



CALCULATION COVER SHEET

PROJECT DAVIS-BESSE, UNIT-1 JOB NO. 12501 CALC. NO. M-8
SUBJECT PRESSURIZER SURGE LINE - CLASS-I PIPING ANALYSIS

COMPUTER PROGRAM: ☐ NONE ☒ SCP ☐ OTHER

TOTAL NO. 8
OF SHEETS

PROGRAM NO(S) ME-101 ME-210 VERSION/RELEASE NO. K1/4-15-84, 5/12-15-82

ATT. NO. 1 = 3 SHTS., ATT. NO. 2 = 14 SHTS., ATT. NO. 3 = 4 SHTS., ATT. NO. 4 = 2 SHTS., ATT. NO. 5 = 1 SHT.

☐ PRELIMINARY CALC.

☐ COMMITTED PRELIMINARY CALC.

☐ SUPERSEDED CALC.

☒ FINAL CALC.

8502200336 850201
PDR ADDCK 05000346
S PDR

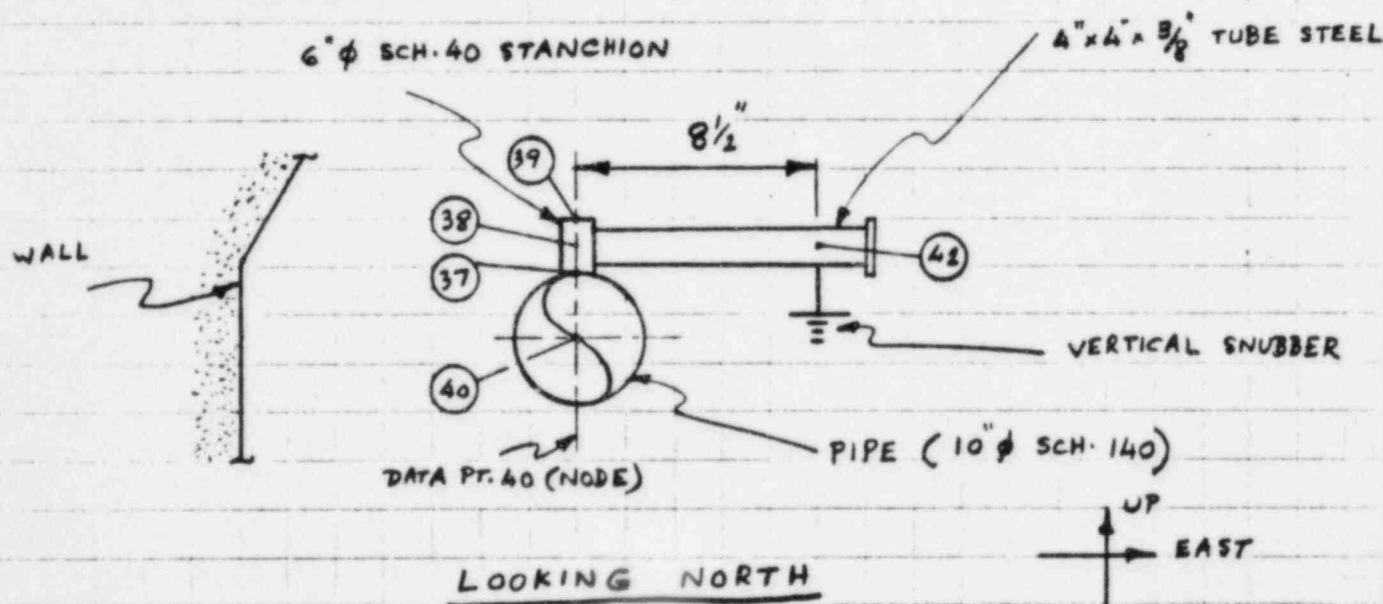
| NO. | DESCRIPTION | BY | DATE | CHKD. | DATE | APPROVED | DATE |
|-----------|------------------------|-----|---------|--------------------|---------|----------|---------|
| 01 | PRESSURIZER SURGE LINE | SPL | 1-31-85 | <i>[Signature]</i> | 1-31-85 | MSW - | 1-31-85 |
| REVISIONS | | | | | | | |



CALCULATION SHEET

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|-----------------------------------|-----------------|------------------------|-----------------|
| JOB NO. 12501 DAVIS-BESSE, UNIT 1 | CALC. NO. M-8 | REV. NO. 01 | SHEET NO. 1 |
| PRESSURIZER SURGE LINE | | | |
| ORIGINATOR Siva P. Lingam | DATE 1-30-85 | CHECKED [Signature] | DATE 1-31-85 |

AS-BUILT CONDITION OF VERTICAL SNUBBER (PSU-R1) ON PRESSURIZER SURGE LINE



THE PURPOSE OF THIS CALCULATION IS TO CHECK THE PRIMARY PIPE STRESSES (CATASTROPHIC FAILURE) ON THE PRESSURIZER SURGE LINE FOR LONG-TERM OPERATION. CRITERIA EXCLUSIVE OF FINAL CLASS-I FATIGUE ANALYSIS.

ORIGINAL ANALYSIS OF THIS LINE WAS DONE BY B&W ON MAY 3, 1974 (STRESS ANALYSIS OF SURGE LINE, REPORT #6, REV. 1). ALL POINTS WERE ANALYZED BY USING THE SIMPLIFIED METHOD PER USAS B31.7, 1968 (1-705 & TABLE D-201, APPENDIX-D). IN THIS ANALYSIS, VERTICAL SNUBBER PSU-R1 IS CONSIDERED AT THE CENTER LINE OF PIPE.

AS PER NCR 84-180, THE WEST SIDE VERTICAL SNUBBER (CLOSE TO THE WALL) FAILED. THE REASON OF FAILURE IS DETERMINED AS THERMAL INTERFERENCE BETWEEN WALL AND THE FAILED SNUBBER. AS A RESULT, BECHTEL MODIFIED THIS SNUBBER AS SHOWN ABOVE TO MAKE THE REMAINING SNUBBER ALONE CAPABLE OF CARRYING THE ORIGINAL LOAD. HOWEVER THIS MODIFICATION CAUSES AN UNBALANCED MOMENT (TORSION ON PIPE) AT PIPE AND STANCHION INTERFACE.



CALCULATION SHEET

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|---|-----------------|-------------------------------|-----------------|
| JOB NO. 12501 DAVIS-BESSE, UNIT 1 CALC. NO. M-8 | | REV. NO. 01 | SHEET NO. 2 |
| PRESSURIZER SURGE LINE | | | |
| ORIGINATOR Sara P. Kington | DATE 1-30-85 | CHECKED <i>[Signature]</i> | DATE 1-31-85 |

BECHTEL MADE TWO SEISMIC RUNS OF PRESSURIZER SURGE LINE (BY DECOUPLING FROM HOT LEG), ONE WITH VERTICAL SNUBBER AT THE CENTER LINE OF PIPE AND OTHER WITH VERTICAL SNUBBER MODELED THROUGH STANCHION & TUBE STEEL TO REFLECT THE MODIFICATION AND AT THE SAME TIME CONSIDER THE EFFECT OF AN UNBALANCED MOMENT ON THE SYSTEM AS A WHOLE. THE DYNAMIC PROPERTIES (EIGEN VALUES & EIGEN VECTORS) WERE THEN COMPARED FOR THE TWO RUNS. THERE IS NO SIGNIFICANT CHANGE IN THE DYNAMIC PROPERTIES LEADING TO THE CONCLUSION THAT THE RESULTS OF THE ORIGINAL ANALYSIS REMAIN UNCHANGED INCLUDING NOZZLE LOADS. THE COMPARISON OF EIGEN VALUES (NATURAL FREQUENCIES UPTO 33 Hz) IS SHOWN BELOW (SEE ATTACHMENT NO. 1):

| WITH SNUBBER AT CENTER LINE OF PIPE | WITH SNUBBER ACTUALLY MODELED | DIFFERENCE IN % | SOURCE |
|--|----------------------------------|--------------------|---------------------|
| 10.031 Hz. | 9.805 Hz. | 2.253% | BECHTEL |
| 16.265 | 16.327 | 0.381 | COMPUTER |
| 19.021 | 18.914 | 0.563 | RUNS |
| 21.418 | 20.054 | 6.37 (HIGHER MODE) | G7397(11-28-84) AND |
| 27.479 | 26.913 | 2.06 | G7397(11-28-84) |

HOWEVER, THE EFFECT OF ADDITIONAL TORSION MOMENT HAS TO BE CHECKED LOCALLY BY ADDING TO THE ORIGINAL RESULTS. SINCE THE MAXIMUM SEISMIC STRESS AND MAX. PRIMARY STRESS INTENSITY (EQ. 9 OF 1-705.1 OF B31.7, 1968) OCCUR VERY CLOSE TO THIS SNUBBER (4 1/4" AWAY) IN THE ORIGINAL ANALYSIS, - THE CORRESPONDING MOMENTS ARE CONSIDERED AT THE SNUBBER AND ARE NOTED BELOW (B&W DATA PT. 3 - SEE ATTACHMENT #2):

| LOAD TYPE | MOMENT IN INCH-POUNDS | | | |
|---------------|-----------------------|----------|-----------|-------------------------|
| | Mx # | My # | Mz # | TORSIONAL MOMENT (Mx) # |
| WEIGHT | 12615.24 | 4661.04 | 51039.12 | — |
| SEISMIC (OBE) | 8872.8 | 22011.6 | 244343.04 | 20400 (2400 x 8.5) |
| SEISMIC (SSE) | 15204.6 | 38394. | 451370.28 | 33150 (3900 x 8.5) |
| WEIGHT + OBE | 21488.04 | 26672.64 | 295382.16 | 20400 |
| WEIGHT + SSE | 27819.84 | 43055.04 | 502409.4 | 33150 |



CALCULATION SHEET

| | | | |
|---|-----------------|-------------------------------|-----------------|
| JOB NO. 12501 DAVIS-BESSE, UNIT-1 CALC. NO. M-8 | | REV. NO. 01 | SHEET NO. 3 |
| PRESSURIZER SURGE LINE | | | |
| ORIGINATOR Siva P. Lingam | DATE 1-30-85 | CHECKED <i>[Signature]</i> | DATE 1-31-85 |

EQUATION - 9

$$B_1 \frac{PD_0}{2t} + B_2 \frac{D_0}{2I} M_i \leq 1.5 S_m \quad (\text{UPSET})$$

$$B_1 \frac{PD_0}{2t} + B_2 \frac{D_0}{2I} M_i \leq 2.25 S_m \quad (\text{FAULTED PER B\&W ANALYSIS})$$

SEE ATTACH. NO. 2, SHT. NO. 13

$B_1 = 1.0$ (along) (conservative as stanchion is on straight pipe) → Ref. Table D.201 of APP. D
 No hole on the run pipe - this causes only longitudinal pressure stress.

$P = 2500 \text{ psi}$

$D_0 = 10.75''$

$t = 1.0''$

$I = 368 \text{ in}^4$

$$M_i = \sqrt{(31488.04 + 20400)^2 + (26672.64)^2 + (295382.16)^2}$$

$$= 299527.4 \text{ in.-lb. (upset)}$$

$$B_2 = 0.75 C_2 \left[\frac{1.95}{\left(\frac{E R}{n_1} \right)^{1/3}} \right] M_i = \sqrt{(27819.84 + 33150)^2 + (43055.04)^2 + (502409.4)^2}$$

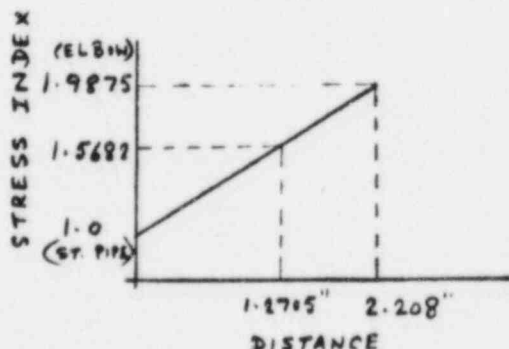
$$= 507923.5 \text{ in.-lb. (Faulted)}$$

$B_2 = 1.9875$ (FOR ELBOW)

$B_2 = 1.5$ (FOR WTEE)

$$\sqrt{A t} = \sqrt{4.875 \times 1.0} = 2.208''$$

ACTUAL DISTANCE BETWEEN ELBOW
 WELD & NEAREST STANCHION WELD
 $= 0.9875''$



ASSUMING LINEAR DISTRIBUTION OF STRESS INDEX,

$$\frac{0.9875}{B} = \frac{2.208}{1.2705}$$

$$B = 0.5682$$

$$B = 1.0 + 0.5682 = 1.5682$$

$$B_2 = 1.5682 \times 1.5 = 2.3523 \quad (\text{multiplication of overlapping stress index is not required but is implied in note 2 of Table D.201})$$

If assumed as an unreinforced tee (UTEE), $i = \frac{0.9}{A^{2/3}}$ where

$$A = \frac{t n}{n} \quad (\text{from class. 2})$$

$$t_n = 1.0, \quad n = 4.875$$

$$i = 2.5877$$

$$B_2 = 2.5877 \quad (\text{conservative - no hole on the run pipe})$$



CALCULATION SHEET

| | | | | | |
|-----------------------------------|---------|-----------------|---------|-------------|-------------|
| JOB NO. 12501 DAVIS-BESSE, UNIT-1 | | CALC. NO. M-8 | | REV. NO. 01 | SHEET NO. 4 |
| PRESSURIZER SURGE LINE | | | | | |
| ORIGINATOR | DATE | CHECKED | DATE | | |
| Eric P. Lingham | 1-30-85 | Randall K. Liss | 1-31-85 | | |

CONSIDER THE HIGHEST VALUE OF $B_2 = 2.5877$ (UTEE)

$$B_1 \frac{PD_0}{2E} + B_2 \frac{PD_0}{2E} M_1 \leq 1.5 S_m$$

$$1.0 \times \frac{2500 \times 10.75}{2 \times 1.0} + 2.5877 \times \frac{10.75}{2 \times 368} \times 299527.4 \leq 24,800 \text{ psi}$$

$$24,759 \leq 24,800 \text{ psi}$$

(UPSET CONDITION)

$$1.0 \times \frac{2500 \times 10.75}{2 \times 1.0} + 2.5877 \times \frac{10.75}{2 \times 368} \times 507923.5 \leq 37,575 \text{ psi}$$

$$32,635 \leq 37,575 \text{ psi}$$

(Faulted condition).
SEE ATTACH. NO. 2



CALCULATION SHEET

| | | | |
|---|---------|----------------|-------------|
| JOB NO. 12501 DAVIS-BESSE, UNIT-1 CALC. NO. M-8 | | REV. NO. 01 | SHEET NO. 5 |
| PRESSURIZER SURGE LINE | | | |
| ORIGINATOR | DATE | CHECKED | DATE |
| Siva P. Arinam | 1-30-85 | T. J. Little's | 1-31-85 |

BECHTEL PROGRAM ME-210 ALSO CALCULATES THE LOCAL STRESSES AT THE STANCHION & PIPE INTERFACE. Ref.: WRC-107

CHECKS 1A, 1B, 2A & 2B OF ME-210 DEAL WITH UPSET PRIMARY (CIRCUMFERENTIAL), FAULTED PRIMARY (CIRCUMFERENTIAL), UPSET PRIMARY (LONGITUDINAL) & FAULTED PRIMARY (LONGITUDINAL) RESPECTIVELY. (SEE SHT. 4 OF ATTACH. NO. 3)

$$1A \rightarrow \frac{PD_o}{2t} + \text{stresses from ME-210} = 14,030 \text{ psi}$$

$$13437.5 + \text{stresses from ME-210} = 14,030$$

$$\text{stress from ME-210} = 14030 - 13437.5 = 592.5$$

Applying stress index of 2.5877,

$$1A \rightarrow 13437.5 + (2.5877 \times 592.5) = 14,971 \text{ psi} (< 24,720 \text{ psi})$$

$$1B \rightarrow 13437.5 + 2.5877 \times (14400 - 13437.5) = 15,929 \text{ psi}$$

(< 37,575 psi)
B&N = 2.255

$$2A \rightarrow \frac{PD_o}{4t} + \text{stresses from ME-210 including ME-101 stresses} = 12,970$$

$$6718.75 + \text{stresses from ME-210 including ME-101 stresses} = 12,970$$

$$\text{stresses from ME-210 including ME-101 stresses} = 6251.25$$

Applying stress index of 2.5877,

$$1A \rightarrow 6718.75 + (2.5877 \times 6251.25) = 22,896 \text{ psi} (< 24,720 \text{ psi})$$

$$2B \rightarrow 6718.75 + 2.5877 \times (17390 - 6718.75) = 34,332 \text{ psi}$$

(< 37,575 psi)



CALCULATION SHEET

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|------------------------|---------------|-------------------------|--------------|
| JOB NO. 12501 | CALC. NO. M-8 | REV. NO. 01 | SHEET NO. 6 |
| DAVIS-BESSE UNIT ONE | DATE 1-31-85 | CHECKED Sura P. Lingham | DATE 1-31-85 |
| ORIGINATOR J. J. P. P. | | | |

REANALYSIS USING CODE CASE N-411 RESULTED IN THE SYSTEM EXPERIENCING THE FOLLOWING REDUCTIONS IN DISPLACEMENTS, LOADINGS AND STRESSES (WHEN COMPARED TO THE ORIGINAL ANALYSIS):
(CODE CASE N-411 CALLS OUT FOR 5% DAMPING FOR 0-10cps, A LINEAR DECREASE FROM 5% TO 2% DAMPING FOR 10-20cps, AND 2% DAMPING FOR FREQUENCIES GREATER THAN 20cps - SEE ATTACHMENT #4)

SUPPORTS: @ BECHTEL D.P. (42) : 64% REDUCTION IN LOAD (Y-SNUBBER) - PSU-R1
@ " " (55) : 11% REDUCTION IN LOAD (X-SNUBBER)
@ " " (60) : 70% REDUCTION IN LOAD (Z-SNUBBER)

DISPLACEMENTS : ALL DATA POINTS : 60% TO 75% REDUCTION IN DISPLACEMENT

MOMENTS IN THE PIPE : FOR M_x : 51% TO 70% REDUCTION IN LOADING
FOR M_y : 62% TO 70% REDUCTION IN LOADING
FOR M_z : 48% TO 70% REDUCTION IN LOADING

STRESSES IN THE PIPE : AN OVERALL REDUCTION OF 64% TO 69% IN STRESSES.

NOZZLE LOADS : FOR HOT LEG (BECHTEL D.P. (5)) : 49% TO 69% REDUCTION IN LOADING
FOR PRESSURIZER (BECHTEL D.P. (100)) : 11% TO 70% REDUCTION IN LOADING

THE REDUCTIONS SHOWN ABOVE REFLECT OBE AND SSE CONDITIONS.
IN GENERAL, THE MORE SIGNIFICANT LOADINGS EXPERIENCED APPROXIMATELY A 65% REDUCTION IN LOADINGS.

REFER TO : SNUMB N° G0087 DATED 1-30-85 - OBE USING CODE CASE N-411
SNUMB N° G0096 DATED 1-31-85 - SSE USING CODE CASE N-411



CALCULATION SHEET

| | | | |
|---|-----------------|------------------------|-----------------|
| JOB NO. 12501 DAVIS-BESSE, UNIT-1 CALC. NO. M-8 | | REV. NO. 01 | SHEET NO. 7 |
| PRESSURIZER SURGE LINE | | | |
| ORIGINATOR Siva P. Arinam | DATE 1-31-85 | CHECKED [Signature] | DATE 1-31-85 |

IT IS EVIDENT FROM THE PREVIOUS SHEET THAT AT LEAST 40% REDUCTION IN Y-LOAD, MOMENTS & STRESSES CAN BE ATTAINED FOR CODE CASE N-411 WHICH PERMITS THE USE OF HIGHER DAMPING (5% TO 2% OF CRITICAL DAMPING). APPLYING THIS REDUCTION IN EQUATION-9, WE GET THE FOLLOWING:

$$B_1 \frac{PD_0}{2t} + B_2 \frac{D_0}{2I} M_1 \leq 1.5 S_m$$

$$1.0 \times \frac{2500 \times 10.75}{2 \times 11.0} + 2.5877 \times \frac{10.75}{2 \times 368} (299527.4) \times 0.6 \leq 24,800 \text{ psi}$$

$$20,231 \leq 24,800 \text{ psi}$$

(upset condition)

$$1.0 \times \frac{2500 \times 10.75}{2 \times 11.0} + 2.5877 \times \frac{10.75}{2 \times 368} (507923.5) \times 0.6 \leq 37,575 \text{ psi}$$

$$24,956 \leq 37,575 \text{ psi}$$

(faulted condition)

IN A SIMILAR WAY, ME-210 STRESSES (CHECKS 1A, 1B, 2A & 2B) WILL BE MUCH WITHIN THE ALLOWABLES.

CONCLUSIONS

EVEN WITH CONSERVATIVE PRIMARY STRESS INDICES (B_1 FOR AN ELBOW ALTHOUGH STANCHION IS ON A STRAIGHT PIPE AND B_2 FOR AN UNREINFORCED TEE ALTHOUGH THERE IS NO HOLE IN THE PIPE), CONDITION FOR CATASTROPHIC FAILURE IS SATISFIED FOR LONG TERM OPERATION. IN ADDITION, WE HAVE SHOWN THAT SEISMIC ANALYSIS USING 5% DAMPING WOULD REDUCE STRESS LEVELS AN ADDITIONAL 18% (AT LEAST) AND MATERIAL TEST REPORTS SHOW THE ACTUAL YIELD STRENGTH TO BE GREATER THAN THE ALLOWABLE DESIGN VALUES.

TITLE 1 PRESSUR, SURGE LINE
PROJECT NUMBER 1 12501
PROBLEM NUMBER 1 M8
USER 1 SPL
LOAD CASE 1 SEISI

EIGEN SOLVER 1 DETERMINANT SEARCH

FREQUENCIES FOR THE SEISI LOAD CASE (CP3)

10.0315230 16.2666015 19.0205320 21.4183087 27.4791067

EIGEN VALUES (natural frequencies)

SEISMIC

PERIODS FOR THE SEISI LOAD CASE (SEC)

.0006877 .0618829 .0525748 .0866890 .0363913

WITHOUT BROKEN SNUBBER

PRESSURIZER SURGE LINE

ATTACHMENT NO. 1

PROB. NO. M-8 (01)

SHT. NO. 1 OF 3

Added by: Siva G. Lingam Date: 1-30-85

CHK'd by: Langley Date: 1-31-85

WE101/K1

FREQUENCIES AND PERIODS

TITLE 1 PRESS. SURGE LTNE
PROJECT NUMBER 1 12501
PROBLEM NUMBER 1 M8
USER 1 SPL
LOAD CASE 1 SEISM

EIGEN SOLVER 1 DETERMINANT SEARCH

FREQUENCIES FOR THE SEISM LOAD CASE (CPH)

| | 16.3267960 | 16.9136306 | 20.0543249 | 26.9129386 |
|-----------|------------|------------|------------|------------|
| 9.8881866 | | | | |

SEISMIC

PERIODS FOR THE SEISM LOAD CASE (SEC)

| | .0612590 | .0528719 | .0498046 | .0371568 |
|----------|----------|----------|----------|----------|
| .1019975 | | | | |

WITH BROKEN SNUBBER

$\approx 2.3\%$ - four bearing

PRESSURIZER SURGE LINE

ATTACHMENT NO. 1

PROB. NO. M-8(01)

SHT. NO. 2 OF 3

Added by: Siva P. Singam Date: 1-30-85

checked by: Vandagobboles Date: 1-31-85

Pandy Kies A.P.N: SIVA LINGAM

Babcock & Wilcox

a BURNHAM COMPANY

Nuclear Power Generation Division

FIG. 1007.1 P. 20

GENERAL CALCULATIONS

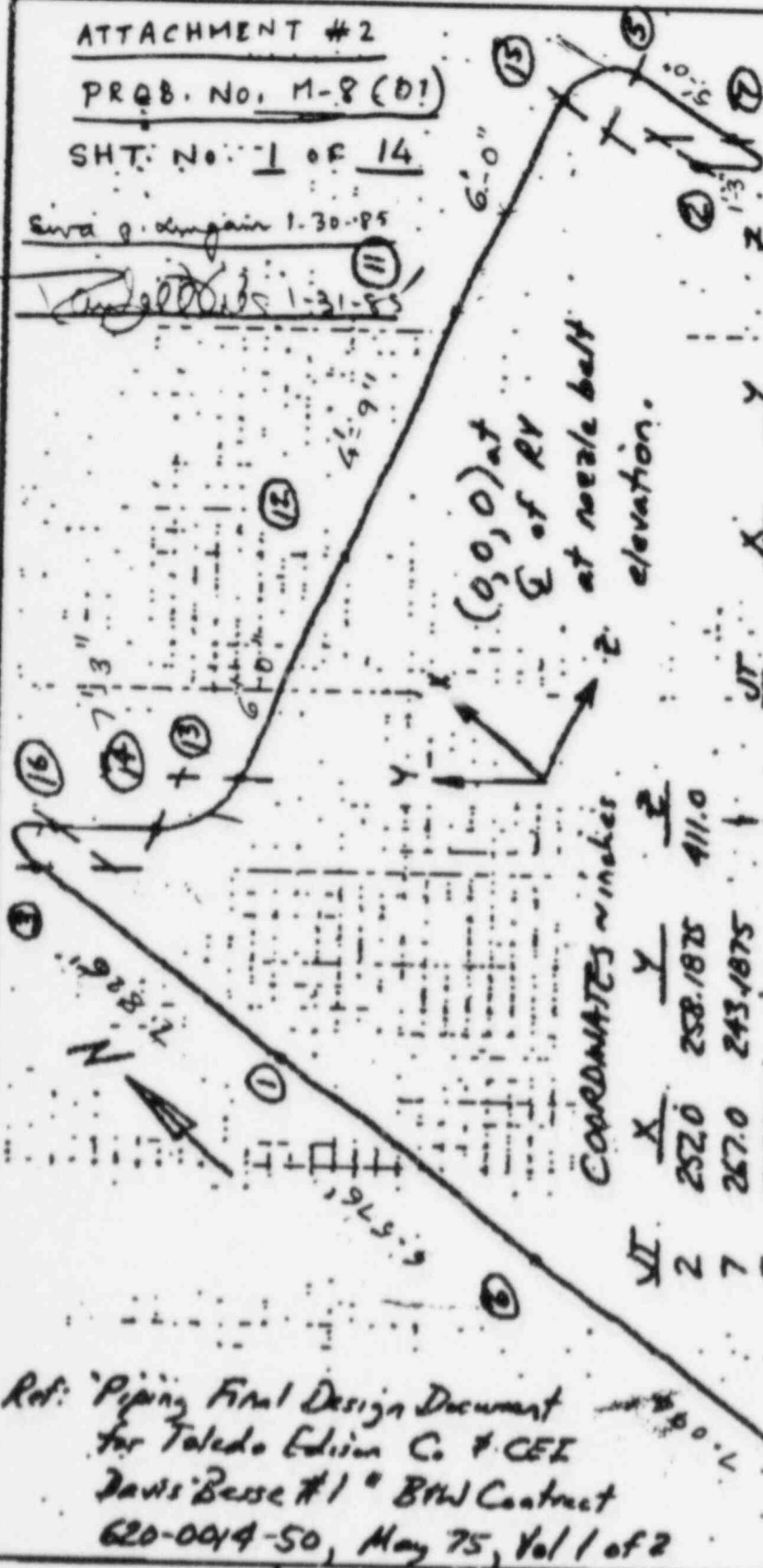
ATTACHMENT #2

PRQ. NO. M-8 (01)

SHT. NO. 1 OF 14

Added by: Siva Lingam 1-30-85

Checked by: [Signature] 1-31-85



(0,0,0) at
C of RV
at nozzle belt
elevation.

COORDINATES in inches

| ST | X | Y | Z |
|----|----------|-------|---------|
| 16 | 311.9375 | 335.0 | 210.0 |
| 3 | 286.9375 | 330.0 | |
| 1 | 218.030 | | |
| 6 | 139.122 | | |
| 23 | 60.214 | | |
| 36 | 49.607 | | |
| 54 | 23.688 | | |
| 71 | 0 | | |
| | | | 214.393 |
| | | | 240.312 |
| | | | 264.0 |

| ST | X | Y | Z |
|----|----------|----------|-------|
| 2 | 252.0 | 258.1875 | 411.0 |
| 7 | 267.0 | 243.1875 | |
| 5 | 286.9375 | | 38.0 |
| 15 | 311.9375 | | 339.0 |
| 11 | | | 282.0 |
| 12 | | | 225.0 |
| 13 | | | 210.0 |
| 14 | | | |
| | | 258.1875 | |

Ref: Piping Final Design Document
for Toledo Edison Co. & CEE
Jaws Base #1 - B&W Contract
620-0044-50, May 75, Vol 1 of 2

PREPARED BY RP Polukhin

DATE 6/25/82

DOC. NO. _____

REVIEWED BY _____

DATE _____

PAGE NO. _____

SURGE LINE SUPPRESSOR/HANGER LOADS

(See Figure 4)

| <u>Type of Loading</u> | <u>Forces (Kips)</u> | | | <u>Moments (Ft-Kips)</u> | | |
|------------------------|----------------------|-----------|-----------|--------------------------|-----------|-----------|
| | <u>Fx</u> | <u>Fy</u> | <u>Fz</u> | <u>Mx</u> | <u>My</u> | <u>Mz</u> |
| Dead Weight | 0 | -3.8 | 0 | 0 | 0 | 0 |
| OBE | 7.5 | 2.4 | 3.2 | 0 | 0 | 0 |
| DBE | 13.7 | 3.9 | 5.8 | 0 | 0 | 0 |

PROB. NO. M-8(01)

ATTACHMENT # 2

SHT. NO. 2 OF 14

Added by: Siva P. Lingam Date: 1-30-85

checked by: Rajalal Date: 1-31-85

Introduction

This report contains the stress analysis of the surge line. All points in the surge line are analyzed including the bimetallic weld at the hot leg surge nozzle. The analysis of the intersection at the pressurizer end is contained in pressurizer Design Report "Surge Nozzle Analysis". The branch intersection analysis is contained in this Design Report under a different section "Surge Nozzle".

Results

All points in the surge line satisfy primary stress limits either in accordance with equation 9 or per Appendix F of the B31.7 code.

Per equation 9 simplified analysis

Maximum Primary Stress = 22074.96 psi $< 1.5 S_m = 24800$ psi @ 670°F
Maximum for an elbow (joint 3) = 22074.96 psi < 24800 psi
Maximum for a straight (joint 1) = 10220.54 psi < 24800 psi

All points in the surge line do not satisfy the $3 S_m$ primary plus secondary stress limit. However, calculations are provided showing that an Elastic-Plastic Analysis is applicable.

Maximum primary plus secondary stress (Bimetallic Weld) (joint 54)
= 75997.62 psi $> 3 S_m = 50100$ psi @ 650°F (PAGE C-11)

Maximum primary plus secondary stress for an elbow (joint 2)
= 67368.71 psi > 50100 psi (PAGE C-13)

Primary plus secondary stress for cycles occurring more than 240 times:

Joint 2 = 36860.4 psi $< 3 S_m = 50100$ psi

Joint 3 = 33787.9 psi $< 3 S_m = 50100$ psi

Joint 19 = 36929.7 psi $< 3 S_m = 50100$ psi

Maximum Usage Factors:

Usage Factor at Bimetallic weld (joint 2) = 0.87 < 1.0 = allowable

Usage Factor for joint 3 = 0.046 < 1.0 = allowable

Usage Factor for joint 19 = 0.036 < 1.0 = allowable

PROB. NO. M-8 (01)

ATTACHMENT # 2

SHT. NO. 3 OF 14

Added by: Siva P. Lingam Date: 1-30-85

checked by: Vandell Date: 1-31-85

Ref: "Stress Analysis of Surge Line, Report #6, for Toledo Edison Company, Davis-Besse," 620-0014-50, Jun 1972 (Rev 1, 5/3/74). RP 7/2/82

This section demonstrates that all points in the surge line satisfy primary stress limits according to either Equation 9 or Appendix F of B31.7. A flexibility analysis was run for dead weight, and either (x + y) or (z + y) earthquakes. The moments generated by this analysis are shown on Pages A-4 thru A-7.

These moments are then combined with design pressure of 2500 psi to generate primary stresses in accordance with equation 9 using applicable indicies. The indicies used are listed in the stress output. Two cases were ran: 1) pressure, deadload, (x + y) earthquake; 2) pressure, deadload, (z + y) earthquake.

The results are then compared to $1.5 S_m$ at 670°F for SA-376-TP-316 (straights) and A-403-WP-316 (bends). Part of the surge line actually has a design temperature of 650°F . $S_m = 16,500$ psi. for both materials thus the allowable primary stress is $1.5 (16,500.) = 24,800.$ psi.

The largest primary stress is 22074.96 psi at joint 3 for the x + y earthquake at an elbow juncture. Complete results are tabulated on Page A-8 and 9.

PROB. NO. M-8 (01)

ATTACHMENT # 2

SHT. NO. 4 OF 14

Added by: Siva S. Singam date: 1-30-85

ch'kd by: Varghese date: 1-31-85

STRESS INDICES

(JOINT CLASSIFICATION)

TYPE

DESCRIPTION

- 1 STRAIGHT PIPE, REMOTE FROM WELDS OR OTHER DISCONTINUITIES
- 2 GIRTH BUTT WELD BETWEEN STRAIGHT PIPE OR BETWEEN PIPE AND BUTT-WELDING COMPONENTS. FLUSH
- 3 GIRTH BUTT WELD BETWEEN STRAIGHT PIPE OR BETWEEN PIPE AND BUTT-WELDING COMPONENTS. AS WELDED
- 4 GIRTH FILLET WELD TO SOCKET WELD FITTINGS, SLIP-ON FLANGES, OR SOCKET-WELDING FLANGES
- 5 LONGITUDINAL BUTT WELDS IN STRAIGHT PIPE. FLUSH
- 6 LONGITUDINAL BUTT WELDS IN STRAIGHT PIPE. AS WELDED
- 7 TAPERED TRANSITION JOINTS PER SUBPAR. 1-727.4.2(C) AND FIG.1-727.3.1
- 8 BRANCH CONNECTIONS PER SUBDIV. 1-704.3
- 9 CURVED PIPE OR BUTT-WELDING ELBOWS PER USAS B16.9, USAS B16.28, OR MSS SP48
- 10 BUTT-WELDING TEES PER USAS B16.9 OR MSS SP48
- 11 BUTT-WELDING REDUCERS PER USAS B16.9 OR MSS SP48

PROB. NO. M-8(01)

ATTACHMENT # 2SHT. NO. 5 OF 14Added by: Siva P. Kingam Date: 1-30-85Chkd by: Vijayalakshmi Date: 1-31-85

TOLEDO SURGE LINE

SECTION PROPERTIES

| SECTION | OUTSIDE RADIUS (IN) | OUTSIDE DIAMETER (IN) | THICKNESS (IN) | MOMENT OF INERTIA (IN ⁴) | BEND RADIUS (IN) | DESCRIPTION |
|---------|---------------------------|-----------------------------|-------------------|--|------------------------|----------------|
| 1 | 5.3750 | 10.7500 | 1.0000 | 367.805 | | SURGE LINE ST. |
| 2 | 5.3750 | 10.7500 | 1.0000 | 367.805 | 15.0000 | SURGE LINE CR. |

PROB. NO. M-8 (01)

ATTACHMENT # 2

SHT. NO. 6 OF 14

Added by: Siva P. Lingam date: 1-30-85

ch'd by: Tandall's date: 1-31-85

DEAD LOAD MOM. (FT-LBS)

| JOINT | N(X) | N(Y) | N(Z) |
|-------|---------|--------|---------|
| 1 | 1051.27 | 190.21 | 2956.52 |
| 2 | 48.76 | 575.73 | 5475.20 |
| 3 | 1051.27 | 388.42 | 4253.26 |
| 5 | 11.08 | 462.85 | 162.55 |
| 6 | 1051.27 | 8.60 | 4545.22 |
| 7 | 11.08 | 538.05 | 3365.43 |
| 11 | 4009.10 | 120.24 | 1611.11 |
| 12 | 3647.55 | 121.16 | 1611.11 |
| 13 | 352.88 | 362.57 | 1611.11 |
| 14 | 870.89 | 426.09 | 1674.64 |
| 15 | 1437.53 | 361.65 | 1611.11 |
| 16 | 1013.59 | 426.09 | 1915.25 |
| 18 | 942.24 | 426.09 | 1794.94 |
| 23 | 1051.27 | 206.20 | 512.79 |
| 36 | 780.06 | 251.45 | 142.01 |
| 54 | 1677.71 | 426.33 | 2599.77 |

PROB. NO. M-8 (01)

ATTACHMENT NO. 2

SHT. NO. 7 OF 14

Added by: Siva P. Rangan Date: 1-30-85

ch'd by: Ramchandran Date: 1-31-85

| JOINT | H(X) | H(Y) | H(Z) |
|-------|---------|---------|----------|
| 1 | 552.91 | 5774.54 | 13644.50 |
| 2 | 1091.14 | 3150.34 | 8890.93 |
| 3 | 552.91 | 1462.31 | 19615.80 |
| 5 | 803.58 | 3093.78 | 5837.96 |
| 6 | 552.91 | 2393.62 | 4150.89 |
| 7 | 803.58 | 2984.70 | 7184.48 |
| 11 | 2332.90 | 3832.01 | 5367.42 |
| 12 | 2374.86 | 4664.09 | 5367.42 |
| 13 | 1685.72 | 2087.29 | 5367.42 |
| 14 | 1926.39 | 1927.74 | 5317.74 |
| 15 | 316.78 | 2491.91 | 5367.42 |
| 16 | 762.69 | 1927.74 | 10767.60 |
| 18 | 2770.96 | 1927.74 | 5636.34 |
| 23 | 552.91 | 2913.27 | 5693.95 |
| 36 | 737.77 | 2680.95 | 7000.95 |
| 54 | 4852.93 | 7976.70 | 10344.10 |

ATTACHMENT # 2

PROB. No. M-8(01)

SHT. NO. 8 OF 14Added by: Siva P. Xingam Date: 1-30-85checked by: Tanlalal's Date: 1-31-85

| JOINT | M(X) | M(Y) | M(Z) |
|-------|---------|---------|---------|
| 1 | 186.49 | 1510.79 | 1828.76 |
| 2 | 314.57 | 812.57 | 1047.93 |
| 3 | 186.49 | 371.99 | 746.12 |
| 5 | 403.67 | 702.55 | 235.87 |
| 6 | 186.49 | 613.62 | 711.74 |
| 7 | 403.67 | 744.95 | 767.22 |
| 11 | 1145.29 | 1185.50 | 496.78 |
| 12 | 881.24 | 1481.76 | 496.78 |
| 13 | 948.49 | 471.82 | 496.78 |
| 14 | 1066.14 | 571.52 | 301.27 |
| 15 | 117.58 | 410.45 | 496.78 |
| 16 | 221.74 | 571.52 | 445.15 |
| 18 | 773.30 | 571.52 | 711.91 |
| 23 | 186.49 | 780.29 | 522.38 |
| 36 | 241.32 | 811.28 | 768.08 |
| 54 | 1042.90 | 1347.92 | 1561.55 |

PROB. NO. M-8(01)

ATTACHMENT # 2

SHT. NO. 9 OF 14

Added by: Siva P. Lingam Date: 1-30-85

ch'kd by: Randall's Date: 1-31-85

2 EARTHQUAKE MOMENTS (FT-LBS)

| JOINT | H(X) | H(Y) | H(Z) |
|-------|---------|---------|----------|
| 1 | 2433.64 | 7961.39 | 4184.12 |
| 2 | 3388.12 | 8215.63 | 10092.10 |
| 3 | 2433.64 | 2335.07 | 3456.56 |
| 5 | 3399.79 | 2767.35 | 1725.99 |
| 6 | 2433.64 | 4134.19 | 2241.79 |
| 7 | 3399.79 | 5695.74 | 6636.94 |
| 11 | 6557.96 | 5244.52 | 943.78 |
| 12 | 8413.93 | 5365.99 | 943.78 |
| 13 | 6341.99 | 2892.85 | 943.78 |
| 14 | 4395.61 | 3892.77 | 1680.56 |
| 15 | 1445.88 | 3424.23 | 943.78 |
| 16 | 1675.18 | 3892.77 | 2984.50 |
| 18 | 3877.61 | 3892.77 | 4513.19 |
| 23 | 2433.64 | 3949.75 | 1820.32 |
| 36 | 2629.71 | 4271.87 | 1651.72 |
| 54 | 4643.93 | 9844.89 | 3448.70 |

PROB. NO. M-8 (01)

ATTACHMENT # 2

SHT. NO. 10 OF 14

Added by: Siva P. Lingam Date: 1-30-85

ch'ed by: Ramalingam's Date: 1-31-85

EQUATION 9 - PRIMARY STRESSES

CONDITION . . . PRESSURE, X+Y EQ, DEAD WT.
EQ 9

MOMENTS IN FT-LBS.

STRESSES IN PSI.

| JOINT | TYPE | HX | HY | HZ | M(I) | B1 | B2 | PRIMARY STRESS | RATIO TO ALLOWABLE |
|-------|------|---------|---------|----------|----------|-----|-----|-------------------|-----------------------|
| 1 | 1 | 1790.67 | 7475.54 | 18429.78 | 19968.65 | .5 | 1.0 | 10220.54 | .413 |
| 2 | 9 | 1454.47 | 4538.64 | 15454.06 | 16172.28 | 1.0 | 2.0 | 19074.58 | .771 |
| 3 | 9 | 1790.67 | 2222.71 | 24615.18 | 24780.11 | 1.0 | 2.0 | 22074.96 | .892 |
| 5 | 9 | 1223.34 | 4256.18 | 6236.38 | 7648.80 | 1.0 | 2.0 | 16103.60 | .651 |
| 6 | 1 | 1790.67 | 3011.64 | 9487.85 | 10039.13 | .5 | 1.0 | 8479.26 | .343 |
| 7 | 9 | 1223.34 | 4271.70 | 11317.13 | 12158.18 | 1.0 | 2.0 | 17675.41 | .714 |
| 11 | 1 | 7487.29 | 5137.75 | 7475.31 | 11761.64 | .5 | 1.0 | 8781.32 | .355 |
| 12 | 1 | 5902.85 | 6267.01 | 7475.31 | 11950.11 | .5 | 1.0 | 8814.37 | .356 |
| 13 | 9 | 2988.09 | 2921.68 | 7475.31 | 8564.18 | 1.0 | 2.0 | 16422.67 | .664 |
| 14 | 9 | 3863.42 | 2925.35 | 7293.65 | 8756.77 | 1.0 | 2.0 | 16489.80 | .666 |
| 15 | 9 | 1871.89 | 3264.00 | 7475.31 | 8368.87 | 1.0 | 2.0 | 16354.59 | .661 |
| 16 | 9 | 1998.02 | 2925.35 | 13127.99 | 13597.57 | 1.0 | 2.0 | 18177.13 | .734 |
| 18 | 1 | 4486.50 | 2925.35 | 8143.19 | 9746.68 | .5 | 1.0 | 8427.97 | .341 |
| 23 | 9 | 1790.67 | 3899.76 | 6729.12 | 7980.96 | 1.0 | 2.0 | 16219.38 | .655 |
| 36 | 9 | 1759.15 | 3743.67 | 7911.04 | 8927.17 | 1.0 | 2.0 | 16549.19 | .669 |
| 54 | 3 | 6773.54 | 9750.94 | 14505.42 | 18744.84 | .5 | 1.0 | 10005.93 | .404 |

PROB. NO. M-8(01)

ATTACHMENT # 2

SHT. NO. 11 OF 14

Added by: Siva P. Singam Date: 1-30-85ch'ed by: Rajesh K. S. Date: 1-31-85

TOLEDO SURGE LINE

EQUATION 9 - PRIMARY STRESSES

CONDITION . . . PRESSURE, Z+Y EQ, DEAD WT.

EQ 9

MOMENTS IN FT-LBS.

STRESSES IN PSI.

| JOINT | TYPE | HX | HY | HZ | H(II) | B1 | B2 | PRIMARY STRESS | RATIO TO ALLOWABLE |
|-------|------|----------|----------|----------|----------|-----|-----|-------------------|-----------------------|
| 1 | 1 | 3671.40 | 9662.39 | 8969.40 | 13685.44 | .5 | 1.0 | 9118.69 | .368 |
| 2 | 9 | 3751.45 | 9603.93 | 16655.23 | 19588.40 | 1.0 | 2.0 | 20265.32 | .819 |
| 3 | 9 | 3671.40 | 3095.47 | 8455.93 | 9724.40 | 1.0 | 2.0 | 16827.08 | .680 |
| 5 | 9 | 3819.54 | 3932.76 | 2124.41 | 5879.51 | 1.0 | 2.0 | 15486.89 | .626 |
| 6 | 1 | 3671.40 | 4752.21 | 7498.75 | 9606.98 | .5 | 1.0 | 8483.47 | .340 |
| 7 | 9 | 3819.54 | 6978.74 | 10769.59 | 13389.39 | 1.0 | 2.0 | 18104.56 | .731 |
| 11 | 1 | 11712.35 | 6550.26 | 3051.67 | 13762.19 | .5 | 1.0 | 9132.15 | .369 |
| 12 | 1 | 12942.72 | 6968.91 | 3051.67 | 15013.08 | .5 | 1.0 | 9351.51 | .378 |
| 13 | 9 | 7643.36 | 3727.24 | 3051.67 | 9034.71 | 1.0 | 2.0 | 16586.68 | .670 |
| 14 | 9 | 6332.64 | 4890.38 | 3656.47 | 8797.04 | 1.0 | 2.0 | 16503.83 | .667 |
| 15 | 9 | 3000.99 | 4196.32 | 3051.67 | 5993.98 | 1.0 | 2.0 | 15526.79 | .627 |
| 16 | 9 | 2910.51 | 4890.38 | 5344.89 | 7807.36 | 1.0 | 2.0 | 16158.87 | .653 |
| 18 | 1 | 5593.15 | 4890.38 | 7020.04 | 10221.55 | .5 | 1.0 | 8511.25 | .344 |
| 23 | 9 | 3671.40 | 4936.24 | 2855.49 | 6782.30 | 1.0 | 2.0 | 15801.57 | .638 |
| 36 | 9 | 3651.09 | 5334.59 | 2561.81 | 6953.50 | 1.0 | 2.0 | 15861.24 | .641 |
| 54 | 3 | 7364.54 | 11619.13 | 7610.02 | 15721.11 | .5 | 1.0 | 9475.67 | .383 |

PROB. NO. M-8(01)

ATTACHMENT NO. 2

SHT. NO. 12 OF 14

Added by: Siva P. Singam Date: 1-30-85Ch'kd by: Ramallu's Date: 1-31-85

EQUATION 9 - PRIMARY STRESSES

CONDITION . . . X+Y DBE, DEAD WT. ,PRESSURE

EQ 9

MOMENTS IN FT-LBS.

STRESSES IN PSI.

| JOINT TYPE | | MOMENTS IN FT-LBS. | | | STRESSES IN PSI. | | | PRIMARY STRESS | RATIO TO ALLOWABLE | ALLOWABLE 2.25 Sm |
|------------|---|--------------------|----------|----------|------------------|-----|-----|----------------|--------------------|----------------------|
| | | MX | MY | MZ | M(I) | B1 | B2 | | | |
| 1 | 1 | 2318.32 | 12877.09 | 33757.68 | 33424.98 | .5 | 1.0 | 12580.30 | .297 | < 37.575 KSI |
| 2 | 9 | 2432.40 | 7482.58 | 23461.15 | 24750.29 | 1.0 | 2.0 | 22064.57 | .521 | < 37.575 KSI |
| 3 | 9 | 2318.32 | 3587.92 | 41867.45 | 42004.81 | 1.0 | 2.0 | 28106.76 | .664 | < " " |
| 5 | 9 | 2024.62 | 7120.80 | 11374.37 | 13571.34 | 1.0 | 2.0 | 18167.98 | .429 | < " " |
| 6 | 1 | 2318.32 | 5246.59 | 13197.06 | 14389.71 | .5 | 1.0 | 9242.19 | .218 | < " " |
| 7 | 9 | 2024.62 | 7058.11 | 17759.43 | 19217.53 | 1.0 | 2.0 | 20136.04 | .475 | < " " |
| 11 | 1 | 9803.24 | 8767.98 | 12269.16 | 17986.47 | .5 | 1.0 | 9872.94 | .233 | < " " |
| 12 | 1 | 9188.59 | 10695.21 | 12269.16 | 18690.91 | .5 | 1.0 | 9996.47 | .236 | < " " |
| 13 | 9 | 4692.66 | 4855.58 | 12269.16 | 14004.64 | 1.0 | 2.0 | 18319.02 | .433 | < " " |
| 14 | 9 | 5805.91 | 4745.36 | 11995.40 | 14146.26 | 1.0 | 2.0 | 18368.38 | .434 | < " " |
| 15 | 9 | 2176.89 | 5534.58 | 12269.16 | 13634.61 | 1.0 | 2.0 | 18190.04 | .429 | < " " |
| 16 | 9 | 2717.00 | 4745.36 | 22607.09 | 23259.00 | 1.0 | 2.0 | 21544.76 | .509 | < " " |
| 18 | 1 | 7090.56 | 4745.36 | 13224.78 | 15738.15 | .5 | 1.0 | 9478.66 | .224 | < " " |
| 23 | 9 | 2318.32 | 6629.38 | 11813.46 | 13743.40 | 1.0 | 2.0 | 18227.96 | .430 | < " " |
| 36 | 9 | 2461.35 | 6278.92 | 14193.89 | 15714.63 | 1.0 | 2.0 | 18915.06 | .447 | < " " |
| 54 | 3 | 10560.31 | 17027.65 | 23895.17 | 31183.98 | .5 | 1.0 | 12187.31 | .288 | < " " |

PROB. NO. M-8(01)

ATTACHMENT NO. 2

SHT. NO. 13 OF 14

Added by: Siva P. Aringam Date: 1-30-85ch'ed by: Rajesh K. S. Date: 1-31-85

EQUATION 9 - PRIMARY STRESSES

CONDITION . . . 24V ODE, DEAD WT., PRESSURE
EQ 9

MOMENTS IN FT-LBS.

STRESSES IN PSI.

| JOINT TYPE | | MOMENTS IN FT-LBS. | | | STRESSES IN PSI. | | | PRIMARY STRESS | RATIO TO ALLOWABLE | ALLOWABLE | |
|------------|---|--------------------|----------|----------|------------------|-----|-----|----------------|--------------------|---------------------|-----|
| | | HX | HY | HZ | H(1) | 01 | 02 | | | 2.25 S _m | |
| 1 | 1 | 5835.29 | 16966.50 | 13066.77 | 22195.79 | .5 | 1.0 | 10611.10 | .251 | 37.575 | KSI |
| 2 | 9 | 6777.76 | 15954.67 | 25707.34 | 31531.99 | 1.0 | 2.0 | 24428.42 | .577 | " | " |
| 3 | 9 | 5835.29 | 5219.98 | 11649.67 | 14036.16 | 1.0 | 2.0 | 18330.00 | .433 | " | " |
| 5 | 9 | 6879.53 | 6516.00 | 3684.99 | 10166.87 | 1.0 | 2.0 | 16981.31 | .401 | " | " |
| 6 | 1 | 5835.29 | 8501.46 | 9627.05 | 14106.93 | .5 | 1.0 | 9192.61 | .217 | " | " |
| 7 | 9 | 6879.53 | 12120.27 | 15735.53 | 21772.59 | 1.0 | 2.0 | 21028.74 | .496 | " | " |
| 11 | 1 | 17704.10 | 11409.37 | 3996.96 | 21437.92 | .5 | 1.0 | 10478.20 | .247 | " | " |
| 12 | 1 | 20483.15 | 12007.76 | 3996.96 | 24077.41 | .5 | 1.0 | 10941.07 | .258 | " | " |
| 13 | 9 | 13398.91 | 6361.97 | 3996.96 | 15360.90 | 1.0 | 2.0 | 18791.76 | .444 | " | " |
| 14 | 9 | 10423.35 | 8419.97 | 5193.87 | 14370.75 | 1.0 | 2.0 | 18440.63 | .436 | " | " |
| 15 | 9 | 4288.30 | 7278.01 | 3996.96 | 9345.30 | 1.0 | 2.0 | 16694.94 | .394 | " | " |
| 16 | 9 | 4423.30 | 8419.97 | 8052.70 | 12462.26 | 1.0 | 2.0 | 17781.40 | .420 | " | " |
| 18 | 1 | 9159.99 | 8419.97 | 11124.49 | 16585.99 | .5 | 1.0 | 9645.58 | .228 | " | " |
| 23 | 9 | 5835.29 | 8567.60 | 4569.77 | 11326.60 | 1.0 | 2.0 | 17386.25 | .410 | " | " |
| 36 | 9 | 5999.27 | 9253.94 | 4190.83 | 11797.87 | 1.0 | 2.0 | 17549.82 | .414 | " | " |
| 54 | 3 | 11665.45 | 20521.17 | 11000.78 | 26042.64 | .5 | 1.0 | 11285.70 | .266 | " | " |

PROB. NO. M-8(01)

ATTACHMENT # 2

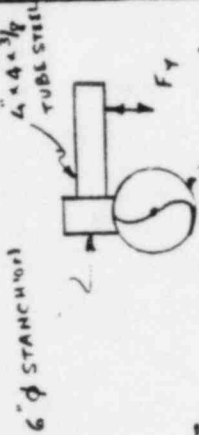
SHT. NO. 14 OF 14

Added by: Siva P. Lingam date: 1-30-85ch'ed by: Ramallu date: 1-31-85



CALCULATION SHEET

ORIGINATOR Siva P. Kingan DATE 11-30-84 CALC. NO. PS/PSU-1 REV. NO. 1
PROJECT DAVIS-BESSE UNIT 1 CHECKED ADP DATE 12-5-84
SUBJECT DATA SHEET FOR LOCAL STRESS CHECK JOB NO. T2501 SHEET NO. 11



6" STANCHION
4" x 3/4" TUBE STEEL
F_y

ATTACH. NO. 3
SHT. NO. 1 OF 4
PROB. NO. M-8 (01)
Added by: Siva P. Kingan 1-30-85
in chkd by: ADP 1-30-85
SM 16.48 ksi

PIPE UALL THK 1.0 in
DESIGN PRESSURE 2500 psig
TEMPERATURE 670 °F

PIPE OUTSIDE DIAMETER 10.75 in
OPERATING PRESSURE 2750 psig
PIPING MATERIAL S.S. SA376-TF316

STRESS PROBLEM NO. M-8 ISSUE: C2 DATA POINT 40
PIPE SUPPORT NO. PSU-K1
TYPE OF SUPPORT: VERTICAL ☒ (SNUBBER) X ☐ Z ☐ ANCHOR ☐ SKRU ☐

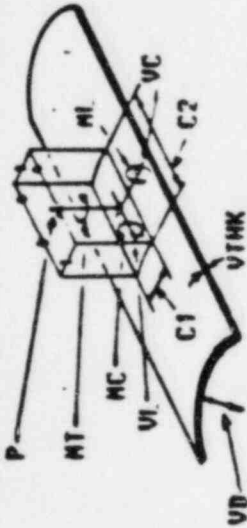
| ME-101 LOAD CASE | SUPPORT LOADS | | | | | | PIPE STRESS (psi) |
|---------------------|---------------|------|---|------------------|---|---|-------------------------|
| | FORCES (lbs) | | | MOMENTS (in-lbs) | | | |
| | X | Y | Z | X | Y | Z | |
| WEIGHT | | — | | | | | 825 |
| DBE | | 2400 | | | | | 4415 |
| SSE | | 3900 | | | | | 8203 |
| THERMAL | | — | | | | | 4546 |
| SAN | | — | | | | | — |

NOTE: 1) The stresses are at the center line of pipe.
2) The loads are as shown in figure. • KSI FOR ME 210 IMPT



CALCULATION SHEET

ORIGINATOR C.H. [Signature] DATE 11/30/84 CALC. NO. PS/PSU-1 REV. NO. 1
PROJECT WATTS-RESE UNIT 1 CHECKED T. Lin DATE 12/11/84
SUBJECT RE 210 INPUT DATA JOB NO. 12501
SHEET NO. 12



| CASE NUMBER | TYPE OF COMBINATION | P lbs | ML in-lbs | MC in-lbs | MT in-lbs | VL lbs | VC lbs | COMMENTS |
|-------------|-------------------------|--------|-----------|-----------|-----------|--------|--------|----------|
| 1 | WEIGHT+ ORE | 2400 ; | 0 ; | 20400 ; | 0 ; | 0 ; | 0 | |
| 2 | WEIGHT+ SSE | 3900 ; | 0 ; | 33150 ; | 0 ; | 0 ; | 0 | |
| 3 | WEIGHT+THRM+ ORE+SAM | 2400 ; | 0 ; | 20400 ; | 0 ; | 0 ; | 0 | |

GEOMETRIC PARAMETERS
 β AND γ CHECK

$$\beta = C1/VD = \dots 5 \dots$$

$$\beta = C2/VD = \dots 5 \dots$$

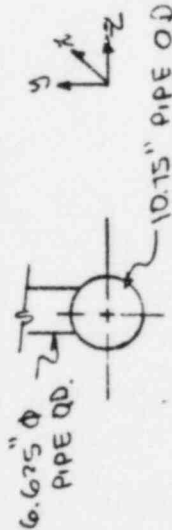
$$\gamma = \frac{VD}{(2 \times VTHK)} = \dots 6.625 \dots$$

0.01 < β < 0.5 IF NOT,
5 < γ < 300 ADJUST VD.

FOR POINT B:

$$V^2 = \sqrt{V^2 + VTHK^2}$$

$$= \dots = \dots$$



| PIPE WALL THICKNESS ACTUAL <input checked="" type="checkbox"/> EFFECTIVE <input type="checkbox"/> | PIPE DIAMETER ACTUAL MEAN <input type="checkbox"/> ADJUSTED <input checked="" type="checkbox"/> | ATTACHMENT DIMENSIONS | | SHAPE |
|--|--|-----------------------|---------|-------|
| | | C1 in | C2 in | |
| 1.0 ; | 13.25 ; | 6.625 ; | 6.625 ; | 1.0 |
| ; | ; | ; | ; | ; |

ATTACH. NO. 3

SHT. NO. 2 OF 4

PROB. NO. M-8(01)

ADJUST PAPER, HIT RETURN

7> TYPE *CALL 81A566*PROG.END
-> TYPE PYOT ADD 81A566*210RUM.

-> TYPE CALL 81A566*PROG.210SUB

Added by: Siva P. Arinam 1-31-85
checked by: [Signature] 1-31-85

ORIGINATOR C.H. Abu
PROJECT DAV. BESE
UNIT 1

DATE 11/30/84
JOB # 12501

CHECKER T. LIN DATE 12/11/84
STANDARD COMPUTER PROGRAM ME-210

CALC NUM. PS/PSU-1
REV NUM. 1

SHEET -13 OF

VERSION : 5
RELEASED : DEC 15, 1982
USER MANUAL VERSION : 1
THEORETICAL MANUAL VERSION : 1
VERIFICATION MANUAL VERSION : 5

B I J L A A R D S T R E S S A N A L Y S I S F O R C Y L I N D E R S

PSU-R1

ATTACH. NO. 3

SHT. NO. 3 OF 4

PROB. NO. M-8 (01)

I N P U T D A T A

| | P (LBS) | ML (IN-LBS) | MC (IN-LBS) | MT (IN-LBS) | VL (LBS) | VC (LBS) | MA (FT-LBS) | MB (FT-LBS) |
|---|------------|----------------|----------------|----------------|-------------|-------------|----------------|----------------|
| 1 | 2400. | 0. | 20400. | 0. | 0. | 0. | 0. | 0. |
| 2 | 3900. | 0. | 33150. | 0. | 0. | 0. | 0. | 0. |
| 3 | 2400. | 0. | 20400. | 0. | 0. | 0. | 0. | 0. |

Added by: Siva P. Aringam 1-30-85

| | VESTHK (IN) | VESDIA (IN) | C1 (IN) | C2 (IN) | SHAPE | PRESSURE (PSI) | SM (KSI) | BEND R (IN) |
|---|----------------|----------------|------------|------------|----------|-------------------|-------------|----------------|
| 1 | 1.0000 | 13.2500 | 6.6250 | 6.6250 | CIRCULAR | .0000 | .0000 | .0000 |
| 2 | 1.0000 | 13.2500 | 6.6250 | 6.6250 | CIRCULAR | .0000 | .0000 | .0000 |
| 3 | 1.0000 | 13.2500 | 6.6250 | 6.6250 | CIRCULAR | .0000 | .0000 | .0000 |

ch'd by: Taniguchi 1-31-85

MAXIMUM PRIMARY PLUS SECONDARY STRESS INTENSITY

| | | | | | | | | |
|--------|-------|-----|-------|-----|-------|------|------|-------|
| 1.0000 | -1.18 | .63 | -1.18 | .63 | -5.06 | 3.87 | 2.71 | -2.61 |
|--------|-------|-----|-------|-----|-------|------|------|-------|

MAXIMUM PRIMARY PLUS SECONDARY STRESS INTENSITY

| | | | | | | | | |
|--------|-------|------|-------|------|-------|------|------|-------|
| 1.0000 | -1.91 | 1.03 | -1.91 | 1.03 | -8.21 | 6.30 | 4.40 | -4.25 |
|--------|-------|------|-------|------|-------|------|------|-------|

MAXIMUM PRIMARY PLUS SECONDARY STRESS INTENSITY

| | | | | | | | | |
|--------|-------|-----|-------|-----|-------|------|------|-------|
| 1.0000 | -1.18 | .63 | -1.18 | .63 | -5.06 | 3.87 | 2.71 | -2.61 |
|--------|-------|-----|-------|-----|-------|------|------|-------|

ORIGINATOR C.H. O'Brien
PROJECT DAVE DESSE
UNIT 1

DATE 11/30/84
JOB # 12501

CHECKER T. Lin DATE 12/1/84
STANDARD COMPUTER PROGRAM ME-210

CALC NUM PS/PSU-1
REV NUM 1

SHEET - 14 OF

***** ME-210 POST-PROCESSOR (VERS. B) 12/8/81 *****

DO YOU WANT TO ENTER PRESSURES AND OTHER STRESSES (YES OR NO)? >YES
ENTER ACTUAL PIPE O.D. AND WALL (INCHES) O.D.,W? >10.75,1.0
ENTER OPERATING AND DESIGN PRESSURE (PSIG) P-OP.,P-DES.? >2750,2500
IS ALL DATA O.K. SO FAR (YES OR NO)? >YES
ENTER FOLLOWING STRESSES WT,UBE,SSE,THRM,SAM (KSI)? >.825,4.415,8.203,4.546,0.0
ENTER SM STRESS ALLOWABLE (KSI)? >16.48
IS ALL DATA O.K. (YES OR NO)? >YES
PIPE O.D. = 10.75
PIPE WALL = 1.000
DESIGN PRESSURE = 2500
OPERATING PRESSURE = 2750
WEIGHT STRESS = .825
UBE STRESS = 4.415
SSE STRESS = 8.203
THERMAL STRESS = 4.546
SAM STRESS = 0.000
ALLOWABLE STRESS (SM) = 16.480

| CHECK | VALUE | ALLOWABLE |
|-------|-------|-----------|
|-------|-------|-----------|

| | | | |
|----|----------------|----------|--|
| 1A | 14.03 | 24.720 | → upset primary in circumferential direction |
| 1B | 14.40 | 49.440 | |
| 2A | 12.97 | 24.720 | → upset primary in longitudinal direction |
| 2B | 17.39 | 49.440 | |
| 3A | 5.06 + 14.78 = | < 49.440 | OK |
| 3B | 5.06 + 17.18 = | < 49.440 | |

FOR CHECK 3A AND 3B YOU MUST ADD THE MAX PRI + SEC STRESS INTENSITY
FROM THE ME-210, RUN FOR LOAD CASE #3 AND MUST STILL
BE BELOW THE SPECIFIED ALLOWABLE

TIME .044
FURPUR 28R3A-U1 974T11 11/30/84 10:47:25
END PACK. TEXT=7.TOC-1.SYM=9

PROB. NO. M-8(01)

ATTACH. NO. 3

SHT. NO. 4 OF 4

Added by: Siva P. Arigam 1-30-85

ch'kd by: Randall 1-30-85

Code Case N-411 Alternative Damping Values for Seismic Analysis of Piping
Section III, Division 1 Class 1, 2, and 3.

Question:

What alternatives to the damping values given in Table N-1230-1, Appendix N, Section III Division 1 are acceptable for use in seismic analysis of Class 1, 2 and 3 piping?

Reply:

It is the opinion of the Committee that for Section III, Division 1, Class 1, 2, and 3, construction, the damping value for seismic analysis of piping shown in Figure 1 may be used as an alternative to those given in Table N-1230-1, Appendix N.

The damping value in Figure 1 is applicable to both OBE and SSE, and is independent of pipe diameter.

This Code Case number shall be shown in the documentation for this analysis and on the Code Data Report.

PROB. NO. M-8(01)

ATTACH. NO. 4

SHT. NO. 1 OF 2

Added by: Siva P. Lingam date: 1-30-85

ch'kd by: Rajagopal date: 1-31-85

PROB. NO. M-8 (01)

ATTACH. NO. 4

SHT. NO. 2 OF 2

Added by: inra p. kringam 1-30-85

chkd by: Sanjiv D. Des 1-31-85

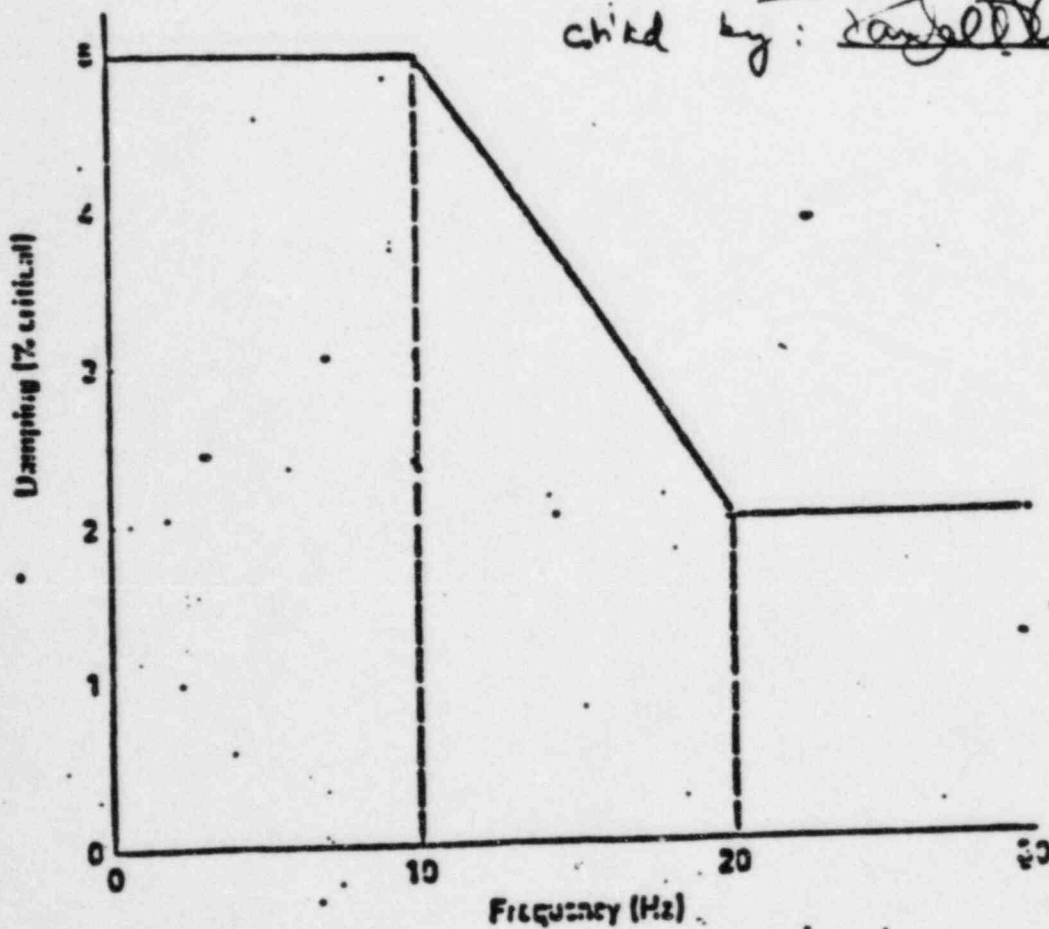


Figure 1

Damping Value for Seismic Analysis of Piping
(Applicable to both OBE & SSE, Independent of Pipe Diameter)

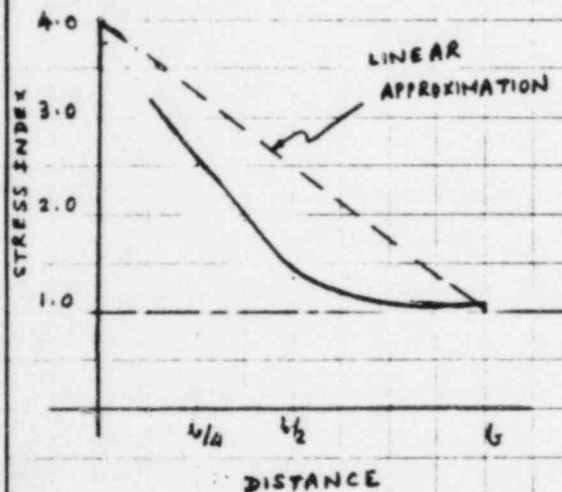


CALCULATION SHEET

ATTACHMENT # 5

| | | | | | |
|-----------------------------------|---------|--------------------|---------|-------------|------------------|
| JOB NO. 12501 DAVIS-BESSE, UNIT-1 | | CALC. NO. M-8 | | REV. NO. 01 | SHEET NO. 1 OF 1 |
| PRESSURIZER SURGE LINE | | | | | |
| ORIGINATOR | DATE | CHECKED | DATE | | |
| Siva P. Lingam | 1-30-85 | <i>[Signature]</i> | 1-31-85 | | |

1) ST. VENANT'S PRINCIPLE STATES THAT AT A DISTANCE EQUAL TO OR GREATER THAN THE MEMBER WIDTH (WALL THICKNESS IN THE CASE OF A PIPE) THE MEMBER STRESSES ARE UNAFFECTED BY LOAD APPLICATION OR GEOMETRIC DISCONTINUITY. REFERENCING WELDING RESEARCH COUNCIL (WRC) BULLETIN 198, THE INTERFERENCE DISTANCE TO "ANY OTHER WELD OR DISCONTINUITY" IS DEFINED AS $\sqrt{A\epsilon}$. SINCE $\sqrt{A\epsilon} = 2.208"$ IS GREATER THAN $\epsilon = 1.0$, WE EVALUATED THE EFFECT OF ADJACENT DISCONTINUITY OUT TO A DISTANCE OF 2.208"



PLOT OF STRESS INDEX VS. DISTANCE FROM SOURCE

(REF.: BEER & JOHNSON - "MECHANICS OF MATERIALS", PAGE 79)

$$\text{AT } \frac{1}{4}, \frac{\sigma_{\max}}{\sigma_{\text{av}}} = 1.027$$

$$\text{AT } \frac{1}{2}, \frac{\sigma_{\max}}{\sigma_{\text{av}}} = 1.387$$

$$\text{AT } \frac{1}{4}, \frac{\sigma_{\max}}{\sigma_{\text{av}}} = 2.575 \text{ WHERE } l = \text{MEMBER WIDTH}$$

AS CAN BE SEEN, A LINEAR DISTRIBUTION OF STRESS INDEX AWAY FROM THE POINT OF STRESS CONCENTRATION IS VERY CONSERVATIVE.

2) USE OF CLASS-II FORMULA IN CLASS-I ANALYSIS CAN BE JUSTIFIED BY THE FOLLOWING FORMULA:

$$B, C, K \text{ \& } i = \frac{\sigma}{S} = \frac{\text{Elastic stress}}{\text{nominal stress}}$$

(Ref: D-101 of Appendix-D)