Southern California Edison Company

P. O. BOX 800

2244 WALNUT GROVE AVENUE

ROSEMEAD, CALIFORNIA 91770

KENNETH P. BASKIN
VICE PRESIDENT

TELEPHONE
818-302-1401

APR 1 1985

Office of Nuclear Reactor Regulation
Attention: Dennis M. Crutchfield, Assistant Director
for Safety Assessment
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket No. 50-206
Seismic Analyses
San Onofre Nuclear Generating Station
Unit 1

Your letter of February 15, 1985 requested that we provide original design analyses for San Onofre Unit 1 which pertain to your review of SCE's April 30, 1982 seismic reevaluation report regarding Balance of Plant Mechanical Equipment and Piping (BOPMEP). As indicated in our letter of September 9, 1979 from J. T. Head to R.H. Engelken, only six original seismic analysis documents pertaining to the San Onofre Unit 1 balance of plant were identified as being available. In a subsequent letter from H. L. Ottoson to R. H. Engelken dated January 14, 1980 it was noted that one of these analyses (Bechtel stress problem number 3246-10) was not applicable to the as-built piping configuration.

In accordance with your request we have asked our contractor, Bechtel Power Corporation, to again search their files for information regarding these original seismic analyses. Based on this effort, seismic design information was located for the following systems:

Item	Description	Calculation No.
1.	Main Steam Piping between the Turbine Stop Valves and Steam Generators	3246-1
2.	Main Feedwater Piping between the Sphere Penetration and Steam Generator E-1B	3246-3
3.	Main Feedwater Piping between the Sphere Penetration and Steam Generator E-1C	3246-14, 15, 16

Encls Rec'd 4/5/85

Aperture Card Dist Encls To: Reg Files - 1 W. Paulson - 1

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A001 1/2

4.	Main Feedwater Piping between Feedwater Pumps G-3A and G-3B and Sphere Penetrations C-3A, C-3B and C-3C	3246-10

In addition, Bechtel has prepared a comparison of the available original seismic design data for the first three systems listed above with the design data used in the April 1982 BOPMEP report. This comparison is provided for your information in Attachments 1, 2 and 3.

With respect to the original seismic design data and seismic analyses located for the four systems identified above, in no case was a complete "seismic calculation package" located. In each case, various independent pieces of information related to original seismic analyses were located. This information has been assembled in Attachments 4 through 7 for the four systems identified above. It should be noted that for Item 4 above, no original seismic analyses could be located; however, Attachment 7 includes tabulations prepared in 1973 for use in pipe break analyses of this system. These are considered to be taken from original seismic calculations based on discussions with the engineer who prepared the 1973 tabulation and the fact that a similar tabulation prepared in 1973 for the main steam piping was also located and it correlates with the stresses developed for the original plant.

Finally, Attachment 8 provides a discussion of a number of differences between the methods and criteria used for the 1982 BOPMEP seismic analyses and methods and criteria which were probably used in the original seismic analyses. The purpose of this discussion is to recognize the fact that there are a number of differences between calculations done during the two time periods. As such, conclusions regarding the original design should not be made based on the results of the 1982 analyses.

If you have any questions regarding the enclosed information, please call me.

Very truly yours,

Kenneth P Baskin

ATTACHMENT (1)

Comparison of design data used for original plant seismic calculations, circa 1964/1965, with design data used for the BOPMEP Report of April 1980 for Main Steam Piping between the Turbine Stop Valves and Steam Generators, Calculation No. 3246-1.

Item	Original Analysis	BOPMEP Analysis	Comments
1. Calc. No.	3246-1	MS-01	
	(a) Turbine Stop Valves to Steam Generators (12/21/64)	Turbine Stop Valves to Steam Generators	1. Subsequent calculations were made in 1965 since the original, 12/21/64 analysis showed high stresses. See comments for Item 5.
	(b) Turbine Stop Valves to Sphere Penetration including Relief Valve Header Piping (4/24/65)		2. Original seismic analysis Item 1(c) cannot be found. Evidence of this analysis is provided by letter as shown on Page 22 of Attachment (4).
	(c) Sphere Penetration to Steam Generators (3/5/65). This computer input/output could not be located.		
2. Method of Analysis	(a) Static Analysis	Dynamic Analysis, Closely Space Modes per Reg. Guide 1.92	
	(b) Static Analysis		
	(c) Static Analysis		

ATTACHMENT (1) (Cont'd)

Item	Original Analysis	BOPMEP Analysis	Comments
3. Response Spectra	(a) 12/21/64 X Direc. = 0.5 g Y Direc. = Not Located Z Direc. = 0.5 g	Fundamental Freq. = 8.7 cps X Direc. = 2.45 g (DBE) Y Direc. = 2.1 g (DBE) Z Direc. = 3.03 g (DBE)	
	(b) 4/24/65 X Direc. = 1.0 g Y Direc. = 0.67 g Z Direc. = 1.0 g		
	(c) 3/5/65 X Direc. = 1.0 g Y Direc. = 1.0 g Z Direc. = 1.0 g		1. See Item 1, comment 2.

ATTACHMENT (1) (Cont'd)

Item	Original Analysis	BOPMEP Analysis	Comments
4. Piping Geometry	(a) 12/21/64 - Computer Model of Piping from Turbine Stop Valve to S.G. Due to Symmetry, one half of piping system was considered. Relief header line was not included. (b) 4/24/65 Computer Model Outside Containment Due to Symmetry, one half of piping system was considered. Included relief header line. (c) 3/5/65 Computer Model Inside Containment Due to Symmetry, one half of piping system was considered.	Considered Full Model for Inside Containment and Outside Containment	1. Considering (a), (b), and (c) of original analyses, the Piping Geometry was similar for both analyses

ATTACHMENT (1) (Cont'd)

Item	Original Analysis	BOPMEP Analysis	Comments
5. No. of Supports	(a) 12/21/64 2 x-direction supports using half model 1 z-direction support using half model	9 supports with x-direction components in half model, 16 supports with z-direction components in half model	High Seismic stresses were calculated in original analysis (12/21/64). The stress problem was then divided into two parts and reruns were made with more supports (i) Turbine Stop Valves to Sphere Penetration with relief header line Outside Containment (ii) Sphere Penetration to Steam Generators Inside Containment
	(b) 4/24/65 Outside Containment		Primary Stresses were within allowable limits for the analysis of 4/24/65, outside containment, and the number, type and location of supports matched those used in the BOPMEP Analysis.
	(c) 3/5/65 Inside Containment This analysis has not been located.		A letter had been sent to Service Bureau Corporation for seismic computer analysis, on 3/5/65, for inside containment portion. Results of the analysis have not been located. However, the number of supports installed in 1965/1966 agree with the number, type and location of supports used in BOPMEP which reflected piping stresses within code allowables.

ATTACHMENT (1) (Cont'd)

Item	Original Analysis	BOPMEP Analysis	Comments
6. Primary Stresses	(a) High Stresses from 12/21/64 Analysis (b) Acceptable stresses from 4/24/65 analysis outside containment (c) Stresses not available	Acceptable Primary Stress 17,623 psi	1. Since seismic spectra was more severe for the BOPMEP analysis, which resulted in acceptable stresses, it can be concluded that for the same piping geometry, support locations and types piping stresses for the original plant design were acceptable per the original plant criteria.

ATTACHMENT (2)

Comparison of design data used for original plant seismic calculations, circa 1964/1965, with design data used for the BOPMEP Report of April 1980 for Main Feedwater Piping between the Sphere Penetration and Steam Generator E-1B, Calculation No. 3246-3.

Item	Original Analysis	BOPMEP Analysis	Comments
1. Calc. No.	3246-3	FW-02	
2. Method of Seismic Analysis	Static Analysis	Dynamic Analysis, Closely Space Modes, Reg. Guide 1.92	
3. Response Spectra	12/29/64 X Direc. = 0.5 g Z Direc. = 0.5 g Analysis for Y Direc. is not available.	Fundamental Freq. = 9.8 cps X Direc. = 2.5 g (DBE) Y Direc. = 1.35 g (DBE) Z Direc. = 1.6 g (DBE)	1. For the original analysis on 12/29/64 a peak acceleration of 0.5 g applied statically, was used. Subsequent static seismic analyses was performed using a peak or 1 g. See Item 5 comments.
4. Piping Geometry	Piping Footage - 200' Elbows - 6	Piping Footage - 200' Elbows - 6	Pipe routing is identical.

ATTACHMENT (2) (Cont'd)

Item	Original Analysis	BOPMEP Analysis	Comments
5. No. of Supports	12/29/64 Computer Model N-S (X Direc.) = 1 Rigid Vert. (Y Direc.) = 4 Rigid E-W (Z Direc.) = 2 Rigid	N-S (X Direc.) = 2 Rigid Vert. (Y Direc.) = 8 Rigid E-W (Z Direc.) = 4 Rigid 5 Skew Snubbers 2 Springs	The 1964 Analysis did not represent the final seismic model and therefore the number of supports differed with the BOPMEP Model. Subsequent seismic analysis performed in 1965 cannot be located. However, the number of supports in 1965/1966 agrees with the number, type, and location used in the BOPMEP Analysis.
6. Primary Stresses	1. High Seismic Stress from 12/29/64 Analysis	Acceptable Primary Stresses - 15,451 psi	Since seismic spectra was more severe for the BOPMEP Analysis, which resulted in acceptable stresses, it can be concluded that for the same piping geometry, support locations and types, piping stresses were acceptable based on original criteria.
	2. Stresses from 1965 Analysis are not available.		

ATTACHMENT (3)

COMPARISON OF DESIGN DATA USED FOR ORIGINAL PLANT SEISMIC CALCULATIONS, CIRCA 1964/65, WITH DESIGN DATA USED FOR THE BOPMEP REPORT OF APRIL 1980 FOR MAIN FEEDWATER PIPING BETWEEN THE SPHERE PENETRATION AND STEAM GENERATOR E-1C CALCULATION NO. 3246-14,15,16

ITEM	ORIGINAL ANALYSIS	BOPMEP ANALYSIS	COMMENTS
1. Calc. No.	3246-14 3246-15 3246-16	FW-01	-
2. Method of Seismic Analysis	Static Analysis	Dynamic Analysis Closely Space Modes Reg. Guide 1.92	
3. Response Spectra	2/65 X Direc. = 1.0 g Y Direc. = .067 g Z Direc. = 1.0 g	Fundamental Freq. = 7.2 cps X Direc. = 2.5 g Y Direc. = 2.3 g Z Direc. = 3.55 g	
4. Piping Geometry	Piping Footage = 92' Elbows = 4	Piping Footage = 97.5' Elbows = 4	1. Almost Identical Geometry
5. No. of Supports	N-S (X Direc.) = 1 Rigid Vert (Y Direc.) = 3 Rigid E-W (Z Direc.) = 1 Snub. 2 Skew Snubbers, 2 Springs	N-S (X Direc.) = 1 Rigid Vert (Y Direc.) = 3 Rigid E-W (Z Direc.) = 1 Snub 2 Skew Snubbers, 2 Springs	1. Support Numbers, types, and locations are identical.
6. Stress	Stress Levels are Acceptable	Acceptable Primary Stress = 17,807 psi	

65 Pages

ATTACHMENT (4)

Copies of original plant design data and seismic analyses for Main Steam Piping between the Turbine Stop Valves and Steam Generators, Calculation No. 3246-1.

ATTACHMENT (4) (Cont'd)

ATTACHMENT 8

The Balance of Plant Mechanical Equipment and Piping (BOPMEP) Report of April 1980 presents the results of a seismic reevaluation performed to evaluate safety related components, structures and equipment of San Onofre 1. The program was based upon the use of then current analysis methods and criteria which differed significantly from, and were more severe than, those used during the original plant design, circa 1964/1965. As a result, it would be expected that significantly higher piping stresses, support and equipment loads would be generated for the BOPMEP evaluation than would be for the original plant. A discussion of the significant differences in analytical methods and criteria between BOPMEP and the original plant follows:

Original plant piping stress analysis was performed using static versus dynamic seismic analysis, per Reg. Guide 1.92 for closely spaced modes, for the BOPMEP evaluation. Also, the original analyses were based on ground motion spectra versus amplified in-structure response spectra used in the BOPMEP evaluation. A comparison of the peak accelerations from the BOPMEP seismic spectra curves with the peak of the original plant spectra curve indicates that resulting stresses and loads could be five times higher for the BOPMEP evaluation if only static seismic analysis was used in each case.

NOTE: OBE and DBE earthquakes were not addressed as such in 1964/65. A comparison of peak accelerations from BOPMEP seismic spectra curves was made against twice the peak of the original spectra curve, as shown in Figure 9.2 of the FSA, since the BOPMEP curves were DBE curves and the Figure 9.2 curve was based on a .25g earthquake. The .25g earthquake is considered comparable to the OBE and the DBE considered comparable to twice the .25g earthquake since the FSA required component functionality for an earthquake with a ground acceleration of twice that of the .25g earthquake. (See Section 9.2.6.3 of the SONGS 1 FSA).

Increases of 1.5 in piping seismic stresses and support and equipment loads could result due to dynamic vs. static analysis, and increases of 1.4 could result using closely spaced modes. Additional increases in stresses and loads could result due to differences in state of the art computer modeling techniques for concentrated and lumped masses.

Methods of combining earthquake loads also differed between BOPMEP and original plant analyses and could account for higher BOPMEP stresses. For BOPMEP, moments resulting from the three earthquake directions, two horizontal and one vertical, were combined using the square root of the sum of the equals method (SRSS); whereas, for the original plant, only one horizontal direction, the one providing highest moments, was combined with the vertical using absolute sum.

Application of stress intensification factors can also be cited as a major reason why piping stresses could be much higher for BOPMEP than for the original plant. For the original plant analyses, stress intensification factors were required to be used only for calculations of high cyclic stresses resulting from thermal expansion. Primary stresses due to weight and seismic loads would not have been considered to be of a

high cyclic nature and therefore, it is concluded that no stress intensification factors were considered in the calculation of these stresses. Stress intensification factors of up to ten were used in the BOPMEP analysis.

Certain piping systems were not considered to be safety related during the original plant design, e.g., the Auxiliary Feedwater Piping. Seismic analysis of this piping using BOPMEP analytical methods and criteria resulted in high piping stresses which would be expected when analyzing a previously non-seismic system as seismic.

Evaluation of small bore piping, piping less than, or equal to, two inches in diameter, for BOPMEP was based on very conservative assumptions and analytical techniques, e.g., rod hangers were considered to be nonexistent, very conservative valve weights were used, an empirical method of evaluation which would conservatively envelope dynamic effects was developed, etc.

Conclusion

It can be concluded that comparisons of resulting piping stresses and support and equipment loads using BOPMEP analytical methods and criteria versus those used for the original plant design could be significantly higher for piping systems considered safety related for both evaluation periods. Increases in stresses by as much as a couple orders of magnitude could be expected to occur considering only the effects of amplified spectra due to in-structure response, effects of dynamic analysis, effects of closely spaced modes and effects of stress intensification factors. Additional increases in stresses could also be expected due to differences in state of the art modeling techniques, and methods of combining earthquake loads.

PIPING FLEXIBILITY CALCULATION

BECHTEL CORPORATION
4550 SEVILLE AVENUE
VERNON, CALIFORNIA

Fx Fy Fz
Mz My Mx

Sc =
Sh =
SA = 1.25Sc + .25Sh
SA =

MAXIMUM STRESS AT POINT

3246-1

SIGNATURE W. L. Stiles DATE 12-18-63
PROJECT SAN ONOFRE JOB NO. 3246
SUBJECT MAIN STM. X E Z ACCELERATION (EARTHQUAKE) (0.5G)

CONVENTION FOR POSITIVE FORCES & MOMENTS

DESIGN DATA

PRESS.
TEMP. 71°F.

MAT'L CARB. STL.
EXP. COEF. .0000063
$E_c \times 10^6$ 27.9

MEMBER DATA

24" x .968 1 → 3, 8 → 12, 22, 25, 26
20" x .812 13, 16, 19 → 21, 27, 30 → 32
30" x 9.000 4 → 7, 17, 18, 23, 24, 28, 29
2" x .020 14, 15

ANCHOR DATA

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A7	15	28.78'	-4.24'	117.26'	0	0	0
A9	21	17.23'	9.66'	121.5'	0	0	0
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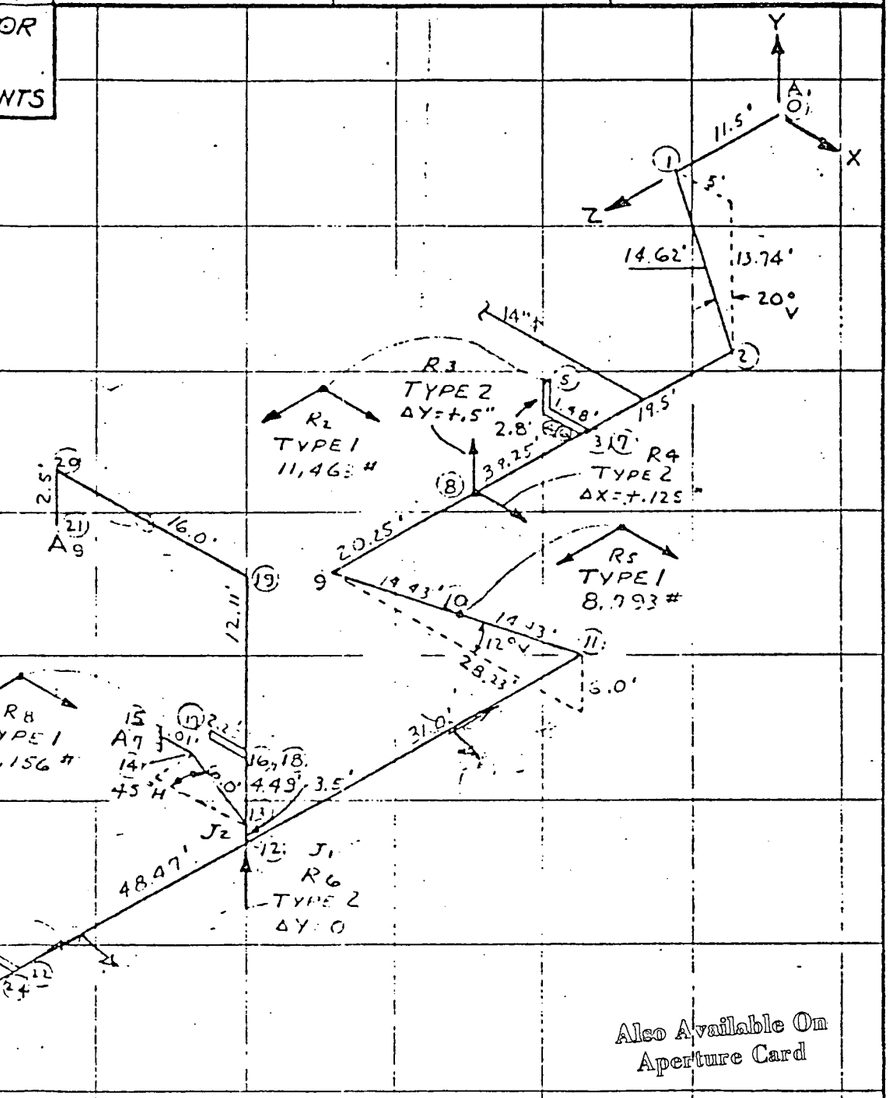
LINE: 1-24" EG TO 6-24" EG



50-206
41/185
8504040294

8504040294-01

INPUT DATA FOR IBM - THREE-PLANE PIPING STRESS ANALYSIS

ECC NO. SAN ONOFRE MAIN STM X ACC.	NAME W.D GROSS
DATE 12-21-64	PAGE 2 OF 21

INSTRUCTIONS

1. REFER TO DESIGN PRACTICE _____ FOR DESCRIPTION OF PROGRAM.
2. USE ONLY CAPITAL LETTERS AND ARABIC FIGURES, WRITE ALPHABETICAL LETTERS O THUS "Ø", AND I THUS "I"; FIGURES ZERO THUS "0", ONE THUS "1".
3. ENTER DATA FOR EACH ANCHOR, STRAIGHT OR CURVED MEMBER, JUNCTION, OR RESTRAINT ON A SEPARATE LINE.
4. NO ENTRY NEED BE MADE FOR ANCHOR DISPLACEMENTS, RESTRAINT DEFLECTION OR FORCE IF VALUES ARE ZERO.
5. THE O.D., THICK., & TEMP. NEED TO BE ENTERED ONLY FOR THE FIRST STRAIGHT OR CURVED MEMBER. THESE VALUES WILL BE USED FOR ALL SUCCEEDING MEMBERS UNTIL DIFFERENT VALUES ARE ENTERED. THE NEW VALUES WILL THEN BE USED UNTIL ANOTHER ENTRY IS MADE.
6. NUMBER STRAIGHT & CURVED MEMBERS CONSECUTIVELY STARTING WITH 1; DITTO FOR ANCHORS & RESTRAINTS; DITTO FOR JUNCTIONS.

CARD NO.

A	10 NUMBER OF PROBLEMS IN RUN (FILL IN ON FIRST SHEET ONLY)
1	PROJECT: SAWEWRC — REFINERY OR PLANT — DATE: DEC 21, 1964
2	NAME: W D GROSS — CASE 1
3	LINE DESIG.: MAIN STEAM X ACCELERATION .5G

SHAPE COEFFICIENT CHECK	MODULUS OF ELASTICITY (PSI)	EXPANSION COEFFICIENT (IN/IN/DEG. F)	NUMBER OF RESTRAINTS	NO. OF TYPE 1 & 3 RESTR.	NO. OF PASSES	PRINT SHAPE COEFFICIENT	PRINT EQUATIONS	ALLOWABLE STRESS (PSI)
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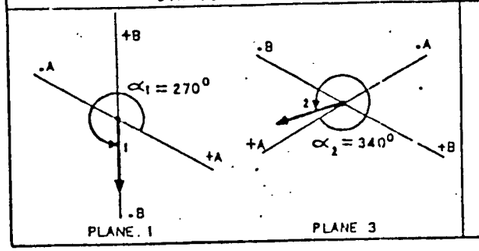
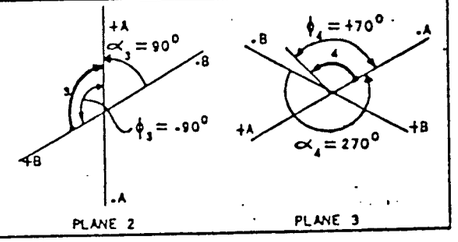
COORDINATE AXES FOR MEASUREMENT OF α AND ϕ FOR STRAIGHT AND CURVED MEMBERS

STRAIGHT MEMBERS



CURVED MEMBERS



TYPE OF MEMBER (STRAIGHT OR CURVED - 0, JUNCTION-50, ANCHOR -99, RESTR. -100)	MEMBER NO. STRAIGHT OR CURVED	MEMBER NO. JUNCTION	MEMBER NO. ANCHORS & RESTR.	STRAIGHT AND CURVED MEMBERS: PLANE 1, 2 OR 3	ANGLE α (DEG)	LENGTH OR RADIUS (FT)	OUTSIDE DIAMETER (IN)	THICKNESS (IN)	TEMP ΔT (F°)	CURVED ONLY: ROTATION AND ϕ (+ OR -, DEG)	ANCHOR DISPLACEMENT: ΔX (IN)	ΔY (IN)	ΔZ (IN)	ϕX (DEG)	ϕY (DEG)	ϕZ (DEG)	RESTRAINTS: DIRECTION 1, 2 OR 3	DEFLECTION FOR TYPE 2 RESTRAINTS (0 FOR TYPES 1 & 3) (IN)	FORCE FOR TYPES 1 & 3 RESTRAINTS ONLY (LBS)	TYPE OF RESTRAINT 1, 2 OR 3
5		75		1							.000	.000	.000							
6	1			2	0	11.5	24.	.968		1										
7	2			3	290	14.62														
8	3			2	0	19.5														
9	4			3	180	1.48301		9												
10	5			3	90	2.8											1		10463	1
11	1010		2																	
12	6			3	270	2.8														
13	7			3	0	1.48														
14	8			2	0	39.25 24		.968									2	.5		2
15	100		3														1	.125		2
16	1010		4																	
17	9			2	0	20.25														
18	10			3	12	14.43											1		8793	1
19	1010		5																	
20	11			3	12	14.43														
21	12			2	0	31.											2	-0.010		2
22	100		6																	
23	50		1																	
24	13			3	90	3.5	20.	.812												
25	50		2																	
26	14			2	225	6.	2.	.2												
27	15			2	270	.01														
28	75		7								.000	.000	.000							
29	16			3	90	4.49	20.	.812												
30	17			3	180	2.25	30.		9								1		6156	1
31	100		8																	
32	18			3	0	2.25														
33	19			3	90	12.111	20.	.812												
34	20			3	180	16.														
35	21			3	270	2.15														
36	175		9																	
37	22			2	0	48.47 24		.968												
38	23			2	270	9.92 30		9												
39	1010		10																	

INPUT DATA FOR IBM - THREE-PLANE PIPING STRESS ANALYSIS

ECC NO. SAN ONOFRE MAIN STM X ACC.	NAME W.D. GROSS
DATE 12-21-69	PAGE 3 OF 21

INSTRUCTIONS

1. REFER TO DESIGN PRACTICE _____ FOR DESCRIPTION OF PROGRAM.
2. USE ONLY CAPITAL LETTERS AND ARABIC FIGURES, WRITE ALPHABETICAL LETTERS O THUS "Ø", AND I THUS "I"; FIGURES ZERO THUS "0", ONE THUS "1".
3. ENTER DATA FOR EACH ANCHOR, STRAIGHT OR CURVED MEMBER, JUNCTION, OR RESTRAINT ON A SEPARATE LINE.
4. NO ENTRY NEED BE MADE FOR ANCHOR DISPLACEMENTS. RESTRAINT DEFLECTION OR FORCE IF VALUES ARE ZERO.
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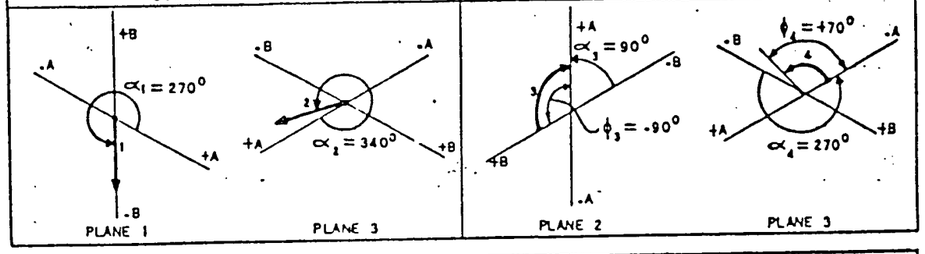
6. NUMBER STRAIGHT & CURVED MEMBERS CONSECUTIVELY STARTING WITH 1; DITTO FOR ANCHORS & RESTRAINTS; CITTO FOR JUNCTIONS.

COORDINATE AXES FOR MEASUREMENT OF α AND ϕ FOR STRAIGHT AND CURVED MEMBERS



CARD NO. A

NUMBER OF PROBLEMS IN RUN (FILL IN ON FIRST SHEET ONLY)

1 PROJECT — REFINERY OR PLANT — DATE — 1 1 9 — C A S E

2 NAME

3 LINE DESIG.

4

SHAPE COEFFICIENT CHECK	MODULUS OF ELASTICITY (PSI)	EXPANSION COEFFICIENT (IN/IN/DEG. F)	NUMBER OF RESTRAINTS	NO. OF TYPE 1 & 3 RESTR.	NO. OF PASSES	PRINT SHAPE COEFFICIENT	PRINT EQUATIONS	ALLOWABLE STRESS (PSI)
1.0	0000000.	0.000000				0	0	

STRAIGHT AND CURVED MEMBERS

	TYPE OF MEMBER (STRAIGHT OR CURVED = 0, JUNCTION = 50, ANCHOR = 75, RESTR. = 100)	MEMBER NO. STRAIGHT OR CURVED	MEMBER NO. JUNCTION	MEMBER NO. ANCHORS & RESTR.	PLANE 1, 2 OR 3	ANGLE α (DEG)	LENGTH OR RADIUS (FT)	OUTSIDE DIAMETER (IN)	THICKNESS (IN)	TEMP ΔT (F^0)	CURVED ONLY: ROTATION AND ϕ (+ OR −, DEG)
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8	100			11							
9	100			12							
10		27			1	0	14.6120.		.8112		
11		28			1	270	4.5130.		9.		
12	100			13							
13		29			1	90	4.51				
14		30			1	0	5.4920.		.8112		
15		31			1	270	17.				
16		32			1	180	2.5				
17	75			14							
18	(One Blank Card Goes Here)										

ANCHOR DISPLACEMENT

	ΔX (IN)	ΔY (IN)	ΔZ (IN)	ϕX (DEG)	ϕY (DEG)	ϕZ (DEG)
17	.000	.000	.000			

RESTRAINTS

	DIRECTION 1, 2 OR 3	DEFLECTION FOR TYPE 2 RESTRAINTS (0 FOR TYPES 1&3) (IN)	FORCE FOR TYPES 1 & 3 RESTRAINTS ONLY (LBS)	TYPE OF RESTRAINT 1, 2 OR 3
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8	1	.000		2
9				
10				
11	1		3449.	1
12				
13				
14				
15				
16				
17				
18				

INPUT DATA FOR IBM - THREE-PLANE PIPING STRESS ANALYSIS

ECC NO. SAN ONOFRE MAIN STM. Z ACC.	NAME W. D. GROSS
DATE 12-21-64	PAGE 4 OF 21

INSTRUCTIONS

1. REFER TO DESIGN PRACTICE _____ FOR DESCRIPTION OF PROGRAM.
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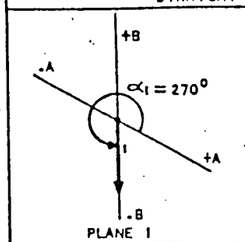
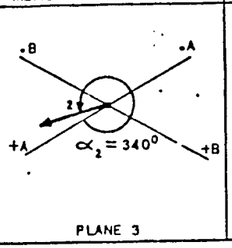
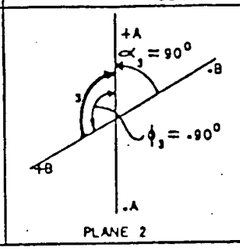
COORDINATE AXES FOR MEASUREMENT OF α AND ϕ FOR STRAIGHT AND CURVED MEMBERS

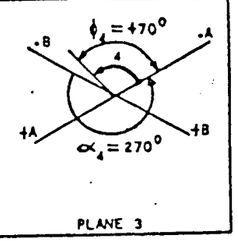
STRAIGHT MEMBERS





CURVED MEMBERS





CARD NO.

A — NUMBER OF PROBLEMS IN RUN (FILL IN ON FIRST SHEET ONLY)

1 — PROJECT _____ REFINERY OR PLANT _____

2 — NAME _____ DATE _____, 19 CASE 1

3 — LINE DESIG. MAIN STEAM Z ACCELERATION .SG

SHAPE COEFFICIENT CHECK	MODULUS OF ELASTICITY (PSI)	EXPANSION COEFFICIENT (IN/IN/DEG. F)	NUMBER OF RESTRAINTS	NO. OF TYPE 1 & 3 RESTR.	NO. OF PASSES	PRINT SHAPE COEFFICIENT	PRINT EQUATIONS	ALLOWABLE STRESS (PSI)
1.0	0000000.	0.000000				0	0	

4

TYPE OF MEMBER (STRAIGHT OR CURVED - 0, JUNCTION - 50, ANCHOR - 75, RESTR. - 100)	MEMBER NO. STRAIGHT OR CURVED	MEMBER NO. JUNCTION	MEMBER NO. ANCHORS & RESTR.	PLANE 1, 2 OR 3	ANGLE α (DEG)	LENGTH OR RADIUS (FT)	OUTSIDE DIAMETER (IN)	THICKNESS (IN)	TEMP ΔT (F^0)	CURVED ONLY ROTATION AND ϕ (+ OR -, DEG)	ANCHOR DISPLACEMENT ΔX (IN)	ΔY (IN)	ΔZ (IN)	ϕX (DEG)	ϕY (DEG)	ϕZ (DEG)	RESTRAINTS DIRECTION 1, 2 OR 3	DEFLECTION FOR TYPE 2 RESTRAINTS (0 FOR TYPES 1&3) (IN)	FORCE FOR TYPES 1 & 3 RESTRAINTS ONLY (LBS)	TYPE OF RESTRAINT 1, 2 OR 3
1010			2														3		11463.	1
1010			5														3		81793.	1
100			8														3		61516.	1
1010			10														3		12124.	1

CAME AS SHEET #2 EXCEPT AS NOTED

IBM APERTURE CARD

Also Available On Aperture Card

8304040294-04

(7)

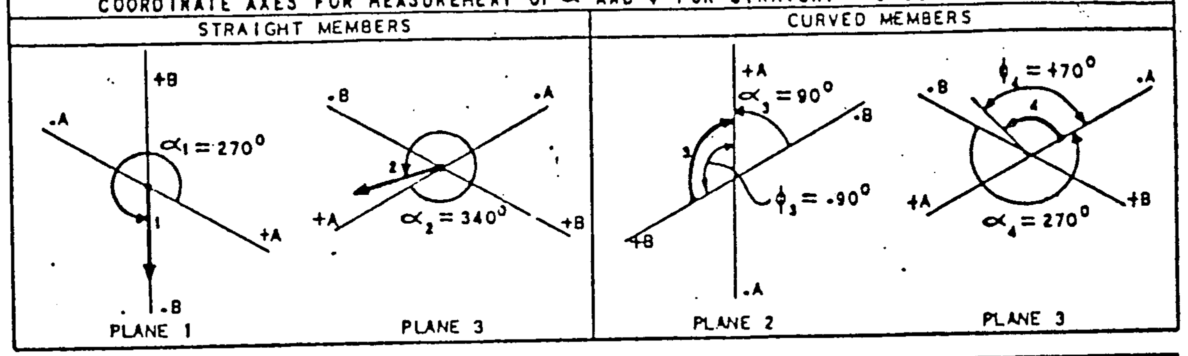
INPUT DATA FOR IBM — THREE-PLANE PIPING STRESS ANALYSIS

ECC NO. SAN ONOFRE MAIN STM. Z ASS.	NAME W D GROSS
DATE 12-21-64	PAGE 5 OF 21

INSTRUCTIONS

1. REFER TO DESIGN PRACTICE ________ FOR DESCRIPTION OF PROGRAM.
2. USE ONLY CAPITAL LETTERS AND ARABIC FIGURES. WRITE ALPHABETICAL LETTERS O THUS "Ø", AND I THUS "I"; FIGURES ZERO THUS "0", ONE THUS "1".
3. ENTER DATA FOR EACH ANCHOR, STRAIGHT OR CURVED MEMBER, JUNCTION, OR RESTRAINT ON A SEPARATE LINE.
4. NO ENTRY NEED BE MADE FOR ANCHOR DISPLACEMENTS, RESTRAINT DEFLECTION OR FORCE IF VALUES ARE ZERO.
5. THE O.D., THICK., & TEMP. NEED TO BE ENTERED ONLY FOR THE FIRST STRAIGHT OR CURVED MEMBER. THESE VALUES WILL BE USED FOR ALL SUCCEEDING MEMBERS UNTIL DIFFERENT VALUES ARE ENTERED. THE NEW VALUES WILL THEN BE USED UNTIL ANOTHER ENTRY IS MADE.
6. NUMBER STRAIGHT & CURVED MEMBERS CONSECUTIVELY STARTING WITH 1; DITTO FOR ANCHORS & RESTRAINTS; DITTO FOR JUNCTIONS.

COORDINATE AXES FOR MEASUREMENT OF α AND φ FOR STRAIGHT AND CURVED MEMBERS



CARD NO.	
A	NUMBER OF PROBLEMS IN RUN (FILL IN ON FIRST SHEET ONLY)
1	PROJECT — REFINERY OR PLANT
2	NAME — DATE , 19 — CASE
3	LINE DESIG.

CARD NO.	SHAPE COEFFICIENT CHECK	MODULUS OF ELASTICITY (PSI)	EXPANSION COEFFICIENT (IN/IN/DEG. F)	NUMBER OF RESTRAINTS	NO. OF TYPE 1 & 3 RESTR.	NO. OF PASSES	PRINT SHAPE COEFFICIENT	PRINT EQUATIONS	ALLOWABLE STRESS (PSI)
4	11.0	00000.	0.00000				0	0	

CARD NO.	TYPE OF MEMBER (STRAIGHT OR CURVED -0, JUNCTION -50, ANCHOR -75, RESTR. -100)	MEMBER NO. (STRAIGHT OR CURVED / JUNCTION / ANCHORS & RESTR.)	PLANE 1, 2 OR 3	ANGLE α (DEG)	LENGTH OR RADIUS (FT)	OUTSIDE DIAMETER (IN)	THICKNESS (IN)	TEMP ΔT (F°)	CURVED ONLY: ROTATION AND φ (+OR -, DEG)	ANCHOR DISPLACEMENT ΔX (IN)	ΔY (IN)	ΔZ (IN)	φX (DEG)	φY (DEG)	φZ (DEG)	DIRECTION 1, 2 OR 3	DEFLECTION FOR TYPE 2 RESTRAINTS (0 FOR TYPES 1&3) (IN)	FORCE FOR TYPES 1 & 3 RESTRAINTS ONLY (LBS)	TYPE OF RESTRAINT 1, 2 OR 3
5																			
6																			
7																			
8																			
9																			
10																			
11																3		3449.	1
12	100	13																	
13																			
14																			
15																			
16																			
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36																			
37																			
38																			
39																			

(SAME AS SHEET #3 EXCEPT AS NOTED)

8504040294-05

PIPING FLEXIBILITY ANALYSIS

SAN ONOFRE — W D GROSS — DEC 21,1964
MAIN STEAM X ACCELERATION .5G — CASE 1 — ENGINEERING DEPT. PROGRAM ENGR 33 — SHEET 1

+ + + INPUT DATA + + +

MODULUS OF ELASTICITY= 27900000. PSI EXPANSION COEFFICIENT= 0.00000638 IN/IN/DEG F ALLOWABLE STRESS= -0. PSI

STRAIGHT OR CURVED MEMBERS

MEMB. NO.	PLANE	ALPHA DEG.	LENGTH OR RADIUS,FT.	O.D. IN.	THICK. IN.	TEMP. DEG.F.	PHI DEG.
1	2	0.	11.50	24.000	0.968		1.
2	3	290.	14.62	24.000	0.968		1.
3	2	0.	19.50	24.000	0.968		1.
4	3	180.	1.48	30.000	9.000		1.
5	3	90.	2.80	30.000	9.000		1.
6	3	270.	2.80	30.000	9.000		1.
7	3	0.	1.48	30.000	9.000		1.
8	2	0.	39.25	24.000	0.968		1.
9	2	0.	20.25	24.000	0.968		1.
10	3	12.	14.43	24.000	0.968		1.
11	3	12.	14.43	24.000	0.968		1.
12	2	0.	31.00	24.000	0.968		1.
JUNCTION NO. 1							
13	3	90.	3.50	20.000	0.812		1.
JUNCTION NO. 2							
14	2	225.	6.00	2.000	0.200		1.
15	2	270.	0.01	2.000	0.200		1.
16	3	90.	4.49	20.000	0.812		1.
17	3	180.	2.25	30.000	9.000		1.
18	3	0.	2.25	30.000	9.000		1.
19	3	90.	12.11	20.000	0.812		1.
20	3	180.	16.00	20.000	0.812		1.
21	3	270.	2.50	20.000	0.812		1.
22	2	0.	48.47	24.000	0.968		1.
23	2	270.	9.92	30.000	9.000		1.

ANCHORS AND RESTRAINTS

(PHI X,Y,Z IN DEGREES---DELTA X,Y,Z IN INCHES)

ANCHOR NO. 1	PHI X	PHI Y	PHI Z	DELTA X	DELTA Y	DELTA Z
	0.000	0.000	0.000	0.000	0.000	0.000

RESTRAINT NO. 2	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
	1	1	0.000	11463.00
RESTRAINT NO. 3	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
	2	2	0.500	0.00
RESTRAINT NO. 4	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
	2	1	0.125	0.00
RESTRAINT NO. 5	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
	1	1	0.000	8793.00
RESTRAINT NO. 6	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
	2	2	0.000	0.00

ANCHOR NO. 7	PHI X	PHI Y	PHI Z	DELTA X	DELTA Y	DELTA Z
	0.000	0.000	0.000	0.000	0.000	0.000

RESTRAINT NO. 8	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
	1	1	0.000	6156.00

ANCHOR NO. 9	PHI X	PHI Y	PHI Z	DELTA X	DELTA Y	DELTA Z
	0.000	0.000	0.000	0.000	0.000	0.000

RESTRAINT NO.10	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
	1	1	0.000	12224.00

PIPING FLEXIBILITY ANALYSIS

STRAIGHT OR CURVED MEMBERS

MEMB. NO.	PLANE	ALPHA DEG.	LENGTH OR RADIUS,FT.	O.D. IN.	THICK. IN.	TEMP. DEG.F.	PHI DEG.
24	2	90.	9.92	30.000	9.000	1.	
25	2	0.	14.53	24.000	0.968	1.	
26	2	270.	43.00	24.000	0.968	1.	
27	1	0.	14.61	20.000	0.812	1.	
28	1	270.	4.51	30.000	9.000	1.	
29	1	90.	4.51	30.000	9.000	1.	
30	1	0.	5.49	20.000	0.812	1.	
31	1	270.	17.00	20.000	0.812	1.	
32	1	180.	2.50	20.000	0.812	1.	

ANCHORS AND RESTRAINTS

(PHI X,Y,Z IN DEGREES---DELTA X,Y,Z IN INCHES)

RESTRAINT NO.11	TYPE 2	DIRECTION 2	DEFLECTION,IN. 0.000	FORCE,LBS. 0.00
RESTRAINT NO.12	TYPE 2	DIRECTION 1	DEFLECTION,IN. 0.000	FORCE,LBS. 0.00
RESTRAINT NO.13	TYPE 1	DIRECTION 1	DEFLECTION,IN. 0.000	FORCE,LBS. 3449.00

ANCHOR NO.14	PHI X 0.000	PHI Y 0.000	PHI Z 0.000	DELTA X 0.000	DELTA Y 0.000	DELTA Z 0.000

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM X ACCELERATION .5G CASE 1 W D GROSS DEC 21,1964

FREE ENDS - COORDINATES AND EXPANSION VALUES

ANCHOR	X (FT)	Y (FT)	Z (FT)	EIDX (LB-FT*3)	EIDY (LB-FT*3)	EIDZ (LB-FT*3)
7	28.98	-4.24	117.26	-166652.94	24373.47	-674371.42
9	17.23	9.86	121.50	-99091.43	-56718.56	-698771.75
14	-9.77	9.86	167.50	56191.19	-56718.55	-963327.27

OK

TEST NO. 6 OKAY

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM X ACCELERATION .5G CASE 1 W D GROSS DEC 21,1964

DEFLECTION OR FORCE AT RESTRAINTS

RESTRAINT NUMBER TYPE 1 OR 3	RESTRAINT NUMBER TYPE 2	DEFLECTION (IN)	FORCE ON ORIGIN (LBS)	FORCE ON RESTRAINT (LBS)
2		.45794		
5		.35661		
8		.17055		
10		.24326		
13		.07494		
	3		1845.99	-1845.99
	4		-10892.22	10892.22
	6		-5981.27	5981.27
	11		2670.05	-2670.05
	12		-11045.89	11045.89

TOTAL MOMENTS AND FORCES ON ANCHORS

ANCHOR	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	-13360.46	94870.33	49271.56	6178.27	880.88	-1549.29
7	13.98	334.56	5.16	5101.82	-3.24	4920.49
9	8926.49	17257.27	-31944.18	6445.07	-4686.52	-1502.87
14	-14291.14	29964.91	-9353.43	2421.73	2343.66	-1868.34

ROTATION AND DEFLECTION OF MEMBERS

MEMBER	PHI X (DEG)	PHI Y (DEG)	PHI Z (DEG)	DELTA X (IN)	DELTA Y (IN)	DELTA Z (IN)
ORIGIN	.000	.000	.000	.000	.000	.000
1	-.006	.043	.047	.065	.009	.001
2	-.021	.068	.051	.229	.067	-.024
3	-.041	.013	-.013	.450	.202	-.023
4	-.041	.012	-.014	.450	.206	-.019
5	-.041	.009	-.014	.458	.207	-.043
6	-.041	.006	-.015	.449	.206	-.019
7	-.041	.005	-.015	.449	.202	-.021
8	-.017	.004	-.040	.125	.500	-.018
9	.006	.063	-.054	.322	.513	-.017
10	.017	.044	-.047	.357	.357	-.174
11	.031	.004	-.025	.380	.250	-.236
12	.035	-.005	.044	.268	.000	-.234
13	.038	-.001	.057	.230	.000	-.207
14	.000	.002	.000	-.002	-.000	.000
15	-.000	.000	.000	-.002	-.000	.000
16	.044	.004	.069	.171	.001	-.168
17	.044	.004	.069	.171	-.031	-.166
18	.044	.004	.070	.171	.001	-.168
19	.038	.018	.038	.005	.003	-.057
20	.004	.007	-.008	.003	.000	.001
21	.000	-.000	.000	-.000	.000	.000
22	.019	-.055	-.006	.244	-.235	-.229
23	.019	-.061	-.007	.243	-.221	-.353
24	.020	-.067	-.008	.244	-.236	-.216
25	.024	-.064	-.023	.006	-.302	-.215
26	.050	.034	-.038	-.000	.000	-.183

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM X ACCELERATION .5G CASE 1 W D GROSS DEC 21,1964

ROTATION AND DEFLECTION OF MEMBERS

MEMBER	PHI X (DEG)	PHI Y (DEG)	PHI Z (DEG)	DELTA X (IN)	DELTA Y (IN)	DELTA Z (IN)
27	.038	.023	-.020	.097	.001	-.034
28	.038	.023	-.020	.075	.037	-.034
29	.037	.023	-.019	.097	.001	-.034
30	.019	.034	-.012	.113	.001	-.000
31	-.004	.013	-.002	.001	.000	-.001
32	-.000	-.000	.000	-.000	.000	-.000

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM X ACCELERATION .5G — CASE 1 — W D GROSS — DEC 21,1964

STRESS, MOMENTS AND FORCES ON MEMBERS

MEMBER START/END	STRESS (PSI)	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	3334.40	-13360.46	94870.33	49271.56	6178.27	880.88	-1549.29
	1696.78	-3230.40	23820.22	49271.56	6178.27	880.88	-1549.29
2	1696.78	-3230.40	23820.22	49271.56	6178.27	880.88	-1549.29
	1535.18	-24514.99	16073.26	-40012.08	6178.27	880.88	-1549.29
3	1535.18	-24514.99	16073.26	-40012.08	6178.27	880.88	-1549.29
	3467.93	-7337.92	-104403.02	-40012.08	6178.27	880.88	-1549.29
4	520.58	-7337.92	-104403.02	-40012.08	6178.27	880.88	-1549.29
	508.49	-7337.92	-102110.07	-38708.39	6178.27	880.88	-1549.29
5 30"O.D.	508.49	-7337.92	-102110.07	-38708.39	6178.27	880.88	-1549.29
	484.92	-2999.92	-102110.07	-21409.23	6178.27	880.88	-1549.29
6	484.92	-2999.92	-102110.07	-21409.23	-5284.73	880.88	-1549.29
	476.62	-7337.92	-102110.07	-6611.99	-5284.73	880.88	-1549.29
7	476.62	-7337.92	-102110.07	-6611.99	-5284.73	880.88	-1549.29
	487.64	-7337.92	-104403.02	-7915.68	-5284.73	880.88	-1549.29
8	3248.53	-7337.92	-104403.02	-7915.68	-5284.73	880.88	-1549.29
	3307.22	27236.43	103022.60	-7915.68	-5284.73	880.88	-1549.29
9	3307.22	27236.43	103022.60	-7915.68	5607.49	-965.11	-1549.29
	472.13	7692.95	-10529.06	-7915.68	5607.49	-965.11	-1549.29
10	472.13	7692.95	-10529.06	-7915.68	5607.49	-965.11	-1549.29
	1279.66	12341.07	-32396.75	22529.92	5607.49	-965.11	-1549.29
11	1279.66	12341.07	-32396.75	22529.92	-3185.51	-965.11	-1549.29
	1942.87	16989.19	-54264.44	26595.08	-3185.51	-965.11	-1549.29
12	1942.87	16989.19	-54264.44	26595.08	-3185.51	-965.11	-1549.29
	1653.31	-12929.22	44486.38	26595.08	-3185.51	-965.11	-1549.29
13	2110.95	301.99	7174.14	39044.08	-5390.89	4689.76	-3417.62
	1312.15	12263.67	7174.14	20175.96	-5390.89	4689.76	-3417.62
14	9989.94	-.24	385.56	-18.94	-5101.82	3.24	-4920.49
	9938.81	-13.98	-383.76	-5.20	-5101.82	3.24	-4920.49
15	9938.81	-13.98	-383.76	-5.20	-5101.82	3.24	-4920.49
	8666.47	-13.98	-334.55	-5.16	-5101.82	3.24	-4920.49
16	1307.17	12263.91	6788.59	20194.89	-289.07	4686.52	1502.87
	1107.25	5516.05	6788.59	18896.95	-289.07	4686.52	1502.87
17	96.74	5516.05	6788.59	18896.95	-289.07	4686.52	1502.87
	140.06	5516.05	3407.14	29441.63	-289.07	4686.52	1502.87
18	140.06	5516.05	3407.13	29441.63	-6445.07	4686.52	1502.87
	96.74	5516.05	6788.58	18896.95	-6445.07	4686.52	1502.87
19	1107.25	5516.05	6788.58	18896.95	-6445.07	4686.52	1502.87
	3237.08	-12683.65	6788.58	-59152.88	-6445.07	4686.52	1502.87
20	3237.08	-12683.65	6788.58	-59152.88	-6445.07	4686.52	1502.87
	1416.19	-12683.65	-17257.27	15831.49	-6445.07	4686.52	1502.87
21	1416.19	-12683.65	-17257.27	15831.49	-6445.07	4686.52	1502.87
	1988.11	-8926.48	-17257.27	31944.17	-6445.07	4686.52	1502.87
22	1284.44	-13231.21	37312.23	-12449.00	2205.38	326.39	1868.34
	2189.27	2589.11	-69582.61	-12449.00	2205.38	326.39	1868.34
23	328.64	2589.11	-69582.61	-12449.00	2205.38	326.39	1868.34
	411.80	2589.11	-88116.49	-9211.18	2205.38	326.39	1868.34
24	411.80	2589.11	-88116.50	-9211.18	-10018.62	326.39	1868.34
	328.64	2589.11	-69582.61	-12449.00	-10018.62	326.39	1868.34
25	2189.27	2589.11	-69582.61	-12449.00	-10018.62	326.39	1868.34
	2393.98	7331.61	75987.89	-12449.00	-10018.62	326.39	1868.34

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM X ACCELERATION .5G CASE 1 W D GROSS DEC 21,1964

STRESS, MOMENTS AND FORCES ON MEMBERS

MEMBER START/END	STRESS (PSI)	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
26	2393.98	7331.61	75987.89	-12449.00	-10018.62	326.39	1868.34
	268.39	7331.61	-4350.55	1585.93	-10018.62	326.39	1868.34
27	461.10	7331.61	-4350.54	1585.93	1027.27	-2343.66	1868.34
	1399.69	-19964.77	-4350.54	16594.39	1027.27	-2343.66	1868.34
28	122.30	-19964.77	-4350.54	16594.39	1027.27	-2343.66	1868.34
	88.61	-9394.85	282.46	16594.39	1027.27	-2343.66	1868.34
29	88.61	-9394.85	282.45	16594.39	-2421.73	-2343.66	1868.34
	131.37	-19964.76	11204.44	16594.39	-2421.73	-2343.66	1868.34
30	1503.52	-19964.76	11204.44	16594.39	-2421.73	-2343.66	1868.34
	1722.86	-30221.92	11204.44	3299.10	-2421.73	-2343.66	1868.34
31	1722.86	-30221.92	11204.44	3299.10	-2421.73	-2343.66	1868.34
	1682.63	9620.31	-29964.93	3299.11	-2421.73	-2343.66	1868.34
32	1682.63	9620.31	-29964.93	3299.11	-2421.73	-2343.66	1868.34
	1834.02	14291.15	-29964.93	9353.42	-2421.73	-2343.66	1868.34

P I P I N G F L E X I B I L I T Y A N A L Y S I S

SAN ONOFRE — W D GROSS — DEC 21,1964
MAIN STEAM Z ACCELERATION .5G — CASE 1 — ENGINEERING DEPT. PROGRAM ENGR 33 — SHEET 1

+ + + I N P U T D A T A + + +

MODULUS OF ELASTICITY= 27900000. PSI, EXPANSION COEFFICIENT= 0.00000638 IN/IN/DEG F ALLOWABLE STRESS= -0. PSI

S T R A I G H T O R C U R V E D M E M B E R S — A N C H O R S A N D R E S T R A I N T S

MEMB NO.	PLANE	ALPHA DEG.	LENGTH OR RADIUS,FT.	O.D. IN.	THICK. IN.	TEMP. DEG.F.	PHI DEG.
							(PHI X,Y,Z IN DEGREES---DELTA X,Y,Z IN INCHES)
							ANCHOR NO. 1 — PHI X 0.000 — PHI Y 0.000 — PHI Z 0.000 — DELTA X 0.000 — DELTA Y 0.000 — DELTA Z 0.000
1	2	0.	11.50	24.000	0.968	1.	
2	3	290.	14.62	24.000	0.968	1.	
3	2	0.	19.50	24.000	0.968	1.	
4	3	180.	1.48	30.000	9.000	1.	
5	3	90.	2.80	30.000	9.000	1.	
							RESTRAINT NO. 2 — TYPE 1 — DIRECTION 3 — DEFLECTION,IN. 0.000 — FORCE,LBS. 11463.00
6	3	270.	2.80	30.000	9.000	1.	
7	3	0.	1.48	30.000	9.000	1.	
8	2	0.	39.25	24.000	0.968	1.	
							RESTRAINT NO. 3 — TYPE 2 — DIRECTION 2 — DEFLECTION,IN. 0.500 — FORCE,LBS. 0.00
							RESTRAINT NO. 4 — TYPE 2 — DIRECTION 1 — DEFLECTION,IN. 0.125 — FORCE,LBS. 0.00
9	2	0.	20.25	24.000	0.968	1.	
10	3	12.	14.43	24.000	0.968	1.	
							RESTRAINT NO. 5 — TYPE 1 — DIRECTION 3 — DEFLECTION,IN. 0.000 — FORCE,LBS. 8793.00
11	3	12.	14.43	24.000	0.968	1.	
12	2	0.	31.00	24.000	0.968	1.	
							RESTRAINT NO. 6 — TYPE 2 — DIRECTION 2 — DEFLECTION,IN. 0.000 — FORCE,LBS. 0.00
	JUNCTION	NO. 1					
13	3	90.	3.50	20.000	0.812	1.	
	JUNCTION	NO. 2					
14	2	225.	6.00	2.000	0.200	1.	
15	2	270.	0.01	2.000	0.200	1.	
							ANCHOR NO. 7 — PHI X 0.000 — PHI Y 0.000 — PHI Z 0.000 — DELTA X 0.000 — DELTA Y 0.000 — DELTA Z 0.000
16	3	90.	4.49	20.000	0.812	1.	
17	3	180.	2.25	30.000	9.000	1.	
							RESTRAINT NO. 8 — TYPE 1 — DIRECTION 3 — DEFLECTION,IN. 0.000 — FORCE,LBS. 6156.00
18	3	0.	2.25	30.000	9.000	1.	
19	3	90.	12.11	20.000	0.812	1.	
20	3	180.	16.00	20.000	0.812	1.	
21	3	270.	2.50	20.000	0.812	1.	
							ANCHOR NO. 9 — PHI X 0.000 — PHI Y 0.000 — PHI Z 0.000 — DELTA X 0.000 — DELTA Y 0.000 — DELTA Z 0.000
22	2	0.	48.47	24.000	0.968	1.	
23	2	270.	9.92	30.000	9.000	1.	
							RESTRAINT NO.10 — TYPE 1 — DIRECTION 3 — DEFLECTION,IN. 0.000 — FORCE,LBS. 12224.00

PIPING FLEXIBILITY ANALYSIS

STRAIGHT OR CURVED MEMBERS

MEMB. NO.	PLANE	ALPHA DEG.	LENGTH OR RADIUS, FT.	O.D. IN.	THICK. IN.	TEMP. DEG.F.	PHI DEG.
24	2	90.	9.92	30.000	9.000	1.	
25	2	0.	14.53	24.000	0.968	1.	
26	2	270.	43.00	24.000	0.968	1.	
27	1	0.	14.61	20.000	0.812	1.	
28	1	270.	4.51	30.000	9.000	1.	
29	1	90.	4.51	30.000	9.000	1.	
30	1	0.	5.49	20.000	0.812	1.	
31	1	270.	17.00	20.000	0.812	1.	
32	1	180.	2.50	20.000	0.812	1.	

ANCHORS AND RESTRAINTS

(PHI X,Y,Z IN DEGREES---DELTA X,Y,Z IN INCHES)

	TYPE	DIRECTION	DEFLECTION, IN.	FORCE, LBS.
RESTRAINT NO.11	2	2	0.000	0.00
RESTRAINT NO.12	2	1	0.000	0.00
RESTRAINT NO.13	1	3	0.000	3449.00

	PHI X	PHI Y	PHI Z	DELTA X	DELTA Y	DELTA Z
ANCHOR NO.14	0.000	0.000	0.000	0.000	0.000	0.000

(17)

PIPING FLEXIBILITY ANALYSIS-ENGR 33

2 - MAIN STEAM Z ACCELERATION .5G CASE 1 W O GROSS DEC 21,1964

FREE ENDS - COORDINATES AND EXPANSION VALUES

ANCHOR	X (FT)	Y (FT)	Z (FT)	EIDX (LB-FT*3)	EIDY (LB-FT*3)	EIDZ (LB-FT*3)
7	28.98	-4.24	117.26	-166652.94	24373.47	-674371.42
9	17.23	9.86	121.50	-99091.43	-56718.56	-698771.75
14	-9.77	9.86	167.50	56191.19	-56718.55	-963327.27

OK

TEST NO. 6 OKAY

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM Z ACCELERATION .5G — CASE 1 — W D GROSS — DEC 21,1964

DEFLECTION OR FORCE AT RESTRAINTS

RESTRAINT NUMBER TYPE 1 OR 3	RESTRAINT NUMBER TYPE 2	DEFLECTION (IN)	FORCE ON ORIGIN (LBS)	FORCE ON RESTRAINT (LBS)
2		.31967		
5		.56559		
8		.53680		
10		.99951		
13		.06636		
	3		1145.53	-1145.53
	4		6519.75	-6519.75
	6		10596.65	-10596.65
	11		-5099.40	5099.40
	12		627.11	-627.11

TOTAL MOMENTS AND FORCES ON ANCHORS

ANCHOR	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	-110296.02	-1623.50	4507.69	1673.70	-276.98	12602.36
7	-46.60	-1231.97	-7.10	17518.48	13.98	18007.65
9	-22694.42	-72531.00	68573.94	-11673.80	11039.20	5436.73
14	30472.30	-18369.88	4996.72	-371.53	-4133.40	6038.26

ROTATION AND DEFLECTION OF MEMBERS

MEMBER	PHI X (DEG)	PHI Y (DEG)	PHI Z (DEG)	DELTA X (IN)	DELTA Y (IN)	DELTA Z (IN)
ORIGIN	.000	.000	.000	.000	.000	.000
1	-.082	-.008	.004	-.006	.098	.002
2	-.109	.007	-.002	.003	.100	.326
3	-.038	.039	-.029	.111	.397	.329
4	-.037	.039	-.029	.111	.406	.341
5	-.036	.038	-.030	.128	.407	.320
6	-.036	.038	-.030	.111	.406	.341
7	-.036	.038	-.030	.111	.397	.329
8	.006	-.062	-.086	.125	.500	.332
9	.002	-.093	-.114	-.253	.469	.334
10	-.019	-.064	-.127	-.176	.111	.566
11	-.031	-.076	-.135	-.093	-.279	.728
12	-.070	-.060	-.151	-.702	-.000	.729
13	-.096	-.061	-.172	-.585	-.000	.664
14	-.000	-.007	-.000	-.005	-.001	.002
15	-.000	.001	.000	-.003	-.000	.002
16	-.113	-.062	-.190	-.410	-.000	.566
17	-.113	-.062	-.190	-.410	.089	.537
18	-.114	-.062	-.191	-.410	-.001	.566
19	-.109	-.092	-.085	-.007	-.001	.259
20	-.010	-.031	.018	-.006	.000	-.002
21	.000	.000	-.000	.000	-.000	.000
22	-.004	.127	-.031	-.238	.255	.736
23	-.005	.126	-.029	-.238	.317	1.000
24	-.005	.120	-.027	-.238	.259	.743
25	-.013	.035	.009	.003	.282	.744
26	-.070	-.084	.034	.000	-.000	.294

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM Z ACCELERATION .5G CASE 1 W D GROSS DEC 21,1964

ROTATION AND DEFLECTION OF MEMBERS

MEMBER	PHI X (DEG)	PHI Y (DEG)	PHI Z (DEG)	DELTA X (IN)	DELTA Y (IN)	DELTA Z (IN)
27	-.065	-.054	.017	-.076	.002	.067
28	-.064	-.053	.017	-.026	-.059	.066
29	-.064	-.053	.017	-.076	.001	.067
30	-.037	-.042	.013	-.093	.002	.005
31	.008	-.008	.001	-.000	.000	.003
32	.000	-.000	-.000	.000	-.000	.000

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM Z ACCELERATION .5G CASE 1 W D GROSS DEC 21,1964

STRESS, MOMENTS AND FORCES ON MEMBERS

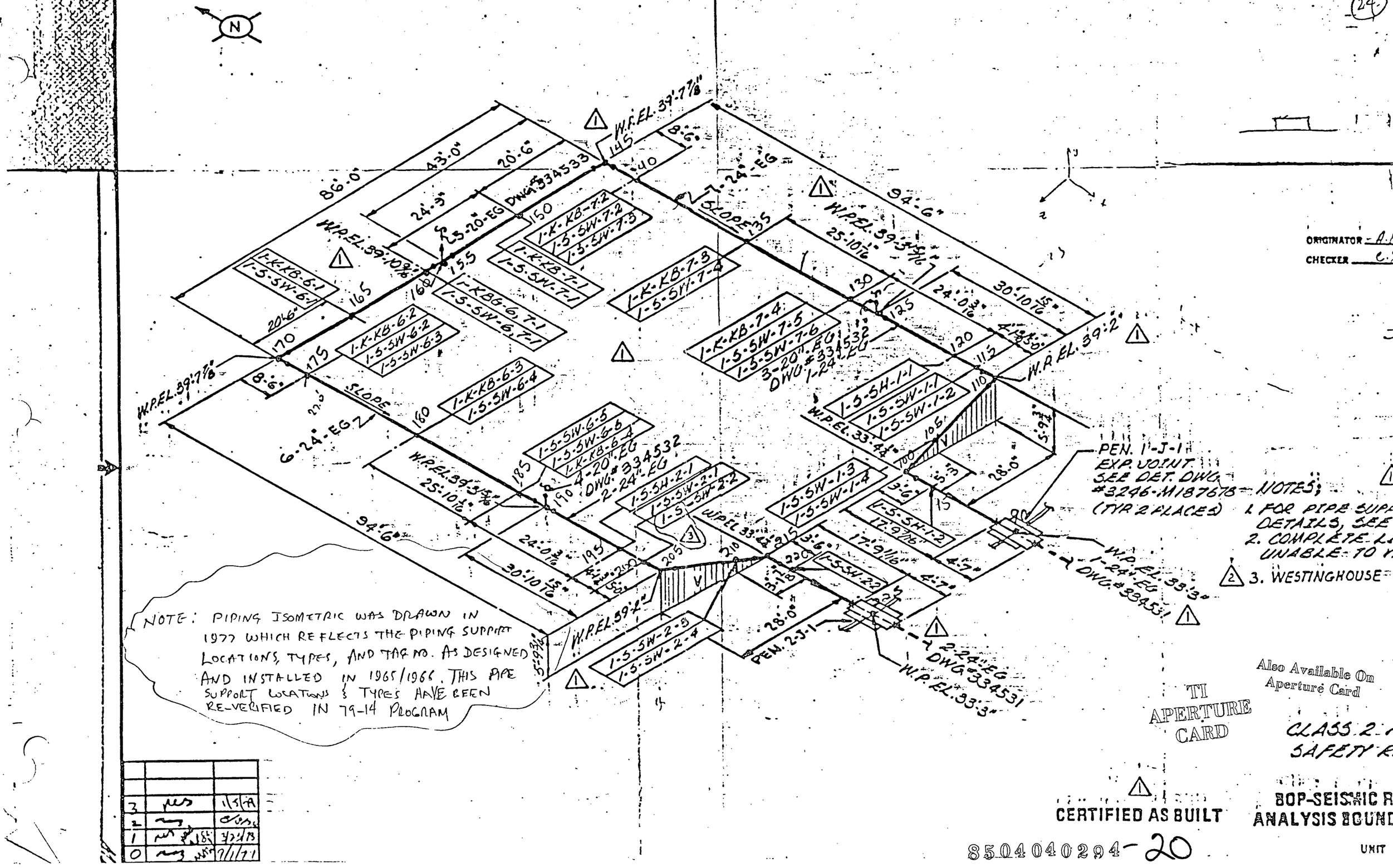
MEMBER START/END	STRESS (PSI)	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	3416.92	-110296.02	-1623.50	4507.69	1673.70	-276.98	12602.36
	3573.92	-113481.32	-20871.08	4507.69	1673.70	-276.98	12602.36
2	3573.92	-113481.32	-20871.08	4507.69	1673.70	-276.98	12602.36
	2321.74	59653.80	42144.94	-17101.13	1673.70	-276.98	12602.36
3	2321.74	59653.80	42144.94	-17101.13	1673.70	-276.98	12602.36
	1785.01	54252.63	9507.75	-17101.13	1673.70	-276.98	12602.36
4	267.95	54252.63	9507.75	-17101.13	1673.70	-276.98	12602.36
	268.25	54252.63	-9143.75	-17511.07	1673.70	-276.98	12602.36
5	268.25	54252.63	-9143.75	-17511.07	1673.70	-276.98	12602.36
	114.54	18966.01	-9143.75	-12824.70	1673.70	-276.98	12602.36
6	114.54	18966.01	-9143.75	-12824.70	1673.70	-276.98	1139.36
	137.91	22156.23	-9143.75	-17511.07	1673.70	-276.98	1139.36
7	137.91	22156.23	-9143.75	-17511.07	1673.70	-276.98	1139.36
	134.57	22156.23	-7457.49	-17101.13	1673.70	-276.98	1139.36
8	896.47	22156.23	-7457.49	-17101.13	1673.70	-276.98	1139.36
	2351.16	11284.64	-73150.30	-17101.13	1673.70	-276.98	1139.36
9	2351.16	11284.64	-73150.30	-17101.13	-4846.04	-1422.52	1139.36
	1082.62	-17521.32	24982.07	-17101.13	-4846.04	-1422.52	1139.36
10	1082.62	-17521.32	24982.07	-17101.13	-4846.04	-1422.52	1139.36
	1470.83	-20939.59	41063.81	-11561.72	-4846.04	-1422.52	1139.36
11	1470.84	-20939.60	41063.81	-11561.72	-4846.04	-1422.52	-7653.64
	2081.89	2022.58	-66964.74	-6022.30	-4846.04	-1422.52	-7653.64
12	2081.89	2022.58	-66964.74	-6022.30	-4846.04	-1422.52	-7653.64
	2893.37	-42075.42	83262.59	-6022.30	-4846.04	-1422.52	-7653.64
13	5000.18	-86844.97	-1629.06	-36024.43	-5844.68	-11053.18	-17288.37
	3314.88	-26335.67	-1629.06	-56480.80	-5844.68	-11053.18	-17288.37
14	26542.93	-12.69	-1023.42	66.54	17518.48	-13.98	-18007.65
	27249.48	46.61	1051.91	7.24	-17518.48	-13.98	-18007.65
15	27249.48	46.61	1051.91	7.24	-17518.48	-13.98	-18007.65
	31905.27	46.61	1231.97	7.10	-17518.48	-13.98	-18007.65
16	3316.82	-26322.98	-605.64	-56547.35	11673.80	-11039.20	719.27
	1587.04	-29552.52	-605.64	-4131.97	11673.80	-11039.20	719.27
17	138.67	-29552.52	-605.64	-4131.97	11673.80	-11039.20	719.27
	192.55	-29552.52	-2224.02	-28970.17	11673.80	-11039.20	719.27
18	192.55	-29552.52	-2224.02	-28970.17	11673.80	-11039.20	-5436.73
	154.35	-29552.52	-14456.64	-4131.97	11673.80	-11039.20	-5436.73
19	1763.12	-29552.52	-14456.64	-4131.97	11673.80	-11039.20	-5436.73
	7587.29	36286.23	-14456.64	137237.80	11673.80	-11039.20	-5436.73
20	7587.29	36286.23	-14456.64	137237.80	11673.80	-11039.20	-5436.73
	4794.21	36286.23	72530.98	-39389.42	11673.80	-11039.20	-5436.73
21	4794.21	36286.23	72530.98	-39389.42	11673.80	-11039.20	-5436.73
	5443.04	22694.42	72530.98	-68573.93	11673.80	-11039.20	-5436.73
22	3112.17	44769.54	84891.65	30002.13	998.64	-965.99	9634.74
	1463.43	-2052.13	36487.79	30002.13	998.64	-965.99	9634.74
23	219.68	-2052.13	36487.79	30002.13	998.64	-965.99	9634.74
	290.61	-2052.13	-59088.79	20419.48	998.64	-965.99	9634.74
24	290.61	-2052.13	-59088.79	20419.48	998.64	-965.99	-2589.26
	417.91	-2052.13	-84774.29	30002.13	998.64	-965.99	-2589.26
25	2783.99	-2052.13	-84774.29	30002.13	998.64	-965.99	-2589.26
	3248.51	-16088.01	-99284.46	30002.13	998.64	-965.99	-2589.26

PIPING FLEXIBILITY ANALYSIS-ENGR 33

MAIN STEAM Z ACCELERATION .5G CASE 1 W D GROSS DEC 21,1964

STRESS, MOMENTS AND FORCES ON MEMBERS

MEMBER START/END	STRESS (PSI)	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
26	3248.51	-16088.01	-99284.46	30002.13	998.64	-965.99	-2589.26
	717.35	-16088.00	12053.91	-11535.56	998.64	-965.99	-2589.26
27	1232.43	-16088.00	12053.91	-11535.56	371.53	4133.40	-2589.26
	1361.17	21741.15	12053.91	-6107.57	371.53	4133.40	-2589.26
28	118.93	21741.15	12053.91	-6107.57	371.53	4133.40	-2589.26
	71.28	3099.51	13729.49	-6107.57	371.53	4133.40	-2589.26
29	71.28	3099.51	13729.50	-6107.57	371.53	4133.40	-6038.26
	118.93	21741.15	12053.92	-6107.57	371.53	4133.40	-6038.26
30	1361.17	21741.15	12053.92	-6107.57	371.53	4133.40	-6038.26
	2996.15	54891.22	12053.92	-4067.90	371.53	4133.40	-6038.26
31	2996.15	54891.22	12053.92	-4067.90	371.53	4133.40	-6038.26
	1292.07	-15376.65	18369.85	-4067.90	371.53	4133.40	-6038.26
32	1292.07	-15376.65	18369.85	-4067.90	371.53	4133.40	-6038.26
	1910.55	-30472.31	18369.85	-4996.71	371.53	4133.40	-6038.26



NOTE: PIPING ISOMETRIC WAS DRAWN IN 1977 WHICH REFLECTS THE PIPING SUPPORT LOCATIONS, TYPES, AND TAG NO. AS DESIGNED AND INSTALLED IN 1965/1966. THIS PIPE SUPPORT LOCATIONS & TYPES HAVE BEEN RE-VERIFIED IN 79-14 PROGRAM

NOTES;
1. FOR PIPE SUPP
DETAILS, SEE
2. COMPLETE LI
UNABLE TO Y
2 3. WESTINGHOUSE

ORIGINATOR A.
CHECKER C.

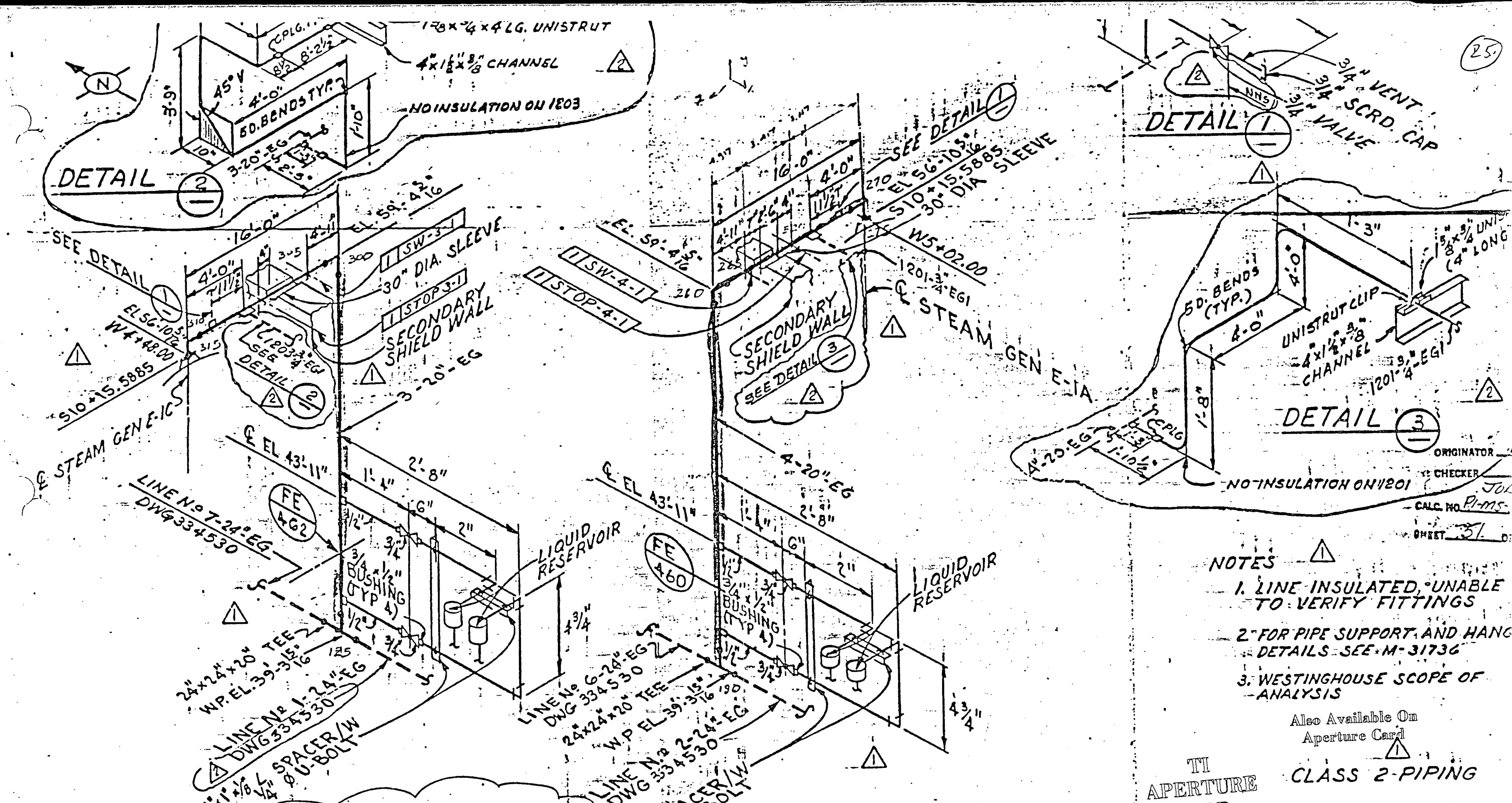
3		[illegible]
2		[illegible]
1		3/22/78
0		7/1/71

CLASS 2
SAFETY R

BOP-SEISMIC R
ANALYSIS BOUND

1 CERTIFIED AS BUILT

UNIT



ORIGINATOR
CHECKER
CALC. NO. PI-MS-
SHEET 35

NOTES

1. LINE INSULATED, UNABLE TO VERIFY FITTINGS
2. FOR PIPE SUPPORT AND HANG DETAILS SEE M-31736
3. WESTINGHOUSE SCOPE OF ANALYSIS

Also Available On Aperture Card

TI APERTURE CARD

CLASS 2-PIPING

SAFETY RELATED

NOTE: THIS PIPING ISOMETRIC WAS DRAWN IN 1977 WHICH REFLECTS THE PIPING SUPPORT LOCATIONS, TYPES, AND TAG NO AS DESIGNED AND INSTALLED IN 1965/1966. THIS PIPE SUPPORT LOCATIONS & TYPES HAVE BEEN REVERIFIED IN 79-14 PROGRAM

2		8/16/79
1		2/23/78
0		7/1/77

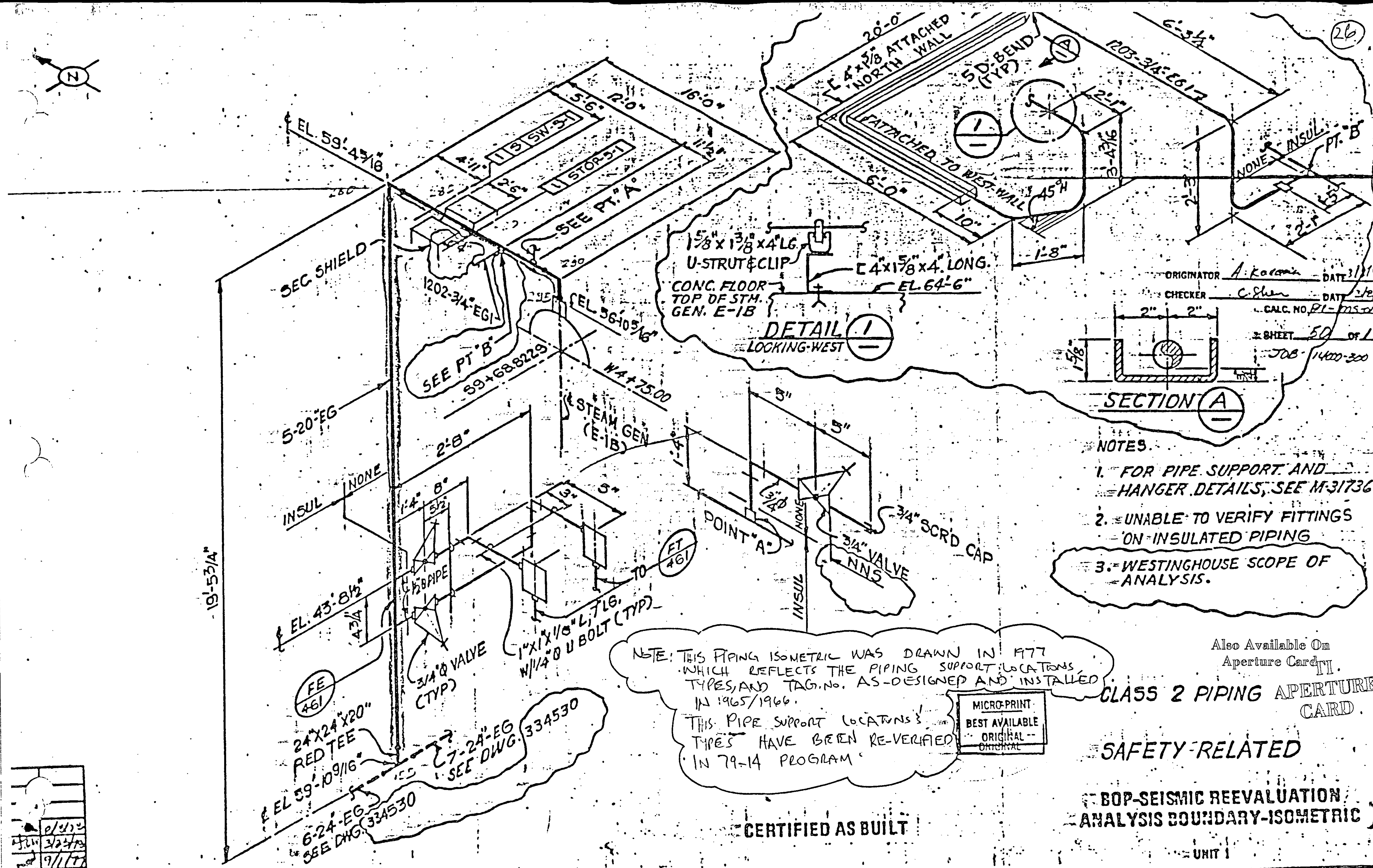
MICRO-PRINT BEST AVAILABLE ORIGINAL

CERTIFIED AS BUILT

8504040294-21

BOP-SEISMIC REEVALUATION ANALYSIS BOUNDARY-ISOMETRIC

UNIT 1



ORIGINATOR A. Koranin DATE 3/1/93
CHECKER C. Shen DATE 3/2/93
CALC. NO. PI-MS-01
SHEET 50 OF 162
JOB 14000-300

NOTES.

1. FOR PIPE SUPPORT AND HANGER DETAILS, SEE M-31736
2. UNABLE TO VERIFY FITTINGS ON INSULATED PIPING
3. WESTINGHOUSE SCOPE OF ANALYSIS.

NOTE: THIS PIPING ISOMETRIC WAS DRAWN IN 1977 WHICH REFLECTS THE PIPING SUPPORT LOCATIONS, TYPES, AND TAG. NO. AS-DESIGNED AND INSTALLED IN 1965/1966.
THIS PIPE SUPPORT LOCATIONS & TYPES HAVE BEEN RE-VERIFIED IN 79-14 PROGRAM.

MICRO-PRINT
BEST AVAILABLE ORIGINAL

Also Available On Aperture Card

TI APERTURE CARD

CLASS 2 PIPING

SAFETY-RELATED

BOP-SEISMIC REEVALUATION
ANALYSIS BOUNDARY-ISOMETRIC
UNIT 1

CERTIFIED AS BUILT

	0/1/93
	3/22/93
	9/1/77
E.	DATE

EL CORPORATION

J.O. NO. | SAN ONOFRE NUCLEAR GENERATING STATION

8504040294 -22

(26)

PIPING FLEXIBILITY CALCULATION

BECHTEL CORPORATION
4550 SEVILLE AVENUE
VERNON, CALIFORNIA

CONVENTION FOR POSITIVE FORCES & MOMENTS: Fx, Fy, Fz, Mz, My, Mx

S_c =
S_h =
$S_A = 1.25S_c + .25S_h$
S_A =

MAXIMUM STRESS

AT POINT

PAGE ___ OF ___

SIGNATURE [illegible] DATE [illegible]
PROJECT [illegible] JOB NO. [illegible]
SUBJECT [illegible] SEISMIC ANALYSIS

DESIGN DATA

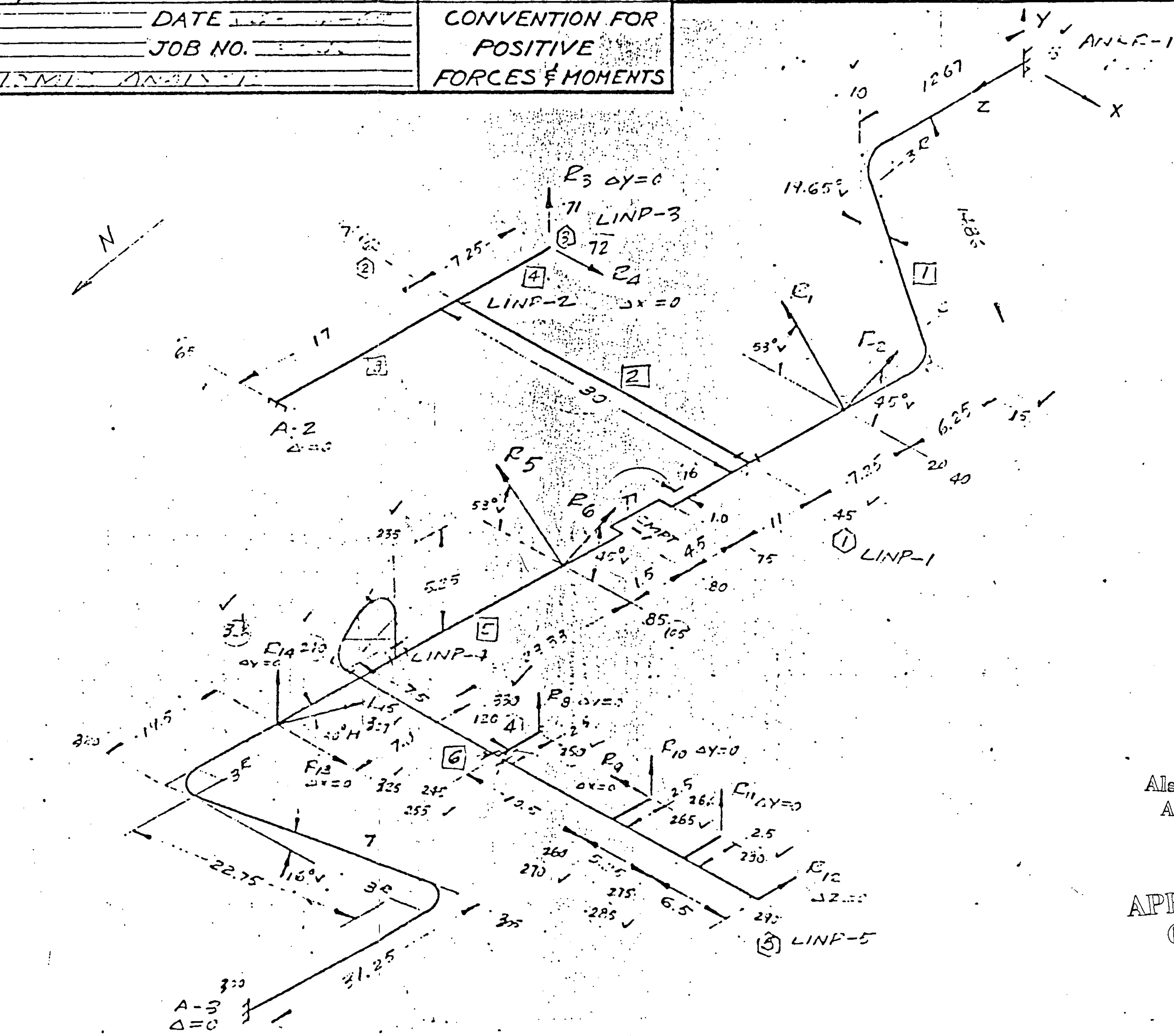
PRESS.
TEMP. [illegible]
MAT'L. [illegible]
EXP. COEF. [illegible]
$E_c \times 10^6$ [illegible]

MEMBER DATA

[illegible]

ANCHOR DATA

ANCHOR No.	PT.	COORDINATES X	Y	Z	END DEFLECTION ΔX	ΔY	ΔZ
1	5	0	0	0	0	0	0
2	65	[illegible]	[illegible]	[illegible]	[illegible]	0	0
3	300	[illegible]	[illegible]	[illegible]	0	0	0



Also Available On Aperture Card

TI APERTURE CARD

SEISMIC

2513 BEGIN PROBLEM C10

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 20 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 40 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 71 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 72 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 85 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 105 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 250 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 265 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 266 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 280 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 290 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 325 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 326 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 327 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF12.

RUN NO. C — PIPING FLEXIBILITY ANALYSIS PROGRAM MEC-21/7094 — PAGE 1 OF 10

** WEIGHT LOADING EFFECTS **

MAIN STEAM SPHERE TO TURBINE — X-ACC 1.0G 4/24/65 — PROBLEM NO. 010

PROJECT NO. 3246 — DATE 000000000

GROUP 0000 — TIME 2513 HRS.

SUMMATION OF THE REACTIONS ON THE STRUCTURE

FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
-58723.	38.	-32.	-2342.	-2591254.	-666151.

SUMMATION OF THE WEIGHT AND UNIFORM LOADING EFFECTS

FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
-58990.	0.	0.	0.	-2608930.	-668977.

CENTER-OF-FORCES COORDINATES			CENTER-OF-GRAVITY COORDINATES		
X, FT.	Y, FT.	Z, FT.	X, FT.	Y, FT.	Z, FT.
0.	-11.3	44.2	0.	-0.	44.2

SUMMATION OF THE REACTIONS AT THE BRANCH-INTERSECTION-POINTS

BINP NO.	FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
LINP 1	2.	0.	18.	-1.	1.	-0.
LINP 2	0.	0.	0.	0.	-0.	-0.
LINP 3	-0.	-0.	-0.	0.	-0.	-0.
LINP 4	265.	38.	-51.	-290.	-135.	-1093.
LINP 5	0.	-0.	0.	0.	0.	0.

** DATA CARD DISPLAY WITH DIAGNOSTIC NOTES **

DATE 00010'UCO TIME 2513 HRS. MAIN STEAM SPHERE TO TURBINE X-ACC 1.0G 4/24/65 PROBLEM NO. 010

```
TYPE ONE CARDS
CNOARTTCTGBRFR DATA PT COORDINATES DIAM THCK RAD  SPECIAL COORDINATES P      DIAGNOSTIC NOTES
                XFT /  YFT /  ZFT /  V / VV/ VFT/ VXFT /  YFT /  ZFT / VV
  51    C101                        240000968                                ZERO COORDINATES.
  10  1                   +0126702400096803
  15  1          +005000-014000+0126702400096803
  20  2 1        +005000-014000+01892024000968
  40  2 1
  45    1        +005000-014000+02617024000968
  60    1 020201-025000-014000+02617020000812
  651     0203   -025000-014000+04317024000968
  70    1        -025000-014000+02617024000968
  71  2 1 030402-025000-014000+01892024000812
  72  2 1
  75    1 040501+005000-014000+03717024000968
  76    1        +004000-014000+03717030009
  77      3      +004000-014000+041670

TYPE TWO CARDS
CNO CMPT DATA OR ANCHOR,RESTRAINT FLEX C CG-R STR LOC-A COS CR
      /    E/    E/    E/    E/    E/    EX / /  Y / /  Z / /  VV
   5
  10
  15
  20                                    +000186-007611+018920 1
  40                                    +010657-008343+018920 1
  45
  60
  65
  70
  71                                    -025000-004000+018920 1
  72                                    -015000-014000+018920 1
  75
  76
  77                                                  1

TYPE THREE CARDS
CNOEXPAN E MU  LOAD  RHO  PSI ULOAD F COS, ANK DELTA ANK ROT,RSNT MOVE
      /  V VV VV    VV / VV   V/   VX /   Y /   Z /   X//   Y//   Z//
   5
  10     2793                21202-1
  15     2793                21202-1
  20     2793                21202-1
  40
  45     2793                21202-1
  60     2793                14802-1
  65
  70     2793                21202-1
  71     2793                21202-1
  72
  75     2793                21202-1
  76     2793
  77     2793                16663-1
```

Also Available On Aperture Card

TI APERTURE CARD

8504040294-26

```
RUN NO.   0          PIPING FLEXIBILITY ANALYSIS PROGRAM MEC-21/7094
                     ** DATA CARD DISPLAY WITH DIAGNOSTIC NOTES **

DATE 00010'U00   TIME 2513 HRS.      MAIN STEAM SPHERE TO TURBINE   X-ACC 1.0G 4/24/65      PROBLEM NO. 010

TYPE ONE CARDS
CNOARTTCTCBRFR DATA PT COORDINATES DIAM THCK RAD  SPECIAL COORDINATES P       DIAGNOSTIC NOTES
                 XFT /  YFT /  ZFT /  V / VV/ VFT/ VXFT /  YFT /  ZFT / VV
 80    1               +005000-C14000+0416703C0C09
 85  2 1               +005C00-C14000+04317C240C00968
105  2 1
120    1               +005CC0-C14CC0+0665C024CC0C968
235    1        05C604+C05CC0-C08750+06650C24CCC096803
240    1               +008516-C08750+07C01624000096803
245    1               +016016-C08750+07001624CC00968
250  1 1               +C16016-C08750+0675163C0CC9CCC
255    1               +C16C16-C08750+07001630C0C9CC0
260    1               +026516-C08750+C7001624CCC968
265  2 1               +026516-C08750+06751630CC09
266  2 1
270    1               +026516-C08750+C7001630C0C9
275    1               +031766-C08750+C7001624CCCC968

TYPE TWO CARDS
CNO CMPT DATA OR ANCHOR,RESTRAINT FLEX C CG-R STR LOC-A COS CR
    /     E/    E/    E/    E/    E/    EX / /  Y / /  Z / /  VV
 80
 85                                      +000186-007611+043170 1
105                                      +01C657-008343+043170 1
120
235
240
245
250                                      +C16016+010000+067516 1
255
260
265                                      +C1C000-C08750+067516 1
266                                      +026516+01C000+067516 1
270
275

TYPE THREE CARDS
CNOEXPAN E MU  LOAD  RHO  PSI ULOAD F COS, ANK DELTA ANK ROT,RSNT MOVE
    /  V VV VV    VV / VV   V/   VX /   Y /   Z /   X//   Y//   Z//
 80    2793
 85    2793                     21202-1   21.2#/IN
105                                       -X DIRECTION
120    2793                     21202-1
235    2793                     21202-1
240    2793                     21202-1
245    2793                     21202-1
250    2793
255    2793
260    2793                     53002-1
265    2793
266
270    2793
275    2793                     53002-1
```

TI APERTURE CARD

Also Available On Aperture Card

8504040294-27

DATE 00010*UC0 TIME 2513 HRS. MAIN STEAM SPHERE TO TURBINE X-ACC 1.0G 4/24/65 PROBLEM NO. 010

TYPE ONE CARDS

CNOARTTCTOBRFR	DATA PT COORDINATES XFT / YFT / ZFT / V / VV	DIAM THCK RAD VFT / VXFT	SPECIAL COORDINATES P YFT / ZFT / VV	DIAGNOSTIC NOTES
280 1 1	+031766-008750+067516 3 0009			
285 1	+031766-008750+070016 3 0009			
290 1 1	+038266-008750+070016 2 40 0968			
3C01 0407	+032878-007726+124250 2 40 0968			
3C5 1	+032878-007726+093000 2 4C 0096803			
320 1	+005000-014000+093000 2 40 0096803			
325 3 1	+005000-014000+073500 2 40 0968			
326 3 1				
327 3 1				
330 1	+005000-014000+066500 2 40 0968			

TYPE TWO CARDS

CNO CMPT /	DATA OR E/	ANCHOR,RESTRAINT E/	FLEX C E/	CG-R STR E/	LOC-A COS EX / /	CR Y / / Z / / VV	
280					+031766+010000+067516	1	
285							
290					+038266-008750+06	1	
3C0							
3C5							
320							
325					+01C000-014000+0735	1	
326					+005000-010000+0735	1	
327					+009000-014000+066572	1	
330							

TYPE THREE CARDS

CNOEXPAN /	E MU V VV VV	LOAD VV / VV	RHO V/	PSI VX /	ULOAD F COS, ANK Y /	DELTA ANK ROT,RSNT MOVE Z //	X//	Y//	Z//
280	2793								
285	2793								
290	2793		46802-1						
3C0									
3C5	2793								
320	2793								
325	2793								
326									
327									
330	2793		21202-1						

ELEMENT ID ELEM ELEM CRD-BR-ELM TYPE PCNT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
330-07-010 TGNT BINP	5.000	-14.000	66.500	7.000	24.000	0.968			-0.010	-0.001	-0.000
327-07-009 RSNT END	5.000	-14.000	73.500						-0.000	0.000	-0.000
326-07-008 RSNT END	5.000	-14.000	73.500						-0.000	0.000	-0.000
325-07-007 RSNT END	5.000	-14.000	73.500						-0.000	0.000	-0.000
325-07-006 TGNT END	5.000	-14.000	73.500	16.500	24.000	0.968			-0.000	0.000	-0.000
320-07-005 BENC END	5.000	-14.000	90.000	4.712	24.000	0.968	3.000	90.000	0.017	0.000	-0.000
320-07-004 TGNT END	7.927	-13.341	93.000	22.575	24.000	0.968			0.019	0.001	-0.001
305-07-003 BENC END	29.951	-8.385	93.000	4.712	24.000	0.968	3.000	90.000	0.018	0.005	-0.001
305-07-002 TGNT END	32.878	-7.726	96.000	28.250	24.000	0.968			0.016	0.005	0.000
300-07-001 ANKR END	32.878	-7.726	124.250		24.000	0.968			0.000	-0.	-0.
290-06-019 RSNT BINP	38.266	-8.750	70.016						-0.005	0.003	0.000
290-06-018 TGNT END	38.266	-8.750	70.016	6.500	24.000	0.968			-0.005	0.003	0.000
285-06-017 TGNT END	31.766	-8.750	70.016	2.500	30.000	9.000			-0.005	0.003	-0.006
280-06-016 RSNT END	31.766	-8.750	67.516						-0.002	0.000	-0.006
280-06-015 TGNT END	31.766	-8.750	67.516	2.500	30.000	9.000			-0.002	0.000	-0.006
275-06-014 TGNT END	31.766	-8.750	70.016	5.250	24.000	0.968			-0.005	0.003	-0.006
270-06-013 TGNT END	26.516	-8.750	70.016	2.500	30.000	9.000			-0.005	0.003	-0.014
266-06-012 RSNT END	26.516	-8.750	67.516						-0.000	-0.000	-0.014
265-06-011 RSNT END	26.516	-8.750	67.516						-0.000	-0.000	-0.014
265-06-010 TGNT END	26.516	-8.750	67.516	2.500	30.000	9.000			-0.000	-0.000	-0.014
260-06-009 TGNT END	26.516	-8.750	70.016	10.500	24.000	0.968			-0.005	0.003	-0.014
255-06-008 TGNT END	16.016	-8.750	70.016	2.500	30.000	9.000			-0.006	0.003	-0.020
250-06-007 RSNT END	16.016	-8.750	67.516						-0.007	0.000	-0.020
250-06-006 TGNT END	16.016	-8.750	67.516	2.500	30.000	9.000			-0.007	0.000	-0.020
245-06-005 TGNT END	16.016	-8.750	70.016	6.257	24.000	0.968			-0.006	0.003	-0.020

DATE 00C10'U80 TIME 2513 HRS. MAIN STEAM SPHERE TO TURBINE X-ACC 1.0G 4/24/65 PROBLEM NO. 010

ELEMENT ID ELEM ELEM		ROTATIONS, RADIANS			RSNT	FORCES, LBS.			MOMENTS, FT.-LBS.			STRESS
CRD-BR-ELM	TYPE PONT	PHI X	PHI Y	PHI Z	LOAD	FX	FY	FZ	MX	MY	MZ	SE,PSI
330-07-01C	TGNT BINP	-0.00002	0.00009	0.00004		-1503.	248.	-1201.	-2804.	-11488.	373.	366.
327-07-CC9	RSNT END	-0.00001	0.00013	0.00004	-1416.	-708.	0.	1226.	0.	0.	0.	
326-07-C08	RSNT END	-0.00001	0.00013	0.00004	-195.	-0.	-195.	-0.	0.	0.	0.	
325-07-CC7	RSNT END	-0.00001	0.00013	0.00004	4208.	4208.	0.	0.	0.	0.	0.	
325-07-CC6	TGNT END	-0.00001	0.00013	0.00004		217.	53.	25.	-1066.	5264.	373.	167.
320-07-0C5	BENC END	0.00000	0.00006	0.00003		217.	53.	25.	-192.	1689.	373.	116.
320-07-C04	TGNT END	0.00001	0.00002	0.00002		217.	53.	25.	-50.	1112.	361.	79.
3C5-07-CC3	BENC END	0.00001	-0.00001	0.00001		217.	53.	25.	-173.	1657.	269.	114.
3C5-07-CC2	TGNT END	0.00002	-0.00006	0.00001		217.	53.	25.	-30.	1079.	257.	74.
3C0-07-CC1	ANKR END	-0.	-0.	-0.		217.	53.	25.	1465.	-5041.	257.	163.
290-06-C19	RSNT BINP	-0.00009	-0.00007	0.00000	1320.	0.	0.	-1320.	0.	0.	0.	
290-06-C18	TGNT END	-0.00009	-0.00007	0.00000		0.	-0.	-1320.	-0.	0.	0.	0.
285-06-C17	TGNT END	-0.00009	-0.00010	0.00000		-3650.	-0.	-1320.	-0.	8582.	-0.	40.
280-06-C16	RSNT END	-0.00009	-0.00010	0.00000	-5.	-0.	-5.	-0.	0.	0.	0.	
280-06-C15	TGNT END	-0.00009	-0.00010	0.00000		-3650.	-5.	-1320.	0.	-544.	-0.	3.
275-06-C14	TGNT END	-0.00009	-0.00010	0.00000		-3650.	-5.	-1320.	-11.	8582.	-0.	266.
270-06-C13	TGNT END	-0.00009	-0.00017	0.00000		-6989.	-5.	-1320.	-11.	15513.	-24.	72.
266-06-C12	RSNT END	-0.00009	-0.00017	0.00000	27.	0.	27.	0.	0.	0.	0.	
265-06-C11	RSNT END	-0.00009	-0.00017	0.00000	-16828.	16828.	-0.	-0.	0.	0.	0.	
265-06-C1C	TGNT END	-0.00009	-0.00017	0.00000		9839.	23.	-1320.	0.	-1960.	-24.	9.
260-06-009	TGNT END	-0.00009	-0.00017	0.00000		9839.	23.	-1320.	56.	-26557.	-24.	822.
255-06-008	TGNT END	-0.00009	0.00006	-0.00000		3161.	23.	-1320.	56.	-12694.	213.	59.
250-06-007	RSNT END	-0.00009	0.00006	-0.00000	-101.	-0.	-101.	-0.	0.	0.	0.	
250-06-006	TGNT END	-0.00009	0.00006	-0.00000		3161.	-79.	-1320.	0.	-4792.	213.	22.
245-06-005	TGNT END	-0.00009	0.00007	-0.00000		3161.	-79.	-1320.	-197.	-12694.	213.	393.

RLN NO. 0 PIPING FLEXIBILITY ANALYSIS PROGRAM MEC-2177094 PAGE 7 OF 10
** WEIGHT LOADING EFFECTS **

DATE 000)0'U00 TIME 2513 HRS. MAIN STEAM SPHERE TO TURBINE X-ACC 1.0G 4/24/65 PROBLEM NO. 010

ELEMENT ID ELEM ELEM CRD-BR-ELM TYPE PONT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
240-06-004 BENC END	9.759	-8.750	70.016	2.356	24.000	0.968	3.000	45.000	-0.006	0.003	-0.012
240-06-003 TGNT END	7.637	-8.750	69.137	0.730	24.000	0.968			-0.007	0.002	-0.008
235-06-002 BENC END	7.121	-8.750	68.621	4.712	24.000	0.968	3.000	90.000	-0.008	0.001	-0.007
235-06-001 TGNT END	5.000	-11.750	66.500	2.250	24.000	0.968			-0.011	-0.001	-0.001
235-06-001 TGNT BGIN	5.000	-14.000	66.500	2.250	24.000	0.968			-0.010	-0.001	-0.000
120-05-008 TGNT BINP	5.000	-14.000	66.500	23.330	24.000	0.968			-0.010	-0.001	-0.000
105-05-007 RSNT END	5.000	-14.000	43.170						-0.000	-0.000	-0.000
85-05-006 RSNT END	5.000	-14.000	43.170						-0.000	-0.000	-0.000
85-05-005 TGNT END	5.000	-14.000	43.170	1.500	24.000	0.968			-0.000	-0.000	-0.000
80-05-004 TGNT END	5.000	-14.000	41.670	1.000	30.000	9.000			-0.001	0.000	-0.000
77-05-003 CMPT END	4.000	-14.000	41.670	4.500					-0.001	-0.001	0.001
76-05-002 TGNT END	4.000	-14.000	37.170	1.000	30.000	9.000			-0.007	-0.001	0.001
75-05-001 TGNT END	5.000	-14.000	37.170	11.000	24.000	0.968			-0.007	-0.000	-0.000
75-05-001 TGNT BGIN	5.000	-14.000	26.170	11.000	24.000	0.968			-0.010	-0.001	-0.000
72-04-003 RSNT BINP	-25.000	-14.000	18.920						-0.000	-0.000	-0.000
71-04-002 RSNT END	-25.000	-14.000	18.920						-0.000	-0.000	-0.000
71-04-001 TGNT END	-25.000	-14.000	18.920	7.250	24.000	0.812			-0.000	-0.000	-0.000
71-04-001 TGNT BGIN	-25.000	-14.000	26.170	7.250	24.000	0.812			-0.010	-0.000	-0.000
70-03-002 TGNT BINP	-25.000	-14.000	26.170	17.000	24.000	0.968			-0.010	-0.000	-0.000
65-03-001 ANKR END	-25.000	-14.000	43.170		24.000	0.968			-0.000	-0.	-0.
60-02-001 TGNT BINP	-25.000	-14.000	26.170	30.000	20.000	0.812			-0.010	-0.000	-0.000
60-02-001 TGNT BGIN	5.000	-14.000	26.170	30.000	20.000	0.812			-0.010	-0.001	-0.000
45-01-009 TGNT BINP	5.000	-14.000	26.170	7.250	24.000	0.968			-0.010	-0.001	-0.000
40-01-008 RSNT END	5.000	-14.000	18.920						-0.000	0.000	-0.000
20-01-007 RSNT END	5.000	-14.000	18.920						-0.000	0.000	-0.000

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PCNT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
240-06-004	BEND	END	-0.00009	0.00013	-0.00000		1569.	-79.	-1320.	-197.	-4432.	-279.	302.
240-06-003	TGNT	END	-0.00009	0.00017	0.00000		970.	-79.	-1320.	-127.	-601.	-446.	45.
235-06-002	BEND	END	-0.00009	0.00017	0.00000		784.	-79.	-1320.	-87.	533.	-487.	43.
235-06-001	TGNT	END	-0.00004	0.00011	0.00004		-415.	-79.	-1320.	-3881.	4073.	-716.	296.
235-06-001	TGNT	BGIN	-0.00002	0.00009	0.00004		-987.	-79.	-1320.	-6852.	4073.	862.	248.
120-05-008	TGNT	BINP	-0.00002	0.00009	0.00004		780.	-289.	-170.	-4337.	15426.	-604.	496.
105-05-007	RSNT	END	0.00000	0.00006	0.00006	13511.	9554.	9554.	0.	0.	0.	0.	
85-05-006	RSNT	END	0.00000	0.00006	0.00006	-11328.	6817.	-9047.	-0.	0.	0.	0.	
85-05-005	TGNT	END	0.00000	0.00006	0.00006		11216.	217.	-170.	2413.	-35607.	-604.	1105.
80-05-004	TGNT	END	-0.00000	0.00010	0.00006		10834.	217.	-170.	2087.	-19069.	-604.	89.
77-05-003	CMPT	END	-0.00000	0.00010	0.00006		10834.	217.	-170.	2087.	-18899.	-387.	0.
76-05-002	TGNT	END	-0.00000	0.00010	0.00006		1838.	217.	-170.	1110.	9613.	-387.	45.
75-05-001	TGNT	END	-0.00000	0.00010	0.00006		1838.	217.	-170.	1110.	9443.	-604.	295.
75-05-001	TGNT	BGIN	-0.00000	-0.00007	0.00007		-961.	217.	-170.	-1278.	14268.	-604.	444.
72-04-003	RSNT	BINP	0.00000	-0.00015	-0.00002	3900.	3900.	0.	0.	0.	0.	0.	
71-04-002	RSNT	END	0.00000	-0.00015	-0.00002	86.	0.	86.	0.	0.	0.	0.	
71-04-001	TGNT	END	0.00000	-0.00015	-0.00002		3900.	86.	-0.	0.	-0.	-0.	0.
71-04-001	TGNT	BGIN	0.00000	-0.00004	-0.00002		2055.	86.	-0.	625.	-21587.	-0.	781.
70-03-002	TGNT	BINP	0.00000	-0.00004	-0.00002		-340.	-65.	-327.	601.	-17192.	-898.	533.
65-03-001	ANKR	END	-0.	-0.	-0.		-4665.	-65.	-327.	-499.	25354.	-898.	785.
60-02-001	TGNT	BINP	0.00000	-0.00004	-0.00002		2396.	151.	327.	24.	-4395.	898.	239.
60-02-001	TGNT	BGIN	-0.00000	-0.00007	0.00007		-2932.	151.	327.	24.	5416.	-3626.	347.
45-01-009	TGNT	BINP	-0.00000	-0.00007	0.00007		-3891.	368.	175.	-1256.	19685.	-4231.	624.
40-01-008	RSNT	END	0.00002	-0.00010	0.00012	7034.	4974.	4974.	0.	0.	0.	0.	
20-01-007	RSNT	END	0.00002	-0.00010	0.00012	-7634.	4594.	-6097.	-0.	0.	0.	0.	

ELEMENT ID ELEM-BR-ELM	ELEM TYPE	ELEM PONT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
20-01-CC6	TGNT	END	5.000	-14.000	18.920	3.250	24.000	0.968			-0.000	0.000	-0.000
15-01-CC5	BEND	END	5.000	-14.000	15.670	4.712	24.000	0.968	3.000	90.000	0.003	0.001	-0.000
15-01-CC4	TGNT	END	3.991	-11.175	12.670	8.866	24.000	0.968			-0.000	0.000	0.000
10-01-CC3	BEND	END	1.009	-2.825	12.670	4.712	24.000	0.968	3.000	90.000	-0.013	-0.004	0.000
10-01-CC2	TGNT	END	-0.	-0.	9.670	9.670	24.000	0.968			-0.011	-0.003	0.000
5-01-CC1	ANKR	END	-0.	-0.	-0.		24.000	0.968			-0.000	-0.	-0.

ELEMENT ID ELEM-BR-ELM	ELEM TYPE	ELEM PONT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
20-01-0C6	TGNT	END	0.00002	-0.00010	0.00012		3833.	-755.	175.	-3925.	-15212.	-4231.	504.
15-01-0C5	BENC	END	0.00003	-0.00007	0.00014		3006.	-755.	175.	-1471.	-4100.	-4231.	323.
15-01-CC4	TGNT	END	0.00002	-0.00005	0.00015		1807.	-755.	175.	297.	3433.	1344.	165.
10-01-C03	BEND	END	0.00003	-0.00009	0.00010		-449.	-755.	175.	-1167.	2910.	4764.	338.
10-01-C02	TGNT	END	0.00005	-0.00014	0.00002		-1647.	-755.	175.	601.	-902.	1504.	87.
5-01-C01	ANKR	END	-0.	-0.	-0.		-4107.	-755.	175.	7900.	-28727.	1504.	923.

END, EXECUTION TIME 1.69 MINUTES.

2514 BEGIN PROBLEM C11

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 20 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 40 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 71 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 72 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 85 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 105 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 250 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 265 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 266 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 280 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 290 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 325 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 326 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 327 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
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CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF12.

MAIN STEAM SPHERE TO TURBINE Y-ACC 1.67G 4/26/65 PROBLEM NO. 011
PROJECT NO. 3246 DATE 6001010100
GROUP 0000 TIME 2514 HRS.

SUMMATION OF THE REACTIONS ON THE STRUCTURE

FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
-0.	-98506.	-0.	4356676.	-9.	-520913.

SUMMATION OF THE WEIGHT AND UNIFORM LOADING EFFECTS

FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
0.	-98507.	0.	4356707.	0.	-520917.

CENTER-OF-FORCES COORDINATES			CENTER-OF-GRAVITY COORDINATES		
X, FT.	Y, FT.	Z, FT.	X, FT.	Y, FT.	Z, FT.
5.3	0.	44.2	5.3	-11.3	44.2

SUMMATION OF THE REACTIONS AT THE BRANCH-INTERSECTION-POINTS

BINP NO.	FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
BINP 1	-0.	2.	-0.	8.	-3.	-0.
BINP 2	-0.	0.	0.	0.	-0.	-0.
BINP 3	-0.	-0.	-0.	0.	-0.	-0.
BINP 4	-0.	0.	-0.	-0.	0.	0.
BINP 5	0.	0.	0.	0.	0.	-0.

```
RUN NO.   C                    PIPING FLEXIBILITY ANALYSIS PROGRAM MEC-21/7094
                                 ** DATA CARD DISPLAY WITH DIAGNOSTIC NOTES **

DATE 00010'U00   TIME 2514 HRS.       MAIN STEAM SPHERE TO TURBINE Y-ACC 1.67G 4/26/65          PROBLEM NO. 011

TYPE ONE CARDS
CNOARTTCTCBRFR DATA PT COORDINATES DIAM THCK RAD  SPECIAL COORDINATES P      DIAGNOSTIC NOTES
               XFT /  YFT /  ZFT /  V / VV/ VFT/ VXFT /  YFT /  ZFT / VV
  51    C1C1                     2400C0968                                   ZERO COORDINATES.
  10  1                     +0126702400096803
  15  1        +C05000-014000+0126702400096803
  20 2 1       +005000-014000+018920240C00968
  40 2 1
  45   1       +C05000-C14000+026170240000968
  60   1 020201-C25000-014000+026170200000812
 651    0203   -C25000-014000+043170240000968
  70   1       -025000-014000+026170240C00968
  71 2 1 030402-025000-014000+018920240000812
  72 2 1
  75   1 040501+005000-014000+037170240000968
  76   1       +004000-014000+037170300009
  77    3      +C04000-014000+041670

TYPE TWO CARDS
CNO CMPT DATA OR ANCHOR,RESTRAINT FLEX C CG-R STR LOC-A COS CR
    /    E/    E/    E/    E/    E/    EX / /  Y / /  Z / /  VV
   5
  10
  15
  20                                     +000186-007611+018920 1
  40                                     +010657-008343+018920 1
  45
  60
  65
  70
  71                                     -025000-004000+018920 1
  72                                     -015000-014000+018920 1
  75
  76
  77                                                          1

TYPE THREE CARDS
CNOEXPAN E MU  LOAD  RHO  PSI ULOAD F COS, ANK DELTA ANK ROT,RSNT MOVE
       /  V VV VV     VV / VV    V/    VX /   Y /   Z /   X//   Y//   Z//
   5
  10     2793             35402     -1
  15     2793             35402     -1
  20     2793             35402     -1
  40
  45     2793             35402     -1
  60     2793             24722     -1
  65
  70     2793             35402     -1
  71     2793             35402     -1
  72
  75     2793             35402     -1
  76     2793
  77     2793             27823     -1
```

41

TI APERTURE CARD

Also Available On Aperture Card

8504040294-37

(4.2)

DATE 000)0'000 TIME 2514 HRS. MAIN STEAM SPHERE TO TURBINE Y-ACC 1.67G 4/26/65 PROBLEM NO. 011

TYPE ONE CARDS

CNOARTTCTOBRFR DATA PT	COORDINATES DIAM THCK RAD	SPECIAL COORDINATES P	DIAGNOSTIC NOTES
	XFT / YFT / ZFT / V / VV/	VFT/ VXFT / YFT / ZFT / VV	
80 1	+C05CC0-014C00+04167C3CCC09		
85 2 1	+C05C00-C14C00+C4317024CCCC968		
105 2 1			
120 1	+C05CC0-014C00+06650C24CCCC968		
235 1 050604	+CC5CC0-C08750+C6650024CCCC96803		
240 1	+C08516-CC8750+C7001624CCCC96803		
245 1	+C16016-CC8750+C7001624CCCC968		
250 1 1	+C16016-C08750+C675163CCCC9CC0		
255 1	+C16C16-CC8750+C7001630CCC9CC0		
260 1	+C26516-C08750+C7001624CCCC968		
265 2 1	+C26516-C08750+C67516300CC09		
266 2 1			
270 1	+C26516-CC8750+C700163CCCC9		
275 1	+C31766-CC8750+C7001624CCCC968		

TYPE TWO CARDS

CNO CMPT DATA CR ANCHOR,RESTRAINT FLEX C CG-R STR LOC-A COS CR									
/ E/	E/	E/	E/	E/	EX / /	Y / /	Z / /	VV	
80									
85					+C00186-007611+043170	1			
105					+010657-008343+043170	1			
120									
235									
240									
245									
250					+C16016+010000+067516	1			
255									
260									
265					+C1CCCC-008750+067516	1			
266					+026516+010000+067516	1			
270									
275									

TYPE THREE CARDS

CNOEXPAN E MU LOAC RHO PSI ULOAC F COS, ANK DELTA ANK ROT,RSNT MOVE									
/ V VV VV VV / VV	V/	VX /	Y /	Z /	X//	Y//	Z//		
80 2793									
85 2793		35402	-1						
105									
7 120 2793		35402	-1						
235 2793		35402	-1						
6 240 2793		35402	-1						
245 2793		35402	-1						
5 250 2793									
255 2793									
4 260 2793		88512	-1						
265 2793									
3 266									
270 2793									
2 275 2793		88512	-1						

RUN NO. 0 PIPING FLEXIBILITY ANALYSIS PROGRAM MEC-21/7094 PAGE 4 OF 10
** DATA CARD DISPLAY WITH DIAGNOSTIC NOTES **

DATE 000JC*U00 TIME 2514 HRS. MAIN STEAM SPHERE TO TURBINE Y-ACC 1.67G 4/26/65 PROBLEM NO. 011

TYPE ONE CARDS

CNOARTTCTCBRFR	DATA PT COORDINATES XFT / YFT / ZFT / V / VV	DIAM THCK RAD VFT	SPECIAL COORDINATES P VXFT / YFT / ZFT / VV	DIAGNOSTIC NOTES
280 1 1	+031766-C08750+0675163CCCC9			
285 1	+031766-C08750+07C0163CCCC9			
290 1 1	+C38266-C08750+C7C01624CC0C968			
3C01 0407	+C32678-C07726+12425C24CC0C968			
3C5 1	+C32678-CC7726+C93CCC240CCC96803			
320 1	+CC5CC0-G14C00+C9300024C0CC96803			
325 3 1	+CC5CC0-C14CC0+C735CC240CC0968			
326 3 1				
327 3 1				
330 1	+C05C0C-C14C00+C6650C2400CC968			

TYPE TWC CARDS

CNO CMP.I /	DATA OR ANCHOR, E/	RESTRAINT E/	FLEX E/	C CG=R E/	STR LOC=A EX /	COS CR / Y /	Z /	VV
280					+C31766+010000+067516			1
285								
290					+C38266-008750+06			1
3C0								
3C5								
320								
325					+C1CC00-014000+0735			1
326					+CC5000-010000+0735			1
327					+CC9000-014000+066572			1
330								

TYPE THREE CARDS

CNOEXPAN E /	MU V	LOAD VV	RHO VV	PSI / VV	ULOAD V/	F COS, VX /	ANK DELTA Y /	ANK ROT,RSNT MOVE Z //	X//	Y//	Z//
280	2793										
285	2793										
290	2793				78162	-1					
3C0											
3C5	2793										
320	2793										
325	2793										
326											
327											
330	2793				35402	-1					

ELEMENT ID ELEM-BR-ELM	ELEM TYPE	ELEMENT POINT PONT	COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
330-07-C1C	TGNT	BINP	5.000	-14.000	66.500	7.000	24.000	0.968			0.007	-0.004	0.000
327-07-009	RSNT	END	5.000	-14.000	73.500						0.000	-0.000	0.000
326-07-008	RSNT	END	5.000	-14.000	73.500						0.000	-0.000	0.000
325-07-007	RSNT	END	5.000	-14.000	73.500						0.000	-0.000	0.000
325-07-006	TGNT	END	5.000	-14.000	73.500	16.500	24.000	0.968			0.000	-0.000	0.000
320-07-005	BENC	END	5.000	-14.000	90.000	4.712	24.000	0.968	3.000	90.000	-0.017	0.017	0.000
320-07-004	TGNT	END	7.927	-13.341	93.000	22.575	24.000	0.968			-0.018	0.018	0.001
305-07-003	BENC	END	29.951	-8.385	93.000	4.712	24.000	0.968	3.000	90.000	-0.015	0.006	0.001
305-07-002	TGNT	END	32.878	-7.726	96.000	28.250	24.000	0.968			-0.014	0.004	-0.000
300-07-001	ANKR	END	32.878	-7.726	124.250		24.000	0.968			-0.000	-0.	-0.
290-06-019	RSNT	BINP	38.266	-8.750	70.016						0.002	-0.126	0.000
290-06-018	TGNT	END	38.266	-8.750	70.016	6.500	24.000	0.968			0.002	-0.126	0.000
285-06-017	TGNT	END	31.766	-8.750	70.016	2.500	30.000	9.000			0.002	-0.111	0.009
280-06-016	RSNT	END	31.766	-8.750	67.516						-0.001	-0.000	0.009
280-06-015	TGNT	END	31.766	-8.750	67.516	2.500	30.000	9.000			-0.001	-0.000	0.009
275-06-014	TGNT	END	31.766	-8.750	70.016	5.250	24.000	0.968			0.002	-0.110	0.009
270-06-013	TGNT	END	26.516	-8.750	70.016	2.500	30.000	9.000			0.002	-0.103	0.015
266-06-012	RSNT	END	26.516	-8.750	67.516						-0.000	-0.000	0.015
265-06-011	RSNT	END	26.516	-8.750	67.516						-0.000	-0.000	0.015
265-06-010	TGNT	END	26.516	-8.750	67.516	2.500	30.000	9.000			-0.000	-0.000	0.015
260-06-009	TGNT	END	26.516	-8.750	70.016	10.500	24.000	0.968			0.002	-0.103	0.015
255-06-008	TGNT	END	16.016	-8.750	70.016	2.500	30.000	9.000			0.002	-0.084	0.027
250-06-007	RSNT	END	16.016	-8.750	67.516						-0.002	-0.000	0.027
250-06-006	TGNT	END	16.016	-8.750	67.516	2.500	30.000	9.000			-0.002	-0.000	0.027
245-06-005	TGNT	END	16.016	-8.750	70.016	6.257	24.000	0.968			0.002	-0.083	0.027

RUN NO. 0 PIPING FLEXIBILITY ANALYSIS PROGRAM MEC-2177094 PAGE 6 OF 10
** WEIGHT LOADING EFFECTS **

CATE 00010'UCO TIME 2514 HRS. MAIN STEAM SPHERE TO TURBINE Y-ACC 1.67G 4/26/65 PROBLEM NO. 011

ELEMENT ID ELEM ELEM	ROTATIONS, RADIANS			RSNT	FORCES, LBS.			MOMENTS, FT.-LBS.			STRESS
CRD-BR-ELM TYPE PONT	PHI X	PHI Y	PHI Z	LOAD	FX	FY	FZ	MX	MY	MZ	SE,PSI
330-07-010 TGNT BINP	0.00008	-0.00001	0.00011		5249.	-5557.	238.	46595.	32085.	2445.	1753.
327-07-009 RSNT END	-0.00011	-0.00012	0.00008	296.	148.	-0.	-256.	0.	0.	0.	
326-07-008 RSNT END	-0.00011	-0.00012	0.00008	8613.	0.	8613.	0.	0.	0.	0.	
325-07-007 RSNT END	-0.00011	-0.00012	0.00008	-5584.	-5584.	-0.	-0.	0.	0.	0.	
325-07-006 TGNT END	-0.00011	-0.00012	0.00008		-187.	83.	-18.	-2710.	-4661.	2445.	183.
320-07-005 BEND END	-0.00007	-0.00006	0.00002		-187.	83.	-18.	-1345.	-1578.	2445.	160.
320-07-004 TGNT END	-0.00003	-0.00002	-0.00003		-187.	83.	-18.	-1085.	-1071.	2080.	157.
305-07-003 BEND END	0.00001	0.00001	-0.00005		-187.	83.	-18.	-994.	-1472.	-668.	102.
305-07-002 TGNT END	0.00001	0.00005	-0.00004		-187.	83.	-18.	-734.	-965.	-1034.	88.
300-07-001 ANKR END	-0.	-0.	-0.		-187.	83.	-18.	1603.	4314.	-1034.	146.
290-06-019 RSNT BINP	0.00369	0.00012	-0.00022	617.	0.	0.	-617.	0.	0.	0.	
290-06-018 TGNT END	0.00369	0.00012	-0.00022		0.	0.	-617.	0.	0.	-0.	0.
285-06-017 TGNT END	0.00369	0.00011	-0.00017		0.	-6096.	-617.	0.	4011.	-19814.	94.
280-06-016 RSNT END	0.00368	0.00011	-0.00016	12819.	0.	12819.	0.	0.	0.	0.	
280-06-015 TGNT END	0.00368	0.00011	-0.00016		-0.	6722.	-617.	15241.	4011.	-19814.	118.
275-06-014 TGNT END	0.00368	0.00011	-0.00015		-0.	6722.	-617.	32047.	4011.	-19814.	1173.
270-06-013 TGNT END	0.00343	0.00007	-0.00011		-0.	1146.	-617.	32047.	7250.	842.	153.
266-06-012 RSNT END	0.00342	0.00007	-0.00011	3217.	0.	3217.	0.	0.	0.	0.	
265-06-011 RSNT END	0.00342	0.00007	-0.00011	-5631.	5631.	-0.	-0.	0.	0.	0.	
265-06-010 TGNT END	0.00342	0.00007	-0.00011		5631.	4363.	-617.	29182.	7250.	842.	140.
260-06-009 TGNT END	0.00341	0.00007	-0.00011		5631.	4363.	-617.	40090.	-6827.	842.	1259.
255-06-008 TGNT END	0.00280	0.00011	-0.00016		5631.	-6789.	-617.	40090.	-348.	-11892.	194.
250-06-007 RSNT END	0.00279	0.00011	-0.00015	12137.	0.	12137.	0.	0.	0.	0.	
250-06-006 TGNT END	0.00279	0.00011	-0.00015		5631.	5348.	-617.	57062.	13729.	-11892.	278.
245-06-005 TGNT END	0.00277	0.00011	-0.00015		5631.	5348.	-617.	70432.	-348.	-11892.	2211.

ELEMENT IC ELEM ELEM	ELEMENT POINT COORDINATES			LENGTH	DIAM	THCK	RADIUS	THETA	DISPLACEMENTS, INCHES		
CRD-BR-ELM TYPE PCNT	X, FT.	Y, FT.	Z, FT.	FT.	IN.	IN.	FT.	DEG	DELTA X	DELTA Y	DELTA Z
240-06-004 BEND END	9.759	-8.750	70.016	2.356	24.000	0.968	3.000	45.000	0.001	-0.073	0.035
240-06-003 TGNT END	7.637	-8.750	69.137	0.730	24.000	0.968			0.001	-0.048	0.037
235-06-002 BEND END	7.121	-8.750	68.621	4.712	24.000	0.968	3.000	90.000	0.001	-0.036	0.037
235-06-001 TGNT END	5.000	-11.750	66.500	2.250	24.000	0.968			0.005	-0.004	0.004
235-06-001 TGNT BGIN	5.000	-14.000	66.500	2.250	24.000	0.968			0.007	-0.004	0.000
120-05-008 TGNT BINP	5.000	-14.000	66.500	23.330	24.000	0.968			0.007	-0.004	0.000
105-05-007 RSNT END	5.000	-14.000	43.170						0.000	-0.000	0.000
85-05-006 RSNT END	5.000	-14.000	43.170						0.000	-0.000	0.000
85-05-005 TGNT END	5.000	-14.000	43.170	1.500	24.000	0.968			0.000	-0.000	0.000
80-05-004 TGNT END	5.000	-14.000	41.670	1.000	30.000	9.000			-0.000	-0.003	0.000
77-05-003 CMPT END	4.000	-14.000	41.670	4.500					-0.000	-0.010	0.000
76-05-002 TGNT END	4.000	-14.000	37.170	1.000	30.000	9.000			-0.001	-0.020	0.000
75-05-001 TGNT END	5.000	-14.000	37.170	11.000	24.000	0.968			-0.001	-0.014	0.000
75-05-001 TGNT BGIN	5.000	-14.000	26.170	11.000	24.000	0.968			-0.002	-0.015	0.000
72-04-003 RSNT BINP	-25.000	-14.000	18.920						-0.000	-0.000	-0.000
71-04-002 RSNT END	-25.000	-14.000	18.920						-0.000	-0.000	-0.000
71-04-001 TGNT END	-25.000	-14.000	18.920	7.250	24.000	0.812			-0.000	-0.000	-0.000
71-04-001 TGNT BGIN	-25.000	-14.000	26.170	7.250	24.000	0.812			-0.002	-0.018	-0.000
70-03-002 TGNT BINP	-25.000	-14.000	26.170	17.000	24.000	0.968			-0.002	-0.018	-0.000
65-03-001 ANKR END	-25.000	-14.000	43.170		24.000	0.968			-0.000	-0.	-0.
60-02-001 TGNT BINP	-25.000	-14.000	26.170	30.000	20.000	0.812			-0.002	-0.018	-0.000
60-02-001 TGNT BGIN	5.000	-14.000	26.170	30.000	20.000	0.812			-0.002	-0.015	0.000
45-01-009 TGNT BINP	5.000	-14.000	26.170	7.250	24.000	0.968			-0.002	-0.015	0.000
40-01-008 RSNT END	5.000	-14.000	18.920						0.000	-0.000	0.000
20-01-007 RSNT END	5.000	-14.000	18.920						0.000	-0.000	0.000

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PCNT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
240-06-004	BENC	END	0.00213	0.00010	-0.00016		5631.	2690.	-617.	70432.	3513.	13254.	2370.
240-06-003	TGNT	END	0.00180	0.00000	-0.00010		5631.	1689.	-617.	68648.	9770.	17956.	3155.
235-06-002	BENC	END	0.00173	-0.00001	-0.00012		5631.	1379.	-617.	67857.	12994.	18748.	3151.
235-06-001	TGNT	END	0.00024	0.00007	0.00010		5631.	-623.	-617.	64624.	26248.	3236.	4468.
235-06-001	TGNT	BGIN	0.00008	-0.00001	0.00011		5631.	-1579.	-617.	63236.	26248.	-9434.	2139.
120-05-008	TGNT	BINP	0.00008	-0.00001	0.00011		382.	3978.	-855.	16641.	-5837.	-11879.	658.
105-05-007	RSNT	END	-0.00015	0.00003	0.00051	13799.	9758.	9758.	0.	0.	0.	0.	
85-05-006	RSNT	END	-0.00015	0.00003	0.00051	16988.	-10223.	13568.	0.	0.	0.	0.	
85-05-005	TGNT	END	-0.00015	0.00003	0.00051		-84.	17393.	-855.	39445.	3066.	-11879.	1279.
80-05-004	TGNT	END	-0.00019	0.00002	0.00053		-84.	16756.	-855.	13833.	2939.	-11879.	86.
77-05-003	CMPT	END	-0.00020	0.00002	0.00053		-84.	16756.	-855.	13833.	3794.	4876.	0.
76-05-002	TGNT	END	-0.00020	0.00002	0.00053		-84.	1733.	-855.	-27765.	3416.	4876.	132.
75-05-001	TGNT	END	-0.00019	0.00002	0.00053		-84.	1733.	-855.	-27765.	2561.	3144.	868.
75-05-001	TGNT	BGIN	0.00016	-0.00001	0.00048		-84.	-2940.	-855.	-21126.	1635.	3144.	663.
72-04-003	RSNT	BINP	0.00027	-0.00003	-0.00036	667.	667.	0.	0.	0.	0.	0.	
71-04-002	RSNT	END	0.00027	-0.00003	-0.00036	6482.	0.	6482.	0.	0.	0.	0.	
71-04-001	TGNT	END	0.00027	-0.00003	-0.00036		667.	6482.	-0.	0.	-0.	-0.	0.
71-04-001	TGNT	BGIN	0.00009	-0.00001	-0.00036		667.	3403.	-0.	35833.	-4837.	-0.	1308.
70-03-002	TGNT	BINP	0.00009	-0.00001	-0.00036		-468.	-1358.	-34.	36641.	-4324.	-14636.	1228.
65-03-001	ANKR	END	-0.	-0.	-0.		-468.	-8579.	-34.	-47823.	3633.	-14636.	1552.
60-02-001	TGNT	BINP	0.00009	-0.00001	-0.00036		1135.	4760.	34.	-808.	-514.	14636.	780.
60-02-001	TGNT	BGIN	0.00016	-0.00001	0.00048		1135.	-4139.	34.	-808.	510.	5315.	287.
45-01-009	TGNT	BINP	0.00016	-0.00001	0.00048		1051.	-7077.	-821.	-21926.	2142.	8458.	730.
40-01-008	RSNT	END	0.00010	-0.00005	0.00039	9401.	6648.	6648.	0.	0.	0.	0.	
20-01-007	RSNT	END	0.00010	-0.00005	0.00039	16005.	-9632.	12783.	0.	0.	0.	0.	

ELEMENT ID ELEM ELEM	ELEMENT POINT COORDINATES'			LENGTH	DIAM	THCK	RADIUS	THETA	DISPLACEMENTS, INCHES		
CRD-BR-ELM TYPE PCNT	X, FT.	Y, FT.	Z, FT.	FT.	IN.	IN.	FT.	DEG	DELTA X	DELTA Y	DELTA Z
20-01-C06 TGNT END	5.0C0	-14.0C0	18.920	3.250	24.000	0.968			0.000	-0.000	0.000
15-01-CC5 BENC END	5.CC0	-14.000	15.670	4.712	24.C00	0.968	3.000	90.000	0.003	0.002	0.000
15-01-0C4 TGNT END	3.991	-11.175	12.670	8.866	24.000	0.968			-0.002	-0.003	-0.002
10-01-003 BENC END	1.009	-2.825	12.670	4.712	24.000	0.968	3.000	90.000	-0.015	-0.008	-0.001
10-01-C02 TGNT END	-0.	-0.	9.670	9.670	24.000	0.968			-0.010	-0.006	-0.000
5-01-C01 ANKR END	-0.	-0.	-0.		24.000	0.968			-0.000	-0.	-0.

DATE 00C)0'U00 TIME 2514 HRS. MAIN STEAM SPHERE TO TURBINE Y-ACC 1.67G 4/26/65 PROBLEM NO. 011

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PONT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
20-01-CC6	TGNT	END	0.00010	-0.00005	0.00039		-1933.	9273.	-821.	40549.	9761.	8458.	1317.
15-01-CC5	BENC	END	0.00001	-0.00008	0.00036		-1933.	7893.	-821.	12655.	3477.	8458.	929.
15-01-C04	TGNT	END	0.00004	-0.00014	0.00017		-1933.	5891.	-821.	-6521.	-1494.	9674.	797.
10-01-003	BENC	END	0.00008	-0.00014	0.00009		-1933.	2124.	-821.	335.	955.	5483.	376.
10-01-C02	TGNT	END	0.00007	-0.00014	0.00002		-1933.	123.	-821.	104.	-4017.	1430.	276.
5-01-C01	ANKR	END	-0.	-0.	-0.		-1933.	-3985.	-821.	18780.	-22712.	1430.	913.

END, EXECUTION TIME 1.69 MINUTES.

2516 BEGIN PROBLEM 012

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 20 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 40 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 71 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 72 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 85 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 105 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 250 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 265 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 266 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 280 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 290 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 325 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 326 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

*****THE INITIAL LOAD SPECIFIED FOR THE RIGID RESTRAINT AT DATA POINT 327 HAS BEEN RESET TO ZERO.
TO INCLUDE AN INITIAL LOAD, SPECIFY A FLEXIBLE RESTRAINT.

CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF08.
CONTROL ENTERED BLKF12.

(57)

MAIN STEAM SPHERE TO TURBINE Z-ACC 1.0G 4/27/65 PROBLEM NO. 012
PROJECT NO. 3246 DATE 00010'U00
GROUP 0000 TIME 2516 HRS.

SUMMATION OF THE REACTIONS ON THE STRUCTURE

FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
2.	1.	-58985.	668885.	311977.	34.

SUMMATION OF THE WEIGHT AND UNIFORM LOADING EFFECTS

FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
0.	0.	-58990.	668977.	311927.	0.

CENTER-OF-FORCES COORDINATES			CENTER-OF-GRAVITY COORDINATES		
X, FT.	Y, FT.	Z, FT.	X, FT.	Y, FT.	Z, FT.
5.3	-11.3	0.	5.3	-0.	0.

SUMMATION OF THE REACTIONS AT THE BRANCH-INTERSECTION-POINTS

BINP NO.	FX, LBS.	FY, LBS.	FZ, LBS.	MX, FT.-LBS.	MY, FT.-LBS.	MZ, FT.-LBS.
BINP 1	2.	1.	4.	-7.	17.	-0.
BINP 2	-0.	0.	0.	0.	-0.	-0.
BINP 3	0.	-0.	-0.	0.	0.	-0.
BINP 4	-0.	-0.	0.	0.	-0.	0.
BINP 5	0.	-0.	0.	-0.	0.	0.

```
                                  ** DATA CARD DISPLAY WITH DIAGNOSTIC NOTES **

 DATE 00010'U00   TIME 2516 HRS.        MAIN STEAM SPHERE TO TURBINE Z-ACC-1.0G 4/27/65            PROBLEM NO. 012

 TYPE ONE CARDS
 CNOARTTCTOBRFR DATA PT COORDINATES DIAM THCK RAD  SPECIAL COORDINATES P        DIAGNOSTIC NOTES
                XFT /  YFT /  ZFT /  V / VV/ VFT/ VXFT /  YFT /  ZFT / VV
   51    0101                      24000968                                     ZERO COORDINATES.
  10  1                   +012670240000968C3
  15  1           +005000-014000+01267024000096803
  20 2 1          +005000-014000+018920240000968
  40 2 1
  45  1           +005000-014000+026170240000968
  60  1 C20201-025000-014000+026170200000812
  651   C203   -025000-014000+043170240000968
  70  1           -025000-014000+026170240000968
  71 2 1 030402-025000-014000+018920240000812
  72 2 1
  75  1 040501+005000-014000+037170240000968
  76  1           +004000-014000+037170300009
  77    3         +004000-014000+041670

 TYPE TWO CARDS
 CNO CMPT DATA CR ANCHOR,RESTRAINT FLEX C CG-R STR LOC-A COS CR
      /    E/    E/    E/    E/    E/    EX / /  Y / /  Z / /  VV
   5
  10
  15
  20                                  +000186-007611+018920 1
  40                                  +010657-008343+018920 1
  45
  60
  65
  70
  71                                  -025000-004000+018920 1
  72                                  -015000-014000+018920 1
  75
  76
  77                                                        1

 TYPE THREE CARDS
 CNOEXPAN E MU  LOAD  RHO  PSI ULOAD F COS, ANK DELTA ANK ROT,RSNT MOVE
       /  V VV VV     VV / VV    V/    VX /   Y /   Z /   X//   Y//   Z//
   5
  10     2793                21202          -1
  15     2793                21202          -1
  20     2793                21202          -1
  40
  45     2793                21202          -1
  60     2793                14802          -1
  65
  70     2793                21202          -1
  71     2793                21202          -1
  72
  75     2793                21202          -1
  76     2793
  77     2793                16663          -1
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(52)

TI APERTURE CARD

Also Available On Aperture Card

8504040294-48

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RUN NO.     0                    PIPING FLEXIBILITY ANALYSIS PROGRAM MEC-21/7094                    PAGE   3 OF  10
                                  ** DATA CARD DISPLAY WITH DIAGNOSTIC NOTES **

CATE 00C)C'U00   TIME 2516 HRS.        MAIN STEAM SPHERE TO TURBINE Z-ACC 1.0G 4/27/65          PROBLEM NO. 012

TYPE ONE CARCS
CNOARTTCTOBRFR CATA PT COORDINATES DIAM THCK RAD  SPECIAL COORDINATES P       DIAGNOSTIC NOTES
                 XFT /  YFT /  ZFT /  V / VV/ VFT/ VXFT /  YFT /  ZFT / VV
 80    1         +005CC0-014000+041673CC0C9
 85  2 1         +005C00-014000+04317C24CCC968
1C5  2 1
120    1         +005CC0-014000+06650C24CCC968
235   1   C50604+C05C00-C08750+C6650024CCC968C3
240   1          +008516-C08750+07001624CCC968C3
245    1         +C16016-C08750+07001624CCC968
250  1 1         +C16016-C08750+0675163C0C09CC0
255    1         +C16C16-C08750+C700163CCC9CC0
260    1         +026516-C08750+07001624000968
265  2 1         +C26516-C08750+C675163CCC9
266  2 1
270    1         +026516-008750+C700163CCC9
275    1         +C31766-C08750+C7001624CCC0968

TYPE TWC CARCS
CNO CMPT CATA CR ANCHOR,RESTRAINT FLEX C CG-R STR LOC-A COS CR
     /    E/     E/    E/    E/    E/    EX / / Y / /  Z / /  VV
 80
 85                                      +CC0186-007611+C43170 1
1C5                                      +010657-008343+043170 1
120
235
240
245
250                                      +C16016+010000+C67516 1
255
260
265                                      +01CC00-008750+067516 1
266                                      +026516+01C000+C67516 1
270
275

TYPE THREE CARCS
CNOEXPAN E MU  LOAD  RHO  PSI ULOAD F COS, ANK DELTA ANK ROT,RSNT MOVE
     /  V VV VV    VV / VV   V/    VX /    Y /   Z /   X//   Y//   Z//
 80      2793
 85      2793                  21202             -1
105
120      2793                  21202             -1
235      2793                  21202             -1
240      2793                  21202             -1
245      2793                  21202             -1
250      2793
255      2793
260      2793                  53002             -1
265      2793
266
270      2793
275      2793                  53002             -1
```

APERTURE CARD

Also Available On Aperture Card

8504040294-49

54

DATE 00010'UC0 TIME 2516 HRS. MAIN STEAM SPHERE TO TURBINE Z-ACC 1.0G 4/27/65 PROBLEM NO. 012

TYPE ONE CARDS

CNOARTTCTOBRFR	DATA PT COORDINATES	DIAM	THCK	RAD	SPECIAL COORDINATES				DIAGNOSTIC NOTES
	XFT / YFT / ZFT / V / VV				VFT/	VXFT /	YFT /	ZFT / VV	
280 1 1	+031766-008750+0675163CC0C9								
285 1	+031766-008750+0700163CCCC9								
290 1 1	+038266-008750+0700162400CC968								
3C01 C4C7	+032878-007726+12425C2400CC968								
3C5 1	+032878-007726+0930002400CC96803								
320 1	+C05CC0-014000+0930002400C0968C3								
325 3 1	+C05CC0-014000+0735002400CC968								
326 3 1									
327 3 1									
330 1	+005CC0-014000+0665CC2400CC968								

TYPE TWC CARDS

CNO CMPT DATA OR ANCHOR,RESTRAINT FLEX C CG-R STR LOC-A COS CR									
/ E/	E/	E/	E/	E/	EX /	/ Y	/ / Z	/ / VV	
280					+031766+010000+067516			1	
285									
290					+038266-008750+06			1	
300									
3C5									
320									
325					+010000-014000+0735			1	
326					+005000-010000+0735			1	
327					+009000-014000+066572			1	
330									

TYPE THREE CARDS

CNOEXPAN E MU LOAD RHO PSI ULOAD F COS, ANK DELTA ANK ROT,RSNT MOVE									
/ V VV VV	VV / VV	V/	VX /	Y /	Z /	X//	Y//	Z//	
280 2793									
285 2793									
290 2793		46802		-1					
300									
3C5 2793									
320 2793									
325 2793									
326									
327									
330 2793		21202		-1					

RUN NO. C — PIPING FLEXIBILITY ANALYSIS PROGRAM MEC-21/7094 — PAGE 5 OF 10
** WEIGHT LOADING EFFECTS **

DATE 000)C'U00 TIME 2516 HRS. — MAIN STEAM SPHERE TO TURBINE Z-ACC 1.0G 4/27/65 — PROBLEM NO. 012

ELEMENT ID ELEM ELEM CRD-BR-ELM TYPE PCNT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
320-07-C10 TGNT BINP	5.000	-14.000	66.500	7.000	24.000	0.968			-0.011	-0.011	-0.002
327-07-0C9 RSNT END	5.000	-14.000	73.500						-0.000	0.000	-0.000
326-07-CC8 RSNT END	5.000	-14.000	73.500						-0.000	0.000	-0.000
325-07-0C7 RSNT END	5.000	-14.000	73.500						-0.000	0.000	-0.000
325-07-006 TGNT END	5.000	-14.000	73.500	16.500	24.000	0.968			-0.000	0.000	-0.000
320-07-CC5 BENC END	5.000	-14.000	90.000	4.712	24.000	0.968	3.000	90.000	0.018	0.014	-0.000
320-07-CC4 TGNT END	7.927	-13.341	93.000	22.575	24.000	0.968			0.019	0.018	-0.001
3C5-07-CC3 BENC END	29.951	-8.385	93.000	4.712	24.000	0.968	3.000	90.000	0.018	0.020	-0.002
3C5-07-0C2 TGNT END	32.878	-7.726	96.000	28.250	24.000	0.968			0.017	0.017	0.000
3C0-07-CC1 ANKR END	32.878	-7.726	124.250		24.000	0.968			0.000	-0.	-0.
290-06-C19 RSNT BINP	38.266	-8.750	70.016						-0.010	0.017	-0.000
290-06-018 TGNT END	38.266	-8.750	70.016	6.500	24.000	0.968			-0.010	0.017	-0.000
285-06-C17 TGNT END	31.766	-8.750	70.016	2.500	30.000	9.000			-0.010	0.017	-0.062
280-06-C16 RSNT END	31.766	-8.750	67.516						0.010	0.000	-0.062
280-06-015 TGNT END	31.766	-8.750	67.516	2.500	30.000	9.000			0.010	0.000	-0.062
275-06-014 TGNT END	31.766	-8.750	70.016	5.250	24.000	0.968			-0.009	0.017	-0.062
270-06-C13 TGNT END	26.516	-8.750	70.016	2.500	30.000	9.000			-0.009	0.016	-0.093
266-06-012 RSNT END	26.516	-8.750	67.516						0.000	-0.000	-0.093
265-06-011 RSNT END	26.516	-8.750	67.516						0.000	-0.000	-0.093
265-06-01C TGNT END	26.516	-8.750	67.516	2.500	30.000	9.000			0.000	-0.000	-0.093
260-06-0C9 TGNT END	26.516	-8.750	70.016	10.500	24.000	0.968			-0.009	0.016	-0.093
255-06-0C8 TGNT END	16.016	-8.750	70.016	2.500	30.000	9.000			-0.008	0.017	-0.086
250-06-CC7 RSNT END	16.016	-8.750	67.516						-0.019	0.000	-0.086
250-06-0C6 TGNT END	16.016	-8.750	67.516	2.500	30.000	9.000			-0.019	0.000	-0.086
245-06-0C5 TGNT END	16.016	-8.750	70.016	6.257	24.000	0.968			-0.008	0.017	-0.086

ELEMENT ID ELEM-ELEM		ROTATIONS, RADIANS			RSNT	FORCES, LBS.			MOMENTS, FT.-LBS.			STRESS
CRD-BR-ELM	TYPE PCNT	PHI X	PHI Y	PHI Z	LOAD	FX	FY	FZ	MX	MY	MZ	SE,PSI
330-07-C10	TGNT BINP	-0.00017	0.00012	0.00026		-1733.	943.	-34505.	-11675.	-6693.	4047.	435.
327-07-0C9	RSNT END	-0.00011	0.00013	0.00022	-41932.	-20967.	0.	36314.	0.	0.	0.	
326-07-C08	RSNT END	-0.00011	0.00013	0.00022	-736.	-0.	-736.	-0.	0.	0.	0.	
325-07-CC7	RSNT END	-0.00011	0.00013	0.00022	22926.	22926.	0.	0.	0.	0.	0.	
325-07-CC6	TGNT END	-0.00011	0.00013	0.00022		226.	207.	29.	-5076.	5439.	4047.	262.
320-07-CC5	BENC END	-0.00005	0.00006	0.00012		226.	207.	29.	-1668.	1708.	4047.	205.
320-07-CC4	TGNT END	0.00002	0.00002	0.00004		226.	207.	29.	-1067.	1113.	3592.	261.
3C5-07-CC3	BENC END	0.00005	-0.00001	-0.00001		226.	207.	29.	-1209.	1746.	163.	136.
3C5-07-C02	TGNT END	0.00007	-0.00006	-0.00001		226.	207.	29.	-608.	1152.	-293.	89.
3C0-07-C01	ANKR END	-0.	-0.	-0.		226.	207.	29.	5227.	-5236.	-293.	229.
290-06-C19	RSNT BINP	-0.00055	-0.00085	0.00000	-8833.	-0.	-0.	8833.	0.	0.	0.	
290-06-018	TGNT END	-0.00055	-0.00085	0.00000		0.	-0.	8833.	-0.	0.	0.	0.
285-06-017	TGNT END	-0.00055	-0.00068	0.00000		0.	-0.	5182.	-0.	-45549.	-0.	212.
280-06-C16	RSNT END	-0.00055	-0.00066	0.00000	-16.	-0.	-16.	-0.	0.	0.	0.	
280-06-015	TGNT END	-0.00055	-0.00066	0.00000		0.	-16.	5182.	-0.	-45549.	-0.	212.
275-06-014	TGNT END	-0.00055	-0.00065	0.00000		0.	-16.	5182.	-39.	-45549.	-0.	1410.
270-06-C13	TGNT END	-0.00055	-0.00032	0.00000		0.	-16.	1843.	-39.	-63992.	-83.	297.
266-06-012	RSNT END	-0.00055	-0.00030	0.00000	94.	0.	94.	0.	0.	0.	0.	
265-06-011	RSNT END	-0.00055	-0.00030	0.00000	3261.	-3261.	0.	0.	0.	0.	0.	
265-06-010	TGNT END	-0.00055	-0.00030	0.00000		-3261.	78.	1843.	-0.	-63992.	-83.	297.
260-06-009	TGNT END	-0.00055	-0.00028	0.00000		-3261.	78.	1843.	196.	-55838.	-83.	1728.
255-06-008	TGNT END	-0.00055	0.00035	-0.00000		-3261.	78.	-4835.	196.	-40134.	739.	186.
250-06-007	RSNT END	-0.00055	0.00036	-0.00000	-977.	-0.	-977.	-0.	0.	0.	0.	
250-06-006	TGNT END	-0.00055	0.00036	-0.00000		-3261.	-899.	-4835.	-0.	-48288.	739.	224.
245-06-005	TGNT END	-0.00055	0.00038	-0.00000		-3261.	-899.	-4835.	-2247.	-40134.	739.	1244.

ELEMENT ID ELEM ELEM CRD-BR-ELM TYPE PCNT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
240-06-004 BEND END	9.759	-8.750	70.016	2.356	24.000	0.968	3.000	45.000	-0.008	0.017	-0.050
240-06-003 TGNT END	7.637	-8.750	69.137	0.730	24.000	0.968			-0.014	0.010	-0.036
235-06-CC2 BEND END	7.121	-8.750	68.621	4.712	24.000	0.968	3.000	90.000	-0.017	0.006	-0.033
235-06-C01 TGNT END	5.000	-11.750	66.500	2.250	24.000	0.968			-0.018	-0.011	-0.008
235-06-0C1 TGNT BGIN	5.000	-14.000	66.500	2.250	24.000	0.968			-0.011	-0.011	-0.002
120-05-CC8 TGNT BINP	5.000	-14.000	66.500	23.330	24.000	0.968			-0.011	-0.011	-0.002
105-05-CC7 RSNT END	5.000	-14.000	43.170						-0.000	-0.000	-0.005
85-05-CC6 RSNT END	5.000	-14.000	43.170						-0.000	-0.000	-0.005
85-05-C05 TGNT END	5.000	-14.000	43.170	1.500	24.000	0.968			-0.000	-0.000	-0.005
80-05-CC4 TGNT END	5.000	-14.000	41.670	1.000	30.000	9.000			0.001	0.001	-0.005
77-05-CC3 CMPT END	4.000	-14.000	41.670	4.500					0.001	-0.000	-0.005
76-05-CC2 TGNT END	4.000	-14.000	37.170	1.000	30.000	9.000			0.002	0.002	-0.005
75-05-C01 TGNT END	5.000	-14.000	37.170	11.000	24.000	0.968			0.002	0.004	-0.005
75-05-0C1 TGNT BGIN	5.000	-14.000	26.170	11.000	24.000	0.968			0.002	0.004	-0.006
72-04-0C3 RSNT BINP	-25.000	-14.000	18.920						-0.000	-0.000	-0.001
71-04-C02 RSNT END	-25.000	-14.000	18.920						-0.000	-0.000	-0.001
71-04-C01 TGNT END	-25.000	-14.000	18.920	7.250	24.000	0.812			-0.000	-0.000	-0.001
71-04-CC1 TGNT BGIN	-25.000	-14.000	26.170	7.250	24.000	0.812			0.002	-0.000	-0.001
70-03-CC2 TGNT BINP	-25.000	-14.000	26.170	17.000	24.000	0.968			0.002	-0.000	-0.001
65-03-C01 ANKR END	-25.000	-14.000	43.170		24.000	0.968			0.000	-0.	-0.
60-02-C01 TGNT BINP	-25.000	-14.000	26.170	30.000	20.000	0.812			0.002	-0.000	-0.001
60-02-CC1 TGNT BGIN	5.000	-14.000	26.170	30.000	20.000	0.812			0.002	0.004	-0.006
45-01-CC9 TGNT BINP	5.000	-14.000	26.170	7.250	24.000	0.968			0.002	0.004	-0.006
40-01-008 RSNT END	5.000	-14.000	18.920						0.000	0.000	-0.006
20-01-C07 RSNT END	5.000	-14.000	18.920						0.000	0.000	-0.006

ELEMENT ID ELEM ELEM	ROTATIONS, RADIANS			RSNT	FORCES, LBS.			MOMENTS, FT.-LBS.			STRESS
CRD-BR-ELM TYPE PCNT	PHI X	PHI Y	PHI Z	LOAD	FX	FY	FZ	MX	MY	MZ	SE,PSI
240-06-004 BENC END	-0.00053	0.00054	0.00001		-3261.	-899.	-6426.	-2247.	-4902.	-4885.	475.
240-06-003 TGNT END	-0.00055	0.00052	0.00008		-3261.	-899.	-7026.	-1457.	6466.	-6792.	539.
235-06-002 BENC END	-0.00054	0.00051	0.00009		-3261.	-899.	-7212.	-994.	8456.	-7256.	673.
235-06-001 TGNT END	-0.00026	0.00018	0.00027		-3261.	-899.	-8410.	-23011.	17760.	621.	1657.
235-06-001 TGNT BGIN	-0.00017	0.00012	0.00026		-3261.	-899.	-8983.	-42578.	17760.	7959.	1449.
120-05-008 TGNT BINP	-0.00017	0.00012	0.00026		-1528.	-1842.	25522.	-30903.	24453.	3912.	1226.
105-05-007 RSNT END	0.00007	-0.00005	0.00013	3887.	2749.	2749.	0.	0.	0.	0.	
85-05-006 RSNT END	0.00007	-0.00005	0.00013	-538.	324.	-430.	-0.	0.	0.	0.	
85-05-005 TGNT END	0.00007	-0.00005	0.00013		1544.	477.	19587.	12061.	-11200.	3912.	524.
80-05-004 TGNT END	0.00005	-0.00003	0.00012		1544.	477.	19205.	11345.	-8884.	3912.	69.
77-05-003 CMPT END	0.00005	-0.00003	0.00012		1544.	477.	19205.	11345.	-28089.	4389.	0.
76-05-002 TGNT END	0.00005	-0.00003	0.00012		1544.	477.	10209.	9199.	-21139.	4389.	109.
75-05-001 TGNT END	0.00005	-0.00003	0.00012		1544.	477.	10209.	9199.	-10930.	3912.	458.
75-05-001 TGNT BGIN	-0.00003	0.00000	0.00006		1544.	477.	7410.	3953.	6058.	3912.	255.
72-04-003 RSNT BINP	0.00000	0.00001	-0.00001	533.	533.	0.	0.	0.	0.	0.	
71-04-002 RSNT END	0.00000	0.00001	-0.00001	66.	0.	66.	0.	0.	0.	0.	
71-04-001 TGNT END	0.00000	0.00001	-0.00001		533.	66.	-0.	0.	0.	-0.	0.
71-04-001 TGNT BGIN	-0.00000	0.00003	-0.00001		533.	66.	-1844.	475.	-3864.	-0.	141.
70-03-002 TGNT BINP	-0.00000	0.00003	-0.00001		852.	-14.	-4494.	106.	8838.	-275.	274.
65-03-001 ANKR END	-0.	-0.	-0.		852.	-14.	-8819.	-136.	-5642.	-275.	175.
60-02-001 TGNT BINP	-0.00000	0.00003	-0.00001		-319.	80.	2650.	369.	-12702.	275.	676.
60-02-001 TGNT BGIN	-0.00003	0.00000	0.00006		-319.	80.	-2678.	369.	-13132.	-2118.	708.
45-01-009 TGNT BINP	-0.00003	0.00000	0.00006		1238.	558.	4737.	4314.	-7057.	1794.	262.
40-01-008 RSNT END	-0.00005	0.00002	0.00004	-1430.	-1011.	-1011.	-0.	0.	0.	0.	
20-01-007 RSNT END	-0.00005	0.00002	0.00004	723.	-435.	578.	0.	0.	0.	0.	

ELEMENT ID ELEM-BR-ELM	ELEM TYPE	ELEM PONT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
20-01-CC6	TGNT	END	5.CCO	-14.000	18.920	3.250	24.000	0.968			0.000	0.000	-0.006
15-01-C05	BENC	END	5.000	-14.000	15.670	4.712	24.000	0.968	3.000	90.000	-0.001	-0.002	-0.006
15-01-C04	TGNT	END	3.991	-11.175	12.670	8.866	24.000	0.968			-0.001	-0.004	-0.007
10-01-C03	BENC	END	1.009	-2.825	12.670	4.712	24.000	0.968	3.000	90.000	-0.000	-0.003	-0.002
10-01-CC2	TGNT	END	-C.	-0.	9.670	9.670	24.000	0.968			-0.000	-0.001	-0.000
5-01-C01	ANKR	END	-0.	-0.	-C.		24.000	0.968			-0.000	-0.	-0.

ELEMENT ID ELEM-BR-ELM	ELEM TYPE	ELEM PCNT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
20-01-C06	TGNT	END	-0.00005	0.00002	0.00004		-219.	124.	2892.	272.	1844.	1794.	80.
15-01-C05	BENC	END	-0.00005	0.00002	0.00003		-219.	124.	2065.	-130.	1132.	1794.	95.
15-01-C04	TGNT	END	0.00001	0.00001	-0.00001		-219.	124.	867.	-4181.	-839.	1300.	300.
10-01-C03	BENC	END	0.00006	0.00002	-0.00001		-219.	124.	-1389.	-2000.	-61.	-159.	131.
10-01-002	TGNT	END	0.00002	0.00000	-0.00001		-219.	124.	-2588.	2783.	1123.	-653.	205.
5-01-C01	ANKR	END	-0.	-0.	-0.		-219.	124.	-5048.	1586.	-995.	-653.	61.

END, EXECUTION TIME 1.65 MINUTES.

BECHTEL CORPORATION E&I DIVISION NORWALK, CALIFORNIA

ISOMETRIC SKETCH SHEET

PIPE STRESS CALCULATION NO. (19)

PROJECT SONGS - Nº 1

SUBJECT MAIN-STEAM LINE

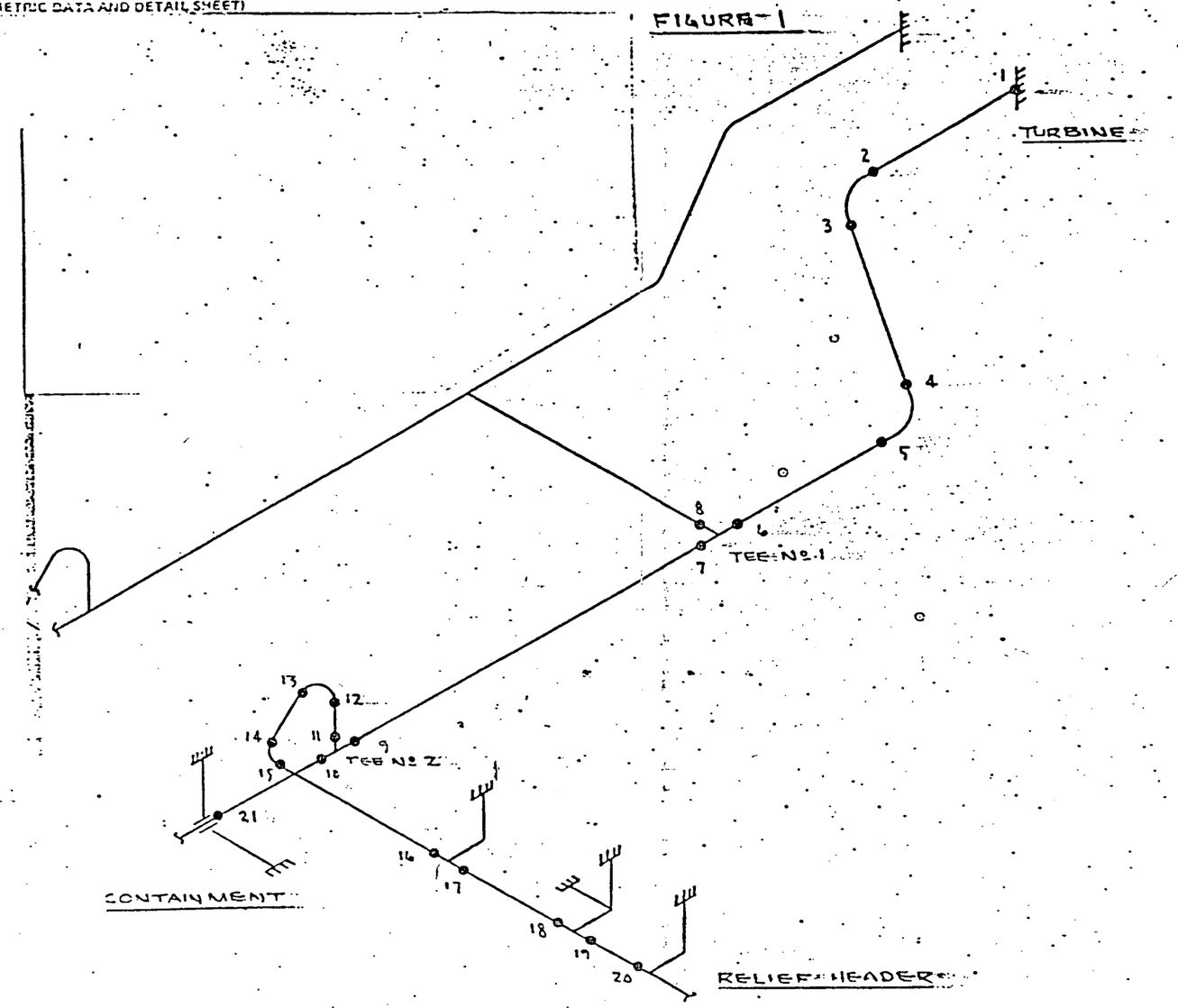
SHEET 1 OF 1

BY Dwg. DATE 6-19-83

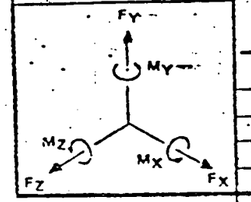
AREA(S) 2

(ADDITIONAL INFORMATION ON ISOMETRIC DATA AND DETAIL SHEET)

FIGURE-1



CONVENTION



REFERENCE DWGS.

MECH.	CIVIL	P&I

MAXIMUM STRESS

TYPE	PT.	PSI
THERM'L	2	12,858.
WEIGHT	12	2,681.
SEISMIC	11	2,815.

Also Available On Aperture Card
TI APERTURE CARD

REV.	BY	DATE	CHK'D	DATE	DESCRIPTION

REVISIONS

REV.	BY	DATE	CHK'D	DATE	DESCRIPTION

REVISIONS

BECHTEL JOB NO. 1304-794

8504040294-57

(162)

MAIN STEAM LINE (TABLE-1)

	SEISMIC					WEIGHT	THERMAL	PRESSURE				$\Sigma\sigma_E$	$\frac{\Sigma\sigma}{S_A+S_H}$	$\frac{\sigma_T}{S_A}$
	X	Z	Y INC. WEIGHT	Y	RESULTANT							$\sigma_E+\sigma_L$		
NODE	σ_{SX}	σ_{SZ}	$\sigma_i=\sigma_{iy}+\sigma_w$	$\sigma_{SY}=.4\sigma_i$	$\sigma_S=\sqrt{\Sigma\sigma_S^2}$	$\sigma_L=.6\sigma_i$	σ_T	P	d	D	$\sigma_P=\frac{Pd^2}{D^2-d^2}$	$+\sigma_T+\sigma_P$		
1	973.	61.	913.	365.	994.	548.	5312.	1000.	22.06	24.	5446.	12,300.	.328	.236
2	87.	205.	276.	110.	248.	166.	12,858.					18,718.	.499	.571
3	338.	131.	378.	150.	392.	226.	8193.					14,257.	.380	.364
4	165.	300	797.	319.	448.	478.	7059.					13,441.	.358	.313
5	323.	95.	929.	372.	502.	557.	11,747.					18,252.	.486	.522
6	—	—	—	—	1256.*	733.*	8279.*					15,716.	.419	.368
7	—	—	—	—	991.*	691.*	7052.*		22.06	24	5446.	14,180.	.378	.313
8	—	—	—	—	1385.*	297.*	5064.*		18.38	20.	5433.	12,179.	.325	.225
9	—	—	—	—	2343.*	514.*	4090.*		22.06	24.	5446.	12,493.	.333	.182
10	—	—	—	—	1568.*	1537.*	3693.*					12,536.	.333	.162
11	—	—	—	—	2815.*	2102.*	1104.*					11,467.	.306	.049
12	296.	1257.	4446.	1787.	2455.	2681.	1273.					11,855.	.316	.057
13	43.	672.	3151.	1260.	1429.	1891.	1332.					9,998.	.267	.059
14	45.	529.	3155.	1262.	1373.	1893.	1224.					9936.	.265	.054
15	302.	475.	2370.	948.	1102.	1422.	1319.					9289.	.248	.059
16	393.	1244.	2211.	884.	1596.	1327.	5127.					8,561.	.236	.023
17	58.	182.	194.	78.	218.	116.	515.	1000.	22.06	24.	5446.	6,287.	.168	.023

NOTES

MATL. A-106 GR B

$T_C = 70°F$, $T_H = 505.°F$

$S_C = S_H = 15,000$ LBS/IN^2

$S_A = f(1.25\,S_C + .25\,S_H)$

$= (1)[(1.25)15,000 + (.25)15,000.]$

$S_A = 22,500.$ LBS/IN^2

$S_A + S_H = 22,500 + 15,000$

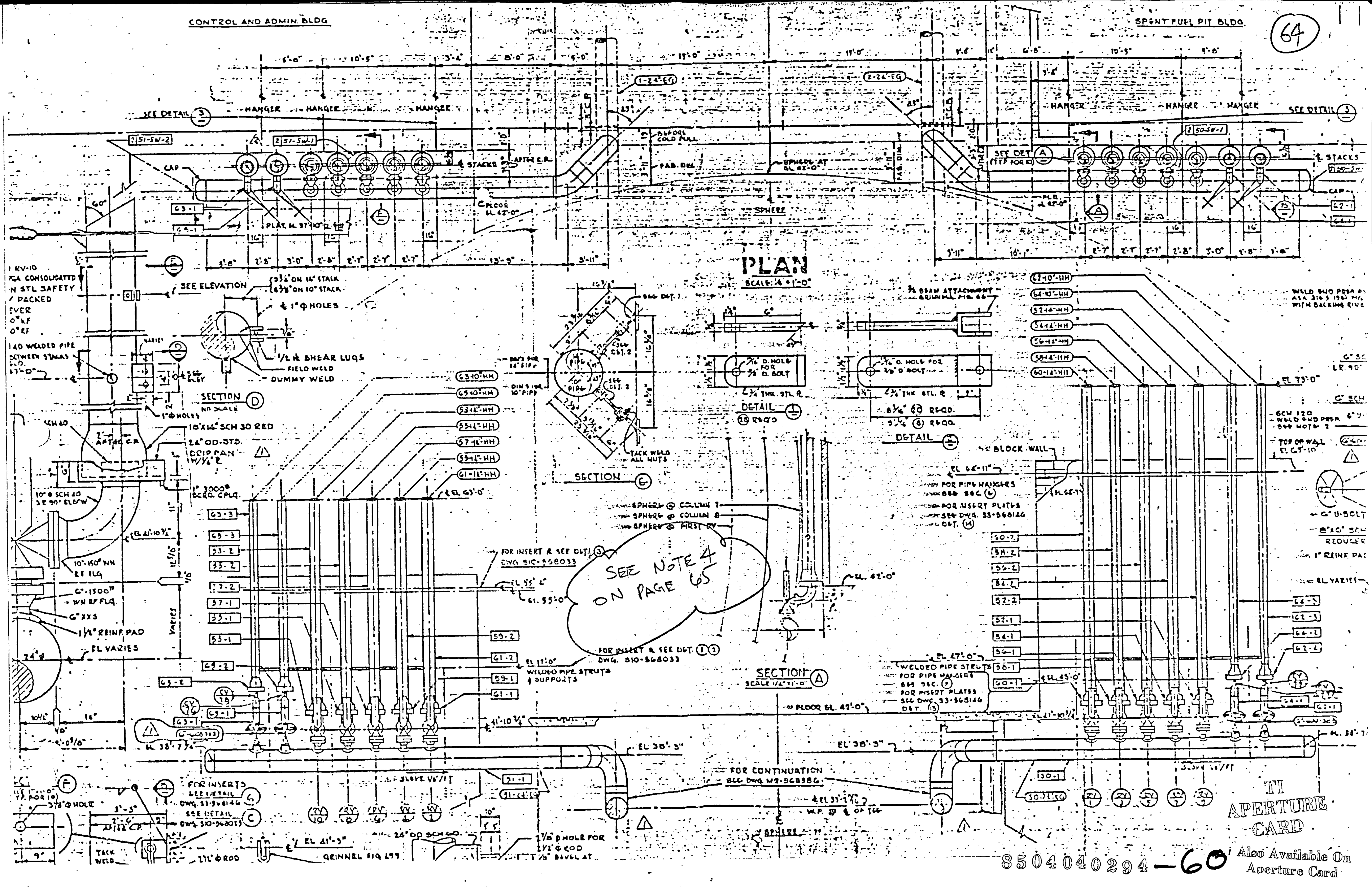
$S_A + S_H = 37,500.$ LBS./IN^2

* HAND-CALCULATED BY USING MOMENTS FROM PROGRAM OUTPUT WITH AN APPROPRIATE STRESS INTENSIFICATION FACTOR.

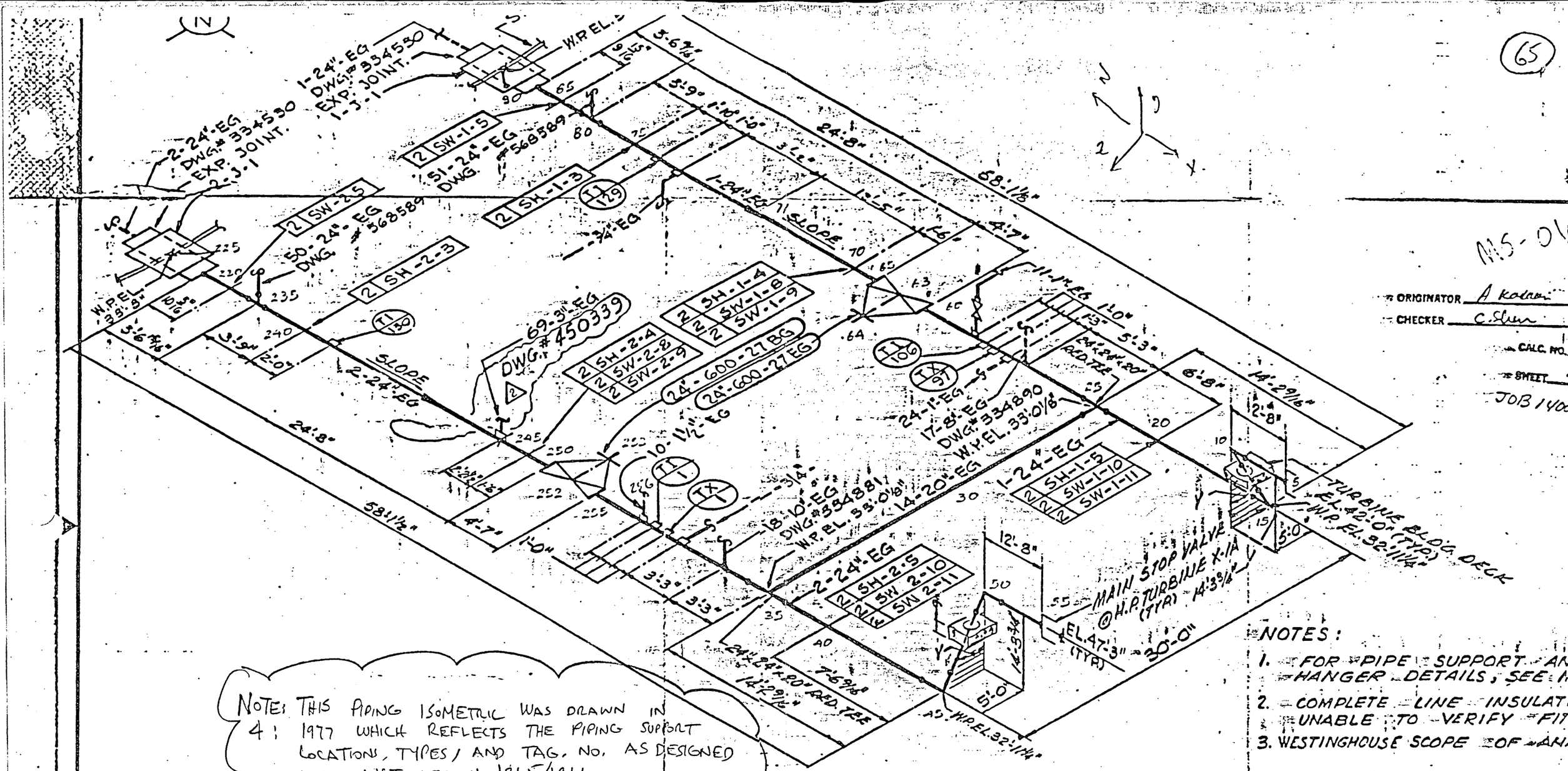
(63)

MAIN STEAM LINE (TABLE 1) CONT.

	SEISMIC					WEIGHT	THERMAL	PRESSURE				$\Sigma\sigma_a$	$\frac{\Sigma\sigma}{S_a+S_h}$	$\frac{\sigma_T}{-S_A}$
	X	Z	Y INCL. WEIGHT	Y	RESULTANT							$\sigma_s+\sigma_w$		
NODE	σ_{sx}	σ_{sz}	$\sigma_i=\sigma_{iy}+\sigma_w$	$\sigma_{sy}=.4\sigma_i$	$\sigma_s=\sqrt{\Sigma\sigma_s^2}$	$\sigma_w=.6\sigma_i$	σ_T	P	d	D	$\sigma_p=\frac{Pd^2}{D^2-d^2}$	$+\sigma_T+\sigma_p$		
18	822.	1725.	1259.	504.	1979.	755.	134.	1000	22.06	24.	5446.	8,314.	.222	.005
19	72.	297.	153.	61.	312.	92.	137.					5,987.	.160	.006
20	266.	1410.	1173.	469.	1510.	704.	84.					7,744.	.207	.004
21	167.	262.	183.	73.	319.	110.	3457.	1000	22.56	24.	5446.	7,332.	.249	.154



CONTROL AND ADMIN. BLDG
SPENT FUEL PIT BLDG.
64
PLAN
SCALE: 1/4"=1'-0"
SECTION D
SECTION E
SECTION A
DETAIL
SEE DETAIL 3
HANGER
STACKS
SPHERE
CAP
SEE ELEVATION
1/2" SHEAR LUGS
FIELD WELD
DUMMY WELD
18"x14" SCH 30 RED
24" OD-STD.
10"-150# WN RF FLG
6"-1500# WN RF FLG
6" XXS
1 1/2" REINF. PAD
EL VARIES
BLOCK WALL
FOR PIPE HANGERS SEE SEC.
FOR INSERT PLATES SEE DWG. 53-568146
FOR INSERT & SEE DET. DWG. 510-568033
WELDED PIPE STRUTS & SUPPORTS
FLOOR EL. 42'-0"
FOR CONTINUATION SEE DWG. M2-568386
EL. 38'-3"
24" OD SCH 60
GRINNEL FIG 299
TACK WELD
SEE NOTE 4 ON PAGE 65
TI APERTURE CARD
8504040294-60
Also Available On Aperture Card



NOTE: THIS PIPING ISOMETRIC WAS DRAWN IN 1977 WHICH REFLECTS THE PIPING SUPPORT LOCATIONS, TYPES, AND TAG. NO. AS DESIGNED AND INSTALLED IN 1965/1966. THIS PIPE SUPPORT LOCATIONS & TYPES HAVE BEEN RE-VERIFIED IN 79-14 PROGRAM

M5-04

ORIGINATOR A Kalra
CHECKER C. Shen
CALC. NO. 1
SHEET 4
JOB 14000

NOTES:

1. FOR PIPE SUPPORT AND HANGER DETAILS, SEE M
2. COMPLETE LINE INSULATE UNABLE TO VERIFY FITT
3. WESTINGHOUSE SCOPE OF ANAL

CLASS 2 PIPI
SAFETY RELATE
Also Available On Aperture Card
BOP-SEISMIC REEVALUAT
ANALYSIS BOUNDARY-ISOM
CERTIFIED AS BUILT
UNIT 1

NO.	SCE P.E.	DATE
2		12/11/78
1		7/14/78
0		9/1/77

BECHTEL CORPORATION

J.O. NO. SAN ONOFRE NUCLEAR GENERATIN

TI APERTURE CARD

PIPING FLEXIBILITY CALCULATION

BECHTEL CORPORATION
4550 SEVILLE AVENUE
VERNON, CALIFORNIA

Fx Fy Fz
Mz My Mx

Sc =
Sh =
SA = 1.25Sc + .25Sh
SA =

MAXIMUM STRESS AT POINT

3246-3

SIGNATURE W. D. Grant DATE 12-29-64
PROJECT SAN ONOFRE JOB NO. 3246
SUBJECT FEEDWATER - SPHERE TO GEN. E-1B X & Z ACCELERATION (.5G)

CONVENTION FOR POSITIVE FORCES & MOMENTS

DESIGN DATA

PRESS. —
TEMP. 91°F

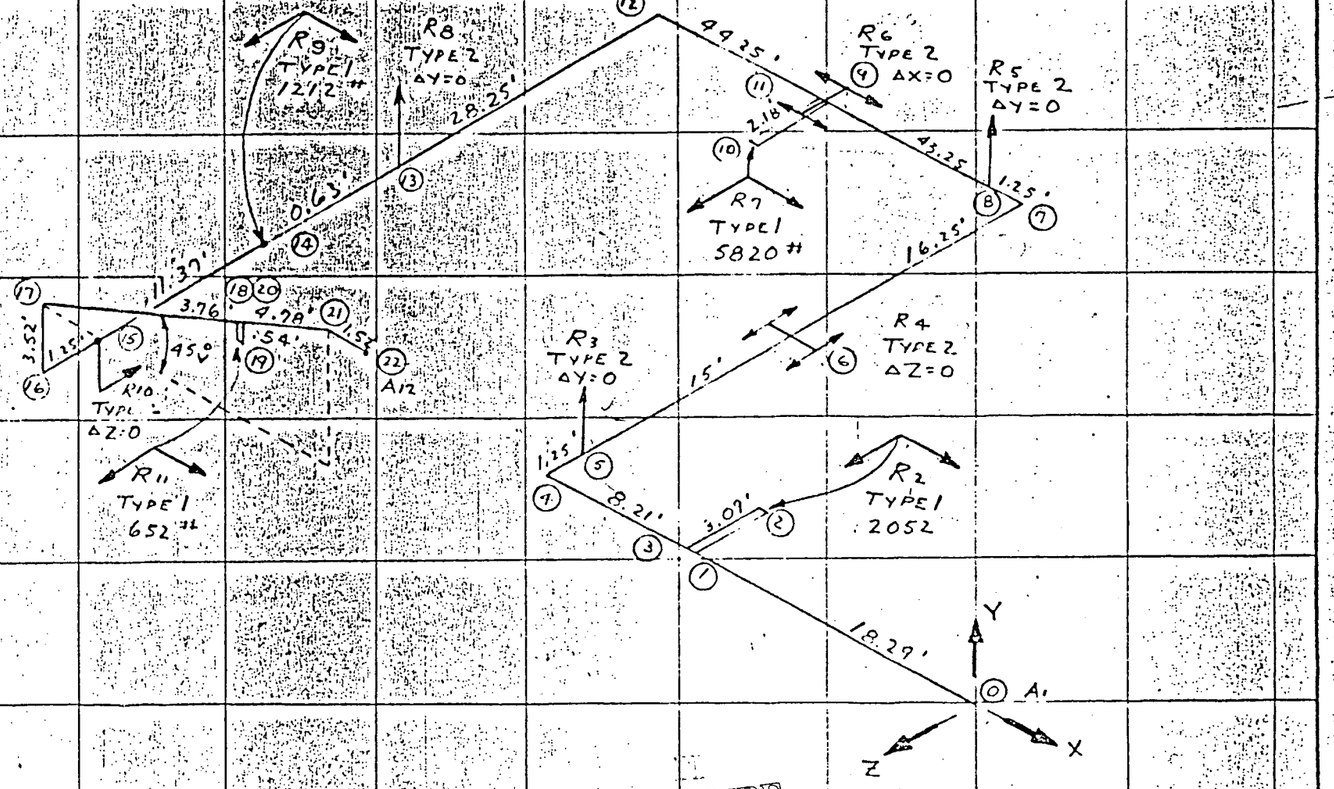
MAT'L CARB. STL.
EXP. COEF. .00000638
Ec x 10^6 29.9

MEMBER DATA

30" O.D. x 9" W.T. 2, 3, 10, 11, 19, 20
10.75" x .5 W.T. ALL OTHERS

ANCHOR DATA

ANCHOR		COORDINATES			END DEFLECTION		
No.	Pt.	X	Y	Z	ΔX	ΔY	ΔZ
A1	0	0	0	0	0	0	0
A12	22	-107.69'	9.56'	9.0'	0	0	0



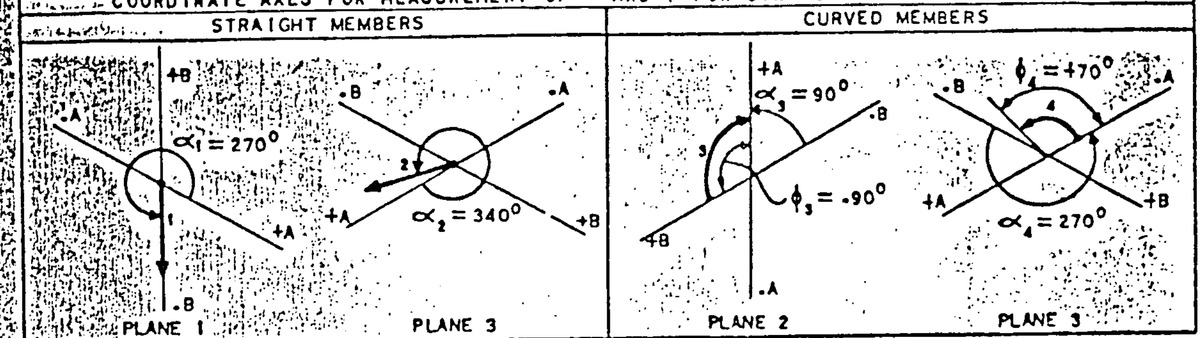
ECC NO. SAN ONOFRE FDWATER-SPHERE TO E-1B X ACCELERATION	NAME W. D. GROSS
DATE 12-29-64	PAGE 17 OF 21

INPUT DATA FOR IBM - THREE-PLANE PIPING STRESS ANALYSIS

INSTRUCTIONS

1. REFER TO DESIGN PRACTICE ________ FOR DESCRIPTION OF PROGRAM.
2. USE ONLY CAPITAL LETTERS AND ARABIC FIGURES, WRITE ALPHABETICAL LETTERS O THUS "Ø", AND I THUS "I"; FIGURES ZERO THUS "0", ONE THUS "1".
3. ENTER DATA FOR EACH ANCHOR, STRAIGHT OR CURVED MEMBER, JUNCTION, OR RESTRAINT ON A SEPARATE LINE.
4. NO ENTRY NEED BE MADE FOR ANCHOR DISPLACEMENTS. RESTRAINT DEFLECTION OR FORCE IF VALUES ARE ZERO.
5. THE O.D., THICK., & TEMP. NEED TO BE ENTERED ONLY FOR THE FIRST STRAIGHT OR CURVED MEMBER. THESE VALUES WILL BE USED FOR ALL SUCCEEDING MEMBERS UNTIL DIFFERENT VALUES ARE ENTERED. THE NEW VALUES WILL THEN BE USED UNTIL ANOTHER ENTRY IS MADE.
6. NUMBER STRAIGHT & CURVED MEMBERS CONSECUTIVELY STARTING WITH 1; DITTO FOR ANCHORS & RESTRAINTS; DITTO FOR JUNCTIONS.

COORDINATE AXES FOR MEASUREMENT OF α AND ϕ FOR STRAIGHT AND CURVED MEMBERS



CARD NO.		
A	NUMBER OF PROBLEMS IN RUN (FILL IN ON FIRST SHEET ONLY)	
1	PROJECT: SAN ONOFRE	REFINERY OR PLANT; DATE: DECEMBER 29, 1964
2	NAME: W D GROSS	
3	LINE DESIG.: FEEDWATER SPHERE TO GEN E-1B X ACCELERATION .5G	CASE 1

CARD NO.	SHAPE COEFFICIENT CHECK	MODULUS OF ELASTICITY (PSI)	EXPANSION COEFFICIENT (IN/IN/DEG. F)	NUMBER OF RESTRAINTS	NO. OF TYPE 1 & 3 RESTR.	NO. OF PASSES	PRINT SHAPE COEFFICIENT	PRINT EQUATIONS	ALLOWABLE STRESS (PSI)
4	101.0	27900000.	0.00000638	10	4	16	0	0	

CARD NO.	TYPE OF MEMBER (STRAIGHT OR CURVED = 0, JUNCTION = 50, ANCHOR = 75, RESTR. = 100)	MEMBER NO. STRAIGHT OR CURVED	MEMBER NO. JUNCTION	MEMBER NO. ANCHORS & RESTR.	PLANE 1, 2 OR 3	ANGLE α (DEG)	LENGTH OR RADIUS (FT)	OUTSIDE DIAMETER (IN)	THICKNESS (IN)	TEMP ΔT (F°)	CURVED ONLY ROTATION AND ϕ (+ OR −, DEG)	ANCHOR DISPLACEMENT ΔX (IN)	ΔY (IN)	ΔZ (IN)	ϕX (DEG)	ϕY (DEG)	ϕZ (DEG)	RESTRAINTS DIRECTION 1, 2 OR 3	DEFLECTION FOR TYPE 2 RESTRAINTS (0 FOR TYPES 1&3) (IN)	FORCE FOR TYPES 1 & 3 RESTRAINTS ONLY (LBS)	TYPE OF RESTRAINT 1, 2 OR 3
5	.75			1								.000	.000	.000							
6		1			2	270	18.27	10.75	.5		1										
7		2			2	180	3.09	30.	9.									1		2052.	1
8	100			2																	
9		3			2	0	3.09														
10		4			2	270	8.21	10.75	.5												
11		5			2	180	1.25											2	.000		2
12	100			3																	
13		6			2	180	15.											3	.000		2
14	100			4																	
15		7			2	180	16.25														
16		8			2	270	1.25											2	.000		2
17	100			5																	
18		9			2	270	43.25											1	.000		2
19	100			6																	
20		10			2	0	2.18	30.	9.									1		5820.	1
21	100			7																	
22		11			2	180	2.18														
23		12			2	270	44.25	10.75	.5												
24		13			2	0	28.25											2	.000		2
25	100			8																	
26		14			2	0	.63											1		1212.	1
27	100			9																	
28		15			2	0	11.37											3	.000		2
29	100			10																	
30		16			2	0	1.25														
31		17			3	90	3.52														
32		18			3	45	3.26														
33		19			3	270	.54	30.	9.									1		652.	1
34	100			11																	
35		20			3	90	.54														
36		21			3	45	7.79	10.75	.5												
37		22			3	0	1.52														
38	.75			12								.000	.000	.000							
39						(ONE BLANK CARD HERE)															

APERTURE CARD

Also Available On Aperture Card

8504040294-63

INPUT DATA FOR IBM — THREE-PLANE PIPING STRESS ANALYSIS

ECC NO. SAN ONOFRE FDWATER-SPHERE TO E-1B	NAME W. D. GROSS
DATE Z ACCELERATION 12-29-64	PAGE 18 OF 27

INSTRUCTIONS

1. REFER TO DESIGN PRACTICE _____ FOR DESCRIPTION OF PROGRAM.
2. USE ONLY CAPITAL LETTERS AND ARABIC FIGURES, WRITE ALPHABETICAL LETTERS O THUS "Ø", AND I THUS "I"; FIGURES ZERO THUS "0", ONE THUS "1".
3. ENTER DATA FOR EACH ANCHOR, STRAIGHT OR CURVED MEMBER, JUNCTION, OR RESTRAINT ON A SEPARATE LINE.
4. NO ENTRY NEED BE MADE FOR ANCHOR DISPLACEMENTS, RESTRAINT DEFLECTION OR FORCE, IF VALUES ARE ZERO.
5. THE O.D., THICK., & TEMP. NEED TO BE ENTERED ONLY FOR THE FIRST STRAIGHT OR CURVED MEMBER. THESE VALUES WILL BE USED FOR ALL SUCCEEDING MEMBERS UNTIL DIFFERENT VALUES ARE ENTERED. THE NEW VALUES WILL THEN BE USED UNTIL ANOTHER ENTRY IS MADE.
6. NUMBER STRAIGHT & CURVED MEMBERS CONSECUTIVELY STARTING WITH 1; DITTO FOR ANCHORS & RESTRAINTS; DITTO FOR JUNCTIONS.

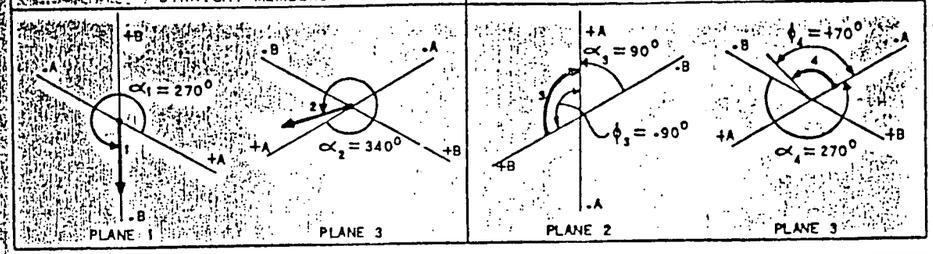
CARD NO.

1	NUMBER OF PROBLEMS IN RUN (FILL IN ON FIRST SHEET ONLY)
1A	REFINERY OR PLANT
2	PROJECT — DATE 19
3	NAME
4	LINE DESIG. FEEDWATER SPHERE TO GEN E-1B Z ACCELERATION .5G CASE 1

SHAPE COEFFICIENT CHECK	MODULUS OF ELASTICITY (PSI)	EXPANSION COEFFICIENT (IN/IN/DEG. F)	NUMBER OF RESTRAINTS	NO. OF TYPE 1 & 3 RESTR.	NO. OF PASSES	PRINT SHAPE COEFFICIENT	PRINT EQUATIONS	ALLOWABLE STRESS, (PSI)
1.0	0 0 0 0 0 0.	0.0 0 0 0 0 0				0	0	

COORDINATE AXES FOR MEASUREMENT OF ∝ AND ϕ FOR STRAIGHT AND CURVED MEMBERS

STRAIGHT MEMBERS — CURVED MEMBERS



TYPE OF MEMBER (STRAIGHT OR CURVED = 0, JUNCTION = 50, ANCHOR = 75, RESTR. = 100)	MEMBER NO. STRAIGHT OR CURVED	MEMBER NO. JUNCTION	MEMBER NO. ANCHORS & RESTR.	STRAIGHT AND CURVED MEMBERS: PLANE 1, 2 OR 3	ANGLE ∝ (DEG)	LENGTH OR RADIUS (FT)	OUTSIDE DIAMETER (IN)	THICKNESS (IN)	TEMP ΔT (F°)	CURVED ONLY: ROTATION AND ϕ (+ OR -, DEG)
100			2							
100			9							
100			11							

SAME AS SHEET # 17 EXCEPT AS NOTED

ANCHOR DISPLACEMENT: ΔX (IN)	ΔY (IN)	ΔZ (IN)	ϕX (DEG)	ϕY (DEG)	ϕZ (DEG)

RESTRAINTS: DIRECTION 1, 2 OR 3	DEFLECTION FOR TYPE 2 RESTRAINTS (0 FOR TYPES 1 & 3) (IN)	FORCE FOR TYPES 1 & 3 RESTRAINTS ONLY (LBS)	TYPE OF RESTRAINT 1, 2 OR 3
3		2058	1
3		5820	1
3		12112	1
3		652	1

P I P I N G F L E X I B I L I T Y A N A L Y S I S

SAN ONOFRE — W D GROSS — DECEMBER 29,1964
FEEDWATER SPHERE TO GEN E-IB X ACCELERATION .5G CASE 1 — ENGINEERING DEPT. PROGRAM ENGR 33 — SHEET 1

I N P U T D A T A

MODULUS OF ELASTICITY= 27900000. PSI EXPANSION COEFFICIENT= 0.00000638 IN/IN/DEG F ALLOWABLE STRESS= -0. PSI

S T R A I G H T O R C U R V E D M E M B E R S A N C H O R S A N D R E S T R A I N T S

MEMB. NO.	PLANE	ALPHA DEG.	LENGTH OR RADIUS,FT.	O.D. IN.	THICK. IN.	TEMP. DEG.F.	PHI DEG.
1	2	270.	18.29	10.750	0.500	1.	
2	2	180.	3.09	30.000	9.000	1.	
3	2	0.	3.09	30.000	9.000	1.	
4	2	270.	8.21	10.750	0.500	1.	
5	2	180.	1.25	10.750	0.500	1.	
6	2	180.	15.00	10.750	0.500	1.	
7	2	180.	16.25	10.750	0.500	1.	
8	2	270.	1.25	10.750	0.500	1.	
9	2	270.	43.25	10.750	0.500	1.	
10	2	0.	2.18	30.000	9.000	1.	
11	2	180.	2.18	30.000	9.000	1.	
12	2	270.	44.25	10.750	0.500	1.	
13	2	0.	28.25	10.750	0.500	1.	
14	2	0.	0.63	10.750	0.500	1.	
15	2	0.	11.37	10.750	0.500	1.	
16	2	0.	1.25	10.750	0.500	1.	
17	3	90.	3.52	10.750	0.500	1.	
18	3	45.	3.76	10.750	0.500	1.	
19	3	270.	0.54	30.000	9.000	1.	
20	3	90.	0.54	30.000	9.000	1.	
21	3	45.	4.78	10.750	0.500	1.	
22	3	0.	1.52	10.750	0.500	1.	

(PHI X,Y,Z IN DEGREES---DELTA X,Y,Z IN INCHES)

ANCHOR NO.	PHI X	PHI Y	PHI Z	DELTA X	DELTA Y	DELTA Z
1	0.000	0.000	0.000	0.000	0.000	0.000

RESTRAINT NO.	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
2	1	1	0.000	-2052.00
3	2	2	0.000	0.00
4	2	3	0.000	0.00
5	2	2	0.000	0.00
6	2	1	0.000	0.00
7	1	1	0.000	5920.00
8	2	2	0.000	0.00
9	1	1	0.000	1212.00
10	2	3	0.000	0.00
11	1	1	0.000	652.00

PIPING FLEXIBILITY ANALYSIS

STRAIGHT OR CURVED MEMBERS — ANCHORS AND RESTRAINTS

MEMB. NO.	PLANE	ALPHA DEG.	LENGTH OR RADIUS,FT.	O.D. IN.	THICK. IN.	TEMP. DEG.F.	PHI DEG.

(PHI X,Y,Z IN DEGREES---DELTA X,Y,Z IN INCHES)

	ANCHOR	PHI X	PHI Y	PHI Z	DELTA X	DELTA Y	DELTA Z
	NO.12	0.000	0.000	0.000	0.000	0.000	0.000

(7)

PIPING FLEXIBILITY ANALYSIS-ENGR 33

FEEDWATER_SPHERE_TO_GEN_E-IB_X_ACCELERATION_.5G CASE 1 W D GROSS DECEMBER 29,1964

FREE ENDS - COORDINATES AND EXPANSION VALUES

ANCHOR	X (FT)	Y (FT)	Z (FT)	EIDX (LB-FT*3)	EIDY (LB-FT*3)	EIDZ (LB-FT*3)
12	-107.69	9.56	9.00	28214.78	-2504.35	-2357.97

TEST NO. 5 OKAY ! OK

PIPING FLEXIBILITY ANALYSIS-ENGR 33

FEEDWATER SPHERE TO GEN E-IB X ACCELERATION .5G CASE 1 W D GROSS DECEMBER 29,1964

DEFLECTION OR FORCE AT RESTRAINTS

RESTRAINT NUMBER TYPE 1 OR 3 -- TYPE 2	DEFLECTION (IN)	FORCE ON ORIGIN (LBS)	FORCE ON RESTRAINT (LBS)
2	.01103		
7	.04453		
9	.26264		
11	.03420		
3		-7.43	7.43
4		489.01	-489.01
5		-15.49	15.49
6		-6303.96	6303.96
8		302.72	-302.72
10		305.60	-305.60

TOTAL MOMENTS AND FORCES ON ANCHORS

ANCHOR	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	-26.48	1797.89	100.15	1940.82	-11.75	272.42
12	-1567.12	281.53	7612.74	1491.22	291.54	522.19

ROTATION AND DEFLECTION OF MEMBERS

MEMBER	PHI X (DEG)	PHI Y (DEG)	PHI Z (DEG)	DELTA X (IN)	DELTA Y (IN)	DELTA Z (IN)
ORIGIN	.000	.000	.000	.000	.000	.000
1	-.001	-.018	-.000	-.000	-.001	.007
2	-.001	-.018	-.000	.011	-.002	.007
3	-.001	-.018	-.000	-.000	-.001	.007
4	-.001	.006	-.002	-.001	.000	.001
5	-.001	.007	-.003	-.003	-.000	.001
6	-.001	.006	-.008	-.033	-.004	-.000
7	.001	-.035	-.015	.004	-.004	-.001
8	.001	-.039	-.015	.003	.000	-.011
9	.011	.097	-.013	-.000	.150	-.174
10	.011	.097	-.013	.045	.145	-.174
11	.011	.097	-.013	.000	.150	-.174
12	.021	.039	.018	-.003	.150	-.003
13	.032	-.018	.057	.265	.000	-.001
14	.032	-.024	.058	.263	-.004	-.001
15	.010	-.058	.074	.134	-.066	.000
16	.004	-.052	.076	.120	-.068	.000
17	-.008	-.029	.072	.064	-.067	-.002
18	-.011	-.012	.057	.028	-.031	.003
19	-.011	-.012	.057	.034	-.031	.004
20	-.011	-.012	.057	.028	-.031	.003
21	-.004	-.000	.017	-.000	-.003	.000
22	-.000	-.000	-.000	-.000	.000	-.000

PIPING FLEXIBILITY ANALYSIS-ENGR 33

FEEDWATER_SPHERE_TO_GEN E-IB X_ACCELERATION .5G CASE 1 W D GROSS DECEMBER 29,1964

STRESS, MOMENTS AND FORCES ON MEMBERS

MEMBER START/END	STRESS (PSI)	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	548.03	-26.48	1797.89	100.15	1940.82	-11.75	272.42
	969.81	-26.48	-3184.68	-114.70	1940.82	-11.75	272.42
2	14.81	-26.48	-3184.68	-114.70	1940.82	-11.75	272.42
	13.08	9.82	2812.45	-114.70	1940.82	-11.75	272.42
3	13.08	9.82	2812.45	-114.70	-111.18	-11.75	272.42
	14.67	-26.48	3156.00	-114.70	-111.18	-11.75	272.42
4	961.09	-26.48	3156.00	-114.70	-111.18	-11.75	272.42
	287.19	-26.48	919.42	-211.14	-111.18	-11.75	272.42
5	287.19	-26.48	919.42	-211.14	-111.18	-11.75	272.42
	246.07	-11.79	780.45	-211.14	-111.18	-11.75	272.42
6	246.07	-11.79	780.45	-211.14	-111.18	-4.31	272.42
	278.01	52.88	-887.24	-211.14	-111.18	-4.31	272.42
7	278.01	52.88	-887.24	-211.14	-111.18	-4.31	-216.58
	823.17	122.95	-2693.90	-211.14	-111.18	-4.31	-216.58
8	823.17	122.95	-2693.90	-211.14	-111.18	-4.31	-216.58
	741.30	122.95	-2423.17	-216.53	-111.18	-4.31	-216.58
9	741.30	122.95	-2423.17	-216.53	-111.18	11.17	-216.58
	2115.10	122.95	6944.12	266.78	-111.18	11.17	-216.58
10	32.29	122.95	6944.11	266.78	6192.78	11.17	-216.58
	30.49	147.31	-6556.15	266.78	6192.78	11.17	-216.58
11	30.49	147.31	-6556.14	266.78	372.78	11.17	-216.58
	26.72	122.95	-5743.49	266.78	372.78	11.17	-216.58
12	1750.12	122.95	-5743.49	266.78	372.78	11.17	-216.58
	1192.02	122.95	3840.39	761.26	372.78	11.17	-216.58
13	1192.02	122.95	3840.39	761.26	372.78	11.17	-216.58
	2053.55	438.63	-6690.61	761.26	372.78	11.17	-216.58
14	2053.55	438.63	-6690.61	761.26	372.78	-291.54	-216.58
	2121.65	254.96	-6925.47	761.26	372.78	-291.54	-216.58
15	2121.65	254.96	-6925.47	761.26	-839.22	-291.54	-216.58
	1246.89	-3059.86	2616.48	761.26	-839.22	-291.54	-216.58
16	1246.89	-3059.86	2616.48	761.26	-839.22	-291.54	-522.19
	1543.98	-3424.29	3665.50	761.26	-839.22	-291.54	-522.19
17	1543.98	-3424.29	3665.50	761.26	-839.22	-291.54	-522.19
	1386.57	-1586.20	3665.50	-2192.80	-839.22	-291.54	-522.19
18	1386.57	-1586.20	3665.50	-2192.80	-839.22	-291.54	-522.19
	1310.30	-197.85	2277.16	-3648.92	-839.22	-291.54	-522.19
19	20.00	-197.85	2277.16	-3648.92	-839.22	-291.54	-522.19
	18.37	-479.83	2277.16	-3195.74	-839.22	-291.54	-522.19
20	18.37	-479.83	2277.16	-3195.74	-1491.22	-291.54	-522.19
	21.41	-197.85	2277.16	-4001.00	-1491.22	-291.54	-522.19
21	1402.26	-197.85	2277.16	-4001.00	-1491.22	-291.54	-522.19
	2502.36	1567.12	512.19	-8055.89	-1491.22	-291.54	-522.19
22	2502.36	1567.12	512.19	-8055.89	-1491.22	-291.54	-522.19
	2366.31	1567.12	-281.53	-7612.74	-1491.22	-291.54	-522.19

P I P I N G F L E X I B I L I T Y A N A L Y S I S

SAN ONOFRE — W D GROSS — DECEMBER 29,1964
FEEDWATER_SPHERE TO GEN E-1B Z ACCELERATION .5G CASE 1 — ENGINEERING DEPT. PROGRAM ENGR 33 — SHEET 1

I N P U T D A T A

MODULUS OF ELASTICITY= 27900000. PSI EXPANSION COEFFICIENT= 0.00000638 IN/IN/DEG F ALLOWABLE STRESS= -0. PSI

S T R A I G H T O R C U R V E D M E M B E R S

MEMB NO.	PLANE	ALPHA DEG.	LENGTH OR RADIUS,FT.	O.D. IN.	THICK. IN.	TEMP. DEG.F.	PHI DEG.
1	2	270.	18.29	10.750	0.500	1.	
2	2	180.	3.09	30.000	9.000	1.	
3	2	0.	3.09	30.000	9.000	1.	
4	2	270.	8.21	10.750	0.500	1.	
5	2	180.	1.25	10.750	0.500	1.	
6	2	180.	15.00	10.750	0.500	1.	
7	2	180.	16.25	10.750	0.500	1.	
8	2	270.	1.25	10.750	0.500	1.	
9	2	270.	43.25	10.750	0.500	1.	
10	2	0.	2.18	30.000	9.000	1.	
11	2	180.	2.18	30.000	9.000	1.	
12	2	270.	44.25	10.750	0.500	1.	
13	2	0.	28.25	10.750	0.500	1.	
14	2	0.	0.63	10.750	0.500	1.	
15	2	0.	11.37	10.750	0.500	1.	
16	2	0.	1.25	10.750	0.500	1.	
17	3	90.	3.52	10.750	0.500	1.	
18	3	45.	3.76	10.750	0.500	1.	
19	3	270.	0.54	30.000	9.000	1.	
20	3	90.	0.54	30.000	9.000	1.	
21	3	45.	4.78	10.750	0.500	1.	
22	3	0.	1.52	10.750	0.500	1.	

A N C H O R S A N D R E S T R A I N T S

(PHI_X,Y,Z_IN_DEGREES---DELTA_X,Y,Z_IN_INCHES)

ANCHOR NO. 1	PHI X	PHI Y	PHI Z	DELTA X	DELTA Y	DELTA Z
	0.000	0.000	0.000	0.000	0.000	0.000

RESTRAINT NO.	TYPE	DIRECTION	DEFLECTION,IN.	FORCE,LBS.
2	1	3	0.000	2058.00
3	2	2	0.000	0.00
4	2	3	0.000	0.00
5	2	2	0.000	0.00
6	2	1	0.000	0.00
7	1	3	0.000	5820.00
8	2	2	0.000	0.00
9	1	3	0.000	1212.00
10	2	3	0.000	0.00
11	1	3	0.000	652.00

PIPING FLEXIBILITY ANALYSIS

STRAIGHT OR CURVED MEMBERS							ANCHORS AND RESTRAINTS (PHI X,Y,Z IN DEGREES---DELTA X,Y,Z IN INCHES)					
MEMB. NO.	PLANE	ALPHA DEG.	LENGTH OR RADIUS,FT.	O.D. IN.	THICK. IN.	TEMP. DEG.F.	PHI DEG.	ANCHOR NO.	PHI X	PHI Y	PHI Z	DELTA X	DELTA Y	DELTA Z
								12	0.000	0.000	0.000	0.000	0.000	0.000

PIPING FLEXIBILITY ANALYSIS-ENGR.33

FEEDWATER SPHERE TO GEN E-1B Z ACCELERATION .5G CASE 1 W D GROSS DECEMBER 29,1964

FREE ENDS - COORDINATES AND EXPANSION VALUES

ANCHOR	X (FT)	Y (FT)	Z (FT)	EIDX (LB-FT*3)	EIDY (LB-FT*3)	EIDZ (LB-FT*3)
12	-107.69	9.56	0.00	28214.78	-2504.35	-2357.97

TEST NO. 5 OKAY

PIPING FLEXIBILITY ANALYSIS-ENGR 33

FEEDWATER_SPHERE_TO_GEN_E-IB_Z_ACCELERATION_.5G CASE 1 W D GROSS DECEMBER 29,1964

DEFLECTION_OR_FORCE_AT_RESTRAINTS

RESTRAINT NUMBER TYPE 1 OR 3	-- TYPE 2	DEFLECTION (IN)	FORCE ON ORIGIN (LBS)	FORCE ON RESTRAINT (LBS)
2		.20537		
7		9.85970		
9		.00036		
11		-.00107		
	3		10.32	-10.32
	4		-3314.55	3314.55
	5		22.93	-22.93
	6		615.10	-615.10
	8		-702.68	702.68
	10		-5713.80	5713.80

TOTAL MOMENTS AND FORCES ON ANCHORS

ANCHOR	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	41.13	14527.34	-147.47	2107.82	17.33	1707.38
12	4724.69	3534.49	-8005.33	-1492.71	-686.77	-993.73

ROTATION AND DEFLECTION OF MEMBERS

MEMBER	PHI X (DEG)	PHI Y (DEG)	PHI Z (DEG)	DELTA X (IN)	DELTA Y (IN)	DELTA Z (IN)
ORIGIN	.000	.000	.000	.000	.000	.000
1	.001	-.028	.000	-.000	.002	.206
2	.001	-.028	.000	.018	.003	.205
3	.001	-.028	.000	-.001	.002	.206
4	.002	-.203	.003	-.001	-.001	.001
5	.002	-.225	.004	.056	-.000	.001
6	.001	-.128	.012	.788	.006	.000
7	-.002	.723	.021	.001	.006	.000
8	-.002	.815	.022	.001	-.000	.202
9	-.018	.024	.021	.000	-.224	9.860
10	-.018	.022	.021	.011	-.216	9.860
11	-.018	.021	.021	.001	-.224	9.860
12	-.034	-.845	-.024	-.001	-.242	.000
13	-.051	.262	-.079	-.898	-.000	.000
14	-.051	.268	-.080	-.863	.007	.000
15	.007	.230	-.102	-.215	.085	-.000
16	.021	.209	-.105	-.157	.081	.000
17	.049	.127	-.097	-.080	.081	.028
18	.043	.064	-.069	-.033	.035	.004
19	.043	.064	-.069	-.041	.035	-.001
20	.043	.064	-.069	-.033	.035	.004
21	.013	.009	-.018	-.000	.003	.001
22	.000	-.000	.000	.000	-.000	-.000

PIPING FLEXIBILITY ANALYSIS-ENGR 33

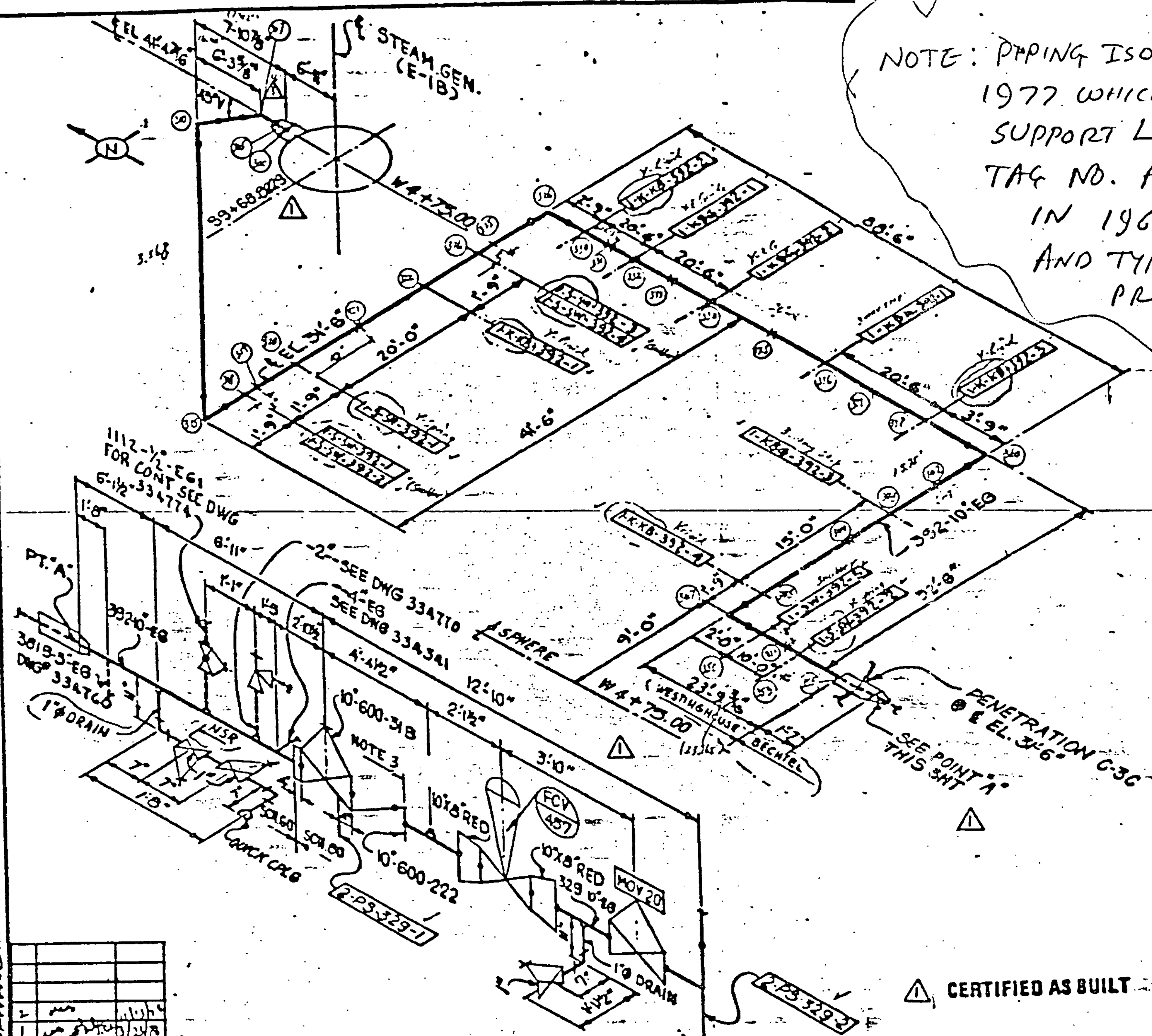
FEEDWATER SPHERE TO GEN E-IB Z ACCELERATION .5G CASE 1 W D GROSS DECEMBER 29,1964

STRESS, MOMENTS AND FORCES ON MEMBERS

MEMBER START/END	STRESS (PSI)	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	4421.16	41.13	14527.34	-147.47	2107.82	17.33	1707.38
	5082.56	41.13	-16700.64	169.48	2107.82	17.33	1707.38
2	77.60	41.13	-16700.64	169.48	2107.82	17.33	1707.38
	47.34	-12.42	-10187.49	169.48	2107.82	17.33	1707.38
3	47.34	-12.42	-10187.49	169.48	2107.82	17.33	-350.62
	77.60	41.13	-16700.64	169.48	2107.82	17.33	-350.62
4	5082.56	41.13	-16700.64	169.48	2107.82	17.33	-350.62
	4207.37	41.13	-13822.05	311.75	2107.82	17.33	-350.62
5	4207.37	41.13	-13822.05	311.75	2107.82	17.33	-350.62
	3405.80	19.47	-11187.28	311.75	2107.82	17.33	-350.62
6	3405.80	19.47	-11187.28	311.75	2107.82	7.01	-350.62
	6217.96	-85.69	20429.97	311.75	2107.82	7.01	-350.62
7	6217.96	-85.69	20429.97	311.75	2107.82	7.01	2963.93
	16641.03	-199.62	54681.98	311.75	2107.82	7.01	2963.93
8	16641.03	-199.62	54681.98	311.75	2107.82	7.01	2963.93
	15513.61	-199.62	50977.07	320.51	2107.82	7.01	2963.93
9	15513.61	-199.62	50977.07	320.51	2107.82	-15.91	2963.93
	23497.52	-199.62	-77212.85	-367.77	2107.82	-15.91	2963.93
10	358.74	-199.62	-77212.85	-367.77	1492.71	-15.91	2963.93
	373.86	-234.31	-80466.96	-367.77	1492.71	-15.91	2963.93
11	373.86	-234.31	-80466.96	-367.77	1492.71	-15.91	-2856.07
	358.74	-199.62	-77212.85	-367.77	1492.71	-15.91	-2856.07
12	23497.52	-199.62	-77212.85	-367.77	1492.71	-15.91	-2856.07
	14966.42	-199.62	49168.29	-1071.98	1492.71	-15.91	-2856.07
13	14966.42	-199.62	49168.29	-1071.98	1492.71	-15.91	-2856.07
	2163.85	-649.20	6999.20	-1071.98	1492.71	-15.91	-2856.07
14	2163.85	-649.20	6999.20	-1071.97	1492.71	686.77	-2856.07
	1873.59	-216.53	6058.79	-1071.97	1492.71	686.77	-2856.07
15	1873.59	-216.53	6058.79	-1071.97	1492.71	686.77	-4068.07
	4058.83	7592.02	-10913.34	-1071.97	1492.71	686.77	-4068.07
16	4058.83	7592.02	-10913.34	-1071.97	1492.71	686.77	1645.73
	4673.70	8450.48	-12779.23	-1071.97	1492.71	686.77	1645.73
17	4673.70	8450.48	-12779.23	-1071.97	1492.71	686.77	1645.73
	4171.07	2657.52	-12779.23	4182.37	1492.71	686.77	1645.73
18	4171.07	2657.52	-12779.23	4182.37	1492.71	686.77	1645.73
	3243.24	-1718.00	-8403.71	6325.15	1492.71	686.77	1645.73
19	49.51	-1718.00	-8403.71	6325.15	1492.71	686.77	1645.73
	46.87	-829.31	-8403.71	5519.08	1492.71	686.77	1645.73
20	46.87	-829.31	-8403.71	5519.08	1492.71	686.77	993.73
	49.28	-1365.92	-8403.71	6325.15	1492.71	686.77	993.73
21	3227.70	-1365.92	-8403.71	6325.15	1492.71	686.77	993.73
	3465.24	-4724.69	-5044.94	9049.21	1492.71	686.77	993.73
22	3465.24	-4724.69	-5044.94	9049.21	1492.71	686.77	993.73
	3026.39	-4724.69	-3534.48	8005.33	1492.71	686.77	993.73

SHT. 37

(23)



NOTE: PIPING ISOMETRIC WAS DRAWN IN 1977 WHICH REFLECTS THE PIPING SUPPORT LOCATIONS, TYPES, AND TAG NO. AS DESIGNED AND INSTALLED IN 1965/66. THESE SUPPORT LOCATIONS AND TYPES HAVE BEEN REVERIFIED IN 79-14 PROGRAM.

NOTES:

1. FOR PIPE SUPPORT AND HANGER DETAILS, SEE M-31756
2. COMPLETE LINE INSULATED UNABLE TO VERIFY FITTINGS.
3. PRESSURE BOUNDRY FOR BOP PROGRAM
4. WESTINGHOUSE / BECHTEL SCOPE OF ANALYSIS AS SHOWN.

⚠ CLASS 2 PIPING

SAFETY RELATED (EXCEPT AS NOTED)

BOP-SEISMIC REEVALUATION ANALYSIS BOUNDARY-ISOMETRIC

UNIT 1

⚠ CERTIFIED AS BUILT

NO.	SCT P.E.	DATE
2	[illegible]	[illegible]
1	[illegible]	3/28
0	[illegible]	9/1/77

BECHTEL CORPORATION
ENGINEERS & CONSTRUCTORS
LOS ANGELES, CALIF.

JOB NO.	DATE	APPROVED
12186-001		

NO.	REVISIONS	DATE	DR.	CHK.			CHF. E.	P.E.	Q.A.E.
2	INCORPORATED CCN #1 (New Chk. NA)	0-14-79	LCB.	DS	[illegible]		N/A	[illegible]	[illegible]
1	INCORPORATED DCN #1 & #2	3-29-78	SHP	SA	[illegible]		N/A	[illegible]	[illegible]
0	AS BUILT (OLD DWG 456494)	9-4-77	ZB	RWM	[illegible]		N/A	[illegible]	[illegible]

SAN ONOFRE NUCLEAR GENERATING STATION

ISOMETRIC-LINE Nº 392-10"-EG FROM FCV-457 THRU PEN. C-3C TO STM. GEN. E-1B

SOUTHERN CALIFORNIA EDISON COMPANY
LOS ANGELES, CALIF.
SCALE NONE

⚠ 334538-2

FW-02
FW-04

17X

TI APERTURE CARD

8504040294-75

PIPING FLEXIBILITY CALCULATION

BECHTEL CORPORATION
4550 SEVILLE AVENUE
VERNON, CALIFORNIA

Sc = ____
Sh = ____
SA = 1.25Sc + .25Sh
SA = ____

MAXIMUM STRESS
AT POINT

3246-14

SIGNATURE W. L. Shaw DATE 2-23-65
PROJECT SAN ONOFRE JOB NO. 3296
SUBJECT FEEDWATER INSIDE SPHERE X ACC. 1.0G STM GEN. E-1C

CONVENTION FOR POSITIVE FORCES & MOMENTS

DESIGN DATA

PRESS. —
TEMP. ΔT = 1°F FOR SEISMIC ANALYSIS

MAT'L. CARB. STL.
EXP. COEF. .00000607
Ec x 10⁶ 27.9

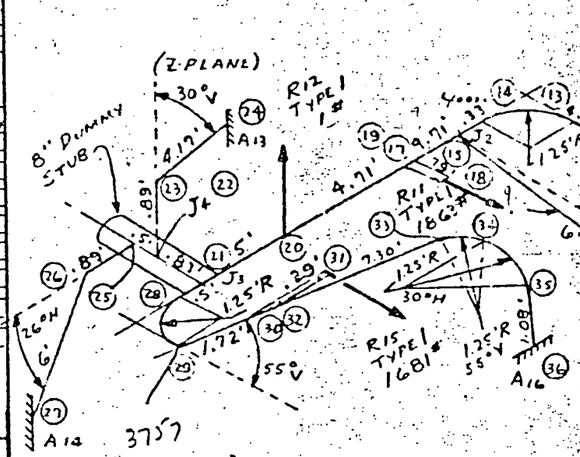
MEMBER DATA

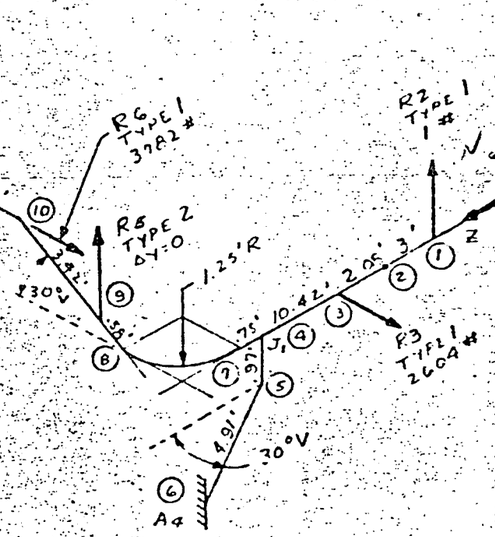
10.75" O.D. x .500" W.T. 1 → 9, 9 → 15, 17, 16, 21, 28 → 30, 33 → 36
8.625" O.D. x .500" W.T. 22 & 25
2" O.D. x .20" W.T. 6, 16, 29, & 29
30" O.D. x 9" W.T. 5, 18, 19, 23, 26, 31, & 32

ANCHOR DATA

ANCHOR No.	Pt.	COORDINATES X	Y	Z	END DEFLECTION ΔX	ΔY	ΔZ
A1	0	0	0	0	0	0	0
A4	6	0	-3.42'	28.75'	0	0	0
A10	16	-31.69'	2.00'	28.60'	0	0	0
A13	24	-38.42'	6.50'	47.50'	0	0	0
A14	27	-38.32'	2.00'	53.78'	0	0	0
A16	36	-30.68'	9.92'	99.96'	0	0	0

CV-66 3 → 4





PIPING FLEXIBILITY ANALYSIS-ENGR 33

FEEDWATER INSIDE SPHERE X ACC 1.0G STN GEN E-IC CASE 1 W D-GROSS FEB 23,1965

DEFLECTION OR FORCE AT RESTRAINTS

RESTRAINT NUMBER TYPE 1 OR 3	TYPE 2	DEFLECTION (IN)	FORCE ON ORIGIN (LBS)	FORCE ON RESTRAINT (LBS)
2		.00189		
3		.12662		
6		.02602		
11		.11670		
12		-.04310		
15		.10476		
	5		-86.50	86.50
	7		217.56	-217.56
	8		330.63	-330.63
	9		-185.73	185.73

TOTAL MOMENTS AND FORCES ON ANCHORS

ANCHOR	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	-223.48	11505.18	103.73	1542.14	22.12	316.67
4	6.97	-59.73	-25.52	20.35	41.85	-67.18
10	1.47	-69.43	-.29	6271.34	-.11	516.63
13	91.29	-50.01	386.69	-1204.04	-2456.41	-41.83
14	-114.04	-166.87	59.80	-162.13	-46.23	-456.26
16	2834.93	-2912.68	669.53	-3462.34	2386.12	62.59

ROTATION AND DEFLECTION OF MEMBERS

MEMBER	PHI X (DEG)	PHI Y (DEG)	PHI Z (DEG)	DELTA X (IN)	DELTA Y (IN)	DELTA Z (IN)
ORIGIN	.000	.000	.000	.000	.000	.000
1	-.002	.057	.002	.083	.002	.001
2	-.002	.039	.002	.115	.003	.001
3	-.001	.013	.003	.127	.004	.001
4	.001	-.055	.005	.049	.004	.002
5	.001	-.055	.005	.050	.004	.002
6	-.000	-.000	.000	-.000	-.000	.000
7	.002	-.054	.005	.041	.004	.002
8	.007	-.016	.008	.030	.001	-.000
9	.007	-.014	.009	.029	.000	-.007
10	.007	-.003	.005	.026	-.005	-.010
11	.007	-.000	-.002	.023	.000	-.000
12	.006	-.018	-.002	.020	-.000	-.039
13	.006	-.018	-.003	.019	.003	-.057
14	.007	-.021	-.002	.018	.002	-.060
15	.007	.024	-.002	.019	.002	-.060
16	.000	.000	-.000	.000	-.000	-.000
17	.018	.038	.001	.117	-.021	-.060
18	.018	.039	.001	.117	-.021	-.060
19	.018	.038	.001	.117	-.021	-.060
20	.028	-.005	.002	.136	-.043	-.059
21	.043	-.016	.004	.129	-.080	-.059
22	.043	-.015	-.000	.129	-.080	-.061
23	.043	-.015	-.000	.129	-.080	-.054
24	.000	.000	.000	.000	-.000	.000

(5)

ROTATION AND DEFLECTION OF MEMBERS

MEMBER	PHI X (DEG)	PHI Y (DEG)	PHI Z (DEG)	DELTA X (IN)	DELTA Y (IN)	DELTA Z (IN)
25	.043	-.015	.000	.129	-.080	-.063
26	.043	-.015	.000	.126	-.088	-.063
27	-.000	-.000	.000	-.000	-.000	.000
28	.044	-.018	.006	.127	-.085	-.059
29	.028	-.023	.051	.121	-.089	-.052
30	.024	-.022	.065	.103	-.077	-.040
31	.024	-.022	.065	.105	-.076	-.040
32	.024	-.022	.065	.103	-.077	-.040
33	.009	-.015	.069	.006	-.010	-.004
34	.003	-.007	.020	.001	-.001	-.001
35	.004	-.003	.003	.000	.000	-.001
36	-.000	-.000	.000	.000	-.000	-.000

PIPING FLEXIBILITY ANALYSIS-ENGR 33

FEEDWATER INSIDE SPHERE X ACC 1.0G STM GEN E-1C CASE 1 W D GROSS FEB 23,1965

STRESS, MOMENTS AND FORCES ON MEMBERS

MEMBER START/END	STRESS (PSI)	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
1	3502.08	-223.48	11505.38	103.73	1542.14	22.12	316.67
	723.13	-24.44	-2373.84	103.73	1542.14	22.12	316.67
2	723.13	-24.44	-2373.84	103.73	1542.14	21.12	316.67
	2130.56	38.90	-7000.25	103.73	1542.14	21.12	316.67
3	2130.56	38.90	-7000.25	103.73	1542.14	21.12	316.67
	3106.70	82.82	-10207.89	103.73	1542.14	21.12	316.67
4	3106.70	82.82	-10207.89	103.73	-1061.86	21.12	316.67
	278.33	302.85	856.74	103.73	-1061.86	21.12	316.67
5	~~.36~~	-59.12	-26.78	-44.17	-20.35	-41.85	67.18
	~~.11~~	6.04	-26.78	-24.43	-20.35	-41.85	67.18
6	~~951.54~~	6.04	-26.78	-24.43	-20.35	-41.85	67.18
	~~1690.64~~	-6.97	59.73	25.52	-20.35	-41.85	67.18
7	294.03	361.97	883.52	147.90	-1041.52	62.96	249.49
	523.66	409.19	1664.66	147.90	-1041.52	62.96	249.49
8	1083.66	409.19	1664.66	147.90	-1041.52	62.96	249.49
	1669.38	487.89	2654.70	226.60	-1041.52	62.96	249.49
9	824.29	487.89	2654.70	226.60	-1041.52	62.96	249.49
	760.17	415.54	2529.38	-43.82	-1041.52	62.96	249.49
10	780.17	415.54	2529.38	-43.82	-1041.52	149.46	249.49
	688.33	-11.08	1790.45	-1382.14	-1041.52	149.46	249.49
11	688.33	-11.08	1790.45	-1382.14	-4823.52	149.46	249.49
	477.44	-11.08	-1462.86	566.83	-4823.52	149.46	249.49
12	477.44	-11.08	-1462.86	566.83	-4823.52	-68.10	-81.14
	166.82	-11.08	-164.62	-522.77	-4823.52	-68.10	-81.14
13	166.82	-11.08	-164.62	-522.77	-4823.52	117.63	-81.14
	65.80	-11.08	214.30	26.57	-4823.52	117.63	-81.14
14	136.44	-11.08	214.30	26.57	-4823.52	117.63	-81.14
	4008.94	135.96	6345.13	173.61	-4823.52	117.63	-81.14
15	1932.09	135.96	6345.13	173.61	-4823.52	117.63	-81.14
	2416.49	174.77	7936.88	173.61	-4823.52	117.63	-81.14
16	~~2641.37~~	-1.53	-102.07	.94	-6271.34	.11	-516.63
	~~2314.60~~	-1.47	89.43	.29	-6271.34	.11	-516.63
17	2447.54	176.30	8038.96	172.67	1447.83	117.52	435.49
	1875.91	1317.45	-6019.42	172.67	1447.83	117.52	435.49
18	~~26.64~~	1317.45	-6019.42	172.67	1447.83	117.52	435.49
	~~22.07~~	1317.45	-5675.38	79.83	1447.83	117.52	435.49
19	~~27.67~~	1317.45	-5675.38	79.83	-415.17	117.52	435.49
	~~28.54~~	1317.45	-6019.42	172.67	-415.17	117.52	435.49
20	1875.91	1317.45	-6019.42	172.67	-415.17	117.52	435.49
	1362.51	1870.98	-4063.95	172.67	-415.17	117.52	435.49
21	1362.51	1870.98	-4063.95	172.67	-415.17	116.52	435.49
	962.45	2453.60	-1988.08	172.67	-415.17	116.52	435.49
22	~~1364.59~~	-79.45	589.76	-2723.35	1366.17	2502.64	498.08
	330.18	-79.45	176.36	-646.16	1366.17	2502.64	498.08
23	3.22	96.98	-37.19	-684.85	1204.04	2456.41	41.83
	1.83	59.76	-37.19	386.74	1204.04	2456.41	41.83
24	10172.87	59.76	-37.19	386.74	1204.04	2456.41	41.83
	10363.15	-91.29	50.01	-386.68	1204.04	2456.41	41.83
25	136.91	-176.43	213.55	38.69	162.13	46.23	456.26
	91.79	-176.43	-14.58	61.81	162.13	46.23	456.26

PIPING FLEXIBILITY ANALYSIS-ENGR 33

FEEDWATER INSIDE SPHERE X ACC 1.0G STM GEN E-1C CASE 1 W D GROSS FEB 23,1965

STRESS, MOMENTS AND FORCES ON MEMBERS

MEMBER START/END	STRESS (PSI)	MX (FT-LBS)	MY (FT-LBS)	MZ (FT-LBS)	FX (LBS)	FY (LBS)	FZ (LBS)
26	87	-176.43	-14.58	-61.81	162.13	46.23	456.26
	1101	-135.28	-158.87	61.81	162.13	46.23	456.26
27	5631.98	-135.28	-158.87	61.81	162.13	46.23	456.26
	5456.63	114.04	166.87	-59.80	162.13	46.23	456.26
28	1409.37	2533.05	-2577.85	2696.02	-1781.34	-2386.12	-62.59
	1098.46	1339.99	-1687.17	2896.02	-1781.34	-2386.12	-62.59
29	1621.30	1339.99	-1687.17	2896.02	-1781.34	-2386.12	-62.59
	3757.87	-1642.66	461.27	5878.67	-1781.34	-2386.12	-62.59
30	1862.80	-1642.66	461.27	5878.67	-1781.34	-2386.12	-62.59
	1808.77	-1554.47	399.52	5722.89	-1781.34	-2386.12	-62.59
31	27.61	-1554.47	399.52	5722.89	-1781.34	-2386.12	-62.59
	26.69	-862.50	-117.07	5722.89	-1781.34	-2386.12	-62.59
32	21.49	-862.50	-117.07	5722.89	-3462.34	-2386.12	-62.59
	21.46	-1554.47	887.01	5722.89	-3462.34	-2386.12	-62.59
33	1824.75	-1554.47	887.01	5722.89	-3462.34	-2386.12	-62.59
	1572.08	-1180.19	624.93	-4990.32	-3462.34	-2386.12	-62.59
34	3261.59	-1180.19	624.93	-4990.32	-3462.34	-2386.12	-62.59
	2818.65	-1146.83	560.85	-4392.61	-3462.34	-2386.12	-62.59
35	2818.65	-1146.83	560.85	-4392.61	-3462.34	-2386.12	-62.59
	1553.01	-1546.43	1101.56	-2901.28	-3462.34	-2386.12	-62.59
36	1055.16	-1546.43	1101.56	-2901.28	-3462.34	-2386.12	-62.59
	1253.58	-2834.93	2912.68	-669.53	-3462.34	-2386.12	-62.59

PIPING FLEXIBILITY CALCULATION

BECHTEL CORPORATION
4550 SEVILLE AVENUE
VERNON, CALIFORNIA

3246-75

CONVENTION FOR POSITIVE FORCES & MOMENTS (Fx, Fy, Fz, Mz, My, Mx)

Sc =
Sh =
SA = 1.25Sc + .25Sh
SA =

MAXIMUM STRESS

AT POINT

SIGNATURE [illegible]
DATE 2-24-65
JOB NO. 3246
PROJECT SAN ONOFRE
SUBJECT FEEDWATER TO GEN. E-1C - LINE 326 - Y ACC 1.67G.

DESIGN DATA

PRESS. —
TEMP. ΔT = 1°F FOR SEISMIC ANALYSIS

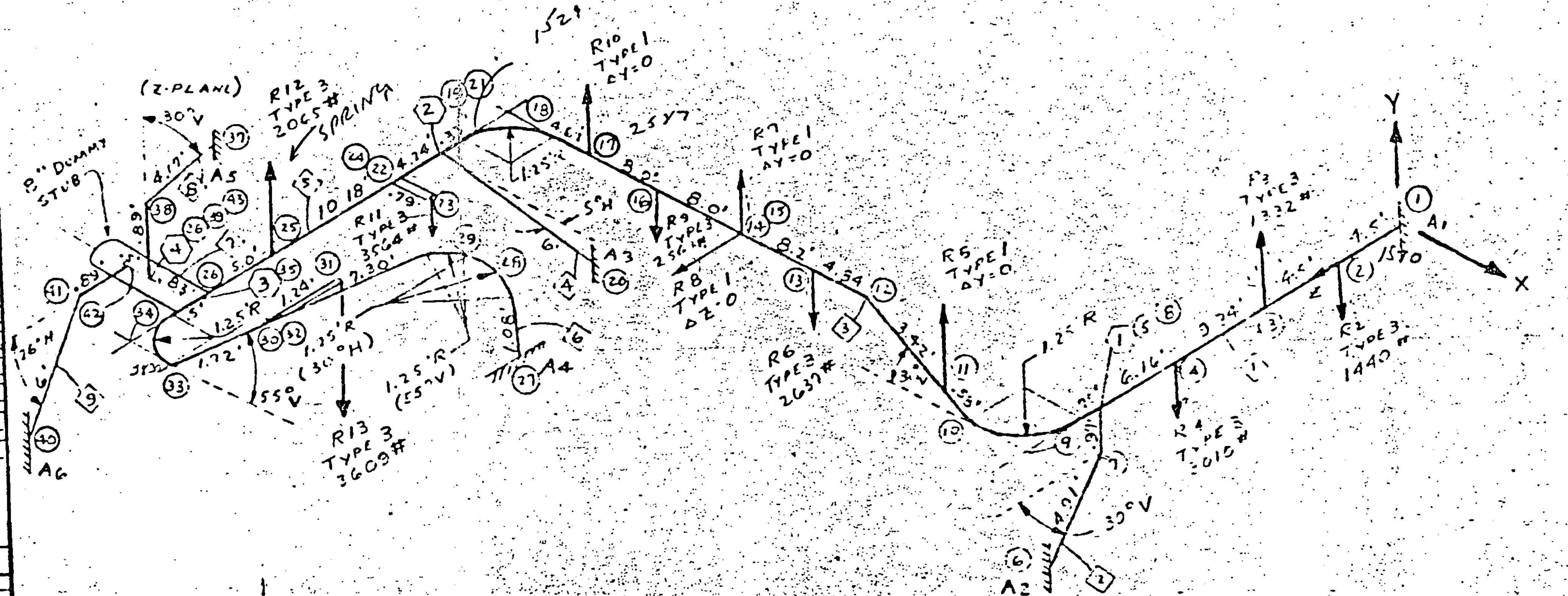
MAT'L. CARB. STL.
EXP. COEF. .00000607
$E_c \times 10^6$ 27.9

MEMBER DATA

10.75" O.D. x .500" W.T. 2 → 5, 9 → 19, 22, 25, 26, 27 → 30, 33 → 35
8.625" O.D. x .500" W.T. 36 & 9
2" O.D. x .20" W.T. 7 21, 38 & 41
30" O.D. x 9" W.T. 8, 23, 24, 31, 32, 39 & 42

ANCHOR DATA

ANCHOR No.	PT.	COORDINATES X	Y	Z	(THERMAL) END DEFLECTION ΔX	ΔY	ΔZ
A1	1	0	0	0	0	0	0
A2	6	0	-3.42'	28.75'	0	0	0
A3	20	-33.69'	2.00'	25.65'	0	0	0
A4	27	-30.68'	9.92'	42.96'	0	0	0
A5	37	-36.42'	6.50'	47.50'	0	0	0
A6	40	-38.37'	2.00'	53.78'	0	0	0



Also Available On Aperture Card

TI APERTURE CARD

8504040294 -81

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PONT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
43-09-004	TGNT	BINP	-40.500	2.000	47.500	0.500	8.625	0.500			0.067	-0.045	-0.030
42-09-003	TGNT	END	-41.000	2.000	47.500	0.890	30.000	9.000			0.067	-0.043	-0.031
41-09-002	TGNT	END	-41.000	2.000	48.390	5.997	2.000	0.200			0.065	-0.043	-0.031
40-09-001	ANKR	END	-38.370	2.000	53.780		2.000	0.200			0.000	-0.	-0.
39-08-003	TGNT	BINP	-40.500	2.000	47.500	0.890	30.000	9.000			0.067	-0.045	-0.030
38-08-002	TGNT	END	-40.500	2.890	47.500	4.166	2.000	0.200			0.071	-0.045	-0.030
37-08-001	ANKR	END	-38.420	6.500	47.500		2.000	0.200			-0.000	-0.	-0.
36-07-001	TGNT	BINP	-40.500	2.000	47.500	0.830	8.625	0.500			0.067	-0.045	-0.030
36-07-001	TGNT	BGIN	-39.670	2.000	47.500	0.830	8.625	0.500			0.067	-0.049	-0.029
35-06-012	TGNT	BINP	-39.670	2.000	47.500	0.500	10.750	0.500			0.067	-0.049	-0.029
34-06-011	BEND	END	-39.670	2.000	48.000	1.963	10.750	0.500	1.250	90.000	0.066	-0.049	-0.029
34-06-010	TGNT	END	-38.420	2.000	49.250	0.010	10.750	0.500			0.063	-0.052	-0.024
33-06-009	TGNT	END	-38.410	2.000	49.250	1.720	10.750	0.500			0.063	-0.052	-0.024
32-06-008	TGNT	END	-37.423	3.409	49.250	1.240	30.000	9.000			0.057	-0.048	-0.021
31-06-007	RSNT	END	-37.423	3.409	48.010						0.065	-0.052	-0.021
31-06-006	TGNT	END	-37.423	3.409	48.010	1.240	30.000	9.000			0.065	-0.052	-0.021
30-06-005	TGNT	END	-37.423	3.409	49.250	7.281	10.750	0.500			0.057	-0.048	-0.021
29-06-004	BEND	END	-33.263	9.384	49.250	1.203	10.750	0.500	1.250	55.154	0.005	-0.011	-0.005
28-06-003	BEND	END	-32.237	9.920	49.250	0.659	10.750	0.500	1.250	30.198	0.000	-0.003	-0.001
28-06-002	TGNT	END	-31.609	9.920	49.420	1.074	10.750	0.500			0.000	-0.001	-0.000
27-06-001	ANKR	END	-30.680	9.920	49.960		10.750	0.500			0.000	-0.	-0.
26-05-007	TGNT	BINP	-39.670	2.000	47.500	5.000	10.750	0.500			0.067	-0.049	-0.029
25-05-006	RSNT	END	-39.670	2.000	42.500						0.063	-0.058	-0.030
25-05-005	TGNT	END	-39.670	2.000	42.500	10.180	10.750	0.500			0.063	-0.058	-0.030
24-05-004	TGNT	END	-39.670	2.000	32.320	0.790	30.000	9.000			0.021	-0.106	-0.030

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PCNT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
43-09-004	TGNT	BINP	0.00005	-0.00017	-0.00041		267.	-21.	-483.	78.	562.	-22.	279.
42-09-003	TGNT	END	0.00005	-0.00013	-0.00040		267.	-21.	483.	78.	320.	-33.	2.
41-09-002	TGNT	END	0.00005	-0.00013	-0.00040		267.	-21.	483.	59.	83.	-33.	2757.
40-09-001	ANKR	END	-0.	-0.	-0.		267.	-21.	483.	-56.	-86.	23.	2734.
39-08-003	TGNT	BINP	0.00005	-0.00012	-0.00041		-924.	-1837.	-34.	-90.	33.	569.	3.
38-08-002	TGNT	END	0.00005	-0.00012	-0.00041		-924.	-1837.	-34.	-60.	33.	-253.	6775.
37-08-001	ANKR	END	-0.	-0.	-0.		-924.	-1837.	-34.	62.	-37.	235.	6373.
36-07-001	TGNT	BINP	0.00005	-0.00012	-0.00041		656.	1859.	-449.	12.	-595.	-547.	396.
36-07-001	TGNT	BGIN	0.00005	-0.00009	-0.00035		656.	1859.	-449.	12.	-968.	-2090.	1127.
35-06-012	TGNT	BINP	0.00005	-0.00009	-0.00035		-443.	2390.	-356.	-2413.	1951.	-1354.	1030.
34-06-011	BEND	END	0.00007	-0.00011	-0.00033		-443.	2390.	-356.	-1219.	1729.	-1354.	1398.
34-06-010	TGNT	END	-0.00014	-0.00045	0.00020		443.	2390.	-356.	1768.	730.	-4341.	2832.
33-06-009	TGNT	END	-0.00014	-0.00045	0.00020		-443.	2390.	-356.	1768.	727.	-4365.	1450.
32-06-008	TGNT	END	-0.00023	-0.00049	0.00042		443.	2390.	-356.	2270.	375.	-6099.	30.
31-06-007	RSNT	END	-0.00023	-0.00049	0.00042	3609.	0.	-3609.	0.	0.	0.	0.	
31-06-006	TGNT	END	-0.00023	-0.00049	0.00042		443.	-1219.	-356.	-693.	925.	-6099.	29.
30-06-005	TGNT	END	-0.00023	-0.00049	0.00043		443.	-1219.	-356.	-2205.	375.	-6099.	1977.
29-06-004	BEND	END	-0.00000	-0.00038	0.00082		443.	-1219.	-356.	-78.	-1106.	1622.	1123.
28-06-003	BEND	END	-0.00006	-0.00020	0.00042		443.	-1219.	-356.	113.	-1471.	3110.	2173.
28-06-002	TGNT	END	0.00000	-0.00005	0.00012		443.	-1219.	-356.	-94.	-1770.	3877.	2486.
27-06-001	ANKR	END	-0.	-0.	-0.		443.	-1219.	-356.	-753.	-2340.	5009.	1698.
26-05-007	TGNT	BINP	0.00005	-0.00009	-0.00035		213.	-531.	-93.	2426.	-2918.	-736.	1176.
25-05-006	RSNT	END	-0.00041	0.00020	-0.00024	2065.	0.	2065.	0.	0.	0.	0.	
25-05-005	TGNT	END	-0.00041	0.00020	-0.00024		213.	1534.	-93.	5090.	-1852.	-736.	1661.
24-05-004	TGNT	END	0.00027	0.00039	0.00000		213.	1534.	-93.	-10538.	320.	-736.	49.

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PONT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
23-05-003	RSNT	END	-38.880	2.000	32.320						0.021	-0.106	-0.034
23-05-002	TGNT	END	-38.880	2.000	32.320	0.790	30.000	9.000			0.021	-0.106	-0.034
22-05-001	TGNT	END	-39.670	2.000	32.320	4.240	10.750	0.500			0.021	-0.106	-0.030
22-05-001	TGNT	BGIN	-39.670	2.000	28.080	4.240	10.750	0.500			0.003	-0.072	-0.031
21-04-002	TGNT	BINP	-39.670	2.000	28.080	6.003	2.000	0.200			-0.003	-0.072	-0.031
20-04-001	ANKR	END	-33.690	2.000	28.600		2.000	0.200			0.000	-0.	-0.
19-03-018	TGNT	BINP	-39.670	2.000	28.080	0.330	10.750	0.500			0.003	-0.072	-0.031
18-03-017	BEND	END	-39.670	2.000	27.750	1.963	10.750	0.500	1.250	90.000	0.001	-0.068	-0.031
18-03-016	TGNT	END	-38.420	2.000	26.500	4.670	10.750	0.500			-0.001	-0.042	-0.032
17-03-015	RSNT	END	-33.750	2.000	26.500						-0.001	-0.000	-0.028
17-03-014	TGNT	END	-33.750	2.000	26.500	8.000	10.750	0.500			-0.001	-0.000	-0.028
16-03-013	RSNT	END	-25.750	2.000	26.500						-0.000	0.001	-0.013
16-03-012	TGNT	END	-25.750	2.000	26.500	8.000	10.750	0.500			-0.000	0.001	-0.013
15-03-011	RSNT	END	-17.750	2.000	26.500						0.000	-0.000	-0.000
14-03-010	RSNT	END	-17.750	2.000	26.500						0.000	-0.000	-0.000
14-03-009	TGNT	END	-17.750	2.000	26.500	8.200	10.750	0.500			0.000	-0.000	-0.000
13-03-008	RSNT	END	-9.550	2.000	26.500						0.001	-0.037	0.002
13-03-007	TGNT	END	-9.550	2.000	26.500	4.840	10.750	0.500			0.001	-0.037	0.002
12-03-006	TGNT	END	-4.710	2.000	26.500	3.418	10.750	0.500			0.001	-0.020	-0.002
11-03-005	RSNT	END	-1.750	0.290	26.500						0.013	-0.000	0.001
11-03-004	TGNT	END	-1.750	0.290	26.500	0.569	10.750	0.500			0.013	-0.000	0.001
10-03-003	TGNT	END	-1.260	-0.000	26.500	0.010	10.750	0.500			0.015	0.003	0.001
9-03-002	BEND	END	-1.250	-0.000	26.500	1.963	10.750	0.500	1.250	90.000	0.015	0.003	0.001
9-03-001	TGNT	END	-0.	-0.000	25.250	0.750	10.750	0.500			0.014	0.004	-0.000
9-03-001	TGNT	BGIN	-0.	-0.000	24.500	0.750	10.750	0.500			0.013	-0.002	-0.000

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PCNT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
23-05-003	RSNT	END	0.00027	0.00039	0.00000	3564.	0.	-3564.	0.	0.	0.	0.	
23-05-002	TGNT	END	0.00027	0.00039	0.00000		213.	-2030.	-93.	-10538.	246.	-1948.	50.
22-05-001	TGNT	END	0.00027	0.00039	0.00000		213.	-2030.	-93.	-10538.	320.	-3551.	3385.
22-05-001	TGNT	BGIN	0.00092	0.00031	0.00048		213.	-2030.	-93.	-1931.	1224.	-3551.	1295.
21-04-002	TGNT	BINP	0.00092	0.00031	0.00048		189.	-24.	-1.	17.	57.	-65.	2276.
20-04-001	ANKR	END	-0.	-0.	-0.		189.	-24.	-1.	4.	-48.	79.	2381.
19-03-018	TGNT	BINP	0.00092	0.00031	0.00048		24.	-2006.	-92.	-1948.	1167.	-3487.	1265.
18-03-017	BEND	END	0.00093	0.00030	0.00052		24.	-2006.	-92.	-1286.	1175.	-3487.	1529.
18-03-016	TGNT	END	0.00111	-0.00002	0.00087		24.	-2006.	-92.	1222.	1090.	-979.	997.
17-03-015	RSNT	END	0.00093	-0.00011	0.00045	3469.	0.	3469.	0.	0.	0.	0.	
17-03-014	TGNT	END	0.00093	-0.00011	0.00045		24.	1463.	-92.	1222.	660.	8388.	2587.
16-03-013	RSNT	END	0.00062	-0.00017	-0.00005	2563.	0.	-2563.	0.	0.	0.	0.	
16-03-012	TGNT	END	0.00062	-0.00017	-0.00005		24.	-1100.	-92.	1222.	-78.	-3318.	1076.
15-03-011	RSNT	END	0.00031	-0.00008	-0.00026	142.	0.	0.	142.	0.	0.	0.	
14-03-010	RSNT	END	0.00031	-0.00008	-0.00026	2680.	0.	2680.	0.	0.	0.	0.	
14-03-009	TGNT	END	0.00031	-0.00008	-0.00026		24.	1580.	50.	1222.	-815.	5481.	1727.
13-03-008	RSNT	END	-0.00000	0.00004	-0.00006	2637.	0.	-2637.	0.	0.	0.	0.	
13-03-007	TGNT	END	-0.00000	0.00004	-0.00006		24.	-1057.	50.	1222.	-408.	-7479.	2309.
12-03-006	TGNT	END	-0.00019	0.00007	0.00052		24.	-1057.	50.	1222.	-167.	-2365.	812.
11-03-005	RSNT	END	-0.00032	0.00009	0.00059	1158.	0.	1158.	0.	0.	0.	0.	
11-03-004	TGNT	END	-0.00032	0.00009	0.00059		24.	101.	50.	1307.	-20.	721.	454.
10-03-003	TGNT	END	-0.00034	0.00010	0.00059		24.	101.	50.	1321.	4.	665.	455.
9-03-002	BEND	END	-0.00034	0.00010	0.00058		24.	101.	50.	1321.	5.	-664.	581.
9-03-001	TGNT	END	-0.00059	0.00008	0.00039		24.	101.	50.	1194.	97.	537.	774.
9-03-001	TGNT	BGIN	-0.00062	0.00008	0.00038		24.	101.	50.	1118.	115.	537.	379.

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PONT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK. IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
8-02-003	TGNT	BINP	-0.	-0.000	24.500	0.970	30.000	9.000			0.013	-0.002	-0.000
7-02-002	TGNT	END	-0.	-0.970	24.500	4.906	2.000	0.200			0.018	-0.002	0.007
6-02-001	ANKR	END	-0.	-3.420	28.750		2.000	0.200			0.000	-0.	-0.
5-01-008	TGN.	BINP	-0.	-0.	24.500	6.160	10.750	0.500			0.013	-0.002	-0.000
4-01-007	RSNT	END	-0.	-0.	18.340						0.008	-0.049	-0.000
4-01-006	TGNT	END	-0.	-0.	18.340	9.340	10.750	0.500			0.008	-0.049	-0.000
3-01-005	RSNT	END	-0.	-0.	9.000						0.002	-0.027	-0.000
3-01-004	TGNT	END	-0.	-0.	9.000	4.500	10.750	0.500			0.002	-0.027	-0.000
2-01-003	RSNT	END	-0.	-0.	4.500						0.001	-0.010	-0.000
2-01-002	TGNT	END	-0.	-0.	4.500	4.500	10.750	0.500			0.001	-0.010	-0.000
1-01-001	ANKR	END	-0.	-0.	-0.		10.750	0.500			0.000	-0.	-0.

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM PCNT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
8-02-003	TGNT	BINP	-0.00062	0.00008	0.00038		19.	-1897.	3321.	-3270.	43.	48.	15.
7-02-002	TGNT	END	-0.00062	0.00008	0.00038		19.	-1897.	3321.	-49.	43.	29.	1845.
6-02-001	ANKR	END	-0.	-0.	-0.		19.	-1897.	3321.	26.	-39.	-18.	1295.
5-01-008	TGNT	BINP	-0.00062	0.00008	0.00038		5.	1998.	-3271.	4388.	72.	489.	1344.
4-01-007	RSNT	END	-0.00035	0.00007	0.00028	3010.	0.	-3010.	0.	0.	0.	0.	
4-01-006	TGNT	END	-0.00035	0.00007	0.00028		5.	-1012.	-3271.	-7920.	102.	-489.	2415.
3-01-005	RSNT	END	0.00039	0.00004	0.00014	1332.	0.	1332.	0.	0.	0.	0.	
3-01-004	TGNT	END	0.00038	0.00004	0.00014		5.	320.	-3271.	1537.	148.	-489.	491.
2-01-003	RSNT	END	0.00029	0.00002	0.00007	1440.	0.	-1440.	0.	0.	0.	0.	
2-01-002	TGNT	END	0.00029	0.00002	0.00007		5.	-1120.	-3271.	92.	170.	-489.	160.
1-01-001	ANKR	END	-0.	-0.	-0.		5.	-1120.	-3271.	5132.	192.	-489.	1570.

END, EXECUTION TIME 1.57 MINUTES.

PIPING FLEXIBILITY CALCULATION

BECHTEL CORPORATION
4550 SEVILLE AVENUE
VERNON, CALIFORNIA

Fx Fy Fz
Mz My Mx

Sc =
Sh =
SA = 1.25Sc + .25Sh
SA =

MAXIMUM STRESS AT POINT

32646

SIGNATURE W. D. Lloyd DATE 2-24-65
PROJECT SAN ONOFRE JOB NO. 3246
SUBJECT FEEDWATER TO GEN. E-1C - LINE 326 - Z ACC. 1.06

CONVENTION FOR POSITIVE FORCES & MOMENTS

DESIGN DATA

PRESS. —
TEMP. ΔT = 1°F FOR SEISMIC ANALYSIS

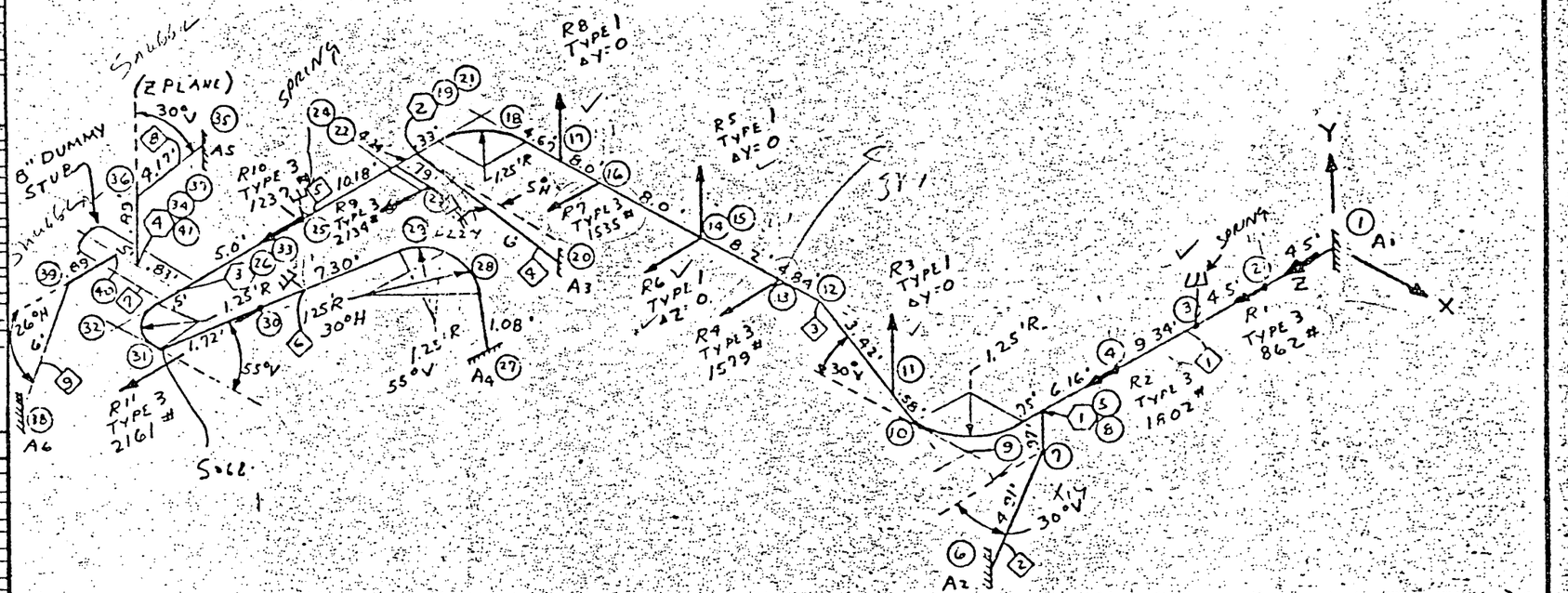
MAT'L. CARB. STL.
EXP. COEF. .0000060?
$E_c \times 10^6$ 27.9

MEMBER DATA

10.75" O.D. x .500" W.T. 2→5, 9→19, 22, 25, 26, 28→33
8.625" O.D. x .500" W.T. 34 & 41
2" O.D. x .20" W.T. 7, 21, 36, & 39
20" O.D. x 9" W.T. 8, 23, 29, 37, & 40

ANCHOR DATA

ANCHOR No.	PT.	COORDINATES X	Y	Z	END DEFLECTION ΔX	ΔY	ΔZ
A1	0	0	0	0	0	0	0
A2	6	0	-3.92'	28.75'	0	0	0
A3	20	-33.69'	2.00'	28.65'	0	0	0
A4	27	-30.68'	9.92'	99.96'	0	0	0
A5	35	-38.42'	6.50'	97.50'	0	0	0
A6	38	-38.37'	2.00'	53.78'	0	0	0



ELEMENT ID CRD-BR-ELM	ELEM ELEM TYPE	ELEM POINT	POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
41-C9-CC4	TGNT	PIPE	-40.500	2.000	47.500	0.500	8.625	0.500			-0.127	0.080	0.086
40-C9-CC3	TGNT	END	-41.000	2.000	47.500	0.890	30.000	9.000			-0.127	0.079	0.080
39-C9-CC2	TGNT	END	-41.000	2.000	48.390	5.937	2.000	0.200			-0.138	0.091	0.080
38-C9-CC1	ANKR	END	-39.270	2.000	53.780		2.000	0.200			0.000	-0.	-0.
37-C8-CC3	TGNT	PIPE	-40.500	2.000	47.500	0.890	30.000	9.000			-0.127	0.080	0.086
36-C8-CC2	TGNT	END	-40.500	2.890	47.500	4.166	2.000	0.200			-0.128	0.080	0.074
35-C8-CC1	ANKR	END	-38.420	6.500	47.500		2.000	0.200			0.000	-0.	-0.
34-C7-CC1	TGNT	PIPE	-40.500	2.000	47.500	0.830	8.625	0.500			-0.127	0.080	0.086
34-C7-CC1	TGNT	PCIN	-39.670	2.000	47.500	0.830	8.625	0.500			-0.127	0.080	0.094
33-C6-C10	TGNT	PIPE	-39.670	2.000	47.500	0.500	10.750	0.500			-0.127	0.080	0.094
32-C6-CC9	BEND	END	-39.670	2.000	48.000	1.963	10.750	0.500	1.250	90.000	-0.130	0.087	0.094
32-C6-CC8	TGNT	END	-38.420	2.000	49.250	0.010	10.750	0.500			-0.135	0.097	0.096
31-C6-CC7	TGNT	END	-38.410	2.000	49.250	1.720	10.750	0.500			-0.135	0.096	0.096
30-C6-CC6	RSNT	END	-37.423	3.409	49.250						-0.114	0.082	0.081
30-C6-CC5	TGNT	END	-37.423	3.409	49.250	7.281	10.750	0.500			-0.114	0.082	0.081
29-C6-CC4	BEND	END	-33.263	9.394	49.250	1.203	10.750	0.500	1.250	55.154	-0.007	0.010	0.008
28-C6-CC3	BEND	END	-32.237	9.920	49.250	0.659	10.750	0.500	1.250	30.198	-0.001	0.000	0.002
28-C6-CC2	TGNT	END	-31.609	9.920	49.420	1.074	10.750	0.500			-0.000	-0.000	0.000
27-C6-CC1	ANKR	END	-30.680	9.920	49.960		10.750	0.500			-0.000	-0.	-0.
26-C5-CC7	TGNT	PIPE	-39.670	2.000	47.500	5.000	10.750	0.500			-0.127	0.080	0.094
25-C5-CC6	RSNT	END	-39.670	2.000	42.500						-0.090	0.029	0.094
25-C5-CC5	TGNT	END	-39.670	2.000	42.500	10.180	10.750	0.500			-0.090	0.029	0.094
24-C5-CC4	TGNT	END	-39.670	2.000	32.320	0.790	30.000	9.000			-0.029	-0.009	0.094
23-C5-CC3	RSNT	END	-38.880	2.000	32.320						-0.029	-0.008	0.099
23-C5-CC2	TGNT	END	-38.880	2.000	32.320	0.790	30.000	9.000			-0.029	-0.008	0.099

ELEMENT ID CRD-BR-ELM	ELEM TYPE	ELEM POINT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	POINT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
41-C9-CC4	IGNT	BINP	-C.CC1C4	-C.CCC93	C.CCCC9		2267.	53.	-4832.	-205.	4175.	-46.	2047.
40-C9-CC3	IGNT	END	-C.CC1C8	-C.CC1CC	C.CCCC9		2267.	53.	4832.	-205.	1760.	72.	8.
39-C9-CC2	IGNT	END	-C.CC1C8	-C.CC1CC	C.CCCC9		2267.	53.	4832.	-158.	-258.	72.	8059.
38-C9-CC1	ANKR	END	-C.	-C.	-C.		2267.	53.	4832.	127.	228.	-67.	6982.
37-C8-CC3	IGNT	BINP	-C.CC1C8	-C.CCC93	C.CCCC9		1647.	3238.	78.	189.	-95.	-1068.	5.
36-C8-CC2	IGNT	END	-C.CC1C8	-C.CCC93	C.CCCC9		1647.	3238.	78.	120.	-95.	397.	11017.
35-C8-CC1	ANKR	END	-C.	-C.	-C.		1647.	3238.	78.	-160.	66.	-393.	11126.
34-C7-CC1	IGNT	BINP	-C.CC1C9	-C.CCC93	C.CCCC9		-3914.	-3291.	-4909.	16.	-4080.	1023.	2059.
34-C7-CC1	IGNT	BEIN	-C.CC1C9	-C.CCC68	-C.CCCC1		-3914.	-3291.	-4909.	16.	-8155.	3755.	4395.
33-C6-C10	IGNT	BINP	-C.CC1C9	-C.CCC6P	-C.CCCC1		-4016.	-3099.	-1411.	4197.	-6839.	3972.	2725.
32-C6-CC9	BEND	END	-C.CC113	-C.CCC61	-C.CCC07		-4016.	-3099.	-1411.	2648.	-4831.	3972.	3683.
32-C6-CC8	IGNT	END	-C.CCCC9	C.CCCC2	-C.CC107		-4016.	-3099.	-1411.	-1226.	-1575.	7845.	5068.
31-C6-CC7	IGNT	END	-C.CCCC9	C.CCCC2	-C.CC107		-4016.	-3099.	-1411.	-1226.	-1589.	7876.	2473.
30-C6-CC6	RSNT	END	-C.CCCC6	C.CCC13	-C.CC134	2161.	C.	C.	2161.	C.	C.	C.	
30-C6-CC5	IGNT	END	-C.CCCC6	C.CCC13	-C.CC134		-4016.	-3099.	750.	761.	-2981.	5277.	1859.
29-C6-CC4	BEND	END	-C.CCC54	C.CCC47	-C.CC129		-4016.	-3099.	750.	-3722.	141.	-5826.	4224.
28-C6-CC3	BEND	END	-C.CCC24	C.CCC22	-C.CC031		-4016.	-3099.	750.	-4124.	911.	-4799.	3331.
28-C6-CC2	IGNT	END	-C.CC01P	C.CCC09	-C.CCCC6		-4016.	-3099.	750.	-4650.	2064.	-2850.	2112.
27-C6-CC1	ANKR	END	-C.	-C.	-C.		-4016.	-3099.	750.	-6325.	4930.	27.	2440.
26-C5-CC7	IGNT	BINP	-C.CC1C9	-C.CCC68	-C.CCCC1		101.	-192.	-3499.	-4181.	-1316.	-217.	1336.
25-C5-CC6	RSNT	END	-C.CCC63	-C.CCC55	C.CCCC3	1237.	C.	C.	1237.	C.	C.	C.	
25-C5-CC5	IGNT	END	-C.CCC63	-C.CCC55	C.CCCC3		101.	-192.	-2267.	-3219.	-809.	-217.	1012.
24-C5-CC4	IGNT	END	-C.CCCC8	-C.CCC48	C.CCC1C		101.	-192.	-2262.	-1261.	224.	-217.	6.
23-C5-CC3	RSNT	END	-C.CCCC8	-C.CCC48	C.CCC1C	2134.	C.	C.	2134.	C.	C.	C.	
23-C5-CC2	IGNT	END	-C.CCCC8	-C.CCC48	C.CCC1C		101.	-192.	-128.	-1261.	-1563.	-65.	9.

ELEMENT ID GRD-BR-ELM	ELEM TYPE	ELEM POINT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
22-C5-CC1	TGNT	END	-39.670	2.000	32.320	4.240	10.750	0.500			-0.029	-0.009	0.094
22-C5-CC1	TGNT	BGIN	-39.670	2.000	28.080	4.240	10.750	0.500			-0.008	-0.011	0.094
21-C4-CC2	TGNT	BINP	-39.670	2.000	28.080	6.083	2.000	0.200			-0.008	-0.011	0.094
20-C4-CC1	ANKR	END	-33.690	2.000	28.600		2.000	0.200			0.000	-0.	-0.
19-C3-C18	TGNT	BINP	-39.670	2.000	28.080	0.330	10.750	0.500			-0.008	-0.011	0.094
18-C3-C17	PEND	END	-39.670	2.000	27.750	1.963	10.750	0.500	1.250	90.000	-0.007	-0.011	0.094
18-C3-C16	TGNT	END	-38.420	2.000	26.500	4.670	10.750	0.500			-0.003	-0.008	0.096
17-C3-C15	RSNT	END	-33.750	2.000	26.500						-0.003	-0.000	0.095
17-C3-C14	TGNT	END	-33.750	2.000	26.500	8.000	10.750	0.500			-0.003	-0.000	0.095
16-C3-C13	RSNT	END	-25.750	2.000	26.500						-0.002	0.003	0.061
16-C3-C12	TGNT	END	-25.750	2.000	26.500	8.000	10.750	0.500			-0.002	0.003	0.061
15-C3-C11	RSNT	END	-17.750	2.000	26.500						-0.002	0.000	0.000
14-C3-C10	RSNT	END	-17.750	2.000	26.500						-0.002	0.000	0.000
14-C3-CC9	TGNT	END	-17.750	2.000	26.500	8.200	10.750	0.500			-0.002	0.000	0.000
13-C3-CC8	RSNT	END	-9.550	2.000	26.500						-0.001	-0.001	0.012
13-C3-CC7	TGNT	END	-9.550	2.000	26.500	4.840	10.750	0.500			-0.001	-0.001	0.012
12-C3-CC6	TGNT	END	-4.710	2.000	26.500	3.418	10.750	0.500			-0.001	-0.001	0.014
11-C3-CC5	RSNT	END	-1.750	0.290	26.500						0.000	0.000	0.006
11-C3-CC4	TGNT	END	-1.750	0.290	26.500	0.569	10.750	0.500			0.000	0.000	0.006
10-C3-CC3	TGNT	END	-1.260	-0.000	26.500	0.010	10.750	0.500			0.000	0.000	0.005
9-C3-CC2	PEND	END	-1.250	-0.000	26.500	1.963	10.750	0.500	1.250	90.000	0.000	0.000	0.005
9-C3-CC1	TGNT	END	-0.	-0.000	25.250	0.750	10.750	0.500			-0.001	0.003	0.003
9-C3-CC1	TGNT	BGIN	-0.	-0.000	24.500	0.750	10.750	0.500			-0.001	0.003	0.003
8-C2-CC3	TGNT	BINP	-0.	-0.000	24.500	0.970	30.000	9.000			-0.001	0.003	0.003
7-C2-CC2	TGNT	END	-0.	-0.970	24.500	4.906	2.000	0.200			-0.002	0.003	0.002

ELEMENT ID END-BR-ELM	ELEM TYPE	ELEM POINT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
22-C5-CC1	IGNT	END	-C.CCCC8	-C.CCC48	C.CCC10		101.	-192.	-128.	-1261.	-1462.	-217.	591.
22-C5-CC1	IGNT	BGIN	C.CCCC1	-C.CCC35	C.CCC13		101.	-192.	-128.	-446.	-1031.	-217.	348.
21-C4-CC2	IGNT	BINP	C.CCCC1	-C.CCC35	C.CCC13		126.	-3.	55.	1.	-138.	-6.	3587.
20-C4-CC1	ANKR	END	-C.	-C.	-C.		126.	-3.	55.	-1.	128.	10.	3320.
19-C3-C18	IGNT	BINP	C.CCCC1	-C.CCC35	C.CCC13		-24.	-190.	-183.	-446.	-893.	-211.	311.
18-C3-C17	BEND	END	C.CCCC1	-C.CCC34	C.CCC13		-24.	-190.	-183.	-384.	-901.	-211.	622.
18-C3-C16	IGNT	END	C.CCCC7	-C.CCCC7	C.CCC16		-24.	-190.	-183.	-147.	-1160.	26.	734.
17-C3-C15	RSNT	END	C.CCCC9	C.CCC11	C.CCC11	259.	C.	259.	C.	C.	C.	0.	
17-C3-C14	IGNT	END	C.CCCC9	C.CCC11	C.CCC11		-24.	70.	-183.	-147.	-2017.	912.	675.
16-C3-C13	RSNT	END	C.CCC13	C.CCC65	-C.CCCC2	1535.	C.	C.	1535.	0.	C.	0.	
16-C3-C12	IGNT	END	C.CCC13	C.CCC65	-C.CCCC2		-24.	70.	1352.	-147.	-3484.	354.	1066.
15-C3-C11	RSNT	END	C.CCC16	C.CCC27	-C.CCCC3	-2590.	-C.	-C.	-2590.	C.	C.	0.	
14-C3-C10	RSNT	END	C.CCC16	C.CCC27	-C.CCCC3	-76.	-C.	-76.	-C.	0.	C.	0.	
14-C3-CC9	IGNT	END	C.CCC16	C.CCC27	-C.CCCC3		-24.	-6.	-1239.	-147.	7329.	-204.	2232.
13-C3-CC8	RSNT	END	C.CCC2C	-C.CCC18	C.CCCCC	1579.	C.	C.	1579.	C.	C.	0.	
13-C3-CC7	IGNT	END	C.CCC2C	-C.CCC18	C.CCCCC		-24.	-6.	340.	-147.	-2828.	-153.	863.
12-C3-CC6	IGNT	END	C.CCC22	C.CCC06	C.CCCC2		-24.	-6.	340.	-147.	-1181.	-123.	364.
11-C3-CC5	RSNT	END	C.CCC2C	C.CCC12	C.CCCC3	-22.	-C.	-22.	-C.	C.	C.	0.	
11-C3-CC4	IGNT	END	C.CCC2C	C.CCC12	C.CCCC3		-24.	-28.	340.	435.	-174.	-64.	144.
10-C3-CC3	IGNT	END	C.CCC1S	C.CCC13	C.CCCC3		-24.	-28.	340.	534.	-7.	-43.	163.
9-C3-CC2	BEND	END	C.CCC19	C.CCC13	C.CCCC3		-24.	-28.	340.	534.	-4.	-43.	165.
9-C3-CC1	IGNT	END	C.CCC1C	C.CCC06	-C.CCCC1		-24.	-28.	340.	569.	391.	-7.	436.
9-C3-CC1	IGNT	BGIN	C.CCCC9	C.CCCC5	-C.CCCCC		-24.	-28.	340.	591.	373.	-7.	213.
8-C2-CC3	IGNT	BINP	C.CCCC9	C.CCCC5	-C.CCCCC		-C.	-75.	132.	-129.	C.	-1.	1.
7-C2-CC2	IGNT	END	C.CCCC9	C.CCCC5	-C.CCCCC		-C.	-75.	132.	-1.	C.	-0.	21.

ELEMENT ID GRD-BR-ELM	ELEM TYPE	ELEM POINT	ELEMENT POINT COORDINATES X, FT.	Y, FT.	Z, FT.	LENGTH FT.	DIAM IN.	THCK IN.	RADIUS FT.	THETA DEG	DISPLACEMENTS, INCHES DELTA X	DELTA Y	DELTA Z
6-C2-CC1	ANCR	END	-C.	-3.420	28.750		2.000	C.200			-C.000	-C.	-C.
5-C1-CC7	TGNT	PINF	-C.	-C.	24.500	6.160	10.750	C.500			-C.001	0.003	0.003
4-C1-CC6	RSNT	END	-C.	-C.	18.340						-0.003	0.007	0.002
4-C1-CC5	TGNT	END	-C.	-C.	18.340	9.340	10.750	C.500			-0.003	0.007	0.002
3-C1-CC4	TGNT	END	-C.	-C.	9.000	4.500	10.750	C.500			-C.002	0.003	0.001
2-C1-CC3	RSNT	END	-C.	-C.	4.500						-C.001	0.001	0.001
2-C1-CC2	TGNT	END	-C.	-C.	4.500	4.500	10.750	C.500			-C.001	0.001	0.001
1-C1-CC1	ANCR	END	-C.	-C.	-0.		10.750	C.500			-0.000	-C.	-0.

ELEMENT ID CRD-PR-ELM	ELEM TYPE	ELEM PCNT	ROTATIONS, RADIANS PHI X	PHI Y	PHI Z	RSNT LOAD	FORCES, LBS. FX	FY	FZ	MOMENTS, FT.-LBS. MX	MY	MZ	STRESS SE,PSI
6-C2-CC1	ANKR	END	-C.	-C.	-C.		-C.	-75.	132.	4.	1.	0.	110.
5-C1-CC7	TGNT	FINE	C.CCCC6	C.CCCC5	-C.00000		-24.	46.	209.	719.	373.	-6.	247.
4-C1-CC6	RSNT	END	C.CCCCC	C.CCCCC	-C.CCCC0	1802.	C.	0.	1802.	C.	C.	0.	-
4-C1-CC5	TGNT	END	-C.CCCCC	C.CCCCC	-C.CCCC0		-24.	46.	2010.	433.	226.	-6.	149.
3-C1-CC4	TGNT	END	-C.CCCC5	-C.CCCC2	-C.CCCC0		-24.	46.	2010.	-1.	3.	-6.	2.
2-C1-CC3	RSNT	END	-C.CCCC4	-C.CCCC2	-C.CCCC0	862.	C.	0.	862.	0.	C.	0.	-
2-C1-CC2	TGNT	END	-C.CCCC3	-C.CCCC2	-C.CCCC0		-24.	46.	2872.	-210.	-104.	-6.	71.
1-C1-CC1	ANKR	END	-C.	-C.	-C.		-24.	-46.	2872.	-419.	-212.	-6.	143.

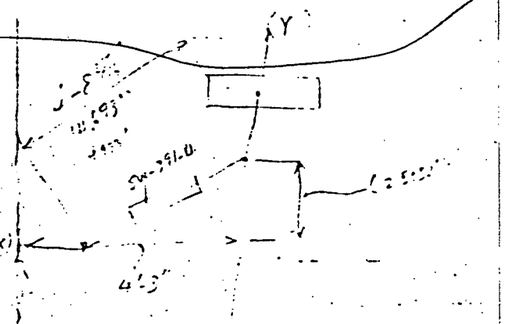
END, EXECUTION TIME 2.76 MINUTES.

24

2872

3004 ON SHELL & SVI-326-4

NOTE: PIPING ISOMETRIC WAS DRAWN IN 1977 WHICH REFLECTS THE PIPING SUPPORT LOCATIONS, TYPES AND TAG NO. AS DESIGNED AND INSTALLED IN 1965/66. THESE PIPE SUPPORT LOCATIONS AND TYPES HAVE BEEN REVERIFIED IN '79-14 PROGRAM....



NOTES;
1. FOR PIPE SUPP
DETAILS, SEE
2. ALL PIPING D
TO VERIFY FI
3. WESTINGHOUSE
OF ANALYSIS.

CLAS
SAFET
(EXCEP

3BA537-2
FW-01

CALCULATION SHEET

BECHTEL
12440 E. IMPERIAL HWY.
NORWALK, CALIFORNIA 90650

SIGNATURE ACH. DATE _____ CHECKED _____ DATE _____

PROJECT SAN ONOFRE UNIT - 1 JOB NO. 1304-794

SUBJECT FEED WATER PIPING SHEET 1 OF 1 SHEETS

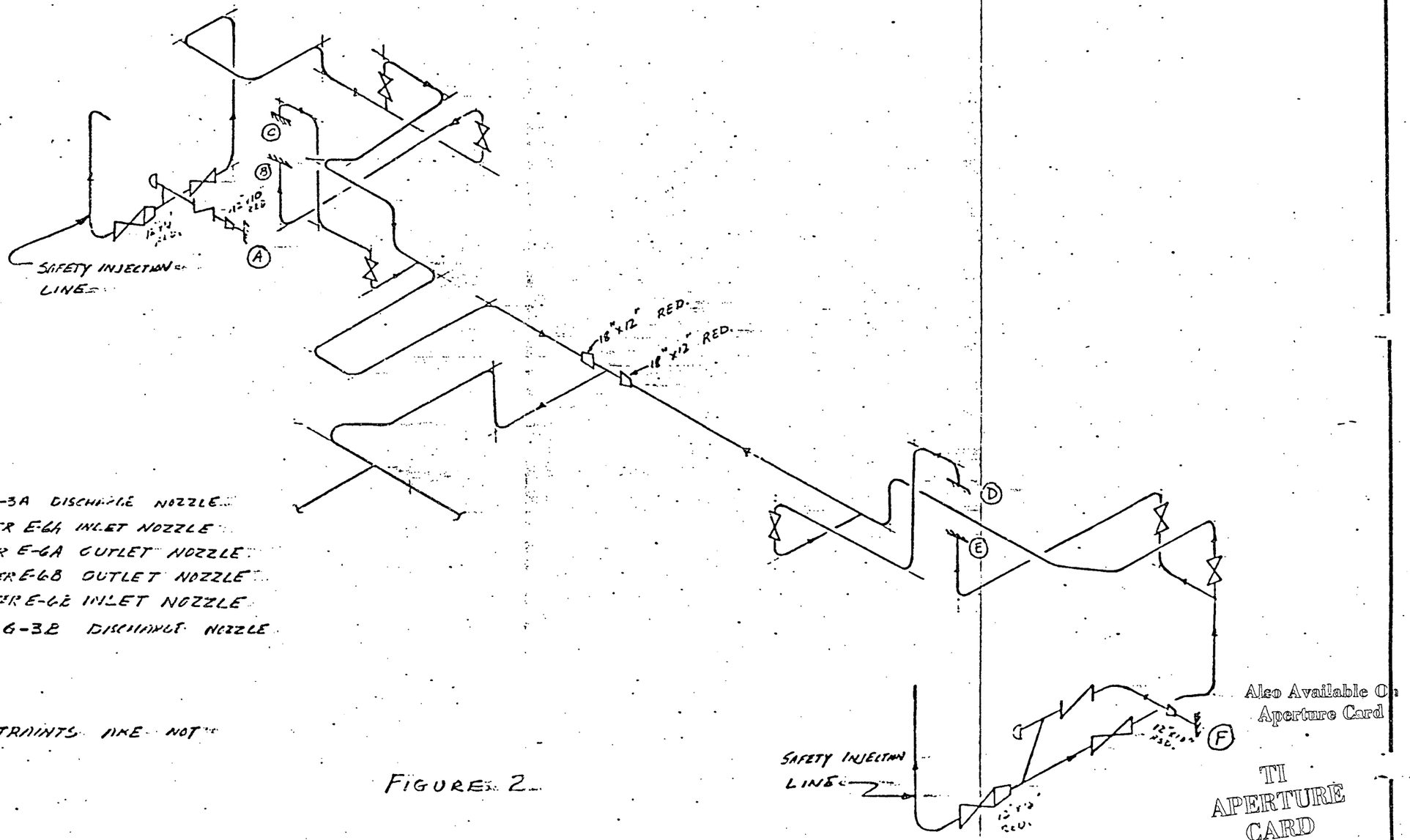


FIGURE 2

-LEGENDS:

A = FEED WATER PUMP G-3A DISCHARGE NOZZLE
B = 1ST. POINT H.P. HEATER E-6A INLET NOZZLE
C = 1ST. POINT H.P. HEATER E-6A OUTLET NOZZLE
D = 1ST. POINT H.P. HEATER E-6B OUTLET NOZZLE
E = 1ST. POINT H.P. HEATER E-6B INLET NOZZLE
F = FEED WATER PUMP G-3B DISCHARGE NOZZLE

NOTES:

1. FOR CLARITY RESTRAINTS LIKE NOT SHOWN.

CALCULATION SHEET

12300 E. IMPERIAL HWY.
NORWALK, CALIFORNIA 90650

SIGNATURE _____ DATE _____ CHECKED _____ DATE _____

PROJECT S.O. UNIT-1 JOB NO. 1304-794-

SUBJECT FEED WATER PIPING SHEET _____ OF _____ SHEETS

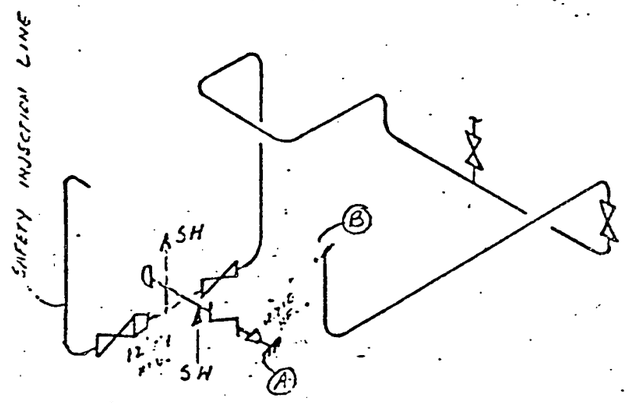


FIGURE 4

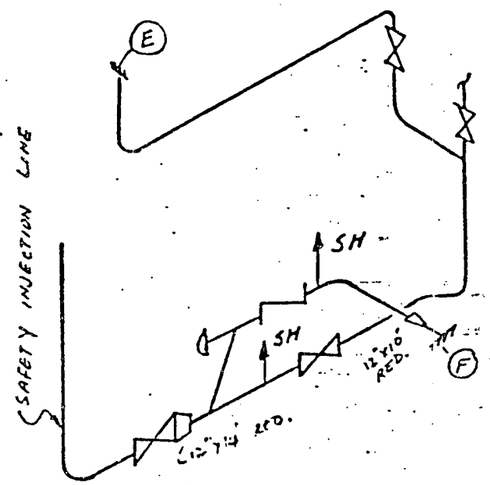


FIGURE 5

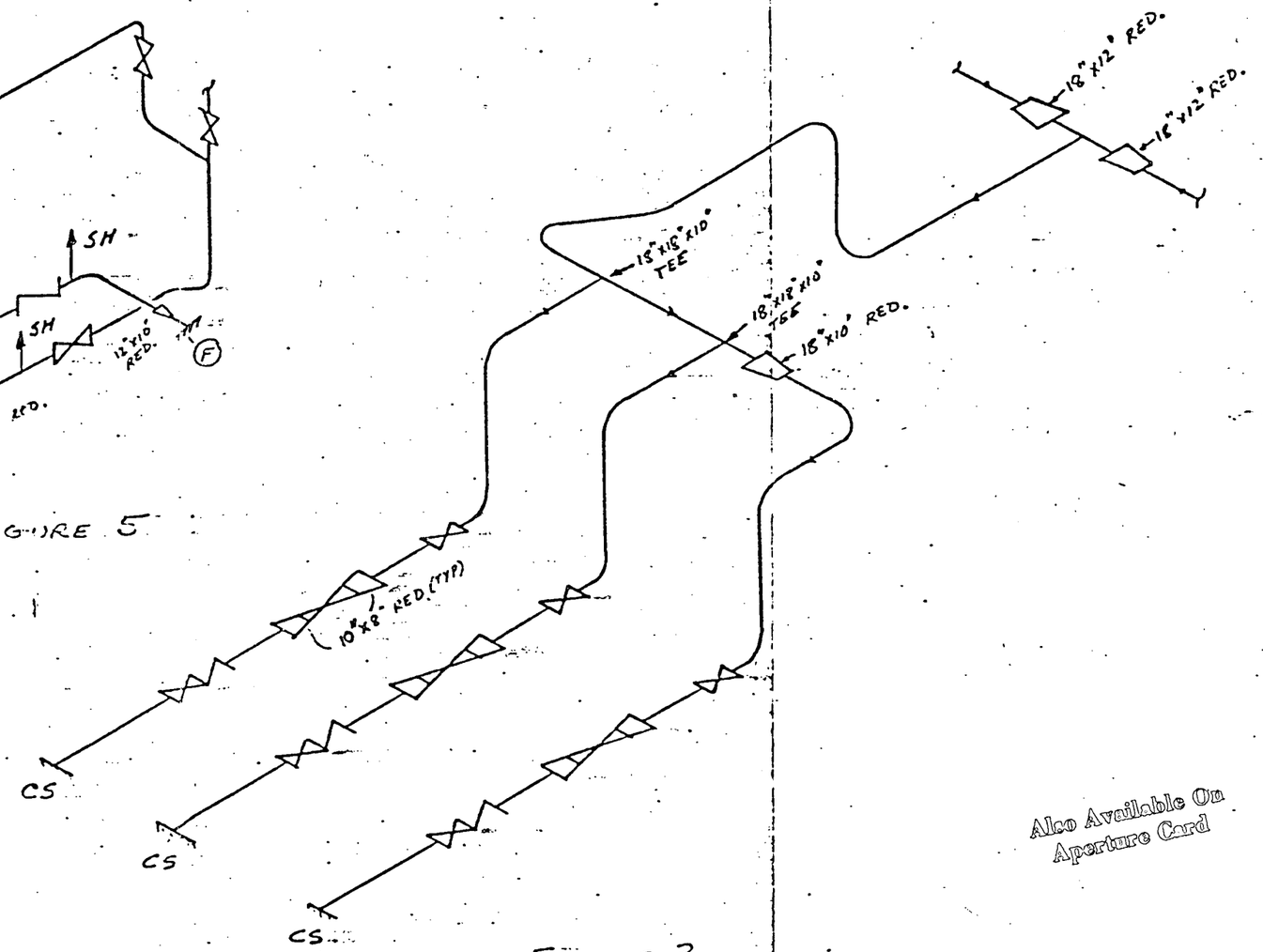


FIGURE 3

LEGENDS:

A = FEED WATER PUMP G-3A DISCHARGE NOZZLE
B = 1ST. POINT H.P. HEATER E-6A INLET NOZZLE
F = FEED WATER PUMP G-3B DISCHARGE NOZZLE
E = 1ST. POINT H.P. HEATER E-6B INLET NOZZLE
SH = SPRING-HANGER (MULTIPLE)
SW = SWAY SNUBBER (ADDITIONAL)
CS = CONTAINMENT STRUCTURES (ANCHORS)

NOTES:

1. FOR CLARITY NO RESTRAINTS EXCEPT THE FOUR ADDITIONAL ONES ARE SHOWN IN THESE FIGURES.

ISOMETRIC SKETCH SHEET

PIPE STRESS CALCULATION NO. (4)

SONGS NO. 1

FEEDWATER LINE

SHEET 1 OF 3

BY AGA DATE 6-20-73

AREA(S)

CONVENTION

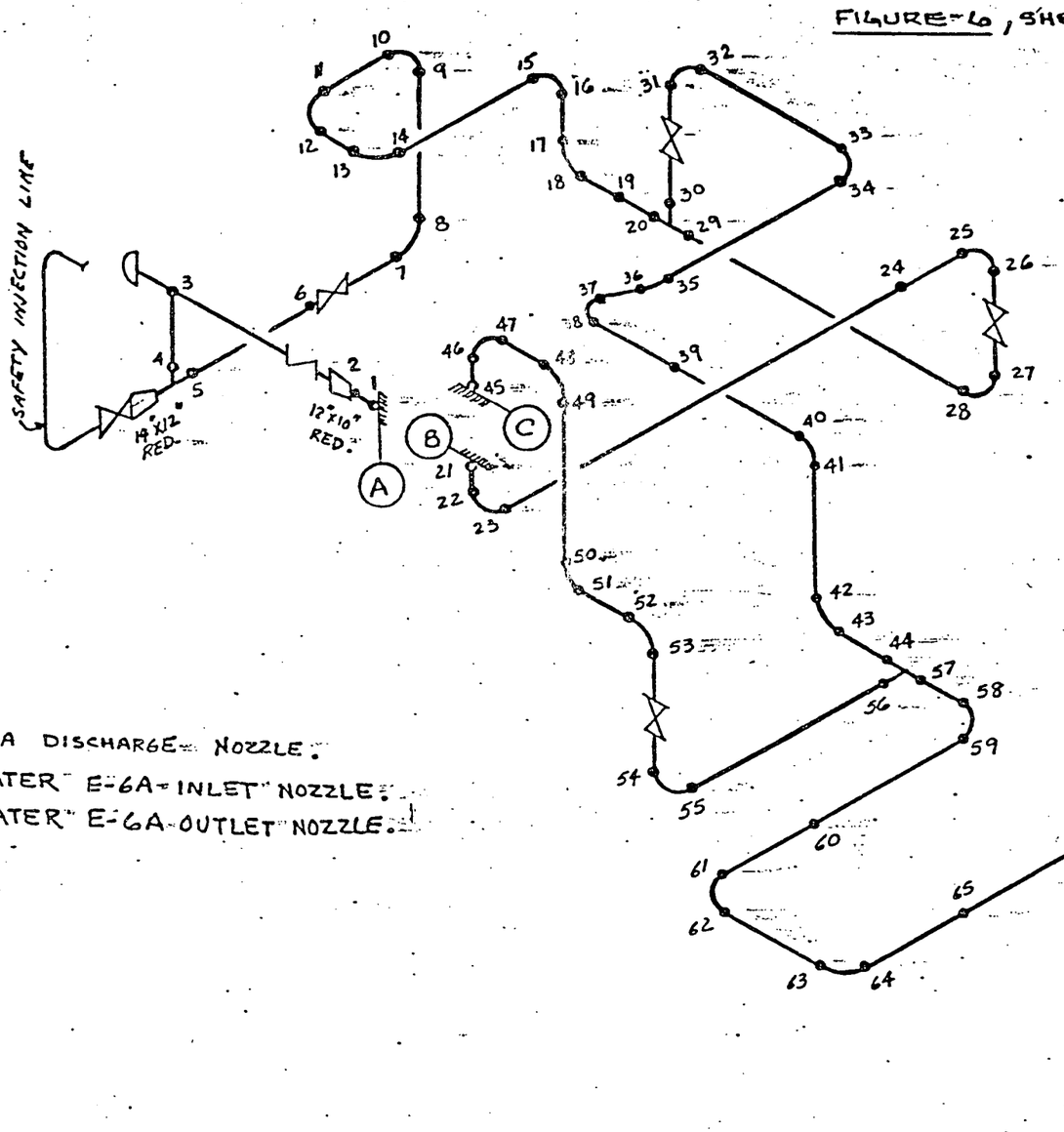
REFERENCE DWGS.

MECH.	CIVIL.	PSI

MAXIMUM STRESS

TYPE	PT.	PSI
THERM'L		
WEIGHT		
SUSTN.		

FIGURE-6, SHEET 1



A = FEED WATER PUMP G-3A DISCHARGE NOZZLE.
B = 1ST. POINT H.P. HEATER E-6A INLET NOZZLE.
C = 1ST. POINT H.P. HEATER E-6A OUTLET NOZZLE.

REV.	BY	DATE	CHK'D	DATE	DESCRIPTION	ACCEPTED JOB NO.
					REVISIONS	

BECHTEL CORPORATION SF-1 DIVISION NORWALK, CALIFORNIA

ISOMETRIC SKETCH SHEET

PIPE STRESS CALCULATION NO. 5

PROJECT SONGS - Nº 1 SUBJECT FEED WATER PIPE

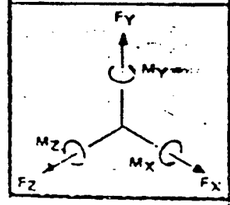
ADDITIONAL INFORMATION (PLUS SPECIFIC DATA AND DETAIL SHEET)

SHEET 2 OF 3

BY AGA DATE 6-20-73

AREA(S)

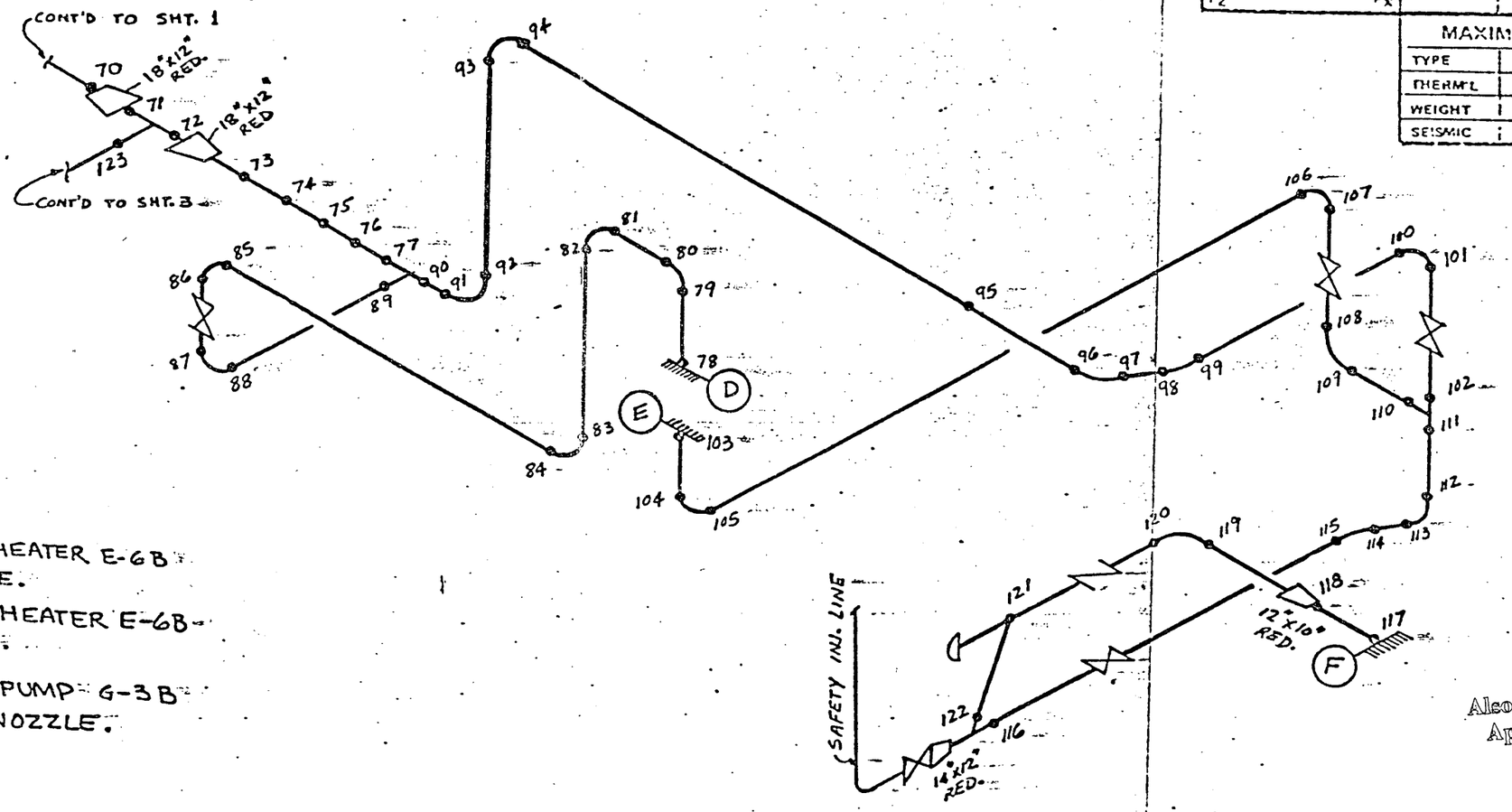
CONVENTION



REFERENCE DWGS.		
MECH.	CIVIL	PSI

MAXIMUM STRESS		
TYPE	PT.	PSI
THERM'L		
WEIGHT		
SEISMIC		

FIGURE 1, SHEET 2



D = 1ST. POINT H.P. HEATER E-6B OUTLET NOZZLE.

E = 1ST. POINT H.P. HEATER E-6B INLET NOZZLE.

F = FEED WATER PUMP G-3B DISCHARGE NOZZLE.

REV.	BY	DATE	CHK'D	DATE	DESCRIPTION

REVISIONS

REV.	BY	DATE	CHK'D	DATE	DESCRIPTION

REVISIONS

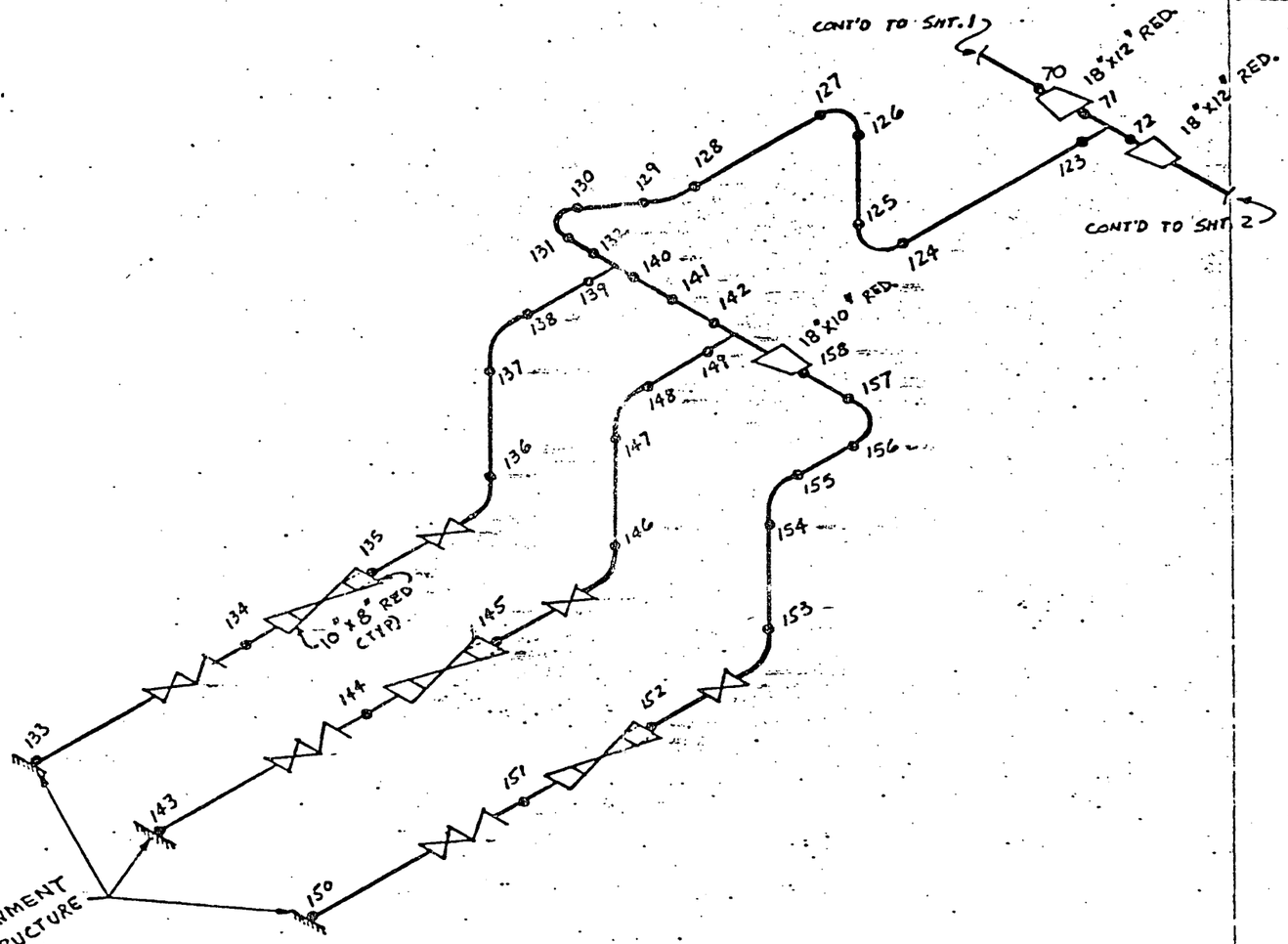
BECHTEL JOB NO.

BECHTEL CORPORATION - E&I DIVISION - NORWALK, CALIFORNIA — ISOMETRIC SKETCH SHEET — PIPE STRESS CALCULATION NO. 6

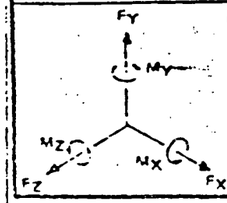
PROJECT SONGS - No-1 — SUBJECT FEED - WATER - PIPE

(ADDITIONAL INFORMATION ON ISOMETRIC DATA AND DETAIL SHEET)

FIGURE-6, SHEET 3.



CONVENTION



SHEET 3 OF 3

BY AGA DATE 6-20-73

AREA(S)

REFERENCE DWGS.

MECH.	CIVIL.	P&I

MAXIMUM STRESS

TYPE	PT.	PSI
THERMAL		
WEIGHT		
SEISMIC		

REV.	BY	DATE	CHK'D	DATE	DESCRIPTION

REVISIONS

REV.	BY	DATE	CHK'D	DATE	DESCRIPTION

REVISIONS

BECHTEL JOB NO.

BECHTEL

"FEED WATER PIPING" (TABLE-Z)

JL 19 73 A.G. ATHAR (7)

NODE	SEISMIC X σ_{sx}	SEISMIC Z σ_{sz}	SEISMIC Y INC. WEIGHT $\sigma_i=\sigma_{iy}+\sigma_w$	SEISMIC Y $\sigma_{sy}=2.4\sigma_i$	SEISMIC RESULTANT $\sigma_s=\sqrt{\sigma_{sx}^2+\sigma_{sy}^2+\sigma_{sz}^2}$	WEIGHT $\sigma_w=.60\sigma_i$	THERMAL σ_T	PRESSURE P	PRESSURE d	PRESSURE D	PRESSURE $\sigma_p=\frac{Pd^2}{D^2-d^2}$
1	1727	3545	73	29	3943	44	2747	1385	9.564	10.75	5258
2	1545	2958	30	12	3337	18	2696		9.564	10.75	5258
3					2320	69	1803		11.376	12.75	5407
4					3818	210	2348				
5					3699	1090	2057				
6	1435	1373	385	154	1992	231	1410				
7	750	2147	313	125	2278	188	1211				
8	1759	1666	236	94	2425	142	1587				
9	396	1005	353	141	1089	212	1866				
10	477	183	572	229	560	343	1375				
11	502	1581	241	96	2183	145	2290				
12	1821	1211	987	395	2222	592	3281				
13	1416	580	534	214	1545	320	1767				
14	2039	1138	865	346	2361	519	908				
15	4464	1596	418	167	4744	251	1230				
16	1195	1317	907	363	1815	544	1221				
17	1200	1375	905	362	1861	543	1182				
18	4388	1319	1637	655	4629	982	1726				
19	2799	946	1193	477	2993	716	1041				
20					6250	1886	2712				
21	1203	2875	80	32	3117	48	2098				
22	1378	231	415	166	1407	249	2674				
23	921	1399	46	18	1675	28	1838				
24	1856	1318	64	26	2277	38	664				
25	2912	2478	199	80	3824	119	725				
26	395	1636	1383	553	1772	830	1062				
27	3420	1429	1522	609	3756	913	2974				
28	3800	309	525	210	3818	315	2252				
29					5217	2361	2117				
30					3356	854	4281				
31	1071	3575	1402	561	3774	841	2507				
32	1419	1571	595	238	2130	357	2050				
33	1064	1345	513	205	1727	308	1606				
34	407	1511	352	141	1571	211	1344				

NODE	$\Sigma\sigma_s$ $\sigma_s+\sigma_w$ $+\sigma_T+\sigma_{LP}$	$\frac{\Sigma\sigma_s}{S_A+S_H}$	$\frac{\sigma_T}{S_A}$	
1	11,992	.32	.12	
2	11,319	.30	.12	
3	9,599	.26	.08	TEE
4	11,783	.31	.10	TEE
5	12,233	.33	.09	TEE
6	9,040	.24	.06	
7	9,084	.24	.05	
8	9,561	.25	.07	
9	8,574	.23	.08	
10	7,685	.20	.06	
11	10,025	.27	.10	
12	11,502	.31	.15	
13	9,039	.24	.08	
14	9,195	.25	.04	
15	11,632	.31	.05	
16	8,987	.24	.05	
17	8,993	.24	.05	
18	12,744	.34	.08	
19	10,157	.27	.05	
20	16,255	.43	.12	TEE
21	10,670	.28	.09	
22	9,737	.26	.12	
23	8,948	.24	.08	
24	8,386	.22	.03	
25	10,075	.27	.03	
26	9,071	.24	.05	
27	13,050	.35	.13	
28	11,792	.31	.10	
29	15,102	.40	.09	TEE
30	13,898	.37	.19	TEE
31	12,529	.33	.11	
32	9,944	.27	.09	
33	9,048	.24	.07	
34	8,533	.23	.06	

$P = 1385$ psig (MAX)

$T = 420°F$ (MAX)

MATERIAL: CS. A-106 GR. B

$S_c = 15,000$ psi

$S_H = 15,000$ psi

$S_A = 1.25 S_c + 0.25 S_H$

$= 22,500$ psi

$S_A + S_H = 37,500$ psi

NOTE:

FOR TEE'S STRESSES WERE HAND-CALCULATED BY USING MOMENTS FROM COMPUTER OUTPUT WITH AN APPROPRIATE STRESS INTENSIFICATION FACTOR.

STATIC ANALYSIS FROM ORIGINAL

BECHTEL

"FEED WATER PIPING" (TABLE 2) CONT.

JL 19 73 A.G.ATHAR (8)

NODE	SEISMIC X σ_{gx}	SEISMIC Z σ_{gz}	SEISMIC Y (INCL. WEIGHT) $\sigma_i=\sigma_{iy}+\sigma_w$	SEISMIC Y $\sigma_{gy}=.4\sigma_i$	SEISMIC RESULTANT $\sigma_g=\sqrt{\sigma_1^2+\sigma_2^2+\sigma_3^2}$	WEIGHT $\sigma_w=.6\sigma_i$	THERMAL σ_T	PRESSURE P	PRESSURE d	PRESSURE D	PRESSURE $\sigma_p=\frac{Pd^2}{D^2-d^2}$	NODE	$\frac{\Sigma\sigma_a}{\sigma_a+\sigma_b+\sigma_T+\sigma_p}$	$\frac{\Sigma\sigma}{S_A+S_H}$	$\frac{\sigma_T}{S_A}$	
35	2190	416	350	140	2234	210	4746	1385	11.376	12.75	5407	35	12,597	.34	.21	
36	2024	739	427	171	2161	256	4142					36	11,966	.32	.18	
37	2027	753	429	172	2169	257	4241					37	12074	.32	.19	
38	1810	1039	297	119	2090	178	5542					38	13217	.35	.25	
39	1005	807	273	109	1294	164	3036					39	9901	.26	.13	
40	1849	1262	422	169	2245	253	2651					40	10,556	.28	.12	
41	633	1016	1080	432	1273	648	1754					41	9,082	.24	.08	
42	2192	2352	1414	566	3265	848	1527					42	11,047	.29	.07	
43	1673	2733	845	338	3222	507	3214					43	12,350	.33	.14	
44					2605	897	2892					44	11,801	.31	.13	TEE
45	858	391	1304	522	1078	782	2640					45	9,907	.26	.12	
46	1578	489	2392	957	1909	1435	4120					46	12,871	.34	.18	
47	1827	687	597	239	1966	358	3320					47	11,051	.29	.15	
48	1853	680	325	130	1978	195	3628					48	11,208	.30	.16	
49	1712	599	1345	538	538	807	4047					49	10,799	.29	.18	
50	2405	1356	259	104	2763	155	6046					50	14,371	.38	.27	
51	2450	1229	316	126	2744	190	5265					51	13,606	.36	.23	
52	1322	3539	306	122	3780	184	3459					52	12,830	.34	.15	
53	1397	3079	419	168	3385	251	4255					53	13,298	.35	.19	
54	3469	3247	-2098	839	4825	1259	941					54	12,432	.33	.04	
55	4352	2284	953	381	4927	572	2786					55	13,692	.37	.12	
56					3105	1322	4331					56	14,165	.38	.19	TEE
57					2088	652	5515					57	13,662	.36	.25	TEE
58	3246	670	1301	520	3355	781	5789					58	15,332	.41	.26	
59	2695	275	1687	675	2795	1012	6117					59	15,331	.41	.27	
60	1945	1362	1034	414	2413	620	4241					60	12,681	.34	.19	
61	1755	2416	1024	410	3032	614	11494					61	20,547	.55	.51	
62	510	1204	559	224	1327	335	12954					62	20,023	.53	.58	
63	203	1560	502	201	1586	301	11094					63	18,388	.49	.49	
64	229	2978	341	136	2990	204	7770					64	16,371	.44	.35	
65	497	1555	330	132	1638	198	2226					65	9,469	.25	.10	
66	1545	2543	681	272	3165	409	7111					66	16,092	.43	.32	
67	1297	4726	495	198	4903	297	10235					67	20,842	.56	.45	
68	982	2900	364	146	3065	218	5764					68	14,454	.39	.26	
69	1158	1584	1083	433	2009	650	8476					69	16,542	.44	.38	

BECHTEL

"FEED WATER PIPING" (TABLE-2) CONT.

JL 19 73 A.G.ATHAR (9)

NODE	SEISMIC X σ_{sx}	SEISMIC Z σ_{sz}	SEISMIC Y (ext. weight) $\sigma_i=\sigma_{iy}+\sigma_w$	SEISMIC Y $\sigma_{iy}=2.4\sigma_i$	SEISMIC RESULTANT $\sigma_s=\sqrt{\sigma_x^2+\sigma_y^2+\sigma_z^2}$	WEIGHT $\sigma_w=.6\sigma_i$	THERMAL σ_T	PRESSURE P	PRESSURE d	PRESSURE D	PRESSURE $\sigma_p=\frac{Pd^2}{D^2-d^2}$	NODE	$\frac{\Sigma\sigma_e}{\sigma_s+\sigma_w+\sigma_T+\sigma_p}$	$\frac{\Sigma\sigma}{S_a+S_H}$	$\frac{\sigma_T}{S_a}$	
70	1658	3493	1333	533	3916	780	10058	1385	11.376	12.75	5407	70	20,161	.54	.45	
71					2690	626	5805	1385	16.126	18.0	5632	71	14,753	.39	.26	TEE
72					2557	1416	3455	↓	↓	↓	↓	72	13,060	.35	.15	TEE
73	1474	3008	2068	827	3450	1241	5416	1385	11.376	12.75	5407	73	15,514	.41	.24	
74	1351	3447	1316	526	3750	790	3624					74	13,571	.36	.16	
75	557	2189	1215	486	2400	729	3013					75	11,549	.31	.13	
76	748	1991	675	270	2144	405	5066					76	13,022	.35	.23	
77					3078	2022	11547					77	22,054	.59	.51	TEE
78	642	414	1623	649	1002	974	2462					78	9,845	.26	.11	
79	1178	644	2940	1176	1785	1764	3855					79	12,811	.34	.17	
80	1429	1095	821	328	1830	493	6738					80	14,468	.39	.30	
81	1369	1209	558	223	1840	335	8379					81	15,961	.43	.38	
82	1073	1310	1632	653	1815	979	9812					82	18,013	.48	.44	
83	1190	1835	966	386	2221	580	11799					83	20,007	.53	.52	
84	1447	1564	683	273	2148	410	10279					84	18,244	.49	.46	
85	1817	3121	769	308	3625	461	5847					85	15,340	.41	.26	
86	1403	2602	1668	667	3030	1001	7182					86	16,620	.44	.32	
87	1473	3663	2010	804	4029	1206	7336					87	17,978	.48	.33	
88	1451	2805	945	378	3181	567	3990					88	13,145	.35	.18	
89					2970	590	5179					89	14,146	.38	.23	TEE
90					2115	1264	7963					90	16,749	.47	.35	TEE
91	1735	2656	904	362	3193	542	9229					91	18,371	.49	.41	
92	860	1329	1375	550	1676	825	4894					92	12,802	.34	.22	
93	1489	1772	1032	413	2351	619	7305					93	15,682	.42	.32	
94	1692	2348	720	288	2998	432	9193					94	18,030	.48	.41	
95	743	2033	680	272	2182	408	4828					95	12,825	.34	.21	
96	1176	3419	837	335	3631	502	8439					96	17,979	.48	.38	
97	1102	2062	646	258	2352	388	8385					97	16,532	.44	.37	
98	1096	2071	636	254	2357	382	8133					98	16,279	.43	.36	
99	1158	2178	279	112	2469	167	8461					99	16,504	.44	.38	
100	1425	2078	748	299	2537	449	9267					100	17,660	.47	.41	
101	347	882	476	190	967	286	7026					101	13,686	.36	.31	
102					2765	518	8152					102	16,842	.45	.36	TEE
103	589	2720	170	68	2784	102	5225	↓	↓	↓	↓	103	13568	.36	.23	

BECHTEL

"FEED WATER PIPING" (TABLE 2) CONT.

NODE	SEISMIC X σ_{Bx}	SEISMIC Z σ_{Bz}	SEISMIC Y INC. WEIGHT $\sigma_i=\sigma_{iy}+\sigma_w$	SEISMIC Y $\sigma_{By}=.4\sigma_i$	SEISMIC RESULTANT $\sigma_B=\sqrt{\sigma_1^2+\sigma_3^2}$	WEIGHT $\sigma_w=.6\sigma_i$	THERMAL σ_T	PRESSURE P	PRESSURE d	PRESSURE D	PRESSURE $\sigma_p=\frac{Pd^2}{D^2-d^2}$	NODE	$\Sigma\sigma=\sigma_B+\sigma_w+\sigma_T+\sigma_p$	$\frac{\Sigma\sigma}{S_A+S_H}$	$\frac{\sigma_T}{-S_A-}$	
104	245	479	437	175	562	262	4028	1385	11.376	12.75	5407	104	10259	.27	.18	
105	221	1147	136	54	1177	82	1108					105	7774	.21	.05	
106	318	790	366	146	864	220	6022					106	12513	.33	.27	
107	623	212	924	370	755	554	5210					107	11926	.32	.23	
108	1543	1410	504	202	2100	302	11412					108	19221	.51	.51	
109	1766	598	331	132	1869	199	10627					109	18102	.48	.47	
110					1300	154	12310					110	19171	.51	.55	TEE
111					1748	426	6376					111	13957	.37	.28	TEE
112	1543	1912	1698	679	2549	1019	2932		11.376	12.75	5407	112	11907	.32	.13	
113	1200	1556	544	218	1977	326	5738					113	13448	.36	.26	
114	1203	1572	537	215	1991	322	5739					114	13459	.36	.26	
115	1525	1555	1374	550	2660	824	4891					115	13782	.37	.22	
116					2334	283	5866					116	13890	.37	.26	TEE
117	2178	3253	2986	1194	4093	1792	1989		9.564	10.75	5258	117	13132	.35	.09	
118	2635	2757	2520	1008	3945	1512	1594					118	12309	.33	.07	
119	3574	2307	1866	746	4319	1120	1203		11.376	12.75	5407	119	12049	.32	.05	
120	1913	826	340	136	2088	204	1748					120	9447	.25	.08	
121					4846	1323	4392					121	15968	.43	.20	TEE
122	2997	1775	2997	1199	3684	1798	5230					122	16119	.43	.23	
123					2198	1154	2361		16.126	18.0	5632	123	11345	.30	.11	TEE
124	2792	1212	431	172	3049	259	2893					124	11833	.32	.13	
125	2877	1025	1054	422	3083	632	2053					125	11400	.30	.09	
126	1557	829	2614	1046	2311	1568	1151					126	10662	.28	.05	
127	3644	1758	2616	1046	4179	1570	1728					127	7477	.20	.08	
128	2163	3079	406	162	3766	244	1865		16.126	18.0	5632	128	11507	.31	.08	
129	2044	3104	805	322	3730	483	1793					129	11638	.31	.08	
130	3220	4805	1559	744	5832	1115	2136					130	14714	.39	.09	
131	3794	3745	1201	480	5355	721	1828					131	13536	.36	.08	
132					2385	800	1411					132	10228	.27	.06	TEE
133	1308	262	1561	624	1473	937	3862		7.75	10.75	6423	133	12695	.34	.17	
134	912	900	1404	562	1399	842	3043		9.564	10.75	5258	134	10542	.29	.14	
135	1250	1187	479	192	1734	287	4780		7.625	8.625	4955	135	11756	.31	.21	
136	3021	3172	590	236	4401	354	2192		7.564	10.75	5258	136	12205	.33	.10	
137	2218	1655	1506	602	2529	904	2260					137	10951	.29	.10	
138	2185	2244	853	341	3911	512	3257					138	12938	.35	.14	

NODE	SEISMIC σ_{sx}	SEISMIC σ_{sz}	SEISMIC $\sigma_1 = \sigma_{iy} + \sigma_w$ (INCL. WEIGHT)	SEISMIC $\sigma_{sy} = 2.4\sigma_i$	SEISMIC RESULTANT $\sigma_s = \sqrt{\Sigma\sigma_s^2}$	WEIGHT $\sigma_w = .6\sigma_i$	THERMAL σ_t	PRESSURE P	PRESSURE d	PRESSURE D	PRESSURE $\sigma_p = \frac{Pd^2}{D^2-d^2}$	NODE	$\frac{\Sigma\sigma}{\sigma_b+\sigma_d+\sigma_t+\sigma_p}$	$\frac{\Sigma\sigma}{S_A+S_H}$	$\frac{\sigma_t}{S_A}$	
139					3737	1960	3141	1385	9.564	10.75	5258	139	14096	.38	.14	TEE
140					3033	584	912		16.126	18.0	5632	140	10161	.27	.04	TEE
141	1510	1142	1655	662	2006	993	716					141	9347	.25	.03	
142					1029	445	1205					142	8311	.22	.05	TEE
143	1075	256	1538	615	1265	923	4073		9.75	10.75	6423	143	12684	.34	.18	
144	665	258	1469	586	924	881	3538		9.564	10.75	5258	144	10601	.28	.16	
145	385	444	543	217	626	326	4052		7.625	8.625	4985	145	9989	.27	.18	
146	445	415	493	197	640	296	872		9.564	10.75	5258	146	7066	.19	.04	
147	1005	243	1627	651	1222	976	1308					147	8764	.23	.06	
148	714	546	1080	432	1149	648	1639					148	8694	.23	.07	
149					3287	1615	3230					149	13390	.36	.14	TEE
150	1299	379	1540	616	1487	924	4180		9.75	10.75	6423	150	13014	.35	.19	
151	928	582	1519	608	1177	911	3791		9.564	10.75	5258	151	11137	.30	.17	
152	1267	1011	674	270	1643	404	3649		7.625	8.625	4985	152	10681	.28	.16	
153	3068	2772	622	249	4142	373	1217		9.564	10.75	5258	153	10990	.29	.05	
154	2158	1334	2206	882	2686	1324	969					154	10237	.27	.04	
155	3153	2583	1641	656	4128	984	1374					155	11744	.31	.06	
156	1431	987	225	90	1741	135	2318					156	9452	.25	.10	
157	2981	2920	1633	653	4224	980	2544					157	13006	.35	.11	
158	3526	2208	1711	684	4216	1037	1525					158	12026	.32	.07	

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