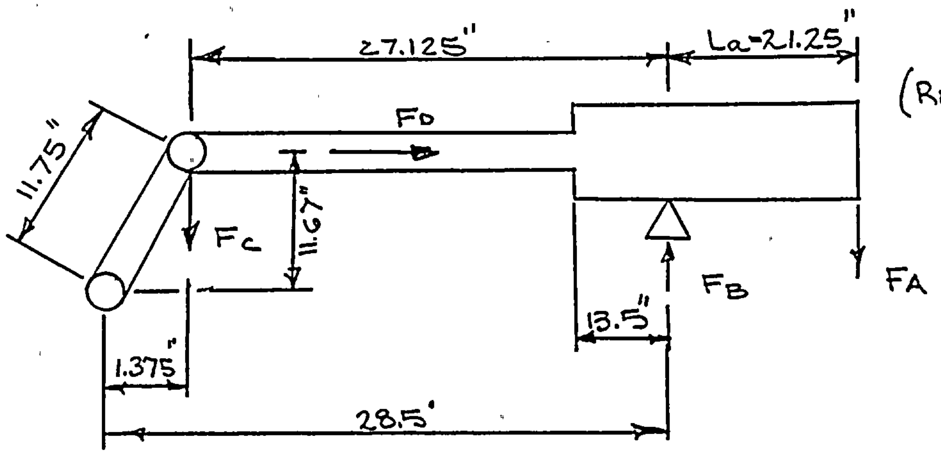
Calculation Sheet	Prepared By: M. Kuntz	Date 11/17/82
	Checked By: RP Cosmosa	Date 12/7/82
Project WPPSS - SEISMIC	Job No. 82044	File No. IP.01/F
Subject REQUALIFICATION		
System B1F AIR OPERATOR	Sheet No. 018001-4.3.3.18	
Analysis No. 018001 Rev. No. 0		

JE RAKOWSKI BY [signature]
A. Searle 4/22/83



(REF DRAWING C-26095) (ref. 2).

FORCE DUE TO CLEVIS RESTRAINT (Z-DIR.)

$F_B = F_A + F_C$

F_A = WEIGHT OF CYLINDER = 593#

$L_a F_a = F_c L_c \quad \therefore \quad F_c = \frac{F_a L_a}{L_c}$

$F_C = \frac{593\,(21.25)}{(27.125)} = 464.6\ \#$

$F_B = \frac{(464.6 + 593)}{2} = 528.8$ #/END OF PIN

FORCE DUE TO CLEVIS RESTRAINT (Y-DIR)

$\frac{F_D}{1.375} = \frac{F_C}{11.67}$

$F_D = \frac{464.6}{11.67}(1.375) = 54.74\ \#$

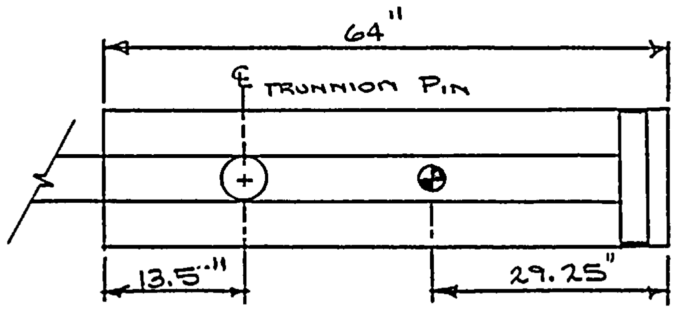
$F_D = 27.34$ #/END OF PIN

Calculation Sheet	Prepared By: M. Kuntz	Date 11/17/82
	Checked By: R.P. Lacasca	Date 12/3/82
Project WPPSS-SEISMIC	Job No. 82044	File No. IP.01F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No. 018001-4.3.3.19	
Analysis No. 018001 Rev. No. 0		

JE RAKOWSKI

D. Searle 4/22/83

OPERATOR SUPPORT BRACKET



$W = 593^{\#}$

FORCES AT TRUNNION PIN

OVERTURNING

$M = gWL = (6.0)(593)(64 - (13.50 + 29.25))$
$= 75607.5 \text{ in.-lb}$

$d = 13.88 + \frac{2(5/8)}{2} = 14.51 \text{ IN}$ (REF. DWG # A-208195) (ref. 6)

$F_1 = \frac{75607.5}{14.51} = 5211^{\#}$

VERTICAL

$F_2 = g(W_{TOTAL})$ $W_{TOTAL} = W_{CYLINDER}$

$W_{CYLINDER} = 593^{\#}$

$F_2 = \frac{(6)(593)}{2} = 1779^{\#}$/END OF PIN

Calculation Sheet	Prepared By: M. Kuntz	Date 11/17/82
	Checked By: R P Caruso	Date 12/7/82
Project WPPSS - SEISMIC	Job No. 82044	File No. 1P.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001- 4.3.3.20	

CYGNA

JE RAKOWSKI BY [signature] A. Searle 4/22/83

F_D = SEATING TORQUE = 964# (BIF REPORT p18) (ref. 4)

$$\text{TOTAL LOAD} = F_D + \sqrt{F_1^2 + F_2^2 + F_B^2 + F_D^2}$$
$$= 964 + \sqrt{5211^2 + 1779^2 + 529^2 + 27^2}$$
$$= 964 + 5531$$
$$= 6496$$

BEARING ON SUPPORT @ TRUNNION PIN

BEARING AREA = A_B - LD

WHERE: L = THICKNESS OF THE PLATE
D = DIAMETER OF THE PIN

L = 1 5/8" D = 1.75" (REF. DWG. A208195
A_B = (1 5/8")(1.75") = 2.84 in² DWG C-26095)

$$\sigma_{BEARING} = \frac{F}{A_B} = \frac{6496}{2.84} = 2287 \text{ psi}$$

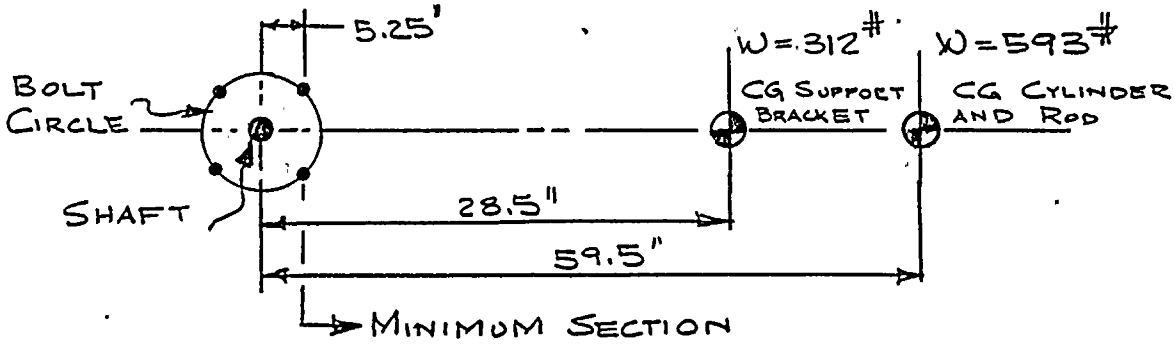
ASSUME A-36 MATERIAL ∴
ALLOWABLE = .9Su = 32.4 ksi

∴ $\sigma_{BEARING}$ = 2287 psi < 32.4 ksi ∴ ok

Calculation Sheet	Prepared By: M. Kuntz	Date 11/17/82
Project WPPSS- SEISMIC	Checked By: R.P. Caruso	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System B/F AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.21	

J E RAKOWSKI
D. Slade 4/22/83

CHECK BRACKET FOR BENDING



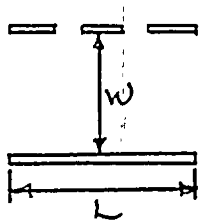
SECTION PROPERTIES (REF 6 w/PROCEDURE FROM REF 4 p 29)

2(.94)=1.88 ϕ HOLE = .94"

L=13.5" LMAX = 23.25" W = 13.88"

THICKNESS = .625"

(WEB DOES NOT EXIST @ MIN. SECTION)



$$\bar{y} = \frac{.31(13.5)(.625) + (13.5-1.88)(.625)(.625+13.88+.31)}{.625(13.5)+(13.5-1.88)(.625)}$$

$$= \frac{2.62+107.59}{8.44+7.26} = 7.02''$$

$$I = \frac{13.5(.625)^2}{12} + \frac{(13.5-1.88)(.625)^2}{12} + 13.5(.625)(7.02)^2$$

$$+ (13.5-1.88)(.625)(.31+(13.88-7.02))^2 = 780.0 \text{ IN}^4$$

$$M = (6)[(59.5-5.25)(593)+(28.5-5.25)(312)] = 236546 \text{ \#IN}$$

$$\sigma_B = \frac{236546\left(\frac{13.88}{2}\right)}{786.4} = 2088 \text{ psi}$$

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CYGNA

Calculation Sheet	Prepared By: M. Kuntz	Date 11/19/82
Project WPPSS - SEISMIC	Checked By: RP Carrasca	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System B/F AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	01800/- 4.3.3.22	

JE RAKOWSKI BY mad
D. Earle 4/22/83

AXIAL STRESS

$A_{T\,MIN} = (13.5 - 1.88)(.625) = 7.26\ IN^2$

$F_{AXIAL} = F_{OVERTURNING} + F^{*}_{VERTICAL} + F^{*}_{SEATING}$

$= \frac{236546}{13.88} + 1779 + 964 = 19785\ \#$

$\sigma_A = \frac{19785}{7.26} = 2725\ psi$

$\sigma_A + \sigma_B = 2725 + 2088 = 4813\ psi$

SHEAR STRESS

$V = 6.0\,(W_{CYL.} + W_{BRACKET})$
$= 6.0\,(593 + 312) = 5430\ \#$

$AREA = 7.26 + 13.5(.625) = 15.7\ IN^2$

$\tau = \frac{5430}{15.7} = 346\ psi$

ALLOWABLES

BENDING : $.6\,S_u = 21{,}600\ psi$

SHEAR : $.4\,S_u = 14{,}400\ psi$

* PREVIOUSLY CALCULATED

1006 00

CYGNA	Calculation Sheet	Prepared By: M. Kuntz	Date 11/19/82
	Project WPPSS - SEISMIC	Checked By: RP Caraan	Date 12/7/82
	Subject REQUALIFICATION	Job No. 82044	File No. IP.01/F
	System BIF AIR OPERATOR	Sheet No.	
	Analysis No. 018001 Rev. No. 0	018001-4.3.3.23	

JE RAKOWSKI BY [signature] [signature] 4/22/83

∴ SINCE σ_{TOTAL} = 4813 < .6 Su = 21,600 psi
τ = 346 < .4 Su = 14,400 psi

THE BRACKET IS ACCEPTABLE

CHECK WELDS OF GUSSET

LOAD ON WELD = 6496#

AREA OF WELD = 2(.707)(.31) = .44 in^2/in

LENGTH OF WELD = 17.75" (NEGLECTING PIPE)

∴ TOTAL AREA = (17.75)(.44) = 7.81 in^2

$$\sigma = \frac{6496}{7.81} = 832 \text{ psi} < 21{,}600 \text{ psi}$$

WELD IS ACCEPTABLE

WELD FATIGUE ANALYSIS

SIMILAR TO THE 8" AIR OPERATOR, THE WELD STRESS IS LOW SUCH THAT THE STRESS RANGE IS FAR BELOW THE RANGE GIVEN BY AISC, 8TH EDITION, SECTION 5, APPENDIX B

JE RAKOWSKI BY [signature] 4/22/83

4.3.3.4 ANALYSIS OF THE 12" OPERATOR

CYLINDER:

ASSUME: OD = 12.625" (DUE TO LACK OF INFORMATION)   ID = 12.0"   t = .31"

$$A = \frac{\pi(12.625^2 - 12.0^2)}{4} = 12.09 \text{ IN}^2$$

$$I = \frac{\pi(12.625^4 - 12.0^4)}{64} = 229.2 \text{ IN}^4$$

WEIGHT OF CYLINDER: (REF 3)

CYLINDER:

12.09 (.283)(47.88) = 163.8 #

BLOCKS:

$2.5\ (12.75)^2(.28)(2) = 227.6$ #

BARS:

2(3)(1.25)(47.88)(.28) = 100.55 #

PISTON:

$$\frac{\pi(2)^2}{4}(46.88 + 4.5 + 4.375)(.283) = 49.6 \#$$

TIE RODS

$$\frac{\pi(1)^2}{4}(4)(46.88)(.283) = 41.7 \#$$

TOTAL WEIGHT = 583 #

Calculation Sheet	Prepared By: L Kane	Date 11/30/82
Project WPPSS-SEISMIC	Checked By: R P Carreras	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01F
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.25	

JE RACOWSKI By [illegible] D. [illegible] 4/22/83

12" ANALYSIS (CONT)

CYLINDER (CONT)

MOMENT ARM = DISTANCE FROM TRUNION TO C.G.

MOMENT ARM: $46.88 - (21.38 + (15.5 - 4.5)) = 14.5''$

$M_{@TRUNION} = (14.5)(583)(5) = 42268''\#$

BENDING STRESSES (X & Z)

$$\sigma_{x,z} = \frac{My}{I} = \frac{42268 \cdot \left(\frac{12.625}{2}\right)}{229} = 1165.1 \text{ psi}$$

AXIAL STRESSES (Y)

$$\sigma_y = \frac{W(g)}{A} = \frac{583(4)}{12.09} = 193. \text{ psi}$$

STRESSES FROM PRESSURE

AXIAL: $\sigma_{AXIAL} = \frac{pr}{2t} = \frac{150(6)}{2(.31)} = 1452 \text{ psi}$

HOOP: $\sigma_{HOOP} = \frac{pr}{t} = \frac{150(6)}{.31} = 2903 \text{ psi}$

RADIAL: $\sigma_{RADIAL} = \frac{-150}{2} = -75 \text{ psi}$

SHEAR STRESS

$$\tau = \frac{Wg}{A} = \frac{583(5)}{12.09} = 241 \text{ psi}$$

CYGNA	**Calculation Sheet**	Prepared By: L Komer	Date 11/30/82
	Project WPPSS-SEISMIC	Checked By: RP Cassaca	Date 12/7/82
	Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
	System BIF AIR OPERATOR	Sheet No.	
	Analysis No. 018001 Rev. No. 0	018001-4.33.26	

JE RAKOWSKI BY A. Searle 4/22/83

12" ANALYSIS (CONT)

DETERMINATION OF PRINCIPAL STRESSES

STRESS	X	Z	Y	OPER	SRSS	OPER +SRSS	OPER -SRSS
σ psi	1165	1165	193	1452	1659	3111	-207
τ psi	241	241	—	—	341	341	-341

$\sigma_{HOOP} = 2903$ $\quad \sigma_3 = \sigma_R = -75$

PRINCIPAL STRESSES:

$$\sigma_{1,2} = \left(\frac{\sigma_{AXIAL} + \sigma_{HOOP}}{2}\right) \pm \sqrt{\left(\frac{\sigma_{AXIAL} - \sigma_{HOOP}}{2}\right)^2 + \tau^2}$$

OPER+SRSS: $\sigma_1 = 3364$ psi $\quad \sigma_2 = 2650$ psi

OPER-SRSS: $\sigma_1 = 2940$ psi $\quad \sigma_2 = -244$ psi

STRESS INTENSITIES:

	OPER+SRSS	OPER-SRSS
$\sigma_1 - \sigma_2$	714	3184
$\sigma_2 - \sigma_3$	2725	-169
$\sigma_3 - \sigma_1$	-3439	-3015

Calculation Sheet	Prepared By: L Kanes	Date 11/30/82
	Checked By: RP Cacacca	Date 12/7/82
Project WPPSS-SEISMIC	Job No. 82044	File No. 1P.01/F
Subject REQUALIFICATION		
System B/F AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.27	

CYGNA

JE RAKOWSKI 37
D. Searle 4/22/83

12" ANALYSIS (CONT)

$$SI_{max} = 3439 \text{ psi}$$

CYLINDER MATERIAL IS ASSUMED TO BE THE SAME AS 8" OR 10". A519 STEEL

∴ ALLOWABLE = 18,000 psi

$$\therefore \quad SI_{max} = 3439 < 18,000 \text{ psi}$$

∴ CYLINDER IS ACCEPTABLE

TIE RODS:

LOAD = (INSIDE AREA) x (PRESSURE)

$$= \frac{\pi (12)^2}{4}(150) = 16965^{\#}$$

$$\text{LOAD PER BOLT} = \frac{16965}{4} = 4241^{\#}$$

TIE ROD DIAMETER - ASSUME 5/8"

$$A_{ROD} = \frac{\pi d^2}{4} = \frac{\pi (5/8)^2}{4} = .31 \text{ IN}^2$$

$$\sigma_{/ROD} = \frac{4241}{.31} = 13681 \text{ psi} < 20 \text{ ksi}$$ (ASSUME A307 THREADED ROD)

∴ TIE RODS ARE ADEQUATE

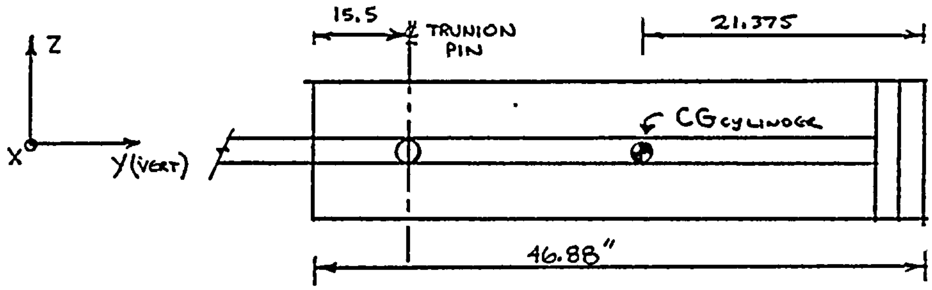
1006 00

Calculation Sheet	Prepared By: L Kamer	Date 11/30/82
Project WPPSS - SEISMIC	Checked By: RP Carasca	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001. 4.3.3.28	

JE RAKOWSKI BY
A. [illegible] 4/22/83

12" ANALYSIS (CONT)

OPERATOR SUPPORT BRACKET



$W_{CYL} = 815^{\#}$

BRACKET WT :

TOP & BOTTOM ℞ :

22(62)(.5)(2) = 1364 IN^3

GUSSET: 16(14)(.5)(2) = 224 IN^3

BAR @ TRUNION : ✓

3(.75)(12)(4) = 108 IN^3

10" SCH. 30 PIPE:

16(10.07)(2) = 322 IN^3

℞ : (3)(3)(.5)(8) = 36 IN^3

(7)(7)(.75) = 37.0 IN^3 $V_{TOTAL} = 2091$

$W_{TOTAL} = 2091(.28) = 586^{\#}$

Calculation Sheet	Prepared By: L. Karr	Date 11/30/82
Project WPPSS - SEISMIC	Checked By: R.P. Cassesse	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01 /F
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.29	

J E RAKOWSKI, BY
A. Sivak 4/22/83

12" ANALYSIS (CONT)

FORCES @ TRUNION PIN

OVERTURNING

$M = gWL = 5.0(583)(46.88 - (15.5 + 21.375))$

$M = 29165''^{\#}$

depth = 16"

$F_1 = \frac{29165''^{\#}}{16''} = 1823^{\#}$

VERTICAL

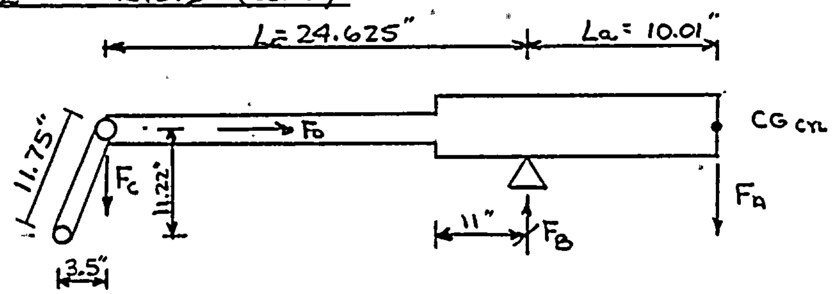
$F_2 = g(W_{CYL})$

$F_2 = \frac{4(583)}{2} = 1166^{\#}$

Calculation Sheet	Prepared By: L Kan	Date 11/30/82
Project WPPSS - SEISMIC	Checked By: R P [illegible]	Date 12/3/82
Subject REQUALIFICATION	Job No. 82044	File No. IP.01/F
System B/F AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001 - 4.3.3.30	

JE RAKOWSKI BY [illegible]
A. [illegible] 4/22/83

12" ANALYSIS (CONT)



FORCE DUE TO CLEVIS RESTRAINT (Z-DIRECTION)

$F_B = F_A + F_C$

F_A = g-load of CYLINDER = 583# $*(g_V + 1)$ = 583*4 = 2332

$L_a F_a = F_c L_c \quad \therefore \quad F_c = \frac{F_a L_a}{L_c}$

$F_c = \frac{2332(10.01)}{24.625} = 948$ #

$F_B = \left(\frac{2332 + 948}{2}\right) = 1640$ /END OF PIN

FORCE DUE TO CLEVIS RESTRAINT (Y-DIRECTION)

$F_c = 948$

$F_D = F_c\left(\frac{3.5}{11.22}\right) = 948(.31) = 294$ *

F_D/END OF PIN $= \frac{294}{2} = 147$ *

1006 00

Calculation Sheet	Prepared By: L Kamer	Date 11/30/82
	Checked By: RP Carrese	Date 12/7/82
Project WPPSS- SEISMIC	Job No. 82044	File No. 1P. 01 / F
Subject REQUALIFICATION		
System B/F AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001 · 4.3.3.31	

JE RAKOWSKI BY
A. Smith 4/22/83

12" ANALYSIS (CONT)

F_O = SEATING TORQUE = 739 "

$$F_{TOTAL} = F_D + \sqrt{F_1^2 + F_2^2 + F_C^2 + F_D^2}$$

$$F_{TOTAL} = 739 + \sqrt{1823^2 + 1166^2 + 1640^2 + 147^2} = 4669$$

BEARING ON SUPPORT @ TRUNION PIN

BEARING AREA = A_B = LD

WHERE L = THICKNESS OF PLATE
D = DIAMETER OF PIN

L = 1.5"   D = 1.75"   (REF 3 ; 7)

A_B = 1.5 (1.75) = 2.63

$$\sigma_{BEARING} = \frac{F}{A_B} = \frac{4669}{2.63} = 1775 \text{ psi}$$

ASSUME A-36 MATERIAL : ALLOWABLE = .9 S_y = 32.4 ksi

$\sigma_{BEARING}$ = 1775 psi < 32.4 ksi ∴ OK

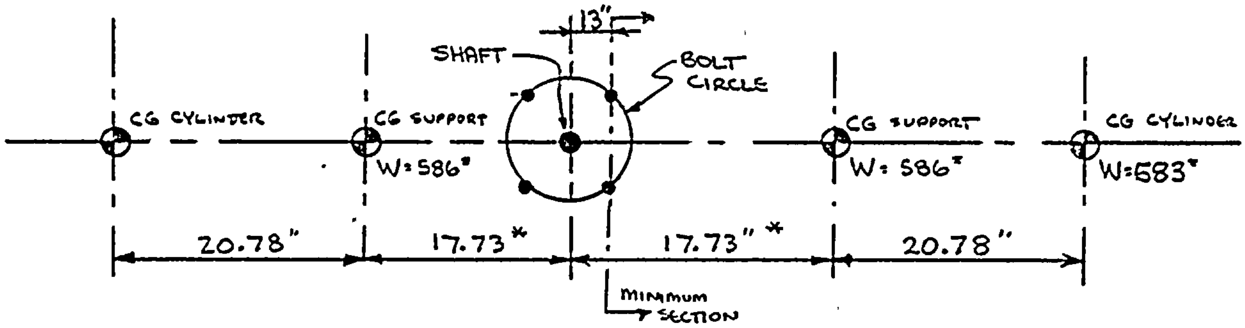
1006 00

Calculation Sheet	Prepared By: L Kanu	Date 11/30/82
Project WPPSS – SEISMIC	Checked By: R Plasencia	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System 31F AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001 – 4.3.3.32	

JE RAKOWSKI
D. Isaak 4/22/83

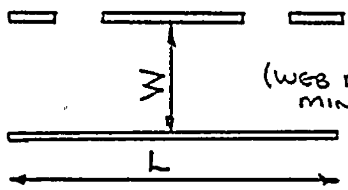
12" ANALYSIS (CONT)

CHECK BRACKET FOR BENDING



SECTION PROPERTIES: (REF 7)

L = 22"   W = 16"   THICKNESS OF PL = .5"



$$\bar{y} = \frac{22(.5)(.25) + (22-2.75)(.5)(16.75)}{22(.5) + (22-2.75)(.5)} = 7.95" \text{ FROM BOTTOM}$$

$$I = \frac{22(.5)^3}{12} + \frac{(22-2.75)(.5)^3}{12} + 22(.5)(7.95-.25)^2$$

$$+ (22-2.75)(.5)(17.-7.95)^2$$

$$I = 1441 \text{ IN}^4$$

* SEE NEXT PAGE

1006 00

Calculation Sheet	Prepared By: L Komer	Date 11/30/82
Project WPPSS - SEISMIC	Checked By: R P Casasa	Date 12/7/82
Subject REQUALIFICATION	Job No. 82044	File No. 1P.01/F
System B/F AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.33	

JE RAKOWSKI BY D. Swale 4/22/83

12" ANALYSIS (CONT)

C.G. OF BRACKET

$$\bar{Y}_{SHAFT} = \frac{31(22)(.5)(\frac{31}{2})(2) + 16(14)(.5)(31-15) + 2(3)(.75)(12)(30.05)}{31(22)(.5)(2) + 16(14)(.5) + 2(3)(.75)(12)}$$

$$\frac{+(10.07)(16)(31-5) + (3)(3)(.5)(13)(2) + (3)(3)(.25)(2)(28.5)}{(10.07)(16) + (3)(3)(.5)(2) + (3)(3)(.25)(2)}$$

$$\frac{+\frac{(7)(7)(.75)}{2}(1.75)}{\frac{7(7)(.75)}{2}} = 17.73''$$

BENDING STRESS:

$$M = (5)\left[586(17.73-13) + 583(38.51-13) + 30.73(586) + 51.51(583)\right]$$

$$M = 328411.^{\#''}$$

$$\sigma_B = \frac{328411(17-7.95)}{1441} = 2063 \text{ psi}$$

Calculation Sheet	Prepared By: L Kosmer	Date 11/30/82
	Checked By: RP Carrara	Date 12/7/82
Project WPPSS - SEISMIC	Job No. 87044	File No. 1P.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No.	
Analysis No. 018001 Rev. No. 0	018001-4.3.3.34	

JE RAKOWSKI
A Searle 4/22/83

12" ANALYSIS (CONT)

AXIAL STRESS

$A_{T_{MIN}} = (22-2.75)(.5) = 9.63 \text{ IN}^2$

$F_{AXIAL} = \frac{328411}{17} + 1166 + 739 = 21223.3$

$\sigma_A = \frac{21223.3}{9.63} = 2204 \text{ psi}$

COMBINE AXIAL & BENDING

$\sigma_{TOTAL} = 2204 + 2063 = 4267 \text{ psi}$

SHEAR STRESS

$V = 5.0 (W_{CYL} + W_{BRACKET})$

$= 5.0 (586 + 583) = 5845^{\#}$

$AREA = 22(.5) + 9.63 = 20.63$

$\tau = \frac{5845}{20.63} = 283.3 \text{ psi}$

ALLOWABLES:

BENDING: $.6 S_u = 21,600 \text{ psi}$

SHEAR: $.4 S_u = 14,400 \text{ psi}$

Calculation Sheet	Prepared By: L. Kasmer	Date 11/30/82
	Checked By: RP Cassana	Date 12/7/82
Project WPPSS-SEISMIC	Job No. 82044	File No. 1P.01/F
Subject REQUALIFICATION		
System BIF AIR OPERATOR	Sheet No. 018001-4.33.35	
Analysis No. 018001 Rev. No. 0		

CYGNA

JE RACOWSKI BY A. Searle 4/22/83

12" ANALYSIS (CONT)

∴ SINCE $\sigma_{TOTAL} = 4267 < .6S_U = 21,600$

& $\tau = 340. < 14,400$ psi

THE BRACKET IS ACCEPTABLE

CHECK WELDS OF GUSSET :

LOAD ON WELD : 21223.3*

AREA OF WELD = 2(.707)(.31) = .44 in^2/in

LENGTH OF WELD = 14"

∴ TOTAL AREA = 14(.44) = 6.16 in^2

$\sigma : \frac{21223.3}{6.16} = 3445$ psi < 21000 psi

∴ OK

1006 00

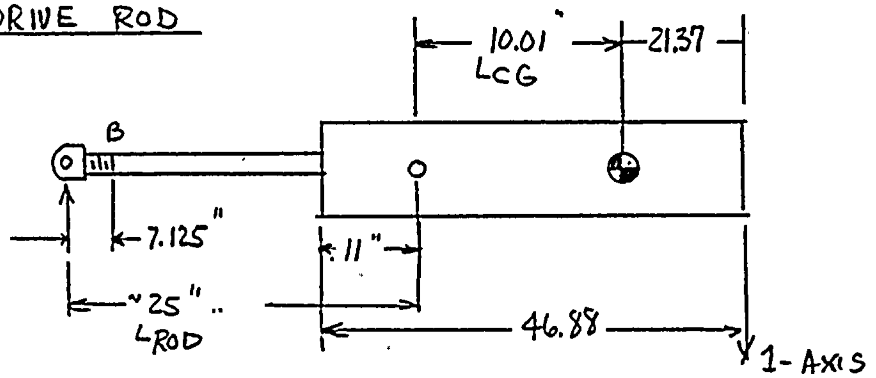
CYGNA

Calculation Sheet

Project: WPPSS Equipment Seismic/Hydrodynamic Requal.	Prepared By: J.E. Rakowski	Date: 4/22/83	
Subject: Requalification	Checked By: [signature]	Date: 5/10/83	
System: BIF Air Operators	Job No. 82044	File No. 1P.01/F	
Analysis No. 018001	Rev. No. 0	Sheet No. 018001-4.3.3.36	

12" ANALYSIS (CONT'D)

DRIVE ROD



USE 8" & 10" CYLINDER DRIVE ROD CROSS SECTIONAL AREA FOR CONSERVATISM

$$F_c = \frac{L_{CG}}{L_{ROD}} * \bar{W}_{AO} * g_1 = \frac{10.01}{25} * 583(3+1) = 934$$

$$M_B = 7.125 * F_c = 6655 \text{ in}\cdot\#$$

MAT'L: AISI-4140

$$\sigma_B = \left.\frac{M_B\, C_B}{I_B}\right)_{8"\,CYL} = 6655 * \frac{.6478}{.1383} = 31{,}172 \text{ PSI} < 86{,}400 \text{ PSI OK}$$

(SHEAR NOT GOVERNING PER 8 & 10" A/O ANALYSES)

DRIVE ROD FATIGUE:

2 * 31,172 = 62,344 PSI < 90,000 PSI STRESS RANGE, CATEGORY A.

TRUNNION PINS

$$M_1 = \bar{W}_{AO} * g_3 * L_{CG} = 583 * 5 * 10.01 = 29{,}179 \text{ in}\#$$

Calculation Sheet

Project: WPPSS Equip. Seismic/Hydrodynamic Requal.		Prepared By: J.E. Rakowski	Date: 4/22/83
Subject: Requalification		Checked By: [signature]	Date: 5/16/83
System: BIF Air Operators		Job No. 82044	File No. 1P.01/F
Analysis No. 018001	Rev. No. 0	Sheet No.	018001 · 4.3.3.37

$$F_{23} = \frac{M_1}{x} = \frac{29{,}179}{12.75 \text{ (for 8" AO)}} = 2289$$

$$F_{11} = \frac{(L_{ROD} + L_{CG})}{L_{ROD}} \frac{\bar{W}_{AO}}{2} g_1 = \frac{(25+10.01)}{25} * \frac{583}{2} * (4) = 1637 \#$$

$$F_{22} = \frac{\bar{W}_{AO}}{2} g_2 = \frac{583}{2} * 5 = 1458 \#$$

F_{ST2} = 739 lb (on one trunnion pin)

$F_{WEIGHT} = \frac{583}{2} = 292$ lb (on one trunnion pin)

} = 1030 lb

$$\tau = \frac{1}{.75 * 2.41 in^2} \left\{ \left[(F_{23} + F_{22})^2 + F_{11}^2 \right]^{\frac{1}{2}} + F_{FIXED} \right\}$$

$$\tau = \frac{1}{.75 \times 2.41} \left\{ \left[(2289+1458)^2 + 1637^2 \right]^{\frac{1}{2}} + 1030 \right\} = 2515 \text{ PSI} < 11{,}840 \text{ PSI}$$

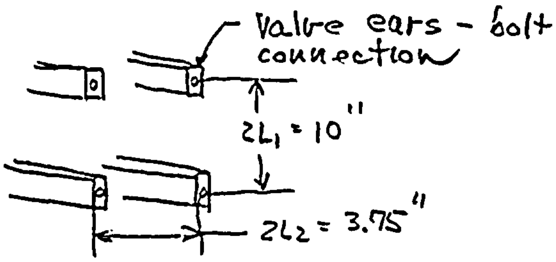
(OK)

<u>SUPPORT BRACKET BOLTS:</u> USE $G_H = G_V = 1.54g$ FOR BOLTS ONLY

$$\text{BOLT TENSION} = \sigma_T = \frac{M_{FB}}{4L_1 A_b} + \frac{M_{AX}}{4L_2 A_b} + \frac{F_{SS}}{4A_b}$$

USE 8" A/O DIMENSIONS FOR CONSERVATISM

A_b (3/4" bolt) = .334 in^2



1006.00

CYGNA

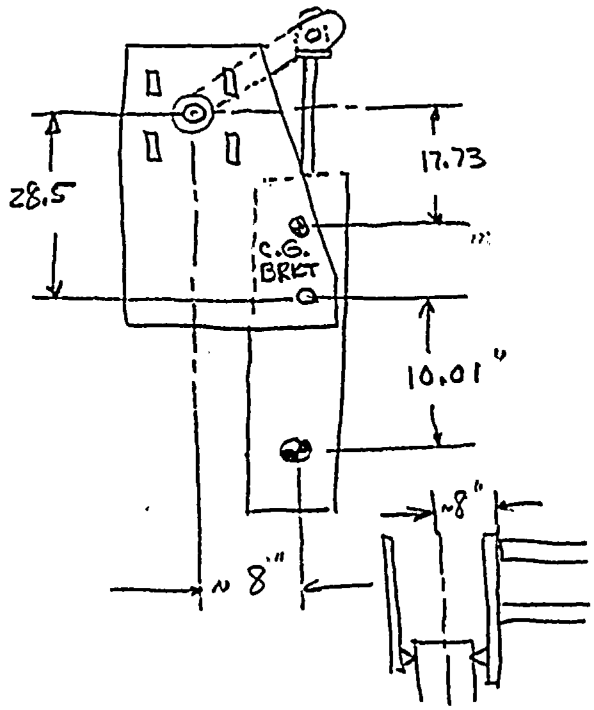
Calculation Sheet

Project: WPPSS Equipment Seismic/Hydrodynamic Requal.	Prepared By: J.E. Rakowski	Date: 4/22/83	
Subject: Requalification	Checked By: [signature]	Date: 5/10/83	
System: BIF Air Operators	Job No.: 82044	File No.: 1P.01/F	
Analysis No.: 018001	Rev. No.: 0	Sheet No.: 018001-4.3.3.38	

$M_{FB} = 583^{\#}(28.5+10.01)(1.54) + 586(17.73)(1.54)$

($W_{BR} = 586^{\#}$, SEE Pg. 28)

$\therefore M_{FB} = 50,575$ in #



$M_{AX} = (583+586)(8)(g_H)$

$M_{AX} = 14,402$ in#

$F_{SS} = (583+586)(g_H) = 1169 * 1.54 = 1800$ #

$\sigma_T)_{Bolts} = \frac{50,575}{4(5)(.334)} + \frac{14,402}{4(3.15)(.334)} + \frac{1800}{4(.334)} = \underline{\underline{12,598}}$ PSI $< 30,000$ OK (FOR A307) (S * 1.5)

$\sigma_T)_{BOLTS} =$

BOLT SHEAR:

$\tau = [S_{FB}^2 + S_{AX}^2]^{\frac{1}{2}}$

FROM PAGE 34:

$F_c = \frac{\Sigma M_{SHAFT}}{4R}$ where $R \geq 13"$)

$M_{SHAFT} = M_{FB} + M_{AX} = 64,977$

$\therefore F_C = \frac{64977}{4(13)} = 1250$ #

1006.00

CYGNA

Calculation Sheet

Project: WPPSS Equip. Seismic/Hydrodynamic Requal.	Prepared By: J.E. Rakowski	Date: 4/22/83	
Subject: Requalification	Checked By:	Date:	
System: BIF Air Operators	Job No. 82044	File No. 1P.01/F	
Analysis No. 018001	Rev. No. 0	Sheet No. 018001-4.3.3.39	

HORIZONTAL BOLT SHEAR DUE TO HORIZONTAL INERTIA:

$$S_{IH} = \frac{(\bar{w}_{AO} + \bar{w}_{BR}) * g_H}{4A_b}$$

$$S_{IH} = \frac{1169 * 1.54}{4(.334)} = 1347 \text{ PSI}$$

VERTICAL + DEADWEIGHT BOLT STRESS:

$$S_{IV} = \frac{1169(1+1.54)}{4A_b} = 2222 \text{ PSI}$$

TOTAL: $(S_{IH}^2 + S_{IV}^2)^{\frac{1}{2}} = 2598$ PSI

ADD SHEAR STRESS DUE TO TORQUE $(= \Sigma M_{FB} + M_{AX})$

$$\tau_{TOTAL} = 2598 + \frac{1250}{.334} = 6339 \text{ PSI}$$

6339 PSI < 15,000 PSI PER AISC, SEC 1.5.2.2, A307 MAT'L. (1.5 * S)

NOTE: NO FATIGUE ANALYSIS FOR 12" A/O BECAUSE NO HYDRODYNAMIC LOAD CYCLING EXPERIENCED.

Calculation Sheet	Prepared By: L Kamen	Date 12/8/82
	Checked By: R P Casasoa	Date 12-8-82
Project WPPSS-Seismic	Job No. 82044	File No. 1P.01/F
Subject Requalification		
System BIF Air Operators	Sheet No. 018001- 4.4.1	
Analysis No. 018001 Rev. No. 0		

4.4 REFERENCES

1. 8" Cylinder, Dwg. No. C-26096, Flick-Reedy Corp.
2. 10" Cylinder, Dwg. No. C-26045, Flick-Reedy Corp.
3. 12" Cylinder, Dwg. No. C-26093, Flick-Reedy Corp.
4. BIF Report TR-74-7, Rev. 1, Dated 1/5/76.
5. Cylinder Support Bracket, 8" x 15" Cylinder Operator., Dwg. No. A-208293.
6. Cylinder Support Bracket, 10" x 15" Cylinder Operator, Dwg. No. A-208195.
7. Cylinder Support Bracket, 12" x 15" Center Trunion Mtd. Miller Cylinders. Dwg. # A-208274.
8. Manual of Steel Construction, AISC, 8th Ed.
9. Cygna Calculation, 82044, QID 361106, Dated 12/7/82, Rev. 2.
10. Cygna Calculation, 82044, QID 361104, Dated 7/23/82, Rev. 0.

APPENDIX A

SUMMARY OF A/O MODEL
USED IN PIPING ANALYSIS

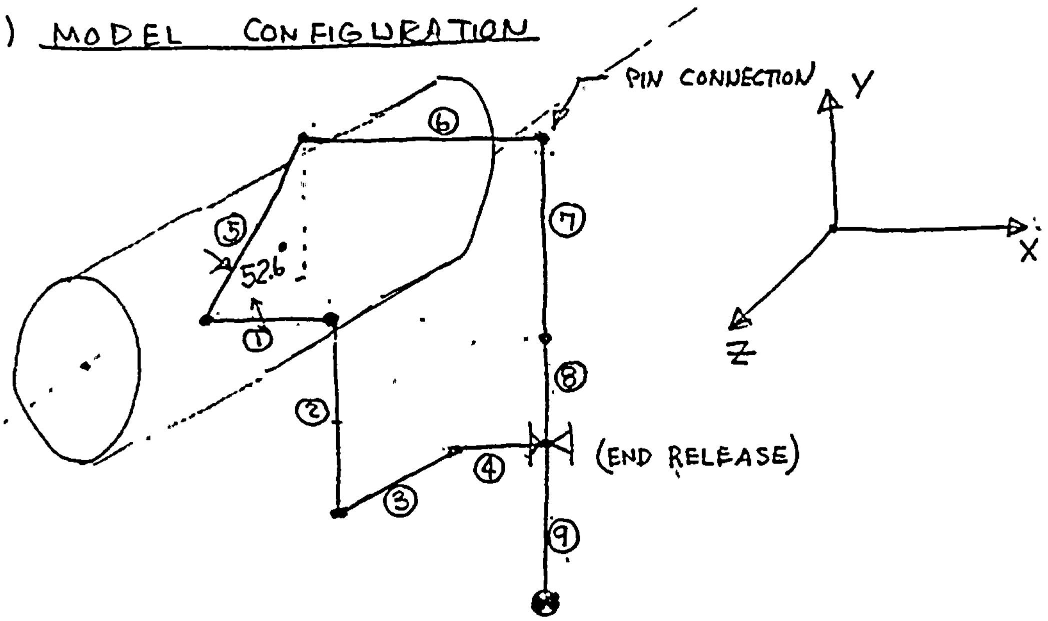
CYGNA

Calculation Sheet

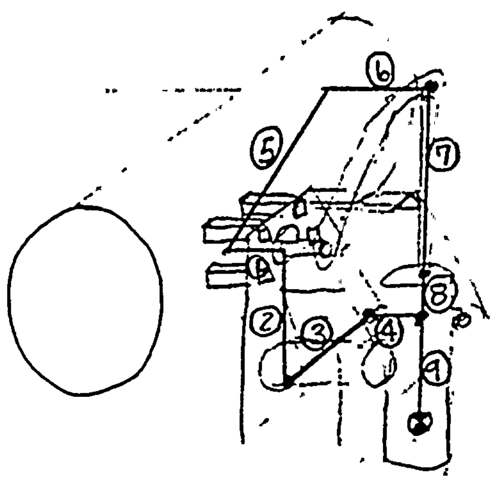
Project: WPPSS EQ		Prepared By: J E Rdonoski	Date: 1/3/83
Subject: BIF VALVE / ACTUATOR MODEL SUMMARY		Checked By: W. E. Searle	Date: 3/24/83
System: CSP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 361104 + 106	Rev. No.: 0	Sheet No.: A 1/3	

SUMMARY

A) MODEL CONFIGURATION



B) ACTUAL STRUCTURE



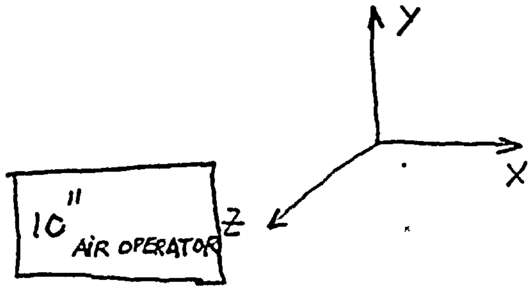
STRUCTURAL MEMBER DIRECTIONS

①	+X
②	-Y
③	-Z
④	+X
⑤	YZ-PLANE
⑥	+X
⑦	+Y
⑧	+Y
⑨	-Y

CYGNA

Calculation Sheet

Project: WPPSS		Prepared By: J E Kotowski	Date: 1/3/83
Subject: BIF VALVE / ACTUATOR MODEL SUMMARY		Checked By: D. E. Searle	Date: 3/24/83
System: CSP		Job No.: 82044	File No.: OT.01/F
Analysis No.: 3611046 361106	Rev. No.: 0	Sheet No.:	A 2/3



① VALUE EARS

8" CYL (24" VALVE)

	8" CYL	10" AIR OPERATOR
$A_x = A_y = A_z$	$= 15\ IN^2$	21
I_{xx}	$= 106\ IN^4$	657
I_{yy}	$= 11.2$ "	21.4
I_{zz}	$= 31.2$ "	63
C_y	$= 5.60$	5.25
C_z	$= 3.75$	4.75
E	$= 28 \times 10^6$ PSI, $F_s = 11.6 \times 10^6$ PSI	✓
l	$= 7.125$"	4.85"

② BRACKET

(Put e = 0 & add 277# 15" down) 321#

$A_x = A_y = A_z$	$= 6.84\ IN^2$	8.5
I_{xx}	$= 102\ IN^4$	255
(I_{yy}	$= 1000\ IN^4$	$1000\ IN^4$
I_{zz}	$= 2.16\ IN^4$	$4.22\ IN^4$
C_x	$= .25$ IN	.313
C_z	$= 6.84$ IN	8.5
E	$= 28 \times 10^6$ PSI, $F_s = 11.6 \times 10^6$ PSI	✓
l	$= 28.5$" (15" down to CG)	

③ & ④ BRACKET OFFSETS $L_3 = 8.8$" (8.5") $L_4 = 6.875$ (8.0")

③ MASSLESS, RIGID LINK, 8.8" LONG (8.5)

④ " " , 6.875" " (8.0)

(END RELEASE FOR ROTATION θ_{xx} ON ④)

CYGNA

Calculation Sheet

Project: WPPSS EQ	Prepared By: E Rakowski	Date: 1/3/83	
Subject: BIF VALVE/ACTUATOR MODEL - SUMMARY	Checked By: D.E. Searle	Date: 3/24/83	
System: CSP	Job No.: 82044	File No.: OT.01/F	
Analysis No.: 361106+361104	Rev. No.: 0	Sheet No.: A 3/3	

(5) SHAFT OFFSET

RIGID LINK 14.48" LONG (14.30)
AT 52.6° ↑ AS SHOWN

(6) SHAFT

$A_x = A_y = A_z =$	$3.98\ IN^2$	4.91
$I_{xx} =$	$2.52\ IN^4$	3.04
$I_{yy} =$	4 "	5.75
$I_{zz} =$	1.26 "	1.92
$C_y =$	1.125	1.25
$C_z =$	1.125	1.25
$E =$	29×10^6 PSI $E_S = 11.6 \times 10^6$ PSI	
$\ell =$	14 in.	12.85"

(7) DRIVE ROD

$A_x = 2.41$ $A_y = 2.41$ $A_z =$	$2.41\ IN^2$	$2.41\ IN^2$
$I_{xx} = I_{zz} =$	$.46\ IN^4$	$.46\ IN^4$
$I_{yy} =$	$.92\ IN^4$	$.92\ IN^4$
$C_x = C_z =$	.875 IN	.875 IN

HIGH STREN. ☆ $E = 30 \times 10^6$ PSI $E_S = 12 \times 10^6$ PSI

(8) & (9) CYLINDER
(PUT ρ=0 + ADD 399# AT END.) → 593#

$L_{(8)} =$	13.5"	13.5"
$L_{(9)} =$	14.0"	19"
$I_{yy} =$	$74\ IN^4$	$180\ IN^4$
$I_{xx} = I_{zz} =$	$52\ IN^4$	$127\ IN^4$
$A_x = A_y = A_z =$	$50\ IN^2$	$78\ IN^2$
$C_x = C_z =$	4"	5 IN

Project	Prepared By:	Date
Subject	Checked By:	Date
System	Job No.	File No.
Analysis No. / Rev. No.	Sheet No.	

APPENDIX B & C

AIR CYLINDER BUSHING PRESSURE EQUATIONS

CYGNA

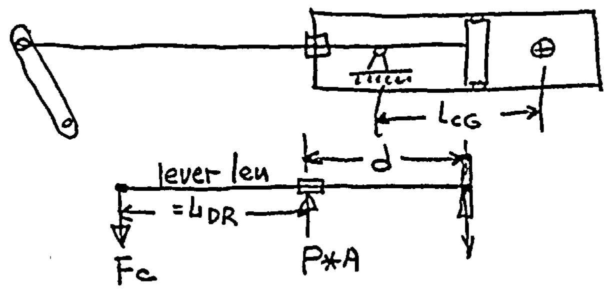
Calculation Sheet

Project: WPPSS EQ		Prepared By: [signature]	Date: 2/18/83
Subject: AIR CYLINDER BUSHING PRESSURE		Checked By: [signature]	Date: 3/22/83
System: CEP, CSP		Job No.: 82044	File No.: OP.01/F
Analysis No.: 018001	Rev. No.: 0	Sheet No.: APPENDIX B - PG. 1/3	

ANALYSIS FOR A/O BUSHING SIDE LOAD PRESSURE

$$\text{BUSHING PRESSURE} = \frac{\text{BUSHING FORCE}}{\text{AREA}}$$

BUSHING FORCE CALCULATED FROM F_c (AT CLEVIS)



$$P = \frac{F_c\,(L_{DR}+d)}{dA}$$

REF __. | . FOR BOTH 8" & 10" A/O, A_{10} = 2.075 in².

WORST CASE IS FOR VALVE-OPEN, WHERE L_{DR} IS MAXIMUM & d IS MINIMUM. 15" STROKE IN EACH CASE.

8"	10"
$L_{DR})_{OPEN}$ = 40 − 13.5 = 26.5"	= $L_{DR})_{OPEN}$) 8" & 10"
d: CYL. LEN. = 51.5"	= 64"

ASSUME PISTON CENTER IS 6" FROM END WHEN ON CLOSED STOP, 51.5 − 6 = 45.5" 64 − 6 = 58"

	8"	10"
∴	d = 45.5 − 15 = 30.5"	58 − 15 = 43"

1006.00

CYGNA

Calculation Sheet

Project: WPPSS EQ		Prepared By: [signature]	Date: 2/18/83
Subject: AIR CYLINDER BUSHING PRESSURE		Checked By: [signature]	Date: 3/22/83
System: CEP, CSP		Job No. 82044	File No. OP.01/F
Analysis No. 018001	Rev. No. 0	Sheet No. APPENDIX B, PG. 2/3	

FOR CYLINDER DRIVE ROD IN OPEN POSITION:

	8"	10"
$L_{ROD}\|_{OPEN}$	40"	40"
$L_{CG}\|_{OPEN}$:	10.96"	16.25"
L_{DR}	26.5"	26.5"
$d\|_o$	30.5"	43"
$A_{Bushing}$	2.075 in²	2.075 in²

$$F_c|_o = \frac{L_{CG}|_{OPEN} * \bar{W}_{AO} * g_1}{L_{ROD}|_{OPEN}}$$

&

$$P_{BUSHING} = \frac{F_c|_o \, (L_{DR} + d)}{d * A_{bushing}}$$

THESE EQUATIONS AND PARAMETERS WERE INCORPORATED INTO THE COMPUTER PROGRAMS FOR CALCULATION OF VALVE AND AIR OPERATOR COMPONENT STRESSES IN QID 361106 & 361104.

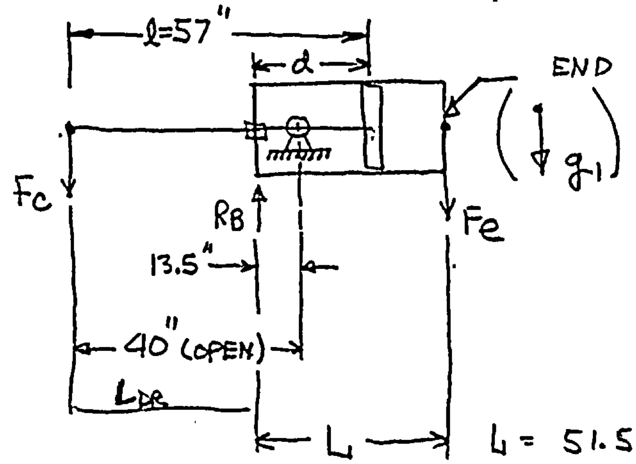
BUSHING PRESSURE AS CALCULATED BY THE SRSS METHOD IN THE PROGRAMS CAN BE USED TO BACK-CALCULATE AN IN-SITU LOAD, Fe TO TEST FOR CYLINDER OPERABILITY. SEE NEXT PAGE.

(CONTINUED)

CYGNA

Calculation Sheet

Project: WPPS EQ		Prepared By: J E Rakowski	Date: 2/19/83
Subject: AIR CYLINDER BUSHING PRESSURE		Checked By: H E Stark	Date: 3/22/83
System: CSP, CEP		Job No.: 82044	File No.: OP.01/F
Analysis No.: 018001	Rev. No.: 0	Sheet No.: APPENDIX B, PG. 3/3	



$L = 51.5''$ for 8" AO   REF: BIF XMITTAL
$= 64''$ for 10" AO   11/9/82, SEC. 7.0

. . .

$$F_C = \frac{L_{CG}|_O}{L_{ROD}|_O} * \bar{W}_{AO} * g_1 = P_{BUSHING} * A_{BUSHING} * \frac{d|_O}{\ell = 57''}$$

(8") Cylinder Open-Position Parameters are used because In situ tests are to be performed, if necessary, on CSP-V-3 & 4, from the open position to fail-closed. (SEE 4.3.1). Bushing pressure was calculated in QID 361106 & 361104 with open-position parameters because this is where pressures are greatest in stroke.

TEST FORCE:

From 361106:

$\therefore F)_{end\,of\,cyl}(51.5-13.5) = 40 F_C$

$L_{cg}|_O = 10.96''$ $W_{AO} = 399\#$

$L_{ROD}|_O = 40''$ $A_{BUSH} = 2.075\ IN^2$

$d|_O = 30.5''$

$$F)_e = \frac{40}{(51.5-13.5)} * P_B * A_B * \frac{d|_O}{\ell = 57}$$

$$= 1.05 * P_B * 2.075 * \frac{30.5}{57}$$

FOR TESTING:

☆ USE ONLY THE DYNAMIC COMP. OF PB IN 361106. | $F_e = 1.17\ P_B$ (#'s) ☆ |

CYGNA

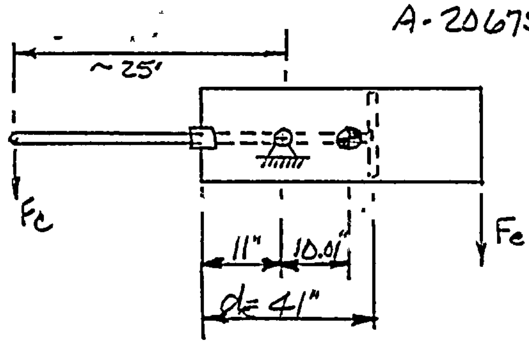
Calculation Sheet

Project: WPPSS - EQUIPMENT QUALIFICATION		Prepared By: [signature]	Date: 4/25/83
Subject: AIR CYLINDER BUSHING PRESSURE		Checked By:	Date:
System: CSP, CEP, ROA, REA		Job No. 82044	File No. OP01/F
Analysis No. QID 018001	Rev. No. 0	Sheet No. APPENDIX C, PG 1/2	

EXTRAPOLATING APPENDIX B APPROACH AND APPLYING TO 12" AIR CYLINDER PARAMETERS

REF DWG C-26093
A-206759

12" CYLINDER	
L_{ROD} | RETRACTED	24"
L_{CG} | RETRACTED	10.01"
L_{DE}	14"
d | R *	41"
$A_{BUSHING}$	2.373 "²
$L_{CYLINDER\ LENGTH}$	47"



CALCULATION IS FOR THE ROD RETRACTED CONDITION

* ASSUME PISTON CENTER IS 6" FROM END WHEN ON CLOSED STOP

$d|_R$ 47-6=41"

TEST FORCE:

$$Fe_{(END)}(47-11) = Fc_{(RET)}(25)$$

$W_{AO} = 583^{\#}$
$g_1 = 1.54$ (LOAD COMPAR. SEC 5.4

$$Fc_{(RET)} = \frac{L_{CG(RET)} \times W_{AO} \times g_1}{L_{ROD(RET)}} \rightarrow P_{BUSH} = \frac{Fc_{(RET)}(L_{DE} + d_R)}{A_{BUSH} * d_R}$$

$$Fe_{(END)} = \left(\frac{25}{36}\right) P_B (2.373)(41)\left(\frac{1}{14+41}\right)$$

$$Fe_{(END)} = 1.23 P_B$$

$$Fc_{(RET)} = \left(\frac{7.25}{24}\right)(583)(1.54)$$

$$Fc_{(RET)} = 271.22^{\#}$$

$$P_{BUSH} = \frac{(271.22)(14+41)}{(41)(2.373)}$$

$$P_{BUSH} = 153.32 \text{ PSI} < 200 \text{ PSI}$$

(MILLER'S EXTENDED USE ALLOW STRESS)

(SEE TELECON SECTION 7.0)

1006 00

Calculation Sheet

Project: WPPSS - EQUIPMENT QUALIFICATION		Prepared By: [signature]	Date: 4/25/83
Subject: AIR CYLINDER BUSHING PRESSURE		Checked By:	Date:
System: ROA & REA		Job No.: 82044	File No.: 1P.01.F
Analysis No.: 018001	Rev. No.: 0	Sheet No.: APPENDIX C 2/2	

CONSIDER ROD EXTENDED CONDITION OF CYLINDER

12" CYLINDER	(ROD EXTENDED)
$L_{ROD/EXTEND}$	36" (ASSUME 5 1/2" CLEVIS)
$L_{CG/EXTEND}$	7.13
L_{AR}	36-11 = 25
d_E*	(41-15) = 26
A_{BUSH}	2.373"²
$L_{C.L.}$	47"

* ASSUME PISTON CENTER IS 6" FROM END WHEN RETRACTED

$$F_{C(EXTEND)} = \frac{L_{CG(EXT)} \times W_{ROA}\, g_1}{L_{ROD(EXT)}} = \frac{7.13}{(36)}(583)(1.54)$$

$$F_{C(EXTEND)} = 177.82\#$$

$$P_{BUSH} = \frac{F_{C(EXT)}(L_{AR}+d_E)}{A_{BUSH}(d_E)}$$

$$= \frac{178(25+26)}{2.373(26)}$$

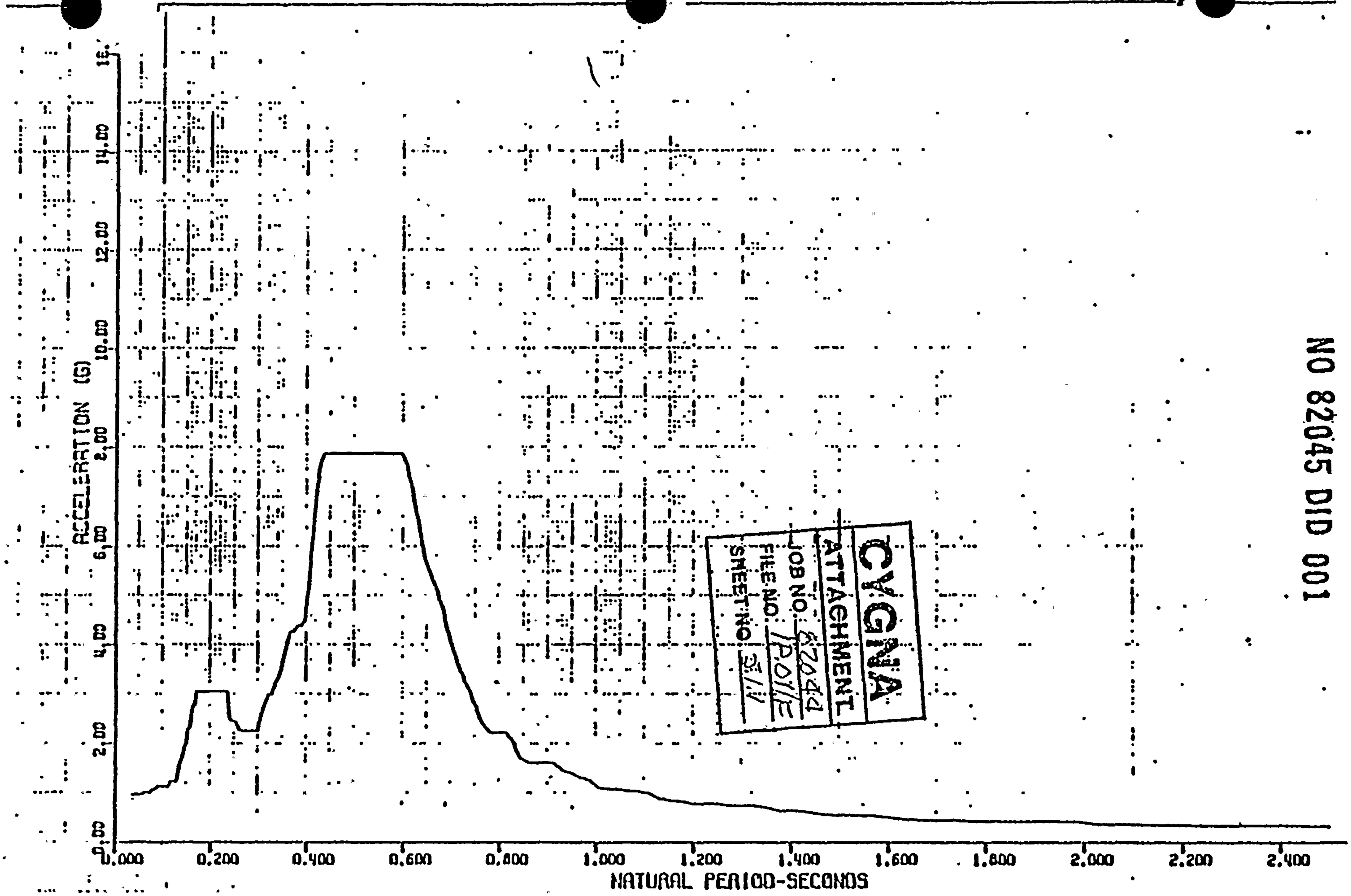
$$P_{BUSH} = 147\ PSI \quad < 200\ PSI$$

∴ OPERABILITY TEST NOT REQUIRED FOR 12" OPERATOR

1006.00

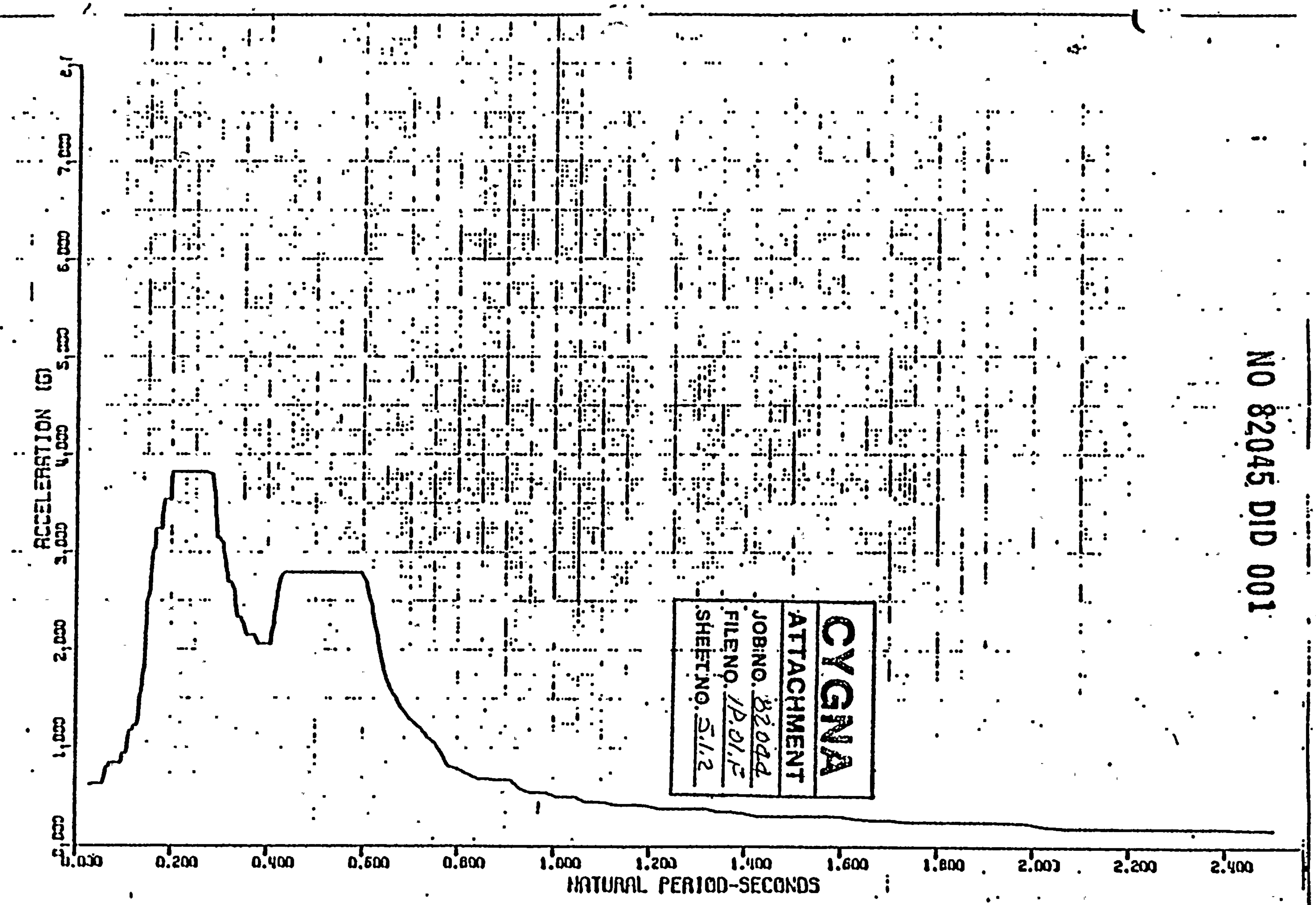
5.0 - CONTENTS

5.1 - RESPONSE SPECTRA

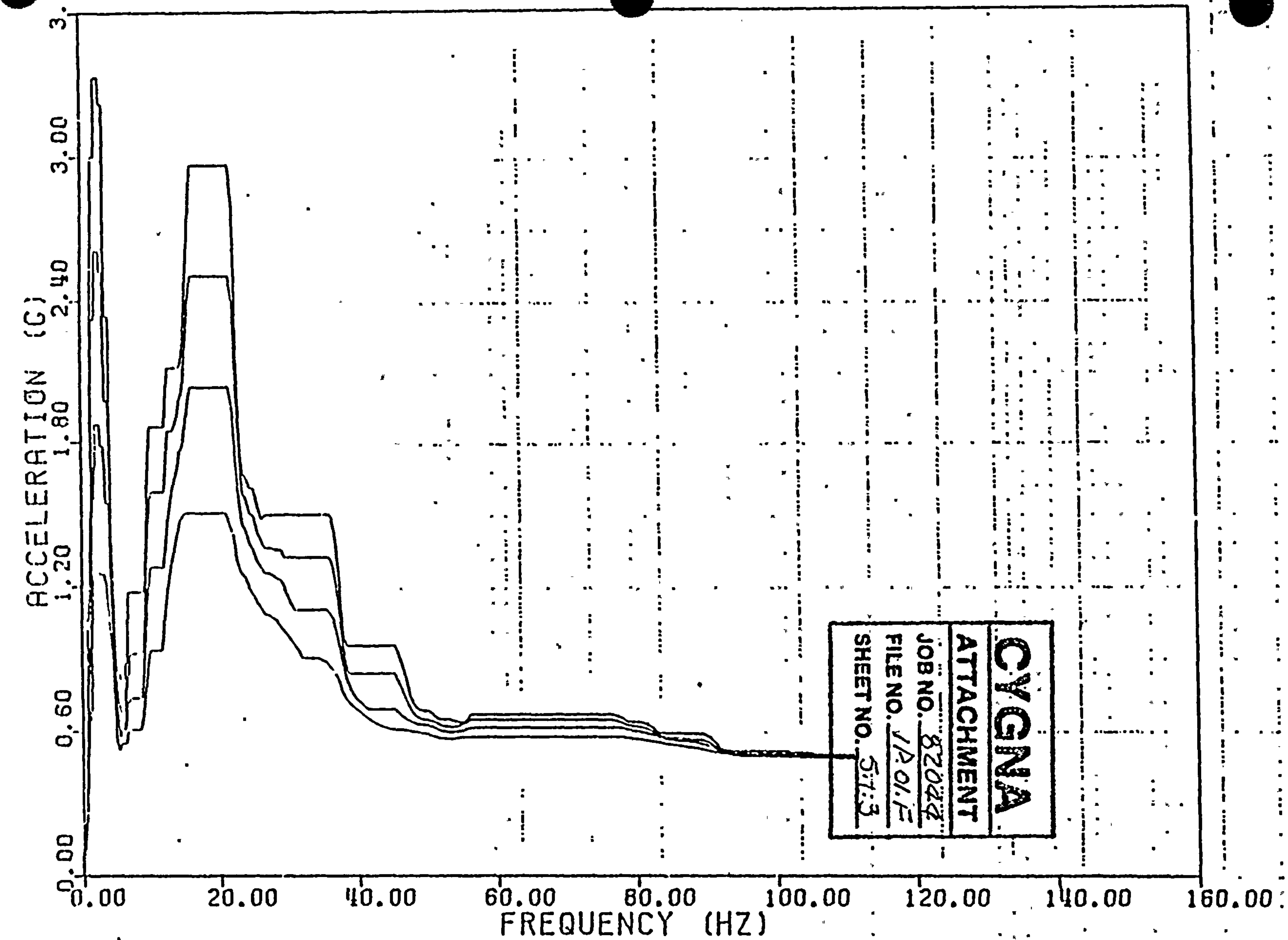


WPPSS, HANFORD NO.2, REACTOR BUILDING, MODEL NO. 2 REV. 1
SSE (DBE) FLOOR SPECTRUM - HORIZONTAL
MASS NO.2, EL. 605'-10.5", DAMPING=0.02

NO 82045 DID 001



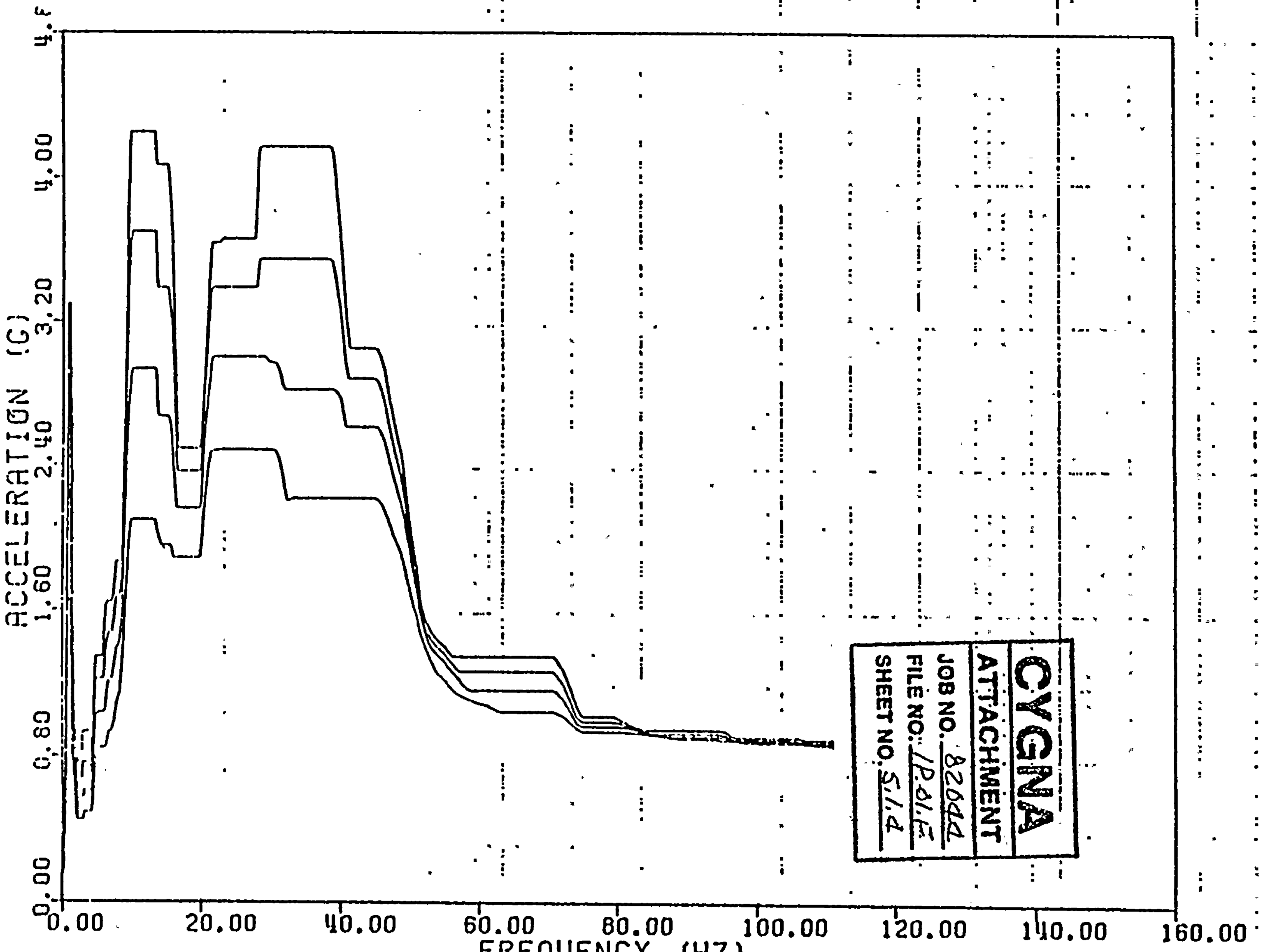
WPPSS, HANFORD NO.2, REACTOR BUILDING, MODEL NO. 2 REV. 1
SSE (OBE) FLOOR SPECTRUM - COMBINED VERTICAL
MASS NO.2, EL. 605'-10.5", DAMPING=0.02



WPPSS REACTOR BLDG. SRSS OF SRV SSE AP/CHUG.

MASS NO. 186 EL. 541 FT. VERT. TRANSLATION

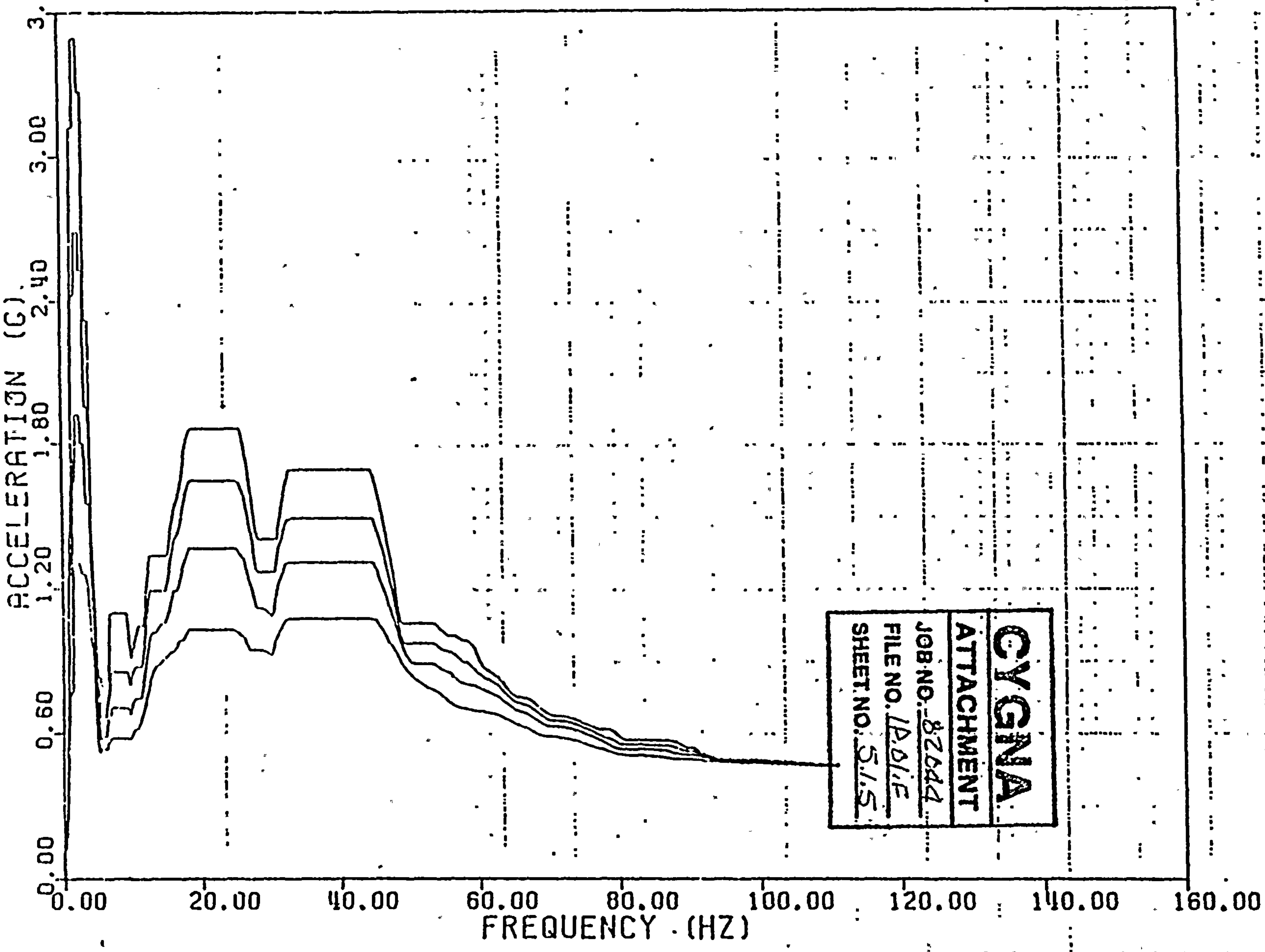
CONTAINMENT VESSEL DAMPING= .005,.01,.02,.04



WPPSS REACTOR BLDG. SRSS OF SRV SSE AP/CHUG.

MASS NO. 187 EL. 558 FT. HORIZ. TRANSLATION

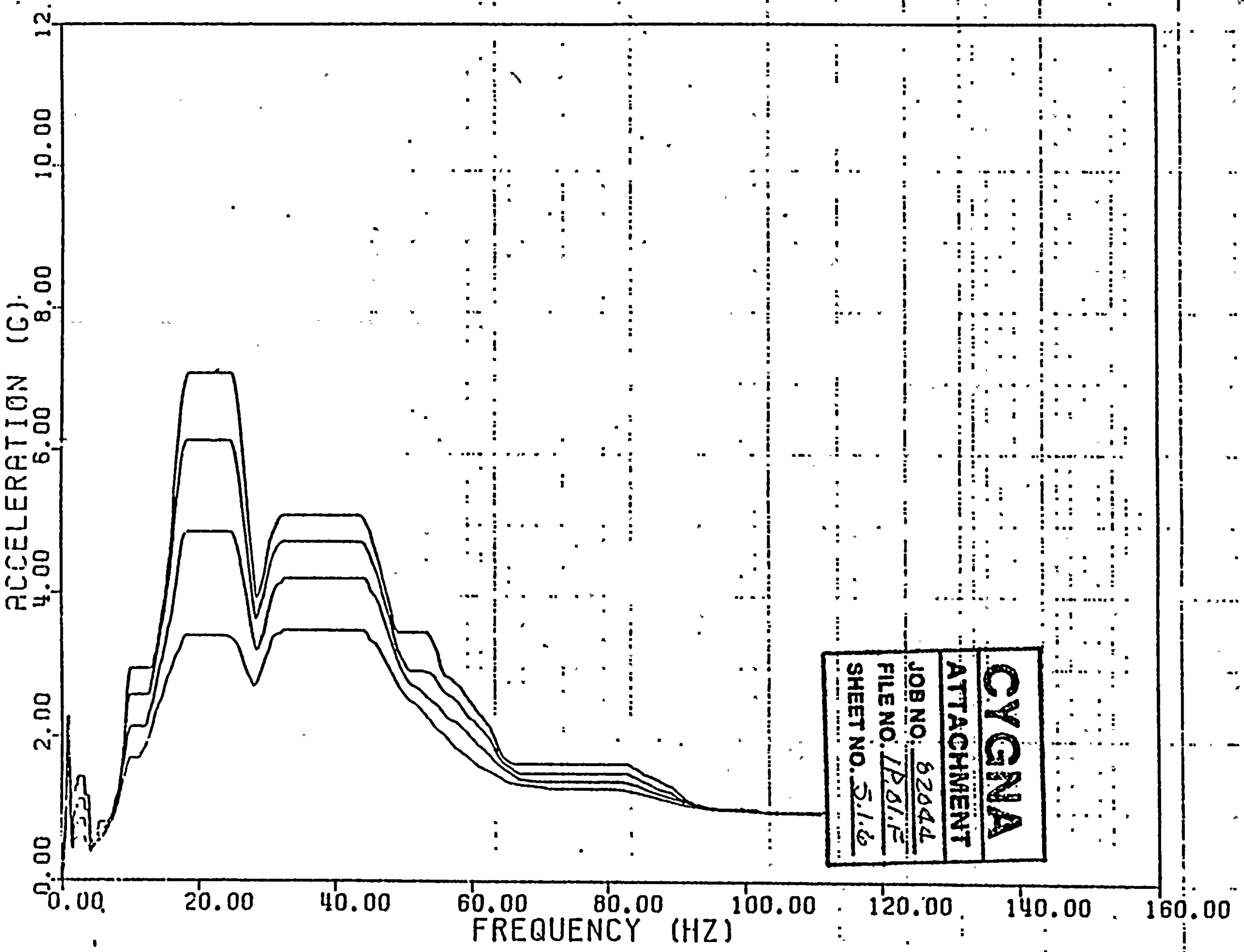
CONTAINMENT VESSEL DAMPING= .005,.01,.02,.04



WPPSS REACTOR BLDG. SRSS OF SRV SSE AP/CHUG.

MASS NO. 182 EL. 500 FT. VERT. TRANSLATION

CONTAINMENT VESSEL DAMPING= .005,.01,.02,.04



WPPSS REACTOR BLDG. SRSS OF SRV SSE AP/CHUG.

MASS NO. 182 EL. 500 FT. HORIZ. TRANSLATION

CONTAINMENT VESSEL DAMPING= .005,.01,.02,.04

5.2 Walkdown Sheets

△

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

CYGNA

EPN# CSP-V-1

QID# 361104

BLDG R | FLOOR EL 501 | COORDS M.5/7.6

MFR BIF | COMPONENT EL 508 | DSCRP 30" BFLY

MOD# A206763 | SERIAL# ____ | MAT'L ____

____ PSI @ ____ °F | LBS ____ SIZE ____

ASME CLASS ____

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( )

YOKE LENGTH ____
(FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS ____

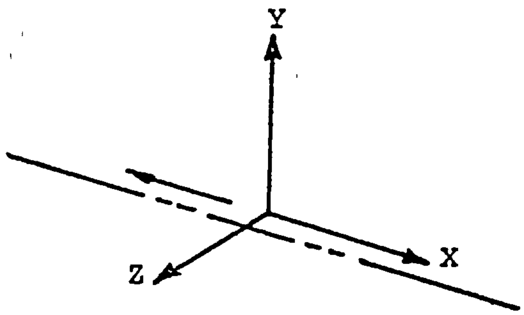
BOLT TYPE ____ BOLT Ø ____

WELD TYPE & SIZE ____

PIPE MOUNTED YES( ) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES( ) NO( )

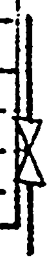
FULL(6WAY) ANCHOR BETWEEN COMPONENT & PRI CONT YES( ) NO( )



GLOBAL CO-ORDINATE SYSTEM

VALVE STEM ORIENTATION

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01.F
SHEET NO. 5.2.1



OPERATOR EPN ____ | MANUFACTURER ____

MODEL NO ____ | SERIAL NO ____

TYPE ____ SIZE ____ | ORDER NO ____

MOTOR EPN ____ | MANUFACTURER ____

MODEL NO ____ | SERIAL NO ____

ID NO ____ INS CLASS ____ | 1-PHASE ( ) 3-PHASE ( ) AC ____ DC ____

COMMENTS: Definition (N/F = Not Found)

Component not installed as of 7/19/82

△ VISUAL INSPECTION PERFORMED 12/22/82; IT WAS NOTED VALVE INSTALLED. SEE SHEET 2 of 2.

PREPARED BY Doug True (SIGNATURE) DATE 7/19/82 REVIEWED BY William Cunha (SIGNATURE) DATE 7/19/82

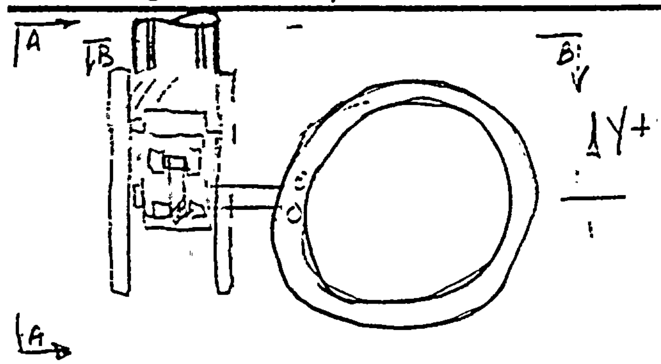
Doug True | WILLIAM CUNHA

△ [signature] 1/5/83

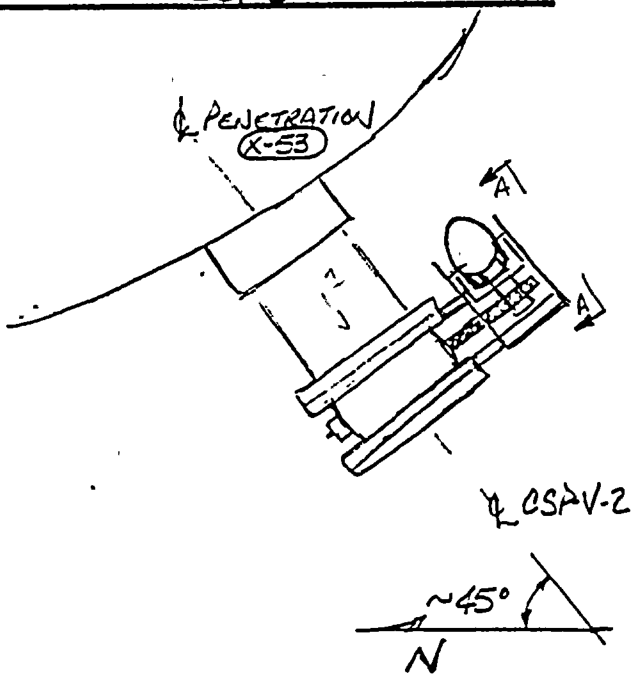
Calculation Sheet

CYGNA

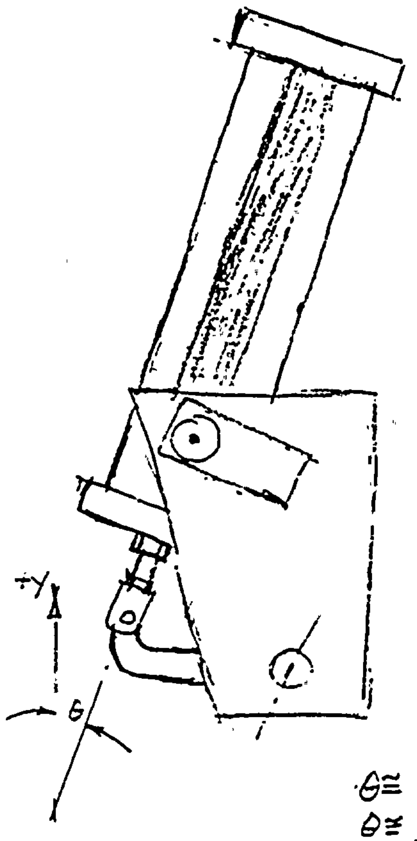
Project WNP #2		Prepared By: [signature]	Date 12/22/82
Subject EQUIP. QUALIFICATION		Checked By: L E Rubinowski	Date 1/4/83
System		Job No. 82044	File No.
Analysis No. QID #361104	Rev. No.	Sheet No. 2 OF 2	



CSP-V-1,2 (TYP VIEW)



PLAN VIEW (B-B)



θ ≅ 7° — CSP-V-1
θ ≅ 6° — CSP-V-2

SECTION VIEW A-A

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. IP.01F
SHEET NO. 5.2.2

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION, ONLY)

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CSF-V-2

QID# 361104

BLDG R FLOOR EL 501 COORDS M.5/7.4

MFR BIF COMPONENT EL 508 DSCRP 30" BFLY

MOD# A-206763 SERIAL# ____ MAT'L ____

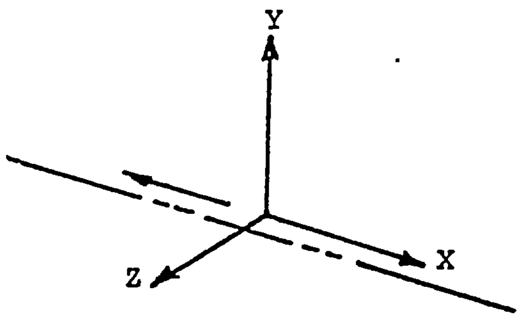
____ PSI @ ____ °F LBS ____ SIZE ____

ASME CLASS ____

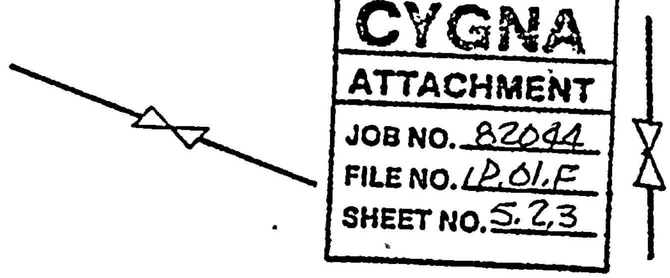
YOKE ORIENTATION	MOUNTING CONDITION
⊥ TO AXIS OF PIPE ( )	NO OF BOLTS ____
// TO AXIS OF PIPE ( )	BOLT TYPE ____ BOLT Ø ____
YOKE LENGTH ____ (FLANGE TO FLANGE)	WELD TYPE & SIZE ____
	PIPE MOUNTED YES( ) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES( ) NO( )

FULL(6WAY) ANCHOR BETWEEN COMPONENT & PRI CONT YES( ) NO( )



GLOBAL CO-ORDINATE SYSTEM



CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 12.01.F
SHEET NO. 5.2.3

VALVE STEM ORIENTATION

OPERATOR EPN ____	MANUFACTURER ____
MODEL NO ____	SERIAL NO ____
TYPE ____ SIZE ____	ORDER NO ____

MOTOR EPN ____	MANUFACTURER ____
MODEL NO ____	SERIAL NO ____
ID NO ____ INS CLASS ____	1-PHASE ( ) 3-PHASE ( ) AC ____ DC ____

COMMENTS: Definition (N/F = Not Found) Limit Switch

△ VISUAL INSPECTION PERFORMED 12/22/82 + IT WAS NOTED VALVE INSTALLED SEE SHEET 2 OF 2

Note: Not installed as of 7/19/82

PREPARED BY [signature] (SIGNATURE) DATE 7/19/82 REVIEWED BY William Cunha (SIGNATURE) DATE 7/19/82

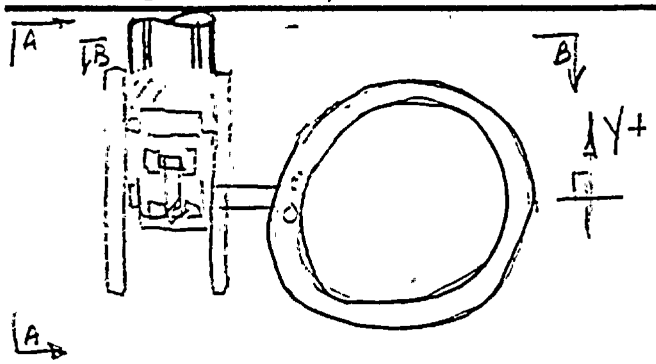
Doug True WILLIAM CUNHA

△ [signature] 1/5/83

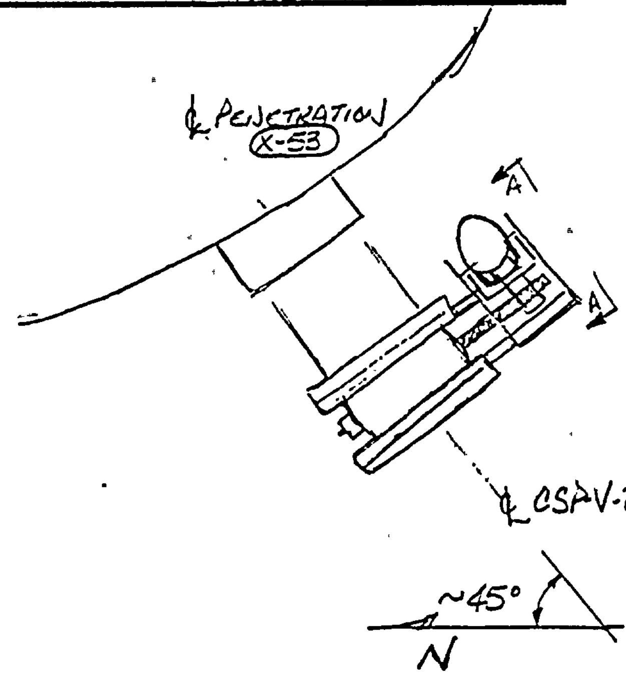
CYGNA

Calculation Sheet

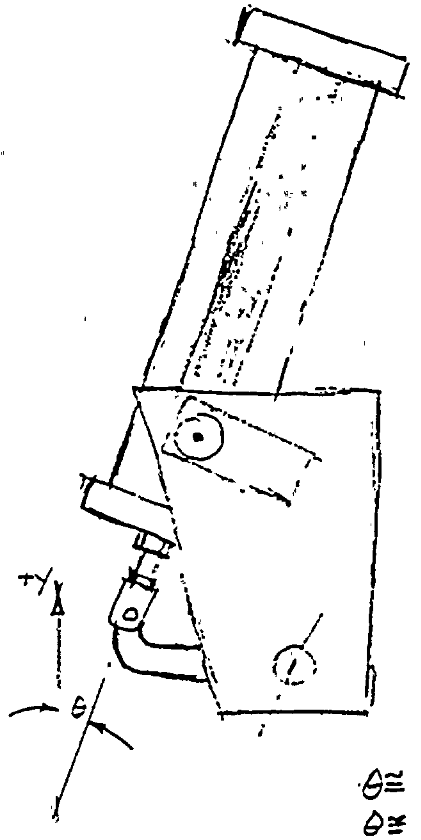
Project: WNP #2		Prepared By: [signature]	Date: 12/22/82
Subject: EQUIP. QUALIFICATION		Checked By: L E Rabinowski	Date: 1/4/83
System:		Job No.: 82044	File No.:
Analysis No.: QID #361104	Rev. No.:	Sheet No.: 2 OF 2	



CSP-V-1,2 (TYP VIEW)



PLAN VIEW (B-B)



θ ≅ 7° — CSP-V-1
θ ≅ 6° — CSP-V-2

SECTION VIEW A-A

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. IP.01.F
SHEET NO. 5.2.4

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION, ONLY)

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

CYGNA

EPN# CSP-V-3

QID# 361106

BLDG R

FLOOR EL 501.47

COORDS M.6/7.6

MFR BIF 0657

COMPONENT EL 481

DSCRP 24" BFLY Cont Isol Valve

MOD# ~~DWG A20764~~

SERIAL# N27235-1

MAT'L SA-516-GR-70

150 PSI @ 275 °F

LBS N/F SIZE 24"

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH 0'-4 1/2" (FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

WELD TYPE & SIZE N/A

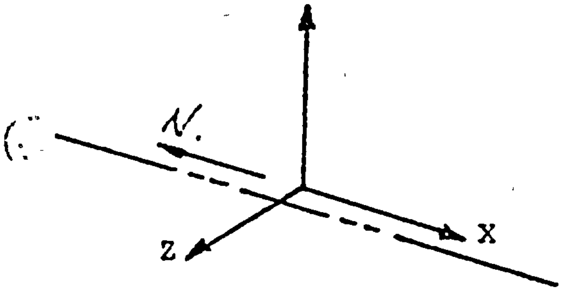
PIPE MOUNTED YES (✓) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

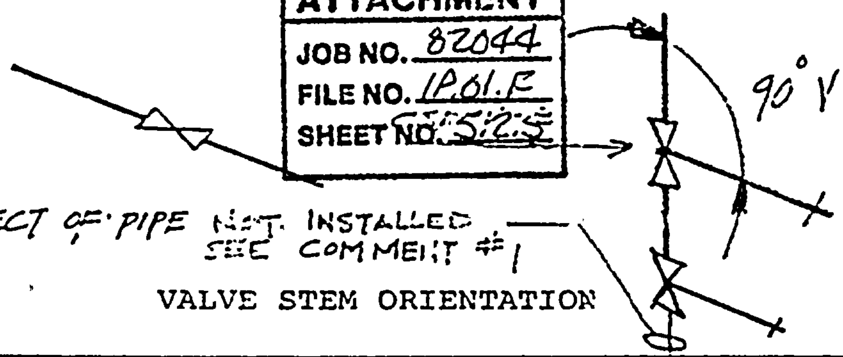
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( ) N/F

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( ) N/F

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 12.01.F
SHEET NO.



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN COVERED W/ PLASTIC MANUFACTURER

MODEL NO SERIAL NO

TYPE SIZE ORDER NO

MOTOR EPN N/A NOT MOTOR OPERATED MANUFACTURER

MODEL NO SERIAL NO

ID NO INS CLASS 1-PHASE ( ) 3-PHASE ( ) AC DC

COMMENTS: Definition (N/F = Not Found)

* CSP-LMS-3

1. LENGTH OF PIPE HAS NOT BEEN INSTALLED FROM VALVE TO CONTAINMENT.

PREPARED BY William Cunha (SIGNATURE) DATE 7/21/82 REVIEWED BY Doug True (SIGNATURE) DATE 7/21/82

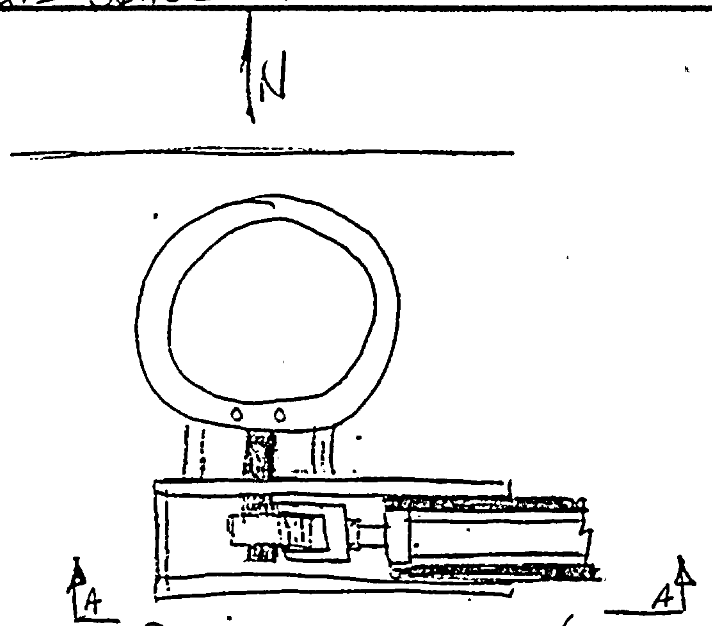
WILLIAM CUNHA Doug True

△ D. Searle 1/5/83

CYGNA

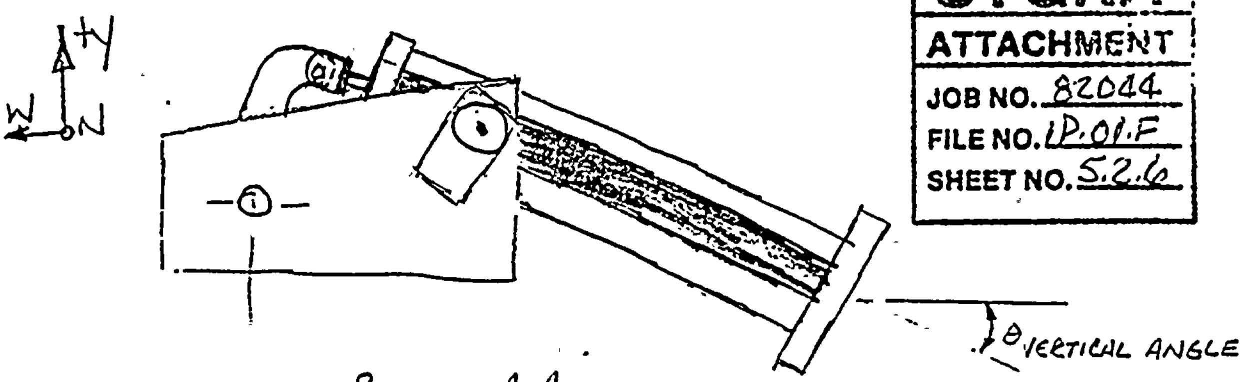
Calculation Sheet

Project: WNP#2		Prepared By: Don Slack	Date: 12/22/82
Subject: Equip. Qualification		Checked By: J E Rabowski	Date: 1/4/83
System: CEP/CSP		Job No. 82044	File No.
Analysis No. QID#361106	Rev. No.	Sheet No.	



PLAN CSP-V-3,4 (TYP VIEW)

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. IP.01.F
SHEET NO. 5.2.6



SECTION A-A

CSP-V-3 — θ ~ 7°
CSP-V-4 — θ ~ 6°

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY)

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CSP-V-4

QID# 361106

BLDG R FLOOR EL 471' COORDS 7.6/M.6

MFR BIF COMPONENT EL 478 DSCRP 24" BFLY CNT. ISOL VALVE

MOD# DWG A26764 0657 SERIAL# 272-35-2 MAT'L SA-516-GR-70

150 PSI @ 275 °F LBS N/F SIZE 24"

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH 0'-4½" (FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

WELD TYPE & SIZE N/A

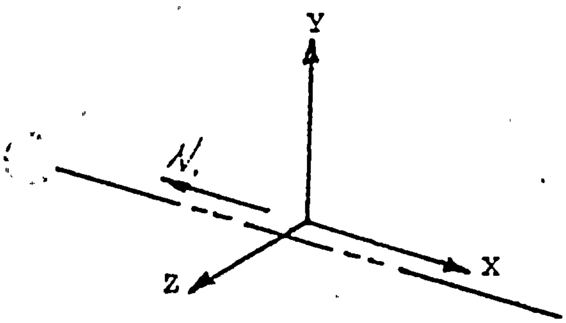
PIPE MOUNTED YES (✓) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

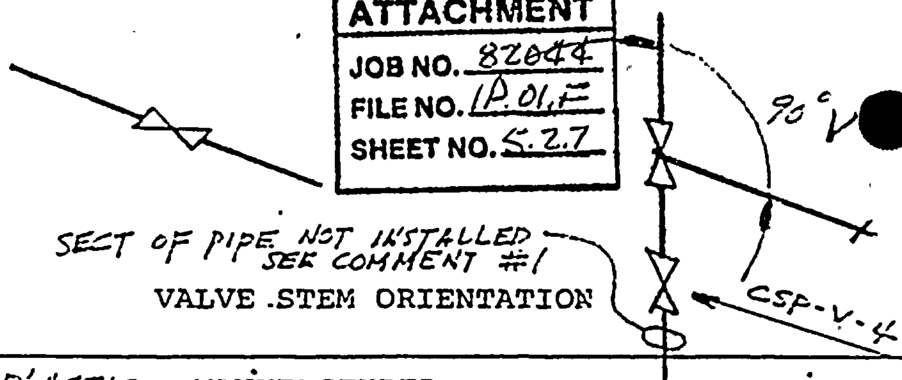
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( ) N/F

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( ) N/F

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 12.01.F
SHEET NO. 5.2.7



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

OPERATOR EPN COVERED W/ PLASTIC MANUFACTURER ____

MODEL NO ____ SERIAL NO ____

TYPE ____ SIZE ____ ORDER NO ____

MOTOR EPN N/A NOT MOTOR OPERATED MANUFACTURER ____

MODEL NO ____ SERIAL NO ____

ID NO ____ INS CLASS ____ 1-PHASE ( ) 3-PHASE ( ) AC ____ DC ____

COMMENTS: Definition (N/F = Not Found)

1. LENGTH OF PIPE HAS NOT BEEN INSTALLED FROM VALVE TO CONTAINMENT.

PREPARED BY [signature] (SIGNATURE) DATE 7/21/82 REVIEWED BY [signature] (SIGNATURE) DATE 7/21/82

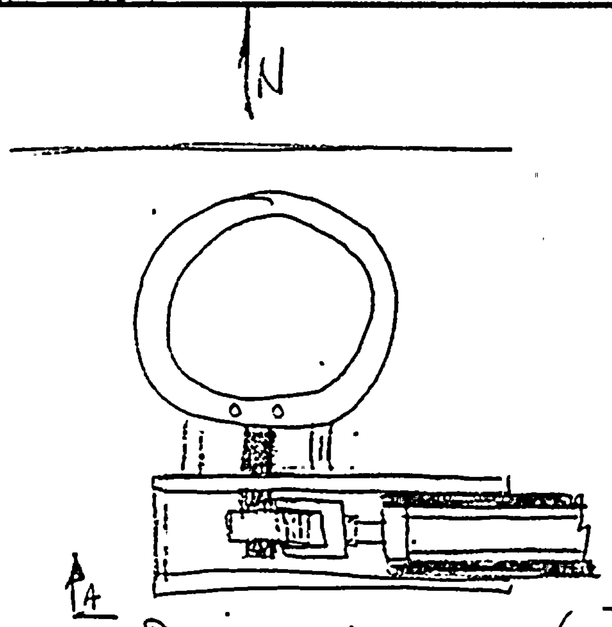
WILLIAM CUNHA Doug True

△ [signature] 1/5/83

CYGNA

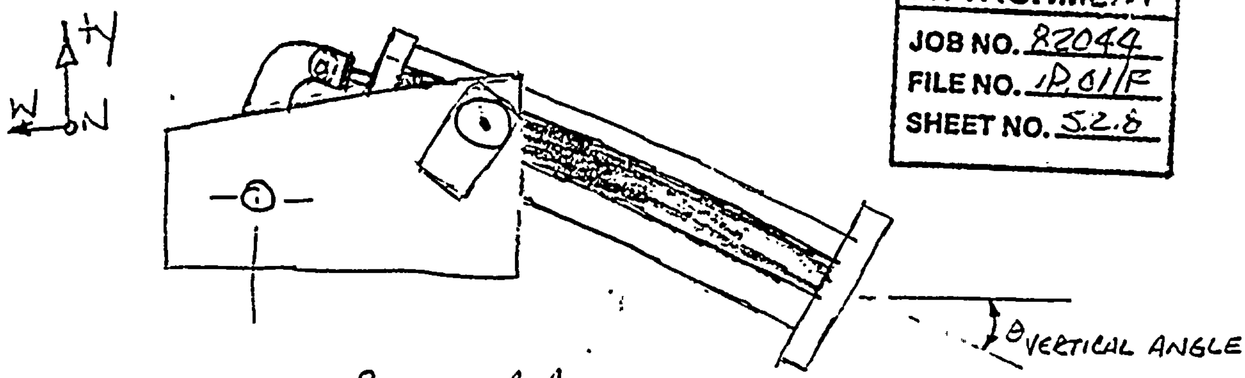
Calculation Sheet

Project: WNP#2		Prepared By: Don Slade	Date: 12/22/82
Subject: EQUIP. QUALIFICATION		Checked By: J E Rabowski	Date: 1/4/83
System: CEP/CSP		Job No. 82044	File No.
Analysis No. QID#361106	Rev. No.	Sheet No.	



PLAN CSP-V-3,4 (TYP VIEW)

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01/F
SHEET NO. 52.8



SECTION A-A

CSP-V-3 — θ ~ 7°
CSP-V-4 — θ ~ 6°

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION ONLY)

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CSP-V-5

QID# 361106

BLDG R FLOOR EL 471 COORDS M.7 / 8.3

MFR GIF COMPONENT EL 475 DSCRP 24" BFLY

MOD# DWG A20765 SERIAL# 27236-1 MAT'L ______

______ PSI @ ______ °F LBS ______ SIZE ______

ASME CLASS ______

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( )

YOKE LENGTH ______
(FLANGE TO FLANGE)

MOUNTING CONDITION

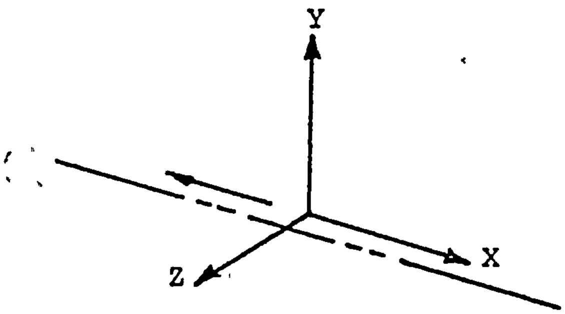
NO OF BOLTS ______

BOLT TYPE ______ BOLT Ø ______

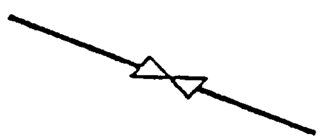
WELD TYPE & SIZE ______

PIPE MOUNTED YES ( ) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO ( )
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( )



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA
ATTACHM[illegible]T
JOB NO. 82044
FILE NO. LP.01/E
SHEET NO. 5.2.9

OPERATOR EPN ______ MANUFACTURER ______
MODEL NO ______ SERIAL NO ______
TYPE ______ SIZE ______ ORDER NO ______

MOTOR EPN ______ MANUFACTURER ______
MODEL NO ______ SERIAL NO ______
ID NO ______ INS CLASS ______ 1-PHASE ( ) 3-PHASE ( ) AC ______ DC ______

△ VISUAL INSPECTION MADE 12/22/82 & IT WAS NOTED VALVE INSTALLED SEE SHEET 2 OF 2
COMMENTS: Definition (N/F = Not Found)

Valve not installed as of 7/21/82

PREPARED BY William [signature] (SIGNATURE) DATE 7/21/82 REVIEWED BY Doug True (SIGNATURE) DATE 7/21/82

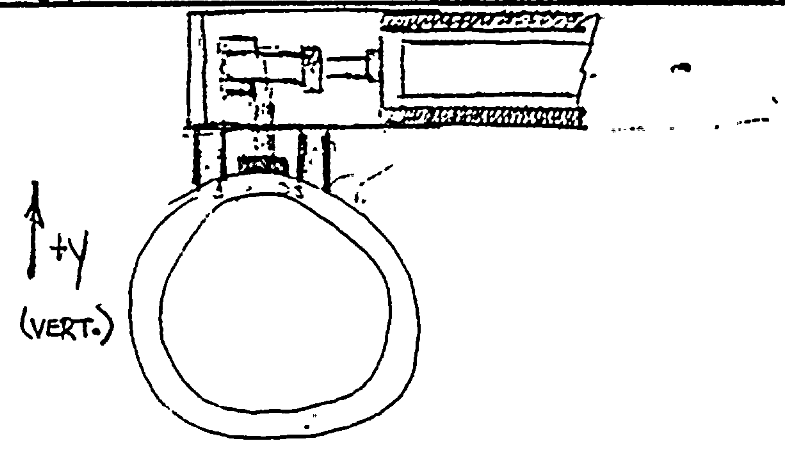
WILLIAM CONNELL Doug True

△ A. Searle 1/5/83

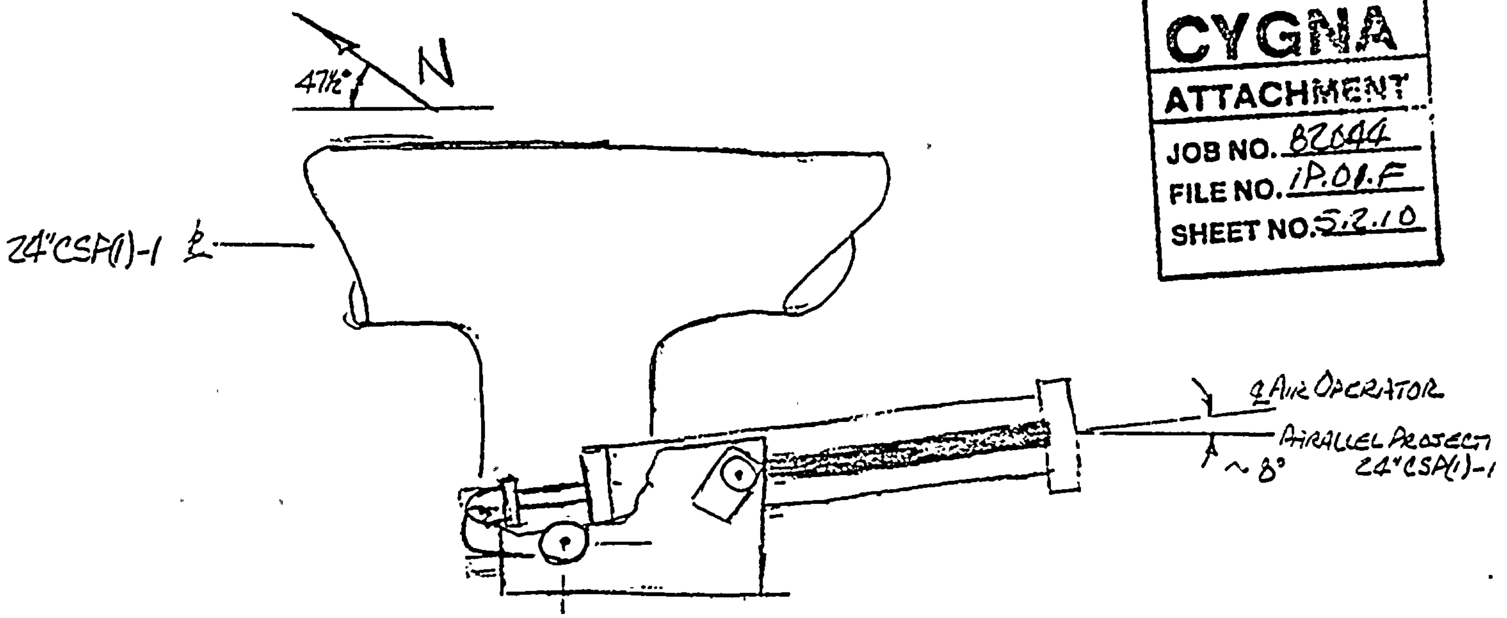
CYGNA

Calculation Sheet

Project WNP #2		Prepared By: [signature]	Date 12/22/82
Subject EQUIP. QUALIFICATION		Checked By: [signature]	Date 1/4/83
System		Job No. 82044	File No.
Analysis No. QID #361106	Rev. No.	Sheet No. 2 OF 2	



CSP-V-5



PLAN VIEW

FIELD SKETCH (FOR THE PURPOSE OF SHOWING OPERATOR ORIENTATION ONLY)

CYGNA

EQUIPMENT QUALIFICATION
WALKDOWN VERIFICATION FORM

EPN# CSP-V-6

QID# 361106

BLDG R FLOOR EL 471 COORDS N.5/7.7 4.5.

MFR BIF COMPONENT EL 480 DSCRP 24" BFLY

MOD# A-206765 SERIAL# ____ MAT'L ____

____ PSI @ ____ °F LBS ____ SIZE ____

ASME CLASS ____

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( )

YOKE LENGTH ____
(FLANGE TO FLANGE)

MOUNTING CONDITION

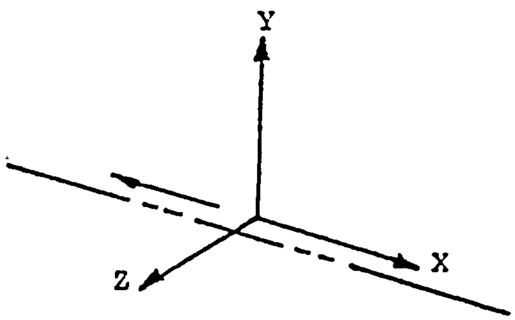
NO OF BOLTS ____

BOLT TYPE ____ BOLT Ø ____

WELD TYPE & SIZE ____

PIPE MOUNTED YES ( ) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO ( )
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( )



GLOBAL CO-ORDINATE SYSTEM

VALVE STEM ORIENTATION

CYGNA
ATTACHMENT
JOB NO. 82__
FILE NO. 1P.01.F
SHEET NO. 5.2.11

OPERATOR EPN ____ MANUFACTURER ____
MODEL NO ____ SERIAL NO ____
TYPE ____ SIZE ____ ORDER NO ____

MOTOR EPN ____ MANUFACTURER ____
MODEL NO ____ SERIAL NO ____
ID NO ____ INS CLASS ____ 1-PHASE ( ) 3-PHASE ( ) AC ____ DC ____

COMMENTS: Definition (N/F = Not Found)
* CSP-LMS-6 1. Not installed as of 7/21/82

△ VISUAL INSPECTION MADE 12/22/82 & IT WAS NOTED VALVE INSTALLED SEE SHEET 2 OF 2

PREPARED BY William Cunha DATE 7/21/82 REVIEWED BY Doug True DATE 7/21/82
(SIGNATURE) (SIGNATURE)

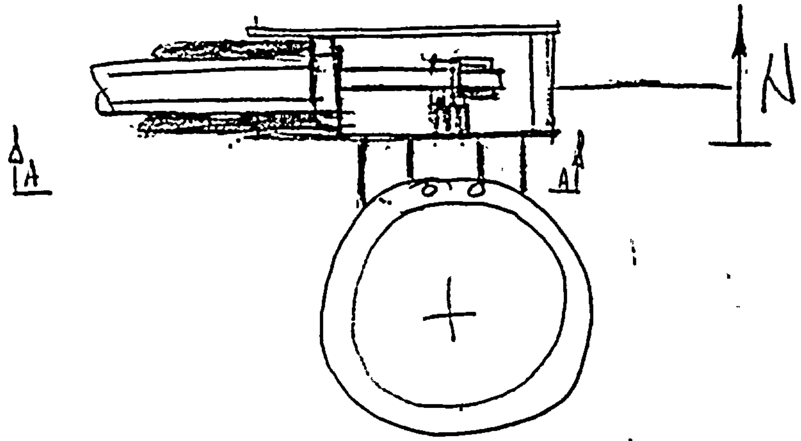
WILLIAM CUNHA △ [signature] 1/5/83 Doug True

12.10

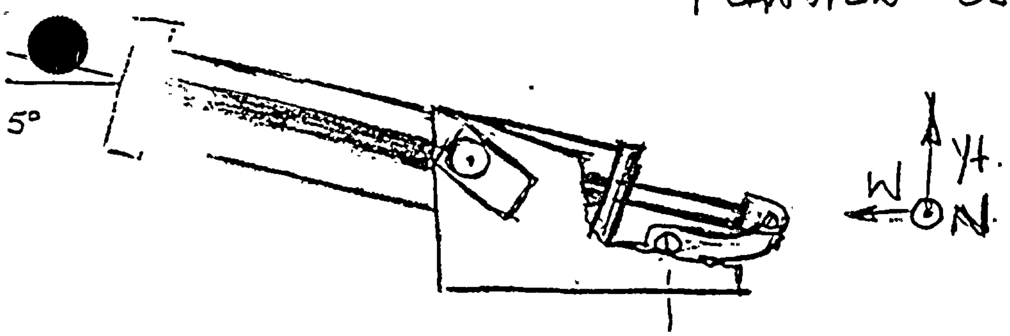
CYGNA

Calculation Sheet

Project: WNP #2		Prepared By: [signature]	Date: 12/22/82
Subject: EQUIP. QUALIFICATION		Checked By: [signature]	Date: 1/4/83
System: CEP/CES		Job No. 82044	File No.
Analysis No. QID # 361106	Rev. No.	Sheet No. 2 OF 2	



PLAN VIEW CSP-V-6



SECTION A-A

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. IP.01.E
SHEET NO. 5.2.12

FIELD SKETCH (FOR THE PURPOSE OF DEPICTING OPERATOR ORIENTATION, ONLY)

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CSP-V-9

QID# 361106

BLDG R FLOOR EL 471 COORDS M9 / 5.1

MFR BIF COMPONENT EL 490 DSCRP 24" BFLY

MOD# A20765 SERIAL# ______ MAT'L ______

______ PSI @ ______ °F LBS ______ SIZE ______

ASME CLASS ______

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( )

YOKE LENGTH ______
(FLANGE TO FLANGE)

MOUNTING CONDITION

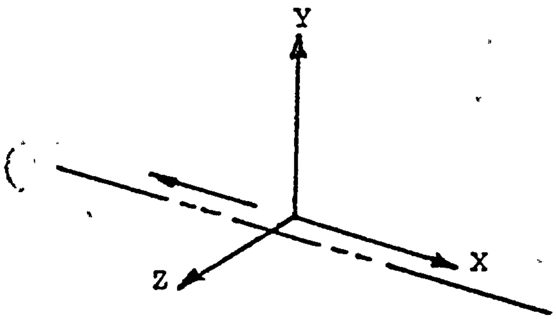
NO OF BOLTS ______

BOLT TYPE ______ BOLT Ø ______

WELD TYPE & SIZE ______

PIPE MOUNTED YES ( ) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO ( )
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO ( )



GLOBAL CO-ORDINATE SYSTEM

VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. P.01/F
SHEET NO. 5.2.13

OPERATOR EPN ______ MANUFACTURER ______
MODEL NO ______ SERIAL NO ______
TYPE ______ SIZE ______ ORDER NO ______

MOTOR EPN ______ MANUFACTURER ______
MODEL NO ______ SERIAL NO ______
ID NO ______ INS CLASS ______ 1-PHASE ( ) 3-PHASE ( ) AC ______ DC ______

COMMENTS: Definition (N/F = Not Found)

Note: not installed as of 7/21/82

PREPARED BY William Cunha DATE 7/21/82 REVIEWED BY Doug True DATE 7/21/82
(SIGNATURE) (SIGNATURE)

WILLIAM CUNHA Doug True

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CEP-V-1A

QID# 361104

BLDG R FLOOR EL 548 COORDS J4/5.4

MFR BIF COMPONENT EL 558 DSCRP 30" Butterfly

MOD# A-206763 SERIAL# 27234-3 MAT'L SA-516-GR70

45 PSI @ 340 °F LBS N/F SIZE 30"

ASME CLASS 2

YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )

// TO AXIS OF PIPE ( ) N/A

YOKE LENGTH N/A
(FLANGE TO FLANGE)

MOUNTING CONDITION

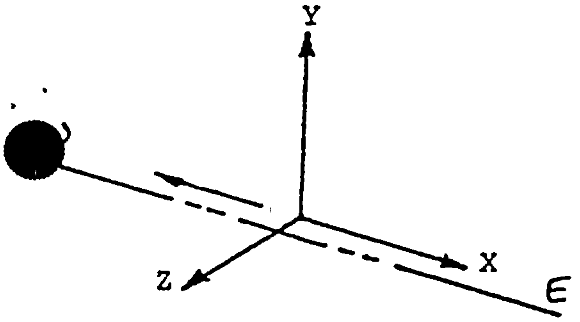
NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

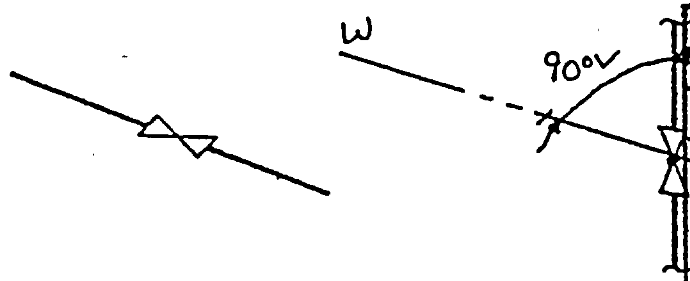
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( ) bolted flanges

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)
IS COMP BETWEEN CONT & 1ST ANC. (FULL 6 WAY ANC) YES (✓) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 1R01.F
SHEET NO. 5.2.14

OPERATOR EPN N/A MANUFACTURER
MODEL NO SERIAL NO
TYPE SIZE ORDER NO

MOTOR EPN N/A MANUFACTURER
MODEL NO SERIAL NO
ID NO INS CLASS 1-PHASE ( ) 3-PHASE ( ) AC DC

COMMENTS: 2 Limit Switches Found EPN's: not known
Model: 1703100 Manufacturer: Namco Controls
EA74080100

PREPARED BY [signature] (SIGNATURE) David Tow DATE 7/14/82 REVIEWED BY William Cunha (SIGNATURE) WILLIAM CUNHA DATE 7/14/82

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CEP-V-2A

QID# 361104

BLDG R   FLOOR EL 548   COORDS J.4 / 5.4

MFR BIF   COMPONENT EL 558   DSCRP 30" Butterfly

MOD# 0657   SERIAL# 27234-4   MAT'L SA-516-GR 70

45 PSI @ 340 °F   LBS N/F SIZE 30"

ASME CLASS 2

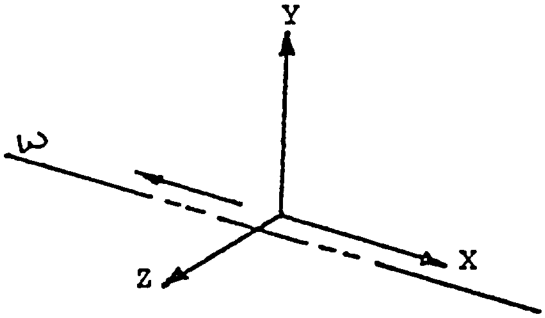
YOKE ORIENTATION

⊥ TO AXIS OF PIPE ( )
// TO AXIS OF PIPE ( ) N/A
YOKE LENGTH N/A
(FLANGE TO FLANGE)

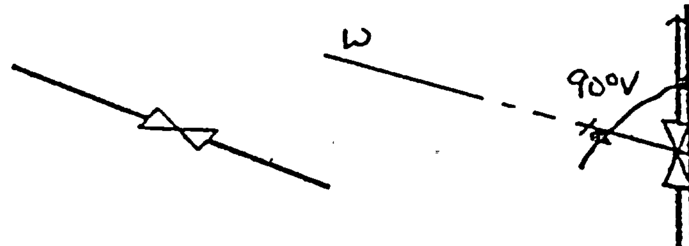
MOUNTING CONDITION

NO OF BOLTS N/A
BOLT TYPE N/A BOLT Ø N/A
WELD TYPE & SIZE N/A
PIPE MOUNTED YES (✓) NO ( ) bolted flanges

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)
IS COMP BETWEEN CONT & 1ST ANC. (FULL 6 WAY ANC) YES (✓) NO ( )
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. ZB.01.F
SHEET NO. 52.15

OPERATOR EPN N/A   MANUFACTURER
MODEL NO N/A   SERIAL NO
TYPE   SIZE   ORDER NO

MOTOR EPN N/A   MANUFACTURER
MODEL NO   SERIAL NO
ID NO   INS CLASS   1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

COMMENTS: 2 Limit Switches found Manufacturer: Namco Controls
Model #: 1703100 EPN: CEP-LMS-2A
#: EA 74080100

PREPARED BY Doug Turner for Dave Doyel (SIGNATURE) DATE 7/14/82 REVIEWED BY William ... (SIGNATURE) DATE 7/14/82
Doug Turner   William ...

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

△

EPN# CEP-V-3A

QID# 36106

BLDG R

FLOOR EL 471

COORDS H.5/5.4

MFR BIF

COMPONENT EL 495

DSCRP 24. BLFY SUPP Chamber Exhaust

MOD# ~~DWG A-206764~~ 0657

SERIAL# N27235-3

MAT'L SA-516 GR - N/F

150 PSI @ 275 °F

LBS N/F SIZE 24"

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH 0' - 4 1/2" (FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

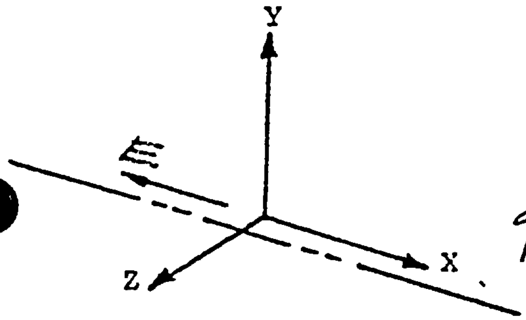
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( )

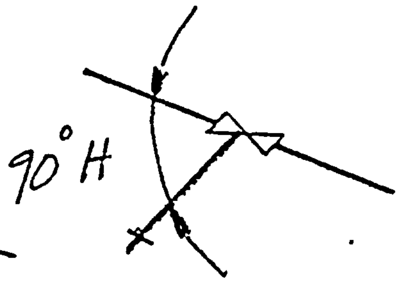
PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (✓) NO ( )

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01.F
SHEET NO. 5.2.16

OPERATOR EPN N/A

MANUFACTURER

MODEL NO

SERIAL NO

TYPE SIZE

ORDER NO

MOTOR EPN N/A

MANUFACTURER

MODEL NO

SERIAL NO

ID NO INS CLASS

1-PHASE ( ) 3-PHASE ( ) AC DC

COMMENTS: Definition (N/F = Not Found)

* CEP-LMS-3A

△ SEE SHEET 2 OF 2 FOR OPERATOR ORIENTATION

PREPARED BY William Cunha (SIGNATURE) DATE 7/21/82 REVIEWED BY Doug True (SIGNATURE) DATE 7/21/82

WILLIAM CUNHA Doug True

△ [signature] 1/5/83

CYGNA

Calculation Sheet

Project: WPPS MECH. E.Q.		Prepared By: J. E. Rokowski	Date: 12/16/82
Subject: BIF VALVE & AO		Checked By: W. E. Searle	Date: 12/20/82
System: CSP / CEP		Job No. 82044	File No.
Analysis No.	Rev. No.	Sheet No. 2/2	

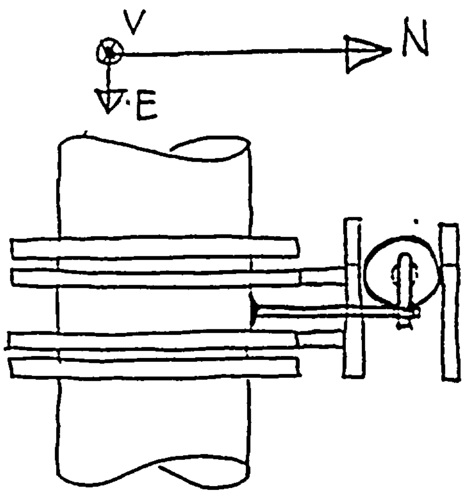
WALKDOWN

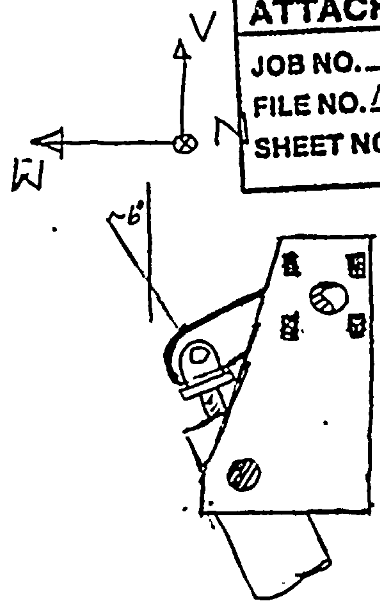
VALVE & OPERATOR ORIENTATIONS

CEP-V-3A & 4A

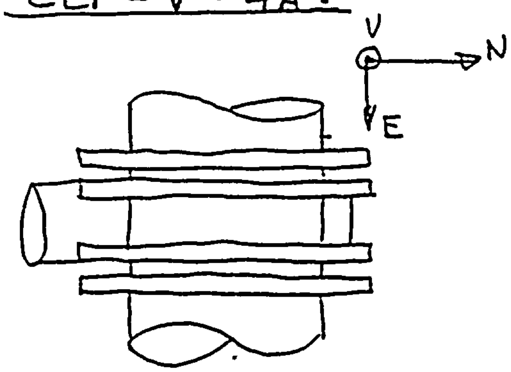
CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01.F
SHEET NO. 5.2.17

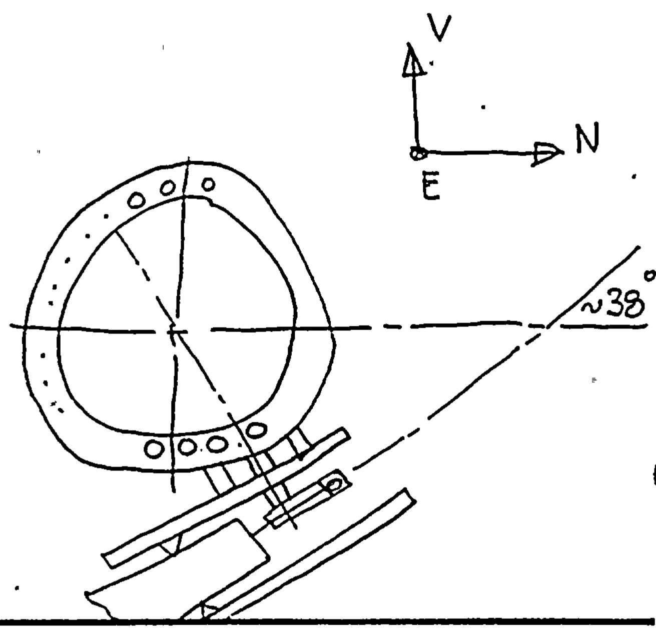
CEP-V-3A:





CEP-V-4A:





1006 00

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# CEP-V-4A

QID# 361106

BLDG R   FLOOR EL 471   COORDS H.5/5.4

MFR BIF   COMPONENT EL 495   DSCRP 24" BFLY

MOD# ~~DWG A 206764~~ 0657   SERIAL# N 27235-4   MAT'L SA-516 GR-N/F

150 PSI @ 275 °F   LBS N/F   SIZE 24"

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH 0'-4½" (FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A   BOLT Ø N/A

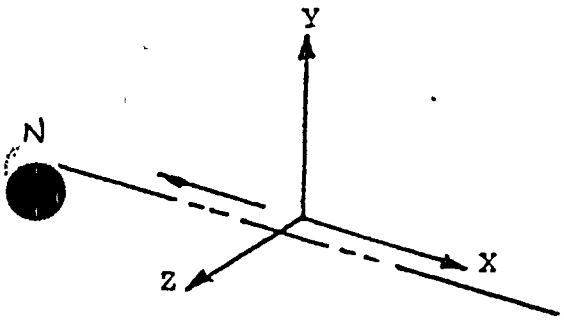
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( )

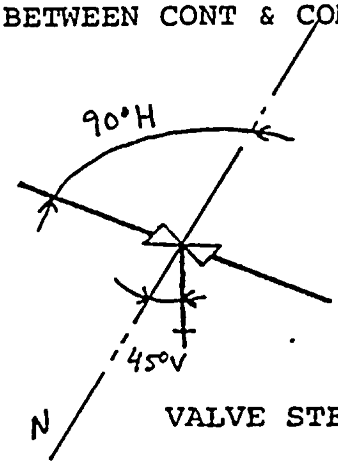
PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES (✓) NO ( )

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01.F
SHEET NO. 52.18

OPERATOR EPN N/A   MANUFACTURER

MODEL NO   SERIAL NO

TYPE   SIZE   ORDER NO

MOTOR EPN N/A   MANUFACTURER

MODEL NO   SERIAL NO

ID NO   INS CLASS   1-PHASE ( ) 3-PHASE ( ) AC ___ DC ___

COMMENTS: Definition (N/F = Not Found)

* CEP-LMS-4A not found

△ SEE SHEET 2 OF 2 FOR OPERATOR ORIENTATION

PREPARED BY William Amaker (SIGNATURE) DATE 7/21/82 REVIEWED BY Doug True (SIGNATURE) DATE 7/21/82

WILLIAM AMAKER   △ W. Searle 1/5/83   Doug True

CYGNA

Calculation Sheet

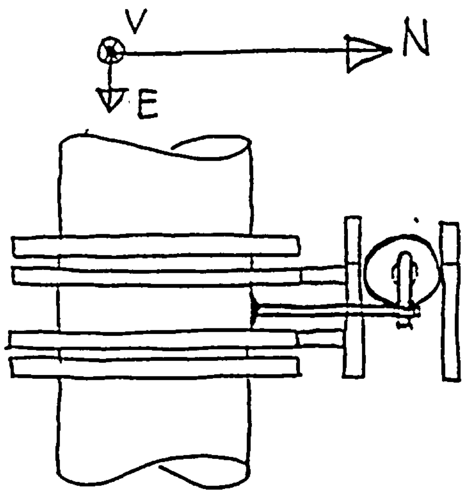
Project: WPPS MECH. E.Q.		Prepared By: J E Rakowski	Date: 12/18/82
Subject: BIF VALVE & AO		Checked By: W.E. Searle	Date: 12/20/82
System: CSP / CEP		Job No.: 82044	File No.:
Analysis No:	Rev. No.:	Sheet No.: 2/2	

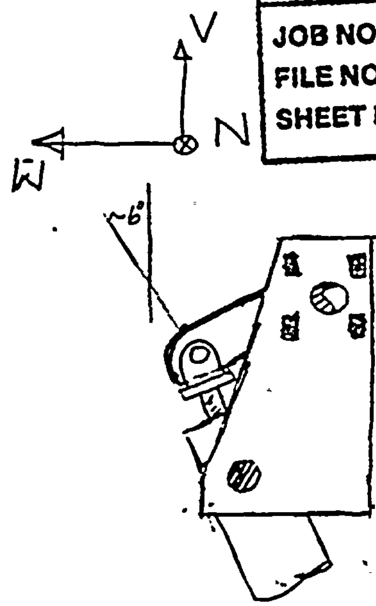
WALKDOWN

VALVE & OPERATOR ORIENTATIONS

CEP-V-3A & 4A

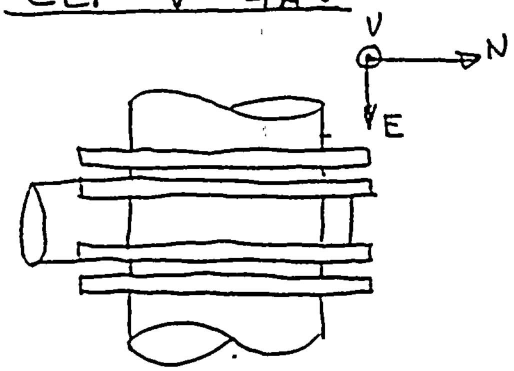
CEP-V-3A:

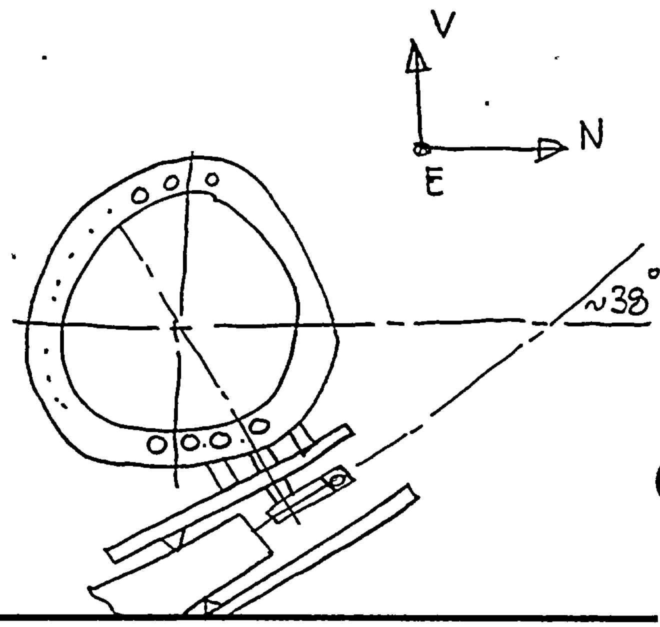




CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01/F
SHEET NO. 5.2.1G

CEP-V-4A:





CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# REA-V-1

QID# 361102

BLDG R

FLOOR EL 572

COORDS H.2/6.2

MFR BIF

COMPONENT EL 597

DSCRP 72" BFLY

MOD# DWG A206760

SERIAL# 27230-1

MAT'L SA-516-GR60

1 PSI @ 110 °F

LBS N/F SIZE N/F

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH 0'-7"
(FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

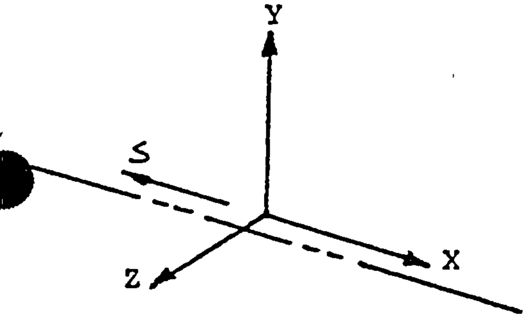
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( )

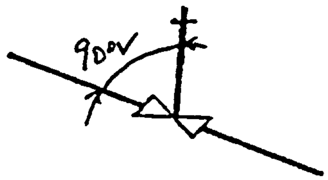
PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO (✓)

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES (✓) NO ( )



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01/F
SHEET NO. 5.2.20

OPERATOR EPN N/A

MANUFACTURER

MODEL NO

SERIAL NO

TYPE SIZE

ORDER NO

MOTOR EPN N/A

MANUFACTURER

MODEL NO

SERIAL NO

ID NO INS CLASS

1-PHASE ( ) 3-PHASE ( ) AC DC

COMMENTS: Definition (N/F = Not Found)

* REA-LMS-1 not accessible / no staging

1. not motor operated

PREPARED BY Doug True (SIGNATURE) DATE 7/21/87 REVIEWED BY William Cunha (SIGNATURE) DATE 7/21/87

Doug True

William Cunha

CYGNA

EQUIPMENT QUALIFICATION
WALKDOWN VERIFICATION FORM

EPN# REA-V-2

QID# 361102

BLDG R FLOOR EL 572 COORDS H.4/6.2

MFR BIF COMPONENT EL 597 DSCRP 72" BFLY

MOD# ~~DWG A-206760~~ 0657 SERIAL# N27230-2 MAT'L SA-516-GR60

1 PSI @ 110 °F LBS N/F SIZE 72"

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH 0'-7"
(FLANGE TO FLANGE)

MOUNTING CONDITION

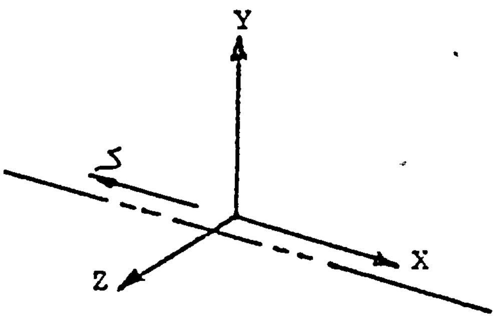
NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

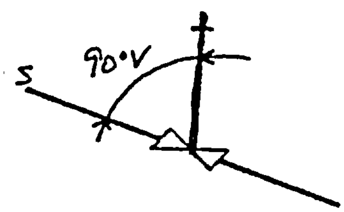
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( )

PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)
IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO (✓)
DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES (✓) NO ( )



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82[illegible]
FILE NO. IP.011F
SHEET NO. 5.2.21

OPERATOR EPN N/A	MANUFACTURER
MODEL NO	SERIAL NO
TYPE SIZE	ORDER NO

MOTOR EPN N/A	MANUFACTURER
MODEL NO	SERIAL NO
ID NO INS CLASS	1-PHASE ( ) 3-PHASE ( ) AC DC

COMMENTS: Definition (N/F = Not Found)

* REA-LMS-2 not accessible; no staging
  note: not motor operated

PREPARED BY [signature] DATE 7/21/82 REVIEWED BY William Cunha DATE 7/21/82
(SIGNATURE) (SIGNATURE)

Doug True WILLIAM CUNHA

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# ROA-V-1

QID# 361101

BLDG R   FLOOR EL 572   COORDS ~~N.7/5.7~~ N.1/6.2

MFR BIF   COMPONENT EL 578   DSCRP 84" R Bldg Isol Valve

MOD# 0657   SERIAL# 27229-1   MAT'L SA-516-GR-60

1 PSI @ 105 °F   LBS N/F   SIZE 84"

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH (FLANGE TO FLANGE) 0'-7 1/2"

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A   BOLT Ø N/A

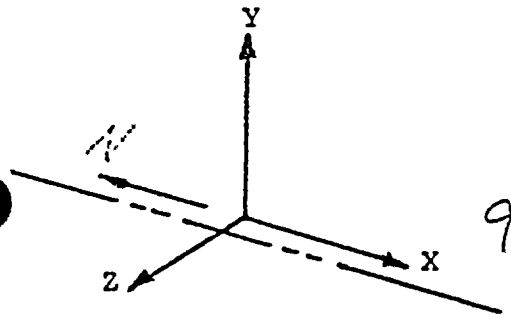
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( )

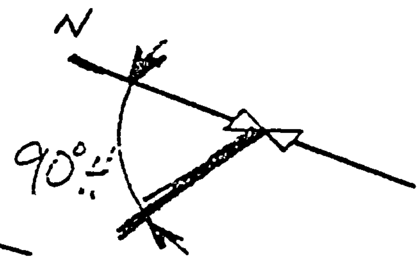
PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO (✓)

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01/F
SHEET NO. 5.2.22

OPERATOR EPN N/A	MANUFACTURER
MODEL NO	SERIAL NO
TYPE SIZE	ORDER NO

MOTOR EPN N/A	MANUFACTURER
MODEL NO	SERIAL NO
ID NO INS CLASS	1-PHASE ( ) 3-PHASE ( ) AC DC

COMMENTS: Definition (N/F = Not Found)

note: coordinates were incorrect

PREPARED BY William Cimla (SIGNATURE) DATE 7/21/82   REVIEWED BY Doug True (SIGNATURE) DATE 7/21/82

William Cimla   Doug True

CYGNA

EQUIPMENT QUALIFICATION WALKDOWN VERIFICATION FORM

EPN# ROA-V-2

QID# 361101

COORDS ~~N.7/5.0~~

BLDG R

FLOOR EL 572

MFR BIF

COMPONENT EL 578

DSCRP 84"R Bldg Isol Valve

MOD# 0657

SERIAL# 27229-2

MAT'L SA 516 GR 60

1 PSI 6/05 °F

LBS N/F SIZE 84"

ASME CLASS N/F

YOKE ORIENTATION

⊥ TO AXIS OF PIPE (✓)

// TO AXIS OF PIPE (✓)

YOKE LENGTH 0'-7 1/2"
(FLANGE TO FLANGE)

MOUNTING CONDITION

NO OF BOLTS N/A

BOLT TYPE N/A BOLT Ø N/A

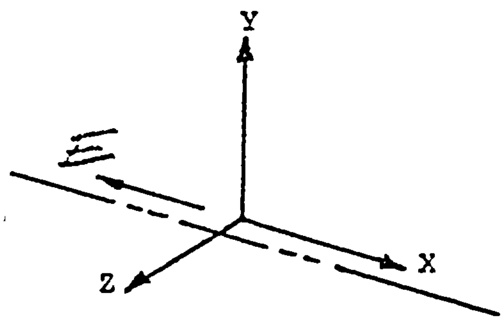
WELD TYPE & SIZE N/A

PIPE MOUNTED YES (✓) NO ( )

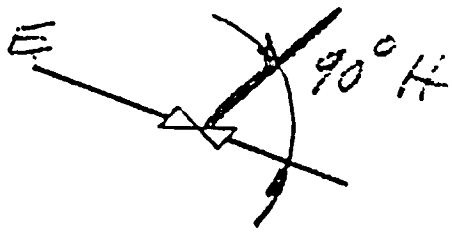
PERMANENT OBSTRUCTION (WITHIN 2") YES ( ) NO (✓)

IS COMP BETWEEN CONT & 1ST ANC (FULL 6 WAY ANC) YES ( ) NO (✓)

DO MULTIPLE SUPPORTS EXIST BETWEEN CONT & COMP YES ( ) NO (✓)



GLOBAL CO-ORDINATE SYSTEM



VALVE STEM ORIENTATION

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 1P.C
SHEET NO. 5.2.23

OPERATOR EPN N/A

MANUFACTURER

MODEL NO

SERIAL NO

TYPE

SIZE

ORDER NO

MOTOR EPN N/A

MANUFACTURER

MODEL NO

SERIAL NO

ID NO

INS CLASS

1-PHASE ( ) 3-PHASE ( ) AC DC

COMMENTS: Definition (N/F = Not Found)

note: coordinates were incorrect

PREPARED BY William Cunha (SIGNATURE) DATE 7/21/82 REVIEWED BY Doug True (SIGNATURE) DATE 7/21/82

WILLIAM CUNHA

Doug True

5.3 SRM Sheets

user number 43 date/time 02/10/83 09:11

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CSP-AO-1	2-CSP-V-1+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	M322	A83B	

DESCRIPTION

AIR OPERATOR FOR CSP-V-1

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	1 3	4320	B1, F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	D5	R	508	N. 0/7.7	R43	

HL	SEIS. QUAL TEST	ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL SEIS	STATUS ENV	TM	FREQ	QID
_ Y		01		9				C A	_	P	07	018001

MESSAGE

CYGNA

PROJECT WPPSS-WNP2

TITLE SRM LIST

PREPARED BY: H. Sianle

DATE 4/22/83

CHECKED BY: [signature]

DATE 5/19/83

JOB NO. 82044

FILE NO. 1P.01/F

SHEET NO. 5.3.1

user number 43 date/time 02/10/83 09:11

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CSP-AO-2	2-CSP-V-2+

CONTRACT	MFG	MODEL	SERIAL NUMBER
8	M322	A83B	

DESCRIPTION

AIR OPERATOR FOR CSP-V-2

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	4320	B1,F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	D6	R	508	7.7/N.0		

HL	SEIS. TEST	QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL SEIS	STATUS ENV	TM	FREQ	QID
- Y		01		- 9			-	C A	-	P	07	018001

MESSAGE

CYGNA

PROJECT WPPSS-WNP2

TITLE SRM LIST

PREPARED BY: D. Searle

DATE 4/22/83

CHECKED BY: [signature]

DATE 5/17/83

JOB NO. 82044

FILE NO. 1P.01.F

SHEET NO. 5.3.2

user number 43 date/time 02/10/83 09:11

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CSP-AO-3	2-CSP-V-3+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	M322	A83B	73354165

DESCRIPTION

AIR OPERATOR FOR CSP-V-3

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	4320	B1, F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	D5	R	481	M.6/7.6	R33	

HL	SEIS. TEST	QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL SEIS	STATUS ENV	TM	FREQ	QID
Y		01		9				C A		P	10	018001

MESSAGE

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY: A. Starke
DATE 4/22/83
CHECKED BY: [signature]
DATE 5/19/83
JOB NO. 82044
FILE NO. 1P.01/F
SHEET NO. 5.3.3

user number 43 date/time 02/10/83 09:12

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CSP-AO-4	2-CSP-V-4+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	M322	A83B	73354165

DESCRIPTION

AIR OPERATOR FOR CSP-V-4

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	4320	B1,F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	C5	R	478	M. 6/7. 6	R33	

HL	SEIS. TEST	QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL SEIS	STATUS ENV	TM	FREQ	QID
— Y		01		— 9				C A		P	10	018001

MESSAGE

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY: D. Searle
DATE 4/22/83
CHECKED BY: [signature]
DATE 5/17/83
JOB NO. 82044
FILE NO. 1P.01/E
SHEET NO. 5.34

user number 43 date/time 02/10/83 09:12

function FIN

-SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CSP-AO-5	2-CSP-V-5+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	M322	A83B	R75508823

DESCRIPTION

AIR OPERATOR FOR CSP-V-5

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	4320	B1, F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	C5	R	475	M. 7/8. 3	R33	

HL	SEIS. TEST	QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL SEIS	STATUS ENV	TM	FREQ	QID
— y		01		— 9				C A	—	P	10	018001

MESSAGE

CYGNA

PROJECT WPPSS WNP2

TITLE SRM LIST

PREPARED BY: D. Searle

DATE 4/23/83

CHECKED BY: [signature]

DATE 5/19/85

JOB NO. 82044

FILE NO. 12.01/F

SHEET NO. 5.3.5

user number 43 date/time 02/10/83 09:1

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CSP-AO-6	2-CSP-V-6+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	M322	A83B	

DESCRIPTION

AIR OPERATOR FOR CSP-V-6

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	4320	B1, F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	B14	R	480	N. 5/7.7	R31	

HL	SEIS. QUAL TEST	SEIS. QUAL ANL	SEIS. QUAL F/O	C	ENV. AGING	QUAL DBE	C	QUAL STATUS SEIS	QUAL STATUS ENV	TM	FREQ	QID
~ X	—	01	—	— 9	—	—	—	C A	—	P	10	018001

MESSAGE

CYGNA	
PROJECT	WPASS-WNP2
TITLE	SRM LIST
PREPARED BY:	A. Slark
DATE	4/22/83
CHECKED BY:	[signature]
DATE	5/13/83
JOB NO.	82044
FILE NO.	1P.01/E
SHEET NO.	5.3.6

user number 43 date/time 02/10/83 09:1

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CSP-AO-9	2-CSP-V-9+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	M322	A83B	

DESCRIPTION

AIR OPERATOR FOR CSP-V-9

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	4320	B1,F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	C6	R	490	M.9/5.1		

HL	SEIS. TEST	QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL SEIS	STATUS ENV	TM	FREQ	QID
w Y	—	01	—	w 9	—	—	—	C A	—	P	10	018001

MESSAGE

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY: D. Searle
DATE 4/22/83
CHECKED BY: [signature]
DATE 5/19/83
JOB NO. 82044
FILE NO. 1P.01/F
SHEET NO. 5.3.7

user number 43 date/time 02/10/83 09:14

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CEP-AO-1A	2-CEP-V-1A+

CONTRACT	MFG	MODEL	SERIAL NUMBER
58	M322	A83B	

DESCRIPTION

AIR OPERATOR FOR CEP-V-1A

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	1.0	B1, F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	J13	R	560	J.4/5.4	R62	

HL	SEIS. QUAL TEST	ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL STATUS SEIS	ENV	TM	FREQ	QID
Y		01		9				A		P	07	018001

MESSAGE

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY: A. Searle
DATE 4/22/83
CHECKED BY: [signature]
DATE 5/19/83
JOB NO. 82044
FILE NO. 1P.01/F
SHEET NO. 5.3.6

user number 43 date/time 02/10/83 09:14

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CEP-AO-2A	2-CEP-V-2A+

CONTRACT	MFG	MODEL	SERIAL NUMBER
2	M322	A83B	73354164

DESCRIPTION
AIR OPERATOR FOR CEP-V-2A

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	1.0	B1,F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	J13	R	558	J.4/5.4	R62	

HL	SEIS. QUAL TEST	SEIS. QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL STATUS SEIS	QUAL STATUS ENV	TM	FREQ	QID
Y		01		9				A		P	07	018001

MESSAGE

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY: A. Searle
DATE 4/22/83
CHECKED BY: [signature]
DATE 5/9/83
JOB NO. 82044
FILE NO. 1P.01/E
SHEET NO. 539

user number 43 date/time 02/10/83 09:14

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CEP-AO-3A	2-CEP-V-3A+

NTRACT	MFG	MODEL	SERIAL NUMBER
B	M322	A83B	73354165

DESCRIPTION

AIR OPERATOR FOR CEP-V-3A

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	1.0	B1,F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	C14	R	497	H.5/5.4	R32	

HL	SEIS. QUAL TEST	SEIS. QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL STATUS SEIS	QUAL STATUS ENV	TM	FREQ	QID
Y		01		9				A		P	10	018001

MESSAGE

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY: D. Searle
DATE 4/22/83
CHECKED BY: [illegible]
DATE 5/13/85
JOB NO. 82044
FILE NO. 12.01/E
SHEET NO. 5.3.10

user number 43 date/time 02/10/83 09:14

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-CEP-AO-4A	2-CEP-V-4A+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	M322	A83B	73354165

DESCRIPTION

AIR OPERATOR FOR CEP-V-4A

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	2 3	1.0	B1,F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M543	C14	R	497	H.5/5.4	R32	

HL	SEIS. TEST	QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL SEIS	STATUS ENV	TM	FREQ	QID
Y		01		9				A		P	10	018001

MESSAGE

CYGNA	
PROJECT	WPPSS-WNP2
TITLE	SRM LIST
PREPARED BY:	D. Slane
DATE	4/22/83
CHECKED BY:	[illegible]
DATE	5/19/83
JOB NO.	82044
FILE NO.	12.01/F
SHEET NO.	5.3.11

user number 43 date/time 04/22/83 14:48

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-ROA-V-1	2-ROA-V-1+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	B250	0657	7229-1

DESCRIPTION

84.0" R BLDG ISO VALVE

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	1 0	4320	B2, D	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M545	F3	R	578	N. 7/5. 7	R73	

HL	SEIS. TEST	QUAL ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL SEIS	STATUS ENV	TM	FREQ	QID
N		02		O				A		P	14	361101

MESSAGE

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY: [signature]
DATE 4/25/83
CHECKED BY: [signature]
DATE 5/19/83
JOB NO. 82044
FILE NO. 1P.01.F
SHEET NO. 5.3.12

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-ROA-V-2	2-ROA-V-2+

CONTRACT	MFG	MODEL	SERIAL NUMBER
68	B250	0657	7229-2

DESCRIPTION
84.0" R BLDG ISO VALVE

LEVEL	EC	USE.	HOURS	SAFETY FUNCTION	ACCURACY
2	A	1 0	4320	B2, D	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M545	F3	R	578	N. 7/5.0	R73	

HL	SEIS. QUAL TEST	ANL	F/O	C	ENV. QUAL AGING	DBE	C	QUAL STATUS SEIS	ENV	TM	FREQ	QID
N		02		0				A		P	14	361101

MESSAGE

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY: Don Leach
DATE 4/25/83
CHECKED BY: [signature]
DATE 5/19/83
JOB NO. 82044
FILE NO. 18.01.F
SHEET NO. 5.3.13

user number 43 date/time 04/22/83 14:47

function FIN -SRM MASTER EQUIPMENT LIST-

EPN	COMPOSITE EPN
2-REA-V-2	2-REA-V-2+

CONTRACT	MFG	MODEL	SERIAL NUMBER
	B250	DWG A-206760	-27230-2

DESCRIPTION

72.0" BFLY R BLD ISO

LEVEL	EC	USE	HOURS	SAFETY FUNCTION	ACCURACY
2	A	1 3	4320	B2,F	

A/E DRAWING	AE ZONE	BLDG	ELEV	DETAIL	ZONE	ROOM
M545	J3	R	597	H. 4/6.2	R71	

HL	SEIS. QUAL TEST	ANL	F/O	C	ENV. AGING	QUAL DBE	C	QUAL STATUS SEIS	ENV	TM	FREQ	QID
								A		P		361102

MESSAGE

CYGNA

PROJECT WPPSS-WNP2

TITLE SRM LIST

PREPARED BY: Don Searle

DATE

CHECKED BY: [signature]

DATE 5/19/83

JOB NO. 82044

FILE NO. IP.011F

SHEET NO. 5.3.14

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
WNP-2 SAFETY RELATED MECHANICAL EQUIPMENT LIST
DWG E553-2 REV 5

DATA DATE 04/06/83

SORTED BY EQUIP. NO.

EQUIPMENT NO. / EQUIPMENT DESCRIPTION	COMPOSITE NO.	DRAWING NO. / PLANT LOCATION	MFG CODE	MFG MODEL NO / CONTRACT	EQUIP.	LV	CLASS	SAFETY FUNCTION HOURS	USE
REA-AO-8+ / SPENT FUEL POOL PUMP ROOM		M545 F10			A	1	J		10
REA-AO-V1 / AIR OPER FOR VALVE REA-V-1	REA-V-1+	M545 J3 / R 597 H.2/6.2	M322	A83B	A	2	B2,F	4320	13
REA-AO-V2 / AIR OPER FOR VALVE REA-V-2	REA-V-2+	M545 J3 / R 597 H.4/6.2	M322	A83B	A	2	B2,F	4320	13
REA-FN-1A / REACTOR BUILDING EXHAUST FAN	REA-FN-1A+	M545 J5 / R 572 H.2/4.2	J127	54-26 1/2-1770 / 2-22A	P	2	*		33
REA-FN-1A+ / REACTOR BUILDING EXHAUST FAN		M545 J5 / R 592 H.2/4.2			P	1	*		33
REA-FN-1B / REACTOR BUILDING EXHAUST FAN	REA-FN-1B+	M545 J5 / R 572 H.2/4.2	J127	54-26 1/2-1770 / 2-22A	P	2	*		33
REA-FN-1B+ / REACTOR BUILDING EXHAUST FAN		M545 J5 / R 585 H.2/4.2			P	1	*		33
REA-SR-27 / SAMPLE RACK FOR REA-RE-15		M544 F2			-	2	B2,F	----	20
REA-SR-37 / FLOW CONT.RACK FOR ELEV. DISCH: PT		M544 F3							
REA-V-1 / 72.0" BFLY R BLD ISO	REA-V-1+	M545 J3 / R 572 H.2/6.2	B250						
REA-V-1+ / RX BLDG EXH VLV DISCH COMPOSITE		M545 J3 / R 597 H.2/6.2							
REA-V-2 / 72.0" BFLY R BLD ISO	REA-V-2+	M545 J3 / R 572 H.4/6.2	B250						
REA-V-2+ / RX BLDG EXH VLV DISCH COMPOSITE		M545 J3 / R 597 H.4/6.2							
RFW-V-10A / 24" CHECK RFW TO RPV (INSIDE PC)		M529 012 / C 512 15 D AZ R36	A391						
RFW-V-10B / 24" CHECK RFW TO RPV (INSIDE PC)		M529 G6 / C 512 345 D AZ R36	A391						

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM LIST
PREPARED BY [signature]
DATE 4/25/83
CHECKED BY [signature]
DATE 5/17/83
JOB NO. 82044
FILE NO. 1.P01.F
SHEET NO. 5.3.15

REA-AO-V1
REA-AO-V2

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
WNP-2 SAFETY RELATED MECHANICAL EQUIPMENT LIST
DWG E553-2 REV 5

DATA DATE 04/06/83

SORTED BY EQUIP. NO.

EQUIPMENT NO. / EQUIPMENT DESCRIPTION	COMPOSITE NO.	DRAWING NO. / PLANT LOCATION	MFG CODE	MFG MODEL NO / CONTRACT	EQUIP.	LV	CLASS	SAFETY FUNCTION HOURS	USE
ROA-AD-15+ ANA RM 1A AUTO DAMPER		M545 G13 R 563 M.8/4.8			A	1	J		10
ROA-AD-17 ANA RM 1B AUTO DAMPER	ROA-AD-17+	M545 G14 R 548 M.8/4.2	M139	331-2782 2-216	A	2	J	4320	10
ROA-AD-17+ ANA RM 1B AUTO DAMPER		M545 G14 R 563 M.8/4.2			A	1	J		10
ROA-AD-19 SPENT FUEL POOL PUMP ROOM	ROA-AD-19+	M545 F8 R 548 L.0/4.0	P014	630-N-31408 216	A	2	J	4320	10
ROA-AD-19+ SPENT FUEL POOL PUMP ROOM		M545 F8 R 548 L.0/4.0			A	1	J		10
ROA-AO-AD10 AIR OPERATOR FOR ROA-AD-10	ROA-AD-10+	M545 E14 R 542 M.5/3.9			A	2	J	4320	10
ROA-AO-AD11 MCC ROOM II AUTO DAMPER	ROA-AD-11+	M545 E8 R 542 M.7/8.1			A	2	J	4320	10
ROA-AO-AD12 DC MCC ROOM AUTO DAMPER	ROA-AD-12+	M545 C7 R 480 J.0/8.3							
ROA-AO-AD13 RECOMB MCC RMI AUTO DAMPER	ROA-AD-13+	M545 G14 R 591 M.5/6.0							
ROA-AO-AD14 RECOMB MCC RM II AUTO DAMPER	ROA-AD-14+	M545 G13 R 591 M.9/7.4							
ROA-AO-AD15 ANA RM 1A AUTO DAMPER	ROA-AD-15+	M545 G12 R 563 M.8/4.8							
ROA-AO-AD17 ANA RM 1B AUTO DAMPER	ROA-AD-17+	M545 G14 R 563 M.8/4.2							
ROA-AO-V1 R BLDG ISO VALVE	ROA-V-1+	M545 F3 R 572 D.0/4.0	M322						
ROA-AO-V2 R BLDG ISO VALVE	ROA-V-2+	M545 F3 R 572 D.0/4.0	M322						
ROA-FN-1A SUPPLY FAN	ROA-FN-1A+	M545 G7 R 572 N2/4.8	B515						

CYGNA
PROJECT WPPSS-WNP2
TITLE SRM List
PREPARED BY: [signature]
DATE 4/25/83
CHECKED BY: [signature]
DATE 5/17/83
JOB NO. 82044
FILE NO. 10.01.E
SHEET NO. 5.3.16

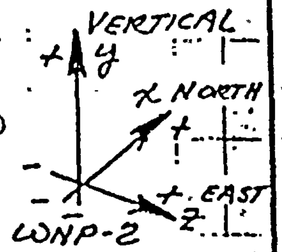
ROA-AO-V1
ROA-AO-V2

5.4 Load Comparative Sheets for REA and ROA Air Cylinders

N/F 7/21/82 Cygan UD 10/7/82 Sroy List

DESIGN CODE:		CODE GROUP:		PIPELINE DESIGN:	
ASME III	CLASS 1	= A		1. BURNS & ROE-(HOME)	▩
ASME III	CLASS 2	= B		2. GENERAL ELECTRIC-NSSS	
ASME III	CLASS 3	= C		3. BURNS & ROE-(SITE)	
B31.1		= D		4. G.E. - IS & E	

BUILDING R
ELEVATION 567
HL N Cygan UD
USE 13
EC A



INTERIM QUALIFICATION:

	LOADS - INTERIM CRITERIA				LOADS - QUALIFYING ANALYSIS			
	x SS	y	z FB	SRSS	x SS	y	z FB	SRSS
VALVE								
OPERATOR								

COMMENTS:

	FAIL	PASS
VALVE		▩
OPERATOR		

FINAL QUALIFICATION:

	LOADS - FINAL PIPING ANALYSIS			
	x HORIZ	y HORIZ	z VERT	SRSS
VALVE	1.0	1.0	0.6	1.54
OPERATOR				

COMMENTS:

	FAIL	PASS
VALVE	▩	
OPERATOR		

ASSEMBLY GEOMETRY:

	WALKDOWN	QUALIFYING ANALYSIS	PIPING ANALYSIS
VALVE BODY WEIGHT	—		
YOKE: LENGTH			
FREQUENCY	—		
STIFFNESS	—		
OPERATOR WEIGHT	—		

COMMENTS:

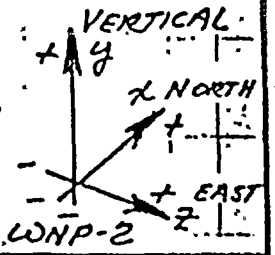
	FAIL	PASS
ASSEMBLY		

PERFORMED BY: ______________ DATE ______ CHECKED BY: ______________ DATE ______

VALVE QUALIFICATION DATA VALVE EPN: REA-V-1 QID: 361102

N/F 7/21/82 Cygna-WD 10/7/82 SRM List

DESIGN CODE:	CODE GROUP:		PIPELINE DESIGN:		BUILDING	R
ASME III CLASS 1	= A		1. BURNS & ROE-(HOME)	▒	ELEVATION	567
ASME III CLASS 2	= B		2. GENERAL ELECTRIC-NSSS		HL	N Cygna WD
ASME III CLASS 3	= C		3. BURNS & ROE-(SITE)		USE	13
B31.1	= D		4. GE.-IS & E		EC	A



INTERIM QUALIFICATION:

	LOADS- INTERIM CRITERIA				LOADS- QUALIFYING ANALYSIS			
	X SS	Y	Z FB	SRSS	X SS	Y	Z FB	SRSS
VALVE								
OPERATOR								

COMMENTS:

	FAIL	PASS
VALVE		▒
OPERATOR		

FINAL QUALIFICATION:

	LOADS - FINAL PIPING ANALYSIS			
	X HORIZ	Y HORIZ	Z VERT	SRSS
VALVE	1.0	1.0	0.6	1.54
OPERATOR				

COMMENTS:

	FAIL	PASS
VALVE	▒	
OPERATOR		

ASSEMBLY GEOMETRY:

	WALKDOWN	QUALIFYING ANALYSIS	PIPING ANALYSIS
VALVE BODY WEIGHT	—		
YOKE: LENGTH			
FREQUENCY	—		
STIFFNESS	—		
OPERATOR WEIGHT	—		

COMMENTS:

	FAIL	PASS
ASSEMBLY		

PERFORMED BY: ______ DATE ______ CHECKED BY: ______ DATE ______

VALVE QUALIFICATION DATA   VALVE EPN: [illegible]EA-V-2   QID: 36[illegible]2

N/F 7/21/82 Cygna WD

10/7/82 SRM List

DESIGN CODE:	CODE GROUP:		PIPELINE DESIGN:			
ASME III CLASS 1	= A		1. BURNS & ROE-(HOME)		BUILDING	R
ASME III CLASS 2	= B		2. GENERAL ELECTRIC-NSSS		ELEVATION	578
ASME III CLASS 3	= C		3. BURNS & ROE-(SITE)		HL	N Cygna WD
B31.1	= D		4. G.E. - IS & E		USE	10
					EC	A

VERTICAL +y, x NORTH +, + EAST z, WNP-2

INTERIM QUALIFICATION:

	LOADS- INTERIM CRITERIA				LOADS- QUALIFYING ANALYSIS			
	x SS	y	z FB	SRSS	x SS	y	z FB	SRSS
VALVE								
OPERATOR								

COMMENTS:

	FAIL	PASS
VALVE		
OPERATOR		

FINAL QUALIFICATION:

	LOADS - FINAL PIPING ANALYSIS			
	x HORIZ	y HORIZ	z VERT	SRSS
VALVE	1.0	1.0	0.6	1.54
OPERATOR				

COMMENTS:

	FAIL	PASS
VALVE		
OPERATOR		

ASSEMBLY GEOMETRY:

	WALKDOWN	QUALIFYING ANALYSIS	PIPING ANALYSIS
VALVE BODY WEIGHT	—		
YOKE: LENGTH			
FREQUENCY	—		
STIFFNESS	—		
OPERATOR WEIGHT	—		

COMMENTS:

	FAIL	PASS
ASSEMBLY		

PERFORMED BY: ______ DATE ______ CHECKED BY: ______ DATE ______

VALVE QUALIFICATION DATA — VALVE EPN: ROA-V-1 — QID: 361101

N/F 7/21/82 Cygna WD

10/7/82 SRM UST

DESIGN CODE:

	CODE GROUP:	
ASME III CLASS 1	= A	
ASME III CLASS 2	= B	
ASME III CLASS 3	= C	
B31.1	= D	

PIPELINE DESIGN:

1. BURNS & ROE-(HOME)	☒
2. GENERAL ELECTRIC-NSSS	
3. BURNS & ROE-(SITE)	
4. G.E. - IS & E	

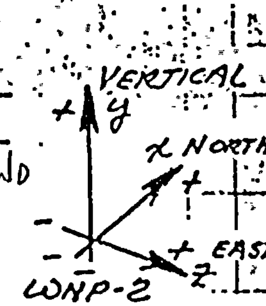
BUILDING R

ELEVATION 578

HL N Cygna WD

USE 10

EC A



INTERIM QUALIFICATION:

	LOADS- INTERIM CRITERIA				LOADS- QUALIFYING ANALYSIS			
	x SS	y	z FB	SRSS	x SS	y	z FB	SRSS
VALVE								
OPERATOR								

COMMENTS:

	FAIL	PASS
VALVE		☒
OPERATOR		

FINAL QUALIFICATION:

	LOADS - FINAL PIPING ANALYSIS			
	x Horiz	y Horiz	z Vert	SRSS
VALVE	1.0	1.0	0.6	1.54
OPERATOR				

COMMENTS:

	FAIL	PASS
VALVE	☒	
OPERATOR		

ASSEMBLY GEOMETRY:

	WALKDOWN	QUALIFYING ANALYSIS	PIPING ANALYSIS
VALVE BODY WEIGHT	—		
YOKE: LENGTH			
FREQUENCY	—		
STIFFNESS	—		
OPERATOR WEIGHT	—		

COMMENTS:

	FAIL	PASS
ASSEMBLY		

PERFORMED BY: ______ DATE ______ CHECKED BY: ______ DATE ______

VALVE QUALIFICATION DATA

VALVE EPN: [illegible]A-V-2

QID: 3[illegible]01

VALVE #	ACCELERATIONS VERTICAL	ACCELERATIONS HORIZONTAL
REA-V-1	0.6g	1.0g
REA-V-2	0.6g	1.0g
ROA-V-1	0.6g	1.0g
ROA-V-2	0.6g	1.0g
CAC-V-1A	0.6g	1.0g
CAC-V-1B	0.6g	1.0g
CAC-V-2A	0.6g	1.0g
CAC-V-2B	0.6g	1.0g
CAC-V-3A	0.6g	1.0g
CAC-V-3B	0.6g	1.0g
CAC-FCV-5A	0.6g	1.0g
CAC-FCV-5B	0.6g	1.0g
CAC-FCV-6A	0.6g	1.0g
CAC-FCV-6B	0.6g	1.0g
CAC-TCV-4A	0.6g	1.0g
CAC-TCV-4B	0.6g	1.0g
CAC-RV-63A	0.6g	1.0g
CAC-RV-63B	0.6g	1.0g
CAC-RV-65A	0.6g	1.0g
CAC-RV-65B	0.6g	1.0g

SRSS $= \sqrt{0.6^2 + 1.0^2 + 1.0^2} = 1.54$

5.5 REVISED B&R INC. PIPING ANALYSIS ACCELERATIONS

D. Armstrong
(x-6834)

APR 19 1993

P. Schuenzel 516-677-~~2130~~ 2493
Burns & Roe
Woodbury

Preliminary Valve accelerations for valves CSP-V-1, 2, 3, 4, 5. Please forward the modified flexible valve model (one that has been checked) to be included in our documentation.

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. IP.01.F
SHEET NO. 55.1

CSP-V-1 Valve Qualification

B&R File No. Dwg. 68-00-0008 Operation I.D. No.

B&R M200 Iso. No. 172 Anchor Group 125

PRELIMINARY

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelerations (g)			Comments
				X	Y	Z	
Valve Operator (Bracket)	25	321	Upset	0.65	1.27	0.65	
			Emergency	0.88	1.58	1.87	
			Faulted	1.31	2.66	2.13	
Valve Operator [illegible]	33	593	Upset	[illegible].76	1.36	0.88	
			Emergency	2.04	2.93	2.62	
			Faulted	[illegible]	3.62	2.80	

[illegible] As-Built Verification of Piping Calculation
Checked

CSP-V-4 Valve Qualification

B&R File No. Dwg 68-00-0009 Operation I.D. No.

B&R M200 Iso. No. 172 Anchor Group 125

PRELIMINARY

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelerations (g) X	Y	Z	Comments
Valve Operator (Bracket)	103	277	Upset	0.95	1.40	0.85	
			Emergency	2.80	1.97	1.71	
			Faulted	2.96	2.91	1.99	
Valve Operator	111	399	Upset	1.14	1.38	1.50	
			Emergency	1.60	1.78	4.07	
			Faulted	1.87	3.17	4.19	

CSP Status: As-Built Verification of Piping Calculation

Checked

Approved

Stress As-Built Verification of Piping Calculation
Checked
Approved

CYGNA
ATTACHMENT
JOB NO. 82044
FILE NO. IP.01/E
SHEET NO. 5.5.4

CSP-V-3 Valve Qualification

B&R File No. Dwg 68-00-0009 Operation I.D. No.

B&R M200 Iso No. 172 Anchor Group 125

PRELIMINARY

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelarations (g) X	Y	Z	Comments
			Upset	0.72	1.32	0.70	
Valve Operator (Bracket)	86	277	Emergency	2.48	1.73	1.14	
			Faulted	2.66	2.76	1.53	
			Upset	1.25	1.60	0.96	
Valve Operator [illegible]	95	399	Emergency	1.80	2.09	3.62	
			[illegible]	[illegible]	2.99	3.96	

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. IP.01/2
SHEET NO. 5.5.6

CSP-V-5 Valve Qualification

B&R File No. Dwg 68-00-0010 Operation I.D. No.

B&R M200 Iso No: 172 Anchor Group 125

PRELIMINARY

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb)	Condition	Accelerations (g)			Comments
				X	Y	Z	
Valve Operator (Bracket)	128	277	Upset	0.95	1.31	1.71	
			Emergency	2.80	1.82	5.32	
			Faulted	2.96	2.81	5.42	
Valve [illegible]	137	295	Upset	0.97	1.40	1.60	
			Emergency	1.29	2.69	2.34	
			[illegible]	[illegible]	3.44	2.55	

Analysis As-Built Verification of Piping Calculation
Checked
Approved

CYGNA ATTACHMENT
JOB NO. 82044
FILE NO. 1P.01|F
SHEET NO. 5.5.5

CSP-V-2 Valve Qualification

B&R File No. Dwg. 68-00-0008 Operation I.D. No.

B&R M200 Iso No. 172 Anchor Group 125

PRELIMINARY

VALVE ACCELERATIONS

Location	Nodal Pt. No.	Mass Wt. (lb.)	Condition	Accelerations (g)			Comments
				X	Y	Z	
Valve Operator (Bracket)	8	321	Upset	0.61	1.27	0.64	
			Emergency	0.81	1.51	1.56	
			Faulted	1.26	2.62	1.86	
Valve Operator (?)	17	579	Upset	0.66	1.33	0.79	
			Emergency	1.06	2.82	1.61	
			Faulted	1.24	3.54	1.90	

Status: As-Built Verification of Piping Calculation

CSP-V-6	BRACK	74	277	11.39	1.78	.75
	CYL	71	399	2.55	3.33	5.85
CEP-V-3A	BODY ~~BRACK~~	21	847	3.10	1.25	0.9
	OPER	24	626	4.57	1.26	.86
CEP-V-4A	BODY	31	847	3.71	1.33	0.89
	OPER	34	626	3.35	1.34	0.86

[illegible]

[illegible]

6.0 DRAWINGS USED FOR REQUALIFICATION

Contents

7.0 PRIOR CALCULATIONS AND TRANSMITTALS USED FOR REQUALIFICATION

QID 018001

CONTENTS

GUGLIELMINO
BOSTON

CENTER OF GRAVITY

CA.

WPPS CYGNA ENERGY N27233 THRU N27236

EXTRAPOLATION

1.) 6"dia x 10" STROKE Miller CYL. S.O.# N27233 GA# A206762
18" B/V SGT-V-2A & 2B SPRING TO OPEN

Rod Retracted = 12.75(100) / 25.00 = 51% / Rod Extended = 13.12(100) / 25.00 = 52.5%

2.) 10" dia x 15" STROKE Miller Cyl. S.O.# N27234 GA# A206763
30" B/V CSP-V-1,-2,-1A, & -2A SPRING TO CLOSE

Rod Retracted = 29.25(100) / 64.00 = 45.7% / Rod Extended = 34.5(100) / 64.00 = 53.9%

∴ THEREFORE: Since all units are of similar Generic construction, the Center of Gravity can be assumed to be proportional, hence item #3 below

3. 8" dia x 15" STROKE Miller CYL. S.O.# N27236 GA# A206765
24" B/V CSP-V-5, -6, & -9 SPRING TO OPEN

C.G. Rod Retracted (Proportional to #1 above) = 51% (51.5) = 26.27in.
C.G. Rod Extended = 52.5% (51.5) = 27.04in.

NEW C.G.'S

24" B/V CSP-V-3, -4, -3A, & -4A SPRING TO CLOSE (Fail Close)
S.O.# N27235 GA# A206764

C.G. Rod Retracted (Proportional to #2 above) = 45.7% (51.5) = 23.54in.
C.G. Rod Extended = 53.9% (51.5) = 27.76in.

NEW C.G.'S

NOTE: B/F Seismic Report # TR-74-7 NOT ADVERSELY AFFECTED. ORIGINAL C.G.'S REPRESENT WORST CASE CONDITIONS.

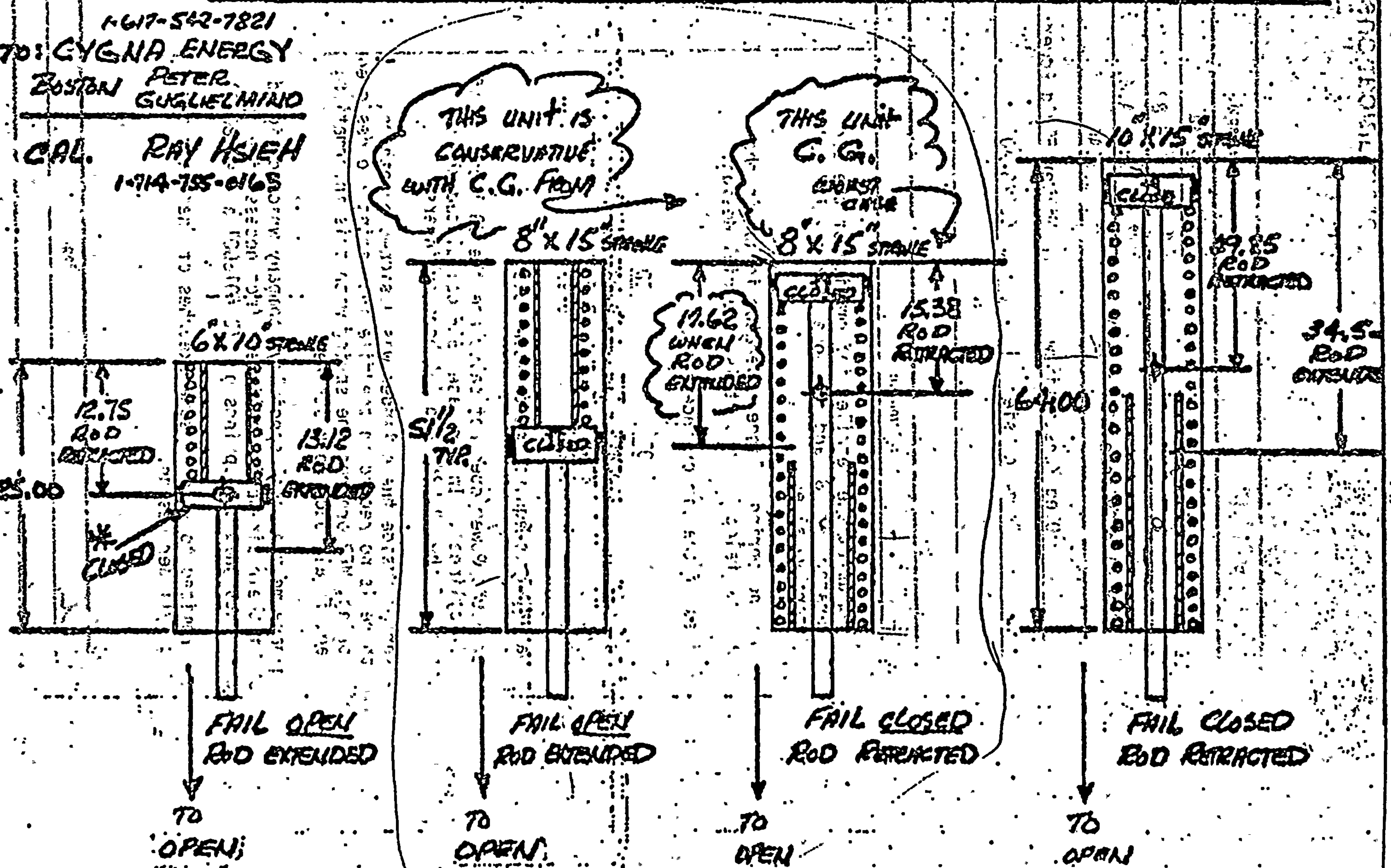
B/F - Richard Disgate
11/9/82

MILLER CYLINDERS C.G.'S SHOWN WITH RODS RETRACTED

* ALL CYLINDER ACTUATORS SHOWN HERE WITH VALVE IN CLOSED POSITION

1-617-542-7821
TO: CYGNA ENERGY
BOSTON PETER GUGLIELMINO

CAL. RAY HSIEH
1-714-755-0165



FROM: BIF RICHARD RICAPITO

Richard Ricapito 11/18/82

CYGNA

Communications Report

Company: CES ☒ Telecon ☐ Conference Report

Project: Washington Public Power Supply System

Job No.: 82044

Date: 10/6/82

Subject: QID #018001 and 018009 (Air Cylinder Operator)

Time: 9:30 A.M.

Place: SDAO

Participants:

Oleg Konstantinow of Miller Fluid Power

Raymond Hsieh of CES/SDAO

of

Item	Comments	Req'd Action By
	I called Oleg about the detailed information of the air cylinder operator (6", 8" and 10" bore) for the 18", 24" and 30" butterfly valves.	

1. The air and spring cylinder operator is not in the Miller's catalog and it is a special design.

2. The sizes of the air cylinders are:

	OD	ID
10" bore	10.425"	9.96"
8" bore	8.45"	7.97"
6" bore	6.255"	5.975"

The material is equivalent to ASTM A519.

3. Miller Fluid Power does not calculate the CG location of the air cylinder. In our case, BIF calculated the CG location of the 6", 8", and 10" bore cylinders.

4. The spring inside the cylinder was designed by others, and there is no record in the file indicating who designed the spring, MFP ordered the spring with this information; preload, final load, work stroke.

5. Oleg gave me the "coil specialty" company which designed most of their air-spring cylinders (not necessarily the one who designed the springs of QID #018001 and #018009).

6. Oleg promised to send me some sketches of their air and spring cylinder design.

Signed: R. Hsieh

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Communications Report

Company: ☐ Telecon ☐ Conference Report

Project: Job No.

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Subject: Time:

QID #018001 and 018009 (Air Cylinder Operator)

Place:

Participants:

of

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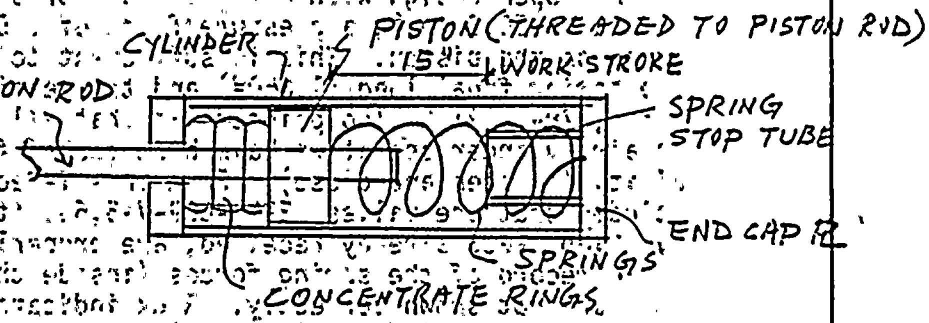
of

Item	Comments	Req'd Action By
	7. Basically, the assembly of the internal components of an air-spring cylinder are: a preloaded compressed spring with a concentrate spring stop tube (welded to the end cap plate) on one end of the piston. And with a series of concentrate rings on the other end of the piston (between the piston and the end plate) to keep the spring in compression. The piston is made from iron and is threaded into the drive rod or piston rod. The piston is able to take the thrust from the air pressure.	
	In case the drive rod is moved in the direction which causes the piston to bear on the end plate (through the concentrate rings) and asserts a thrust on this end plate, the threads on the piston will experience the same magnitude of this thrust. A sketch of the air-spring cylinder operator is as below:	



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CYGNA

Communications Report

Company: CES ☒ Telecon ☐ Conference Report

Project: Washington Public Power Supply System

Job No. 82044

Date: 10/8/82

Subject: QID #018001 and 018009

Time: 8:25 A.M.

Place: SDAO

Participants:

Rick Ricaptto of BIF

Raymond Hsieh of CES/SDAO

Item	Comments	Req'd Action By
1.	Dwg. #C-26096 drawn by Flick-Reedy Corporation (Miller Fluid Power Div.) indicated that both the "fail closed" (CSP-V-3,4 and CEP-V-3A & 4A), and the "fail open" design (CSP-V-5, 6) have the same spring preload (1,500 #) and the final load (3,000 #). (Note that CSP-V-9 (fail open) was not mentioned in C-26096). It was pointed out in QID #361106 that the "fail open" operator assembly does not have enough air pressure to close the butterfly valve if the spring final load is equal to 3,000#. Rick went through the BIF record and confirmed that the information contained in Dwg. #C-26096 is incorrect. There should be two types of spring; one for the "fail close" design which has a spring preload of 1,500# and final load of 3,000#; the other type of spring is for the "fail open" design which has a spring preload of 350# and a spring final load of 1,850#. For the fail open design with a 70 psig air pressure and a piston area of 50.3 in^2; a pressure force of 3,521# could be exerted on the piston. This is sufficient to overcome both the spring final load (1,850#) and the seating torque force of 1,478#. Rick also pointed out that all the valves and its air cylinder operators have been tested for the operability (to open and close). From this Telecon is can be concluded that the valves, EPN #CSP-V-5,6,9 (the fail open design) which WPPSS already received, are properly designed except the record of the spring forces (inside the air cylinder) are not shown correctly. Rick indicated he will send me the required information to clear up the spring forces problem.	
2.	Rick will also send me the support brackets of the 6", 8" and 10" bore air cylinders.	

Signed: R. Hsieh

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Communications Report

Company:	☒ Telecon ☐ Conference Report
Project:	Job No.
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Subject: QID #018001 and 018009	Time:
	Place:
Participants:	of
	of
	of

Item	Comments	Req'd Action By
3.	Rick and I discussed the locations of the CG of the 6", 8" and 10" bore air cylinders (for both the "fail closed" and "fail open" designs). We concluded that the CG locations of the 6" bore air cylinder (fail open design, Dwg. # A-206762) and the 10" bore air cylinder (fail closed design, Dwg. #A-206763) are probably correct (can't find the calcs). However, for the 8" bore air cylinder, Dwg. #A-206764 (fail closed design) and Dwg. #A-206765 (fail open design), both have the identical CG location on the cylinders. There are possibly two mistakes about the CG location on the 8" bore air cylinder. First, the "fail closed" and "fail open" designs could not have the same CG location because the spring and the spring stop tube are located on the opposite end of the cylinder of the two designs. Note that the spring and the spring stop tube are located at the opposite end of the air inlet, and the two designs have a different location of the air inlet (at the opposite end). Second, the CG of the 6" and 10" bore cylinders are both located near the center of the air cylinder. However, the 8" bore air cylinder has its CG located about 9" off the center of the cylinder toward the far end (away from the support bracket). Rick will search for the calculations of the CG locations of the air cylinders. If he failed to find those calculations, he promised to send me a letter stating that the CG location of the 8" bore air cylinder have both the "fail open and fail closed designs and can be assumed to have the same proportion as that of the corresponding 6" bore cylinder (fail open design) and the 10" bore cylinder (fail closed design), respectively.	
4.	The time needed to close or open the butterfly valve is approximately two seconds (estimated).	

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Communications Report

Company: ☒ Telecon ☐ Conference Report

Project: Washington Public Power Supply System

Job No. 82044

Date: 10/6/82

Subject: QID #018001, 018009 (Air Cylinder Operator)

Time: 10:50 A.M.

Place: SDAO

Participants:

Dave Pflam of Coil Specialty Co.

Raymond Hsieh of CES/SDAO

of

Item	Comments	Req'd Action By
1.	Dave explained to me that the spring manufacturer uses the following rules in designing the springs: a. For low cycle spring design: σ_{max} = 0.45 Fu (Fu = ultimate tensile strength of material) b. For high cycle spring design: σ_{max} = 0.3 to 0.35 Fu Dave indicated if he were designing these springs of the air cylinder for WPPSS ten years ago, he will use these same rules.	
2.	The most common used material for the spring which "Coil Specialty" provides to Miller Fluid Power is AISI 5160H which has an Fu of 196 ksi.	
3.	The bar diameter for the 10", 8" and 6" bore air cylinder are: 1", 7/8" and 3/4" respectively.	
4.	Dave mentioned he doesn't know the fatigue life information of the spring. He said that it is very unusual to hear that springs failed in low stress cycles (less than 20,000 cycles) when designed to the rules mentioned in (1) above.	

Signed: R. Hsieh

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CYGNA

Communications Report

Company: CYGNA ☒ Telecon ☐ Conference Report

Project: WPPSS EQ Job No.:

Date:

Subject: 361106 361104 Time: 12/23/82 // 1/3/83

MILLER AIR OPERATORS 01800k Place:

Participants: Jim Rabowski of CES

John Martin 800-323-2520 of MILLER

of

Item	Comments	Req'd Action By
	John Martin - Production / Application Engineer Miller Pneumatic Products	
NOTE: one bushing in a std. cylinder - does not rotate	Air cylinders can take up to 200 PSI "side load" in harsh conditions and up to 400 PSI for harsh / dynamic conditions.	
	Example Shaft Size - Area	
	DIA = 1 3/8 8" cyl. brg area = 1.451 (1.48)	
	1 3/4 10" 2.075 2.41	
	2 12" 2.373 3.24	
		NOT SAME
	EX (?)	
	200 PSI × 2.373 IN^2 ⟹ 84 lb (?) (474?)	
	400 PSI @ 1 3/4 (2.075) ⟹ 830 lb	

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CYGNA

Communications Report

Company: CES   X Telecon   ☐ Conference Report

Project: WPPSS EQ   Job No.

Date: 1/5/83

Subject: MILLER AIR OPERATORS, QID-018001   Time: 8:15 AM

Place: RGHQ

Participants:

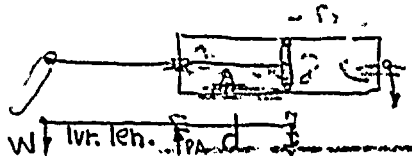
JOHN MARTIN 1-800-323-2520 of MILLER

JIM RAKOWSKI of CES

of

Item	Comments	Req'd Action By
1	JOHN CONFIRMED SENDING A DRAWING SHOWING MILLER CYLINDERS WITH BUSHING. DESIGN DEPICTS CURRENT DESIGN WHICH MAY DIFFER FROM THE BIF VINTAGE, BUT BUSHING DESIGN IS SAME.	
2	BUSHING DESIGN EQUATION: BEARING PRESSURE = $\dfrac{\dfrac{\text{Weight (side load)} \times \text{Lever Length}}{d\ (\text{brg. mid pt} \rightarrow \text{Piston mid Pt.})}}{\text{BEARING AREA}}$	
3	Bushing Design is for: (A) 200 PSI MAX IN DYNAMIC CONDITION, I.E. DRIVE ROD MOVING AXIALLY (B) 400 PSI MAX WITH DRIVE ROD IN STATIC CONDITION (SPRING-HELD, NO ACTUATION)	

ASIDE:



$F(=PA) * d = W * \text{lvr. len.}$ (DOESN'T FIT; SHOULD BE):

$F(=PA) * d = W(d + \text{lvr. len.})$

Signed: J E Rakowski 1/5/83   Page 1 of 1

Distribution:

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CYGNA

Communications Report

Company: CES　　☒ Telecon　　☐ Conference Report

Project:　　Job No.

Date: 2/10/83

Subject:　　Time: 10: AM

Place: RBO

Participants: John Martin of Miller Air Products

Jim Rakowski of CES/RBO

of

Item	Comments	Req'd Action By
	Q - What is bushing / shaft clearance and bushing material in air cylinder operators supplied to BIF. A: Bushing mat'l probably nodular iron. Typical clearance based on piston tolerance of +0" -.001 with the bushing bore held to even closer tolerances.	

Signed:　　Page　　of

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Communications Report

Company: CES ☐ Telecon ☒ Conference Report

Project: WPPSS Equipment Seismic/Hydrodynamic Requalification

Job No.: 82044

Date: 12/13/82

Subject: [redacted] 018004, 018009, 018013, 361020, 361729, 361740, 361901

Time: 1:00

Place: Richland

Participants:

W. Hardy of CES, RBO

L. Fernandez of CES, RBO

Item	Comments	Req'd Action By
1	RBO has original verification packages for the above referenced files which specify incomplete status. These shall be organized into complete package format and filed in the RBO QID bingers. The completed packages are forthcoming from the Area Offices in the form of Revision 1. These Revision 1 requalification packages will supersede Revision 0 in RBO QID files. It is noted that none of these incomplete packages (Revision 0) have been submitted to the SS.	WH

Signed: L C Fernandez Page 1 of 1

Distribution: T. Wittig, F. Khanachet, M. Scott, Project File, L. Fernandez, W. Hardy, M. Benzmiller

1020 00