

REVIEW BURIED PIPING FOR MIDLAND PLANT

1/6/81

Dec 16, 1981 TO NRC

NRC QUESTIONS 16 - 20 (2) 50.54(F)

Fig II-2

1) page 6 Paragraph 2

2) page 15 - Discusses only consolidation theory responses to 50.54(F) Questions (2) 1 and 27

Figure III-3 - theory of behavior

3) page 16 - settlement discussed for diesel generator building.

Fill is in secondary compression settlement phase

a) March 1980 - settlement estimate was provided for calculating future pipe stresses.

b) From time - settlement data from Boros anchors buried in the plant fill.

c) settlement envelope of 0 - 3 inches for the 10-year plant life to be used in analyzing the buried piping in plant fill. (settlement prior March 5, 1980 not included)

4) Page 17 Monitoring program

a) At terminal ends, before first anchor point of each pipe as it enters building.

b) monitor diff. settlement between pipe anchor & underground piping

c) Critical differential movement established as limit

5) Page 18 Seismic

subgrade modulus & shear modulus w/shear strain for sand as developed by Seed & Driss (Ref 8, Fig 2-5)

8408030001 840718
PDR FOIA
RICE84-96
PDR

Review Buried Buried Piping Midland - Dec 15, 1991 To NRC

III.B.2 Future Settlement

50.59 (F) Questions

17' and 20' - stress due to settlement
 valves, pumps, etc

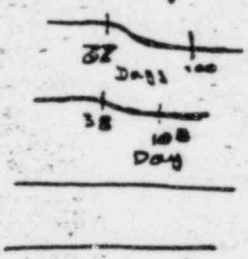
Review Question 27 50.59 (F) Vol 2 & 3

1) 60 BOROS ANCHORS INSTALLED Fig 27-79, 80 & 139

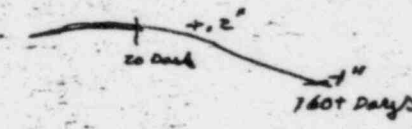
2) BA-100 through BA-106 were installed in fill to monitor settlement of fill under its own weight Fig 27-192 - 198

1a) BA-34 - BA-36; BA 13 - BA 16; outside surcharge limits and influence

- ① BA-13 Elev 627 0.4" settlement
- BA-14 Elev 622.9 0.0" "
- BA-15 Elev 617 0.0 "
- BA-16 Elev 612 0.0 "



- ② BA-34 Elev 629.4 1.1 "
- BA-35 Elev 615.0 0.0 (+.15")
- BA-36 Elev 607.2 0.0 (+.15")



2 a) BA-100 through BA-106 11/9/79 - 5/8/81 ≈ 550 Days Monitoring

- ① BA-100 = 1/4" Drop in last 200 Days Fairly quick Drop leveled off
- ② BA-101 = 1/8" " " last 300 Days " " " " "
- ③ BA-102 = 1/4" Gradual drop in last 250 Days
- ④ BA-103 = 1/4" " " " " " " " " "
- ⑤ BA-104 = 1/5" " " " " " " " " "
- ⑥ BA-105 = 1/4" " " " " " " " " "
- ⑦ BA-106 = 1/4" Prop to 1/4" at 200 days, back up 1/8"

Review of Buried Piping Midland Dec 15, 1981 NRC

Question 4 50.54 (E) Vol 1

- 1) Readings from rebound due to surcharge unloading - dynamic stiffness estimates
- 2) Shear wave velocity in fill ≈ 500 fps by re-measurement (would)
- 3) Permanent dewatering system as a positive solution - liquefaction
- 4) Refer questions 13 & 17 buried utilities
- 5) Borated Water Storage Tanks - Questions 31
- 6) Emergency Diesel Fuel Oil Storage Tanks - Ques 33

Question 13 50.54 (E) Vol 1 - seismic response fill supported

1) Diesel Gen. Bldg

Fill - $V_s = 500$, $\rho = 120$ pcf; Natural Soil - $V_s = 1559$ fps, $\rho = 135$ pcf

2) Service Water Pump Structure -
on Natural Soil

3) Aux Bldg -

5) Underground Utilities - No impact due to poor backfill

Question 17 50.54 (E) Vol 1 - seismic response buried piping

Areas of Possible NRC comment

Conf. call Bated/Consumers/

Jan 12 Meeting

Analysis of Buried Piping for Midland Plant

NRC MEETING 19 Jan 82 - 8:30

1. Cannot Accept - Flow verification tests
2. Go on long with demonstration that includes
 - a) settlement
 - b) ovalization

Mark Harrison

Procedure

A. Initial

1. Seismic Analysis Buried Pipe

Soil Displacement Due to Seismic

2. Stress calculation with load combination
thrust, Soil load, settlement, pressure

3. combine seismic & static stresses to
determine stress - when $\frac{1}{3}$ yield strength

B. Second - if greater check ovality - exceeds relud

Concerns: 1) settlement over 40 yr life

2) properties of foundation vary considerably

3) Distribution of settlement

* Considered about differential settlement and
stress difference developing in pipes

1) Estimated max settlement

2) Distribution of settlement for differential settlement

a) Test data

b) Subsurface profile

Quest. 45 outstanding - April 16

- 1) Cat II under cat I - workout
with loss of soil support is considered
critical for stress loading

Profiles in report - datum change

Monitoring pipe for settlement

- 1) Now only state at anchor points
- 2) DRC concerned about other pipe
would like to monitor settlement
along pipe - Tech spec identifying
monitoring program
- 3) Place settlement vs observed settlement
- * 4) Measuring for qualities

Ref 12 ——— Order of pipeline

see - page 6 2nd paragraph

1) how was soil loading obtained - Fig II-2

2) how arrived at soil props

page 16 last para

0-3 inches - how determined

page 17 last paragraphs

monitoring program - ^{what are plans for} monitoring BWS line page 30

plan to shift from tank to dike

Question 45 - soil & underground pipes

page 20 - no values given related to Midland
NRC will be looking for values and basis

page 18 - refer to 2.5 Ref 8 - for sand
not appropriate for analysis where clay is subgrade

NRC - justified for using sand

page 22 - how maximum soil strain determined

~~Seismic Margin~~

Joe Cane 10:30 Tomorrow Harry Singh

Thurs -

Seismic Margin - Review Study

Walk Thru - Kennedy



RECORDED
2078
NOV 17 1980

James W Cook
Vice President - Projects, Engineering
and Construction

General Offices: 1945 West Parnell Road, Jackson, MI 49201 • (517) 788-0453

November 14, 1980

Robert L Tedesco
Assistant Director for Licensing
Division of Licensing
US Nuclear Regulatory Commission
Washington, DC 20555

MIDLAND PROJECT
NRC REQUEST FOR DETAILS OF STRESS
ANALYSES FOR UNDERGROUND PIPING
FILE: 0485.16/B1.7 UFI: 70*01 00234(S) 15100(E) SERIAL: 10113

As requested in your letter of October 20, 1980, please find attached 15 copies of a summary of the calculations for stresses in underground piping due to differential settlement at the Midland site. Also attached are the calculational input sheets.

After examination of the details provided we agree that a follow-up meeting should take place to discuss the results of our calculations and those provided by the NRC's consultant, Energy Technology Engineering Center (ETEC).

JWC/GSK/RLT/cr

CC RJCook, Midland Resident Inspector

Boo
5/11

oc1180-0102a100

A

~~801180151~~ lp

Bechtel Associates Professional Corporation

SUMMARY OF SETTLEMENT STRESS CALCULATIONS FOR BURIED PIPING

The approach for this analysis was to model portions of this buried piping for which settlement data is available and perform analysis by computer to determine stresses due to differential settlement. Settlements were applied as displacements to artificial vertical restraints at some key points along the length of the pipe so that the deflected shape of the pipe centerline approaches the measured settlement profile as closely as possible. Settlements at each and every available point were not input; however, an adequate number of points were used to closely describe the settlement profile. The starting point was chosen as an artificial anchor with applied vertical displacement and with rotations released. It should be noted that this analysis reflects differential settlement stresses only in the buried piping. The stresses are compared to a limit of $3S_c$ as stated in equation 10a of NC-3652.3(b) of Section III of the ASME Code, 1977 edition. This limit was used as a guide only. Midland piping systems are being designed to 1971 edition of the ASME code with Summer 1973 addenda applicable. Prior to the 1977 edition limits for settlement stresses were not considered by the code.

The Bechtel computer code, ME101, is based on the SAP program and is linear and elastic. Output from the program is in the form of moments at the node points of the model. Stress in the pipe is determined by the relationship:

$$\sigma = \frac{i M_D}{Z}$$

- where
- σ = longitudinal bending stress
 - i = stress intensification factor
 - M_D = bending moment at point under consideration
 - Z = section modulus of pipe

~~8011136~~ 155 88 pp.

Finally, plots of the deflected shape of the centerline of the pipe in the vertical direction from the computer analysis and measured settlement profile have been made for comparison of final calculated shape with field measurements.

The request for backup calculations to the stress values originally reported in Table 17-2 is responded to as follows....

1. Updated profiles have been obtained on some of the lines identified in Table 17-2, Rev 2. New stress values with backup calculation are provided in the enclosed markup of Table 17-2, Rev 2. These lines may be identified by entries in a column entitled "Corrected Stress Values." The updated profiles are indicated in the calculation input sheet.
2. Updated profiles for the remainder of the lines in Table 17-2, Rev 2 will be provided in the November 1980 submittal of responses to NRC questions. Results of revised stress calculations corresponding to these updated profiles will be supplied at a later date. This will be included as a revision to Table 17-2, Rev 2.
3. Review of the ETEC calculations recently provided by the NRC indicates that certain geometric elements may not have been included in their models. One such element occurs at their node points 5, 6 and 7 of lines 26 OHBC-54 which is in actuality a 90° elbow instead of a straight section. Another source of difference may be explained by the fact that the ETEC calculations for 26 OHBC-54 were based on Figure 19-1 whereas the results in Table 17-2, Rev 2 were based on Figure 17-2. The two figures overlap with station 0+00 of Figure 17-2 being approximately equal to station 0+60 of Figure 19-1.



CALCULATION SHEET

ORIGINATOR E. Basavanagi DATE 11-7-80 CALC. NO. 1 REV. NO. _____
PROJECT MIDLAND 1 & 2 CHECKED J. D. ... DATE 11.7.80
SUBJECT SETTLEMENT STRESSES IN BURIED PIPING JOB NO. 7220
SHEET NO. 1 of 3

DESCRIPTION OF ANALYSIS:

SERVICE WATER LINES

26"/36" - OHBC-16
26/36 - OHBC-19
26" - OHBC-54
26" - OHBC-55
10" - OHBC-27
8" - 1 HBC-81
8" - 2 HBC-82
8" - 1 HBC-311
- 26" - 1 JBD-2
26" - 2 JBD-1

CONDENSATE WATER LINE

20" - 1 HCD-169

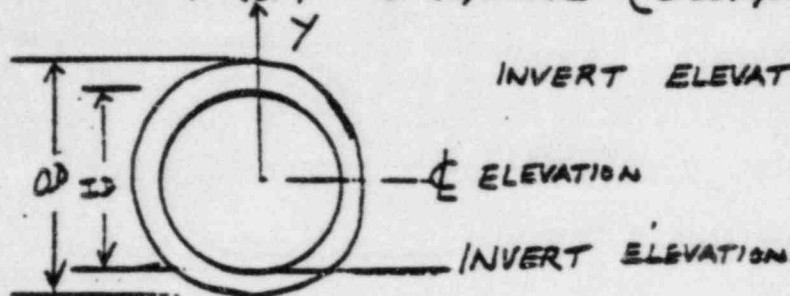
PORTIONS OF BURIED PIPING WITH AVAILABLE SETTLEMENT DATA WERE MODELED AND COMPUTER ANALYSIS WAS PERFORMED TO DETERMINE STRESSES IN BURIED PIPING DUE TO DIFFERENTIAL SETTLEMENT. SETTLEMENTS WERE APPLIED AS DISPLACEMENTS TO FICTITIOUS VERTICAL RESTRAINTS AT SOME KEY POINTS ONLY ALONG THE LENGTH OF PIPE SO THAT THE DEFLECTED SHAPE OF THE PIPE CENTERLINE APPROACHES THE MEASURED SETTLEMENT PROFILE AS CLOSELY AS POSSIBLE. IN OTHER WORDS, SETTLEMENTS AT EACH AND EVERY AVAILABLE POINT WERE NOT INPUT. HOWEVER ADEQUATE NUMBER OF POINTS WERE USED TO CLOSELY DESCRIBE THE SETTLEMENT PROFILE. THE STARTING POINT IS CHOSEN AS A FICTITIOUS ANCHOR, WITH APPLIED DISPLACEMENT IN Y-DIRECTION & WITH ROTATIONS RELEASED. IT MAY BE NOTED THAT THE THERMAL RUN REFLECTS DIFFERENTIAL SETTLEMENT STRESSES ONLY (AND NOT THERMAL EXPANSION STRESSES) IN BURIED PIPING. THE STRESSES ARE COMPARED TO $3S_c$ ALLOWABLE AS STATED IN EQ. (102) OF NC-3652.3(2) OF ASME CODE SEC. III.



CALCULATION SHEET

ORIGINATOR T. Basurwan DATE 11-7-80 CALC. NO. _____ REV. NO. _____
 CHECKED h. m. m. DATE 11-7-80
 PROJECT MIDLAND 1 & 2 JOB NO. 7220
 SUBJECT SETTLEMENT STRESSES IN BURIED PIPING SHEET NO. 2 of 3

INVERT ELEVATIONS WERE SUPPLIED BY THE SURVEYORS AND HENCE THE SETTLEMENT AT ANY PARTICULAR LOCATION ARE DETERMINED BY SUBTRACTING INVERT ELEVATION AFTER SETTLEMENT FROM ORIGINAL (DESIGN) INVERT ELEVATION



$$\text{INVERT ELEVATION} = (\text{E ELEVATION}) - (\text{INSIDE RADIUS OF PIPE})$$

$$\text{SETTLEMENT} : \Delta Y = \left(\begin{array}{c} \text{DESIGN} \\ \text{INVERT} \\ \text{ELEVATION} \end{array} \right) - \left(\begin{array}{c} \text{INVERT ELEVATION} \\ \text{AFTER SETTLEMENT} \end{array} \right)$$

$$\text{MAX. STRESS DUE TO DIFFERENTIAL SETTLEMENT} = (\sigma_{\text{MAX}}) = \frac{i M_D}{Z} \leq 3 S_c \quad \text{ENR. 10A NC 3652-3(b)}$$

FINALLY, PLOTS OF THE DEFLECTED SHAPE OF THE CENTERLINE OF PIPE IN THE Y-DIRECTION FROM COMPUTER ANALYSIS AND MEASURED SETTLEMENT PROFILE ARE MADE FOR COMPARISON PURPOSES. THE FOLLOWING IS THE COORDINATE SYSTEM USED:

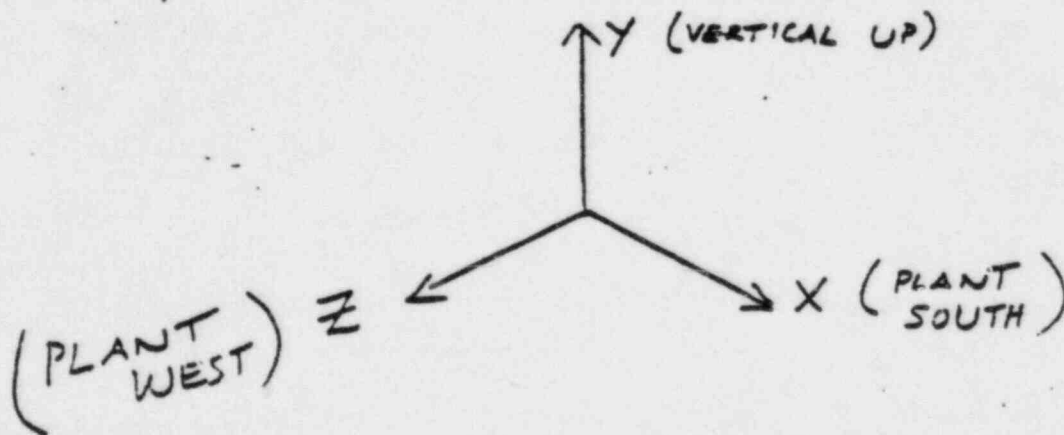


TABLE 17-2
SETTLEMENT STRESSES OF PROFILED SYSTEMS

LOCATION OF MAX. STRESS (STATION)	Line	Settling Category	Location Shown in Figure	Profile Shown in Figure	Stress (kN) (k.s)	Stress Allowable (kN) (k.s)	Code Allowable (kN) (k.s)	Corrected Allowable (kN) (k.s)	DATE OF PROFILE DATA
STA. E+3E	Service water line								
0+00	18"-18" - 0HSC-18	Yes	17-1	17-2	11.8	15.2	52.8		APRIL 79
0+10	18"-18" - 0HSC-18	Yes	17-1	17-2	11.8		52.8		MARCH/JUNE 78
0+20	18"-18" - 0HSC-18	Yes	17-1	17-2	11.8		52.8		APRIL 79
0+28	18"-18" - 0HSC-18	Yes	17-1	17-2	11.8	37.2	11.8		APRIL 79
0+70	18"-18" - 0HSC-18	Yes	17-1	17-2	11.8		52.8		JANUARY 79
0+25	18"-18" - 0HSC-18	Yes	17-1	17-2	11.8		52.8		JANUARY 79
0+20	18"-18" - 0HSC-18	Yes	17-1	17-2	11.8		52.8		SEPT. 79
0+15	18"-18" - 0HSC-18	No	17-1	17-2	11.8		52.8		JANUARY 79
	Condensate water line								
0+4.95	20"-1HCO-169	No	17-1 & 19-1	17-2 & 19-1	23.8	29.8	50.4	50.4	APRIL 79

(1) Analytical values generated from settlement gage data. Bounding in excess of the accuracy of the gage was necessary in several zones. These zones will be subjected to further investigation.
 (2) Equation 10a, AASHTO Section III, Division 3, Subsection MC

Bayleton 23
7/79 11/80



PIPING ANALYSIS CHECK AND COVER SHEET
SPECIAL STUDIES

PROJECT: MIDLAND UNIT - 2 SHEET OF
 JOB NO. 7220 PLANT DESIGN GROUP
 SYSTEM: CONDENSATE WATER LINE
 CALC. NO. 1007 ISO NO. M-167 (2) REV NO. 6

A. DESIGN DATA:

1. PIPING CLASS SHEET: M-4B1 Rev. 15
(JBD - Rev. 13)
 Pipe: 26" - 2JBD-1
 Mat'l.: ASTM A-155 CLASS 2
 KC-70 C.S.

2. Soil & Rock INSTRUMENTATION -
 FULL PROFILE SETTLEMENT GAGE
 DATA SUMMARY - JAN. 5 '79

B. CRITERIA/OBJECTIVES:
 To show that the stresses in Buried Piping due to differential settlement meet the code requirement
 ASME SECT. III, NC-3652.3(b)
 Eq. 10a: $\frac{iM_D}{Z} \leq 3S_c$

C. REFERENCES:
 1. ASME SECT. III, SUBSECTION-NC
 2. ME101 RUN: JACIT (SNUM: 0A5L40 (VER. F2) 6-29-79)
 3. S & RI - FULL PROFILE SETTLEMENT GAGE DATA SUMMARY - JAN. 5 '79
 4. SURVEYED PIPELINE PROFILE: SK-C-650 Rev. A
 5. YARD PIPING PLAN - AREA-C M-167 (2) Rev. 6

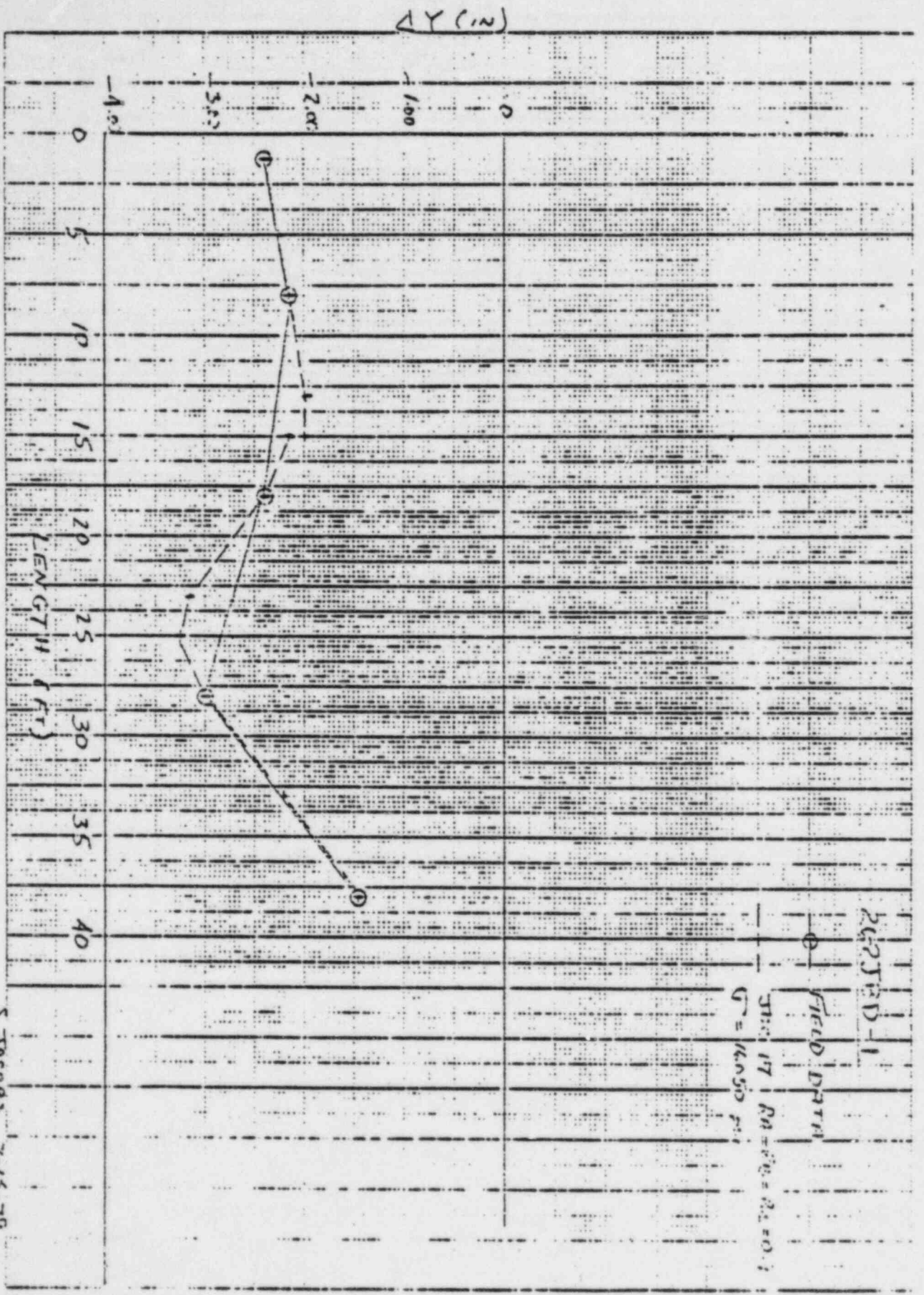
D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:
 DIFFERENTIAL SETTLEMENT STRESSES IN BURIED PIPING
 ME-101 - LINEAR ELASTIC ANALYSIS
 LINE NO.: 26" - 2JBD-1 - SERVICE WATER MAIN SUPPLY LINE FROM DIESEL GENERATOR BLDG. TO UNIT-2 TURBINE BLDG.

E. CONCLUSIONS:
 At data 15 $\rightarrow \sigma_{Max} = \frac{iM_D}{Z} = 16063$; $3S_c = 47100 \text{ psi}$
 Eq. 10a of NC-3652.3 (b) is Met \therefore OK

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	Vinh Lon NGUYEN (For J. JACVAS)	<i>[Signature]</i>	11-7-80
CHECKED BY	C.F. HART	<i>[Signature]</i>	11-7-80
APPROVED BY	A. PATEL	<i>[Signature]</i>	11-8-80

NOTES: Attach sheets if more space is needed.
 P.1238 9/12/74 GKWR/FO

P.1238 9/12/74



2625FD-1

FIELD DATA

ST: 17 RN = 20 = 2.00
U = 16.50 psi

PAGE 3 OF 4

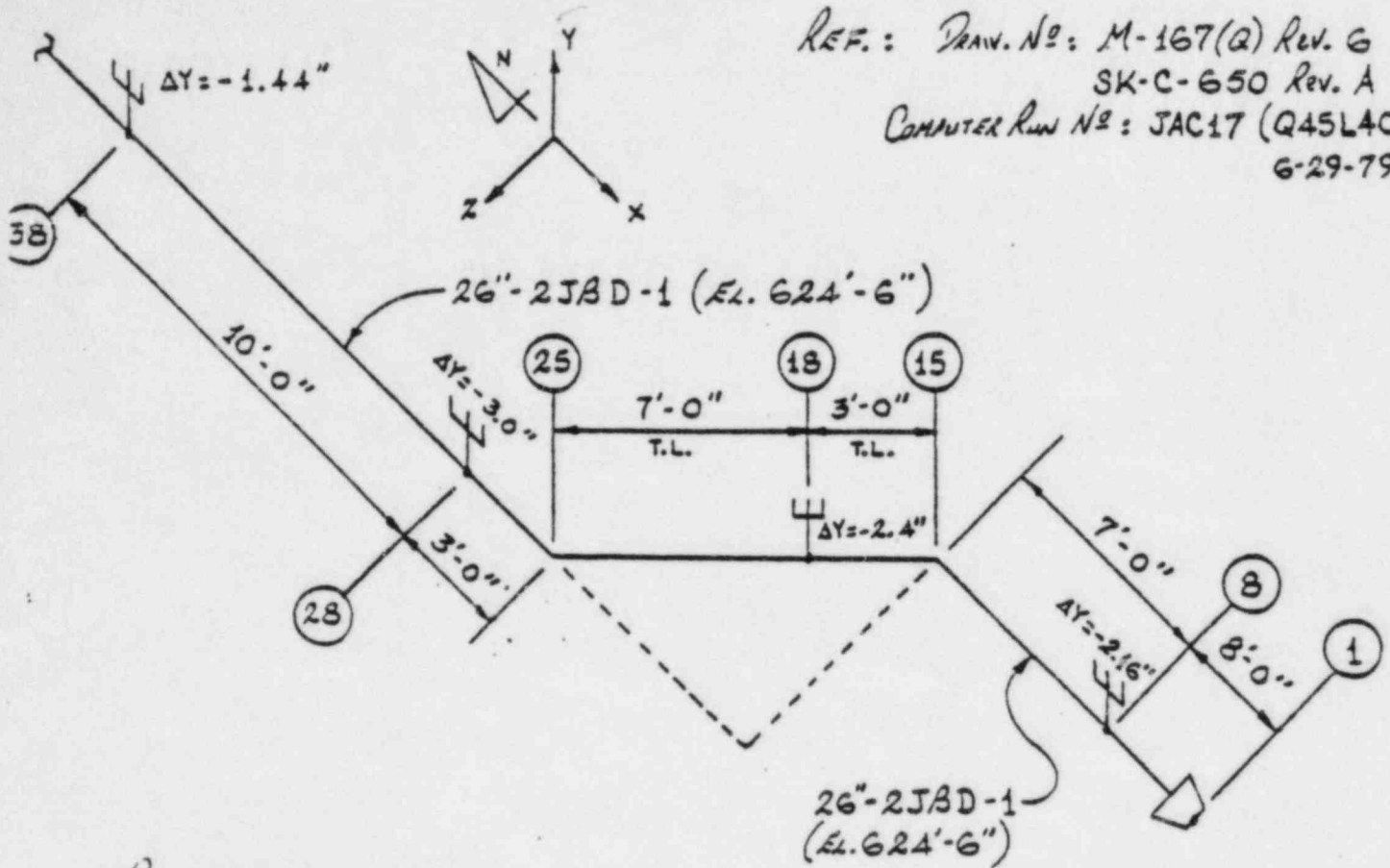
S. JACOBS 7-15-79



CALCULATION SHEET

ORIGINATOR Vincent Nguyen DATE 11-7-80 CALC. NO. 1007 REV. NO. _____
 PROJECT MIDLAND UNIT - 2 CHECKED C.F. Harrit DATE 11-7-80
 SUBJECT LINE No: 26"-2JBD-1 JOB NO. 7220 SHEET NO. _____

REF.: DRAW. No: M-167(Q) Rev. G
 SK-C-650 Rev. A
 COMPUTER Run No: JAC17 (Q45L40
 6-29-79)



COMMENT :

1. $LB/FT = 320.10$ and NOT $LB/FT = 278.50$ as input

INPUT DATA SCAN

DATE 06

TITLE : 26-2JBD-1 EAST VALVE PIT TO FISEB
 PROJECT NUMBER : 7220
 PROBLEM NUMBER : 1007
 USER : SJ
 LOAD CASES :

SNUM No. Q 45 L 40 C/1/7?

	COL 1	COL 4	COL 7	COL 10	COL 21	COL 32	COL 43	COL 51	COL 61	COL 71	COL 80
	+	+	+	+	+	+	+	+	+	+	+
1: HED											
2:											
3:											
4:											
5: ANC				1	-2.40						
6:											
7:											
8:				5-5.0							
9:				8-3.0							
10: PAD				6	1.0						
11:				13-5.0							
12:				15-2.0							
13:				18-2.12							
14: RAD				16	1.0	2.12					
15:				23-3.54							
16:				25-1.34							
17:				28-3.0							
18: RAD				28	1.0						
19:				33-5.0							
20:				38-5.0							
21: PAD				38	1.0						
22: LKD											
	+	+	+	+	+	+	+	+	+	+	+
	1	4	7	10	21	32	43	51	61	71	80
	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL

TITLE=26-2JBD-1 EAST VALVE PIT
 TO FISEB, PROJNO=7220,
 PROJNO=1007, UNITS=2,
 CODE=B31S73, USER=SJ
 E=27.9E6, OD=26.0, THIK=0.375,
 LES/ET=278.5, THERM=0.0,
 RA=0.9, RB=0.9, RC=0.9

EISF=-2.16

DISP=-2.4

DISP=-3.0

DISF=-1.44

SPECIAL STUDIES

PROJECT MIDLAND - 1 & 2 SHEET 1 OF 7
 JOB NO 7220 PLANT DESIGN GROUP
 SYSTEM: SERVICE WATER SUPPLY
 CALC. NO. 1003 ISO NO. M-169(Q) REV NO. 7

<p>A. DESIGN DATA:</p> <p>1) PIPING CLASS SHTS 7220-M-481(Q) REV IS.</p> <p>PIPE: 36" - 0.375" TK. WALL.</p> <p>MATERIAL: SA-155 CLASS 2, GY K2-70</p> <p>2) SOIL & ROCK INSTRUMENTATION FULL PROFILE SETTLEMENT GAGE DATA - JUNE 12, 1979</p> <p>36/26 - OHBC-19</p>	<p>B. CRITERIA/OBJECTIVES</p> <p>TO SHOW THAT THE STRESSES IN BURIED PIPING DUE TO DIFFERENTIAL SETTLEMENT MEET THE CODE REQUIREMENT. ASME SEC III, NC-3652.3(b) EQ. 10(a), 1977. $\frac{LMD}{E} \leq 3S_c$</p> <p>C. REFERENCES:</p> <ol style="list-style-type: none"> 1) ASME SEC III, SUBSECTION NC. 2) ME101 RUN DT 6-21-79 SNUM: Q45N42 3) S&RI FULL PROFILE SETTLEMENT GAGE DATA DT JUNE 12, 1979 FILE: D-2220-R 4) SK-C-675 SURVEYED PIPELINE PROFILES 5) YARD PIPING PLAN - AREA C M-167(Q)
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D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:

DIFFERENTIAL SETTLEMENT STRESSES IN BURIED PIPING - ME101 - LINEAR ELASTIC ANALYSIS.

36"/26" - OHBC-19 : SERVICE WATER SUPPLY HEADER.

E. CONCLUSIONS: $(\sigma_{max})_{AT DP 40} = \frac{LMD}{E} = 26978 ;$

$3S_c = 52500$

EQ. 10 (a) OF NC. 3652.3(b) IS MET.

∴ O.K.

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	S. KANNAN (FOR S. JAGAN)	<i>S. Kannan</i>	11-7-80
CHECKED BY	CHAKRAPANI BASAVARAJU	<i>C. Basavaraju</i>	11-8-80
APPROVED BY	A. PATEL	<i>A. S. Patel</i>	11-8-80

NOTE: Attach sheets if more space is needed.
 P 1230 9/12/74 EXHIBIT

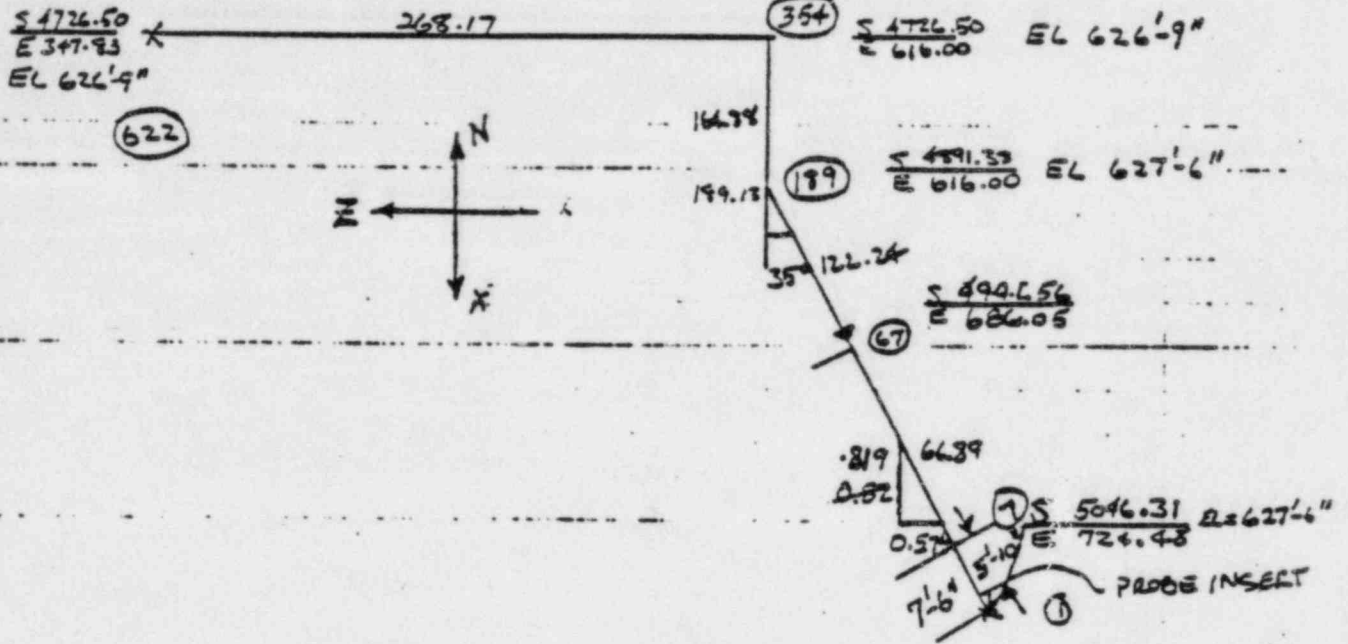
P 1230 9/12/74



CALCULATION SHEET

SA 2 OF 7

ORIGINATOR S. KANNAN (FOR S. J. MOSES) DATE 6-20-79 CALC. NO. 1003 REV. NO. _____
 PROJECT MIDLAND 1 & 2 CHECKED [Signature] DATE 11-7-80 JOB NO. 7220
 SUBJECT 36"-OHBC-19 SHEET NO. 1/1



① TO ⑥⑦

$\frac{5046.31}{4991.56}$	$\frac{724.43}{686.05}$
<u>54.75</u>	<u>38.43</u>

66.89'

⑥⑦ TO ①⑧⑨

$\frac{4991.56}{4991.33}$	$\frac{686.05}{616.00}$
<u>100.18</u>	<u>70.05</u>

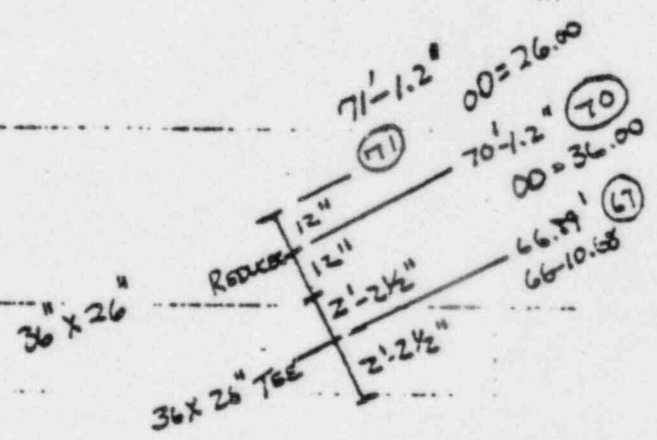
122.24

①⑧⑨ TO ③⑤④

$\frac{4891.33}{4726.50}$	
<u>164.88</u>	

$\frac{616.00}{347.83}$
<u>268.17</u>

⑦ TO ⑥⑦





CALCULATION SHEET

CALC. NO. 1003 REV. NO. _____

ORIGINATOR S. KANNAN (SRS. JAL) DATE 6-20-79 CHECKED S. Barman DATE 11-7-80

PROJECT MIDLAND 1#2 JOB NO. 7220

SUBJECT 36/26-048C-19 SHEET NO. 2/

L	Ft		ΔY (in)	7-23-79 NEW DATA
	DESIGN EL	READING		
0	626.03	625.95	-0.96	-1.20
20	↓	5.62	-4.92	-5.64
40		5.45	-6.96 *	-7.08
60		5.47	-6.72 *	-7.08
80		626.45	626.01	-5.28
100	↓	6.15	-3.60	-3.84
120		6.20	-3.00	-3.48
140		6.20	-3.00 *	-3.36
160		6.27	-2.16	-2.64
180	626.45	6.27	-2.16	-2.88
200	↓	6.37	-2.52 *	
220		6.28	-1.20	
240		6.20	-0.24	
260		6.12	0.00 *	
280	↓	6.03	-0.36	
300		5.95	-2.76	
320		5.87	-4.44	
340		5.78	-5.76	
360	625.70	5.26	-5.28 *	
380	↓	5.11	-7.08	
400		5.02	-8.16	
420		4.98	-8.64	
440		4.94	-9.12 *	
460	↓	5.11	-7.08	
480		5.28	-5.04	
500		5.40	-3.60	
520		5.44	-3.12 *	
540	↓	5.39	-3.72	
560		5.30	-4.80	
580		5.25	-5.40 *	
600		5.39	-3.72	
620	↓	5.66	-0.48 *	

INCORPORATED
1972
1000
ANN ARBOR
MICHIGAN



GEOTECHNICAL CONSULTANTS

GOLDBERG · ZOINO · DUNNICLIFF & ASSOCIATES, II

June 12, 1979
File No. D-2220-R

NOTE: PLEASE ROUTE THIS QUIPPED COPY TO CHUCK MC CONNELL.

Bechtel Power Corp.,
P.O. Box 1000,
Ann Arbor, Michigan 48106

Attention: Mr. R. L. Castleberry

Re: Midland Units 1 & 2
Results of Full Profile
Settlement Gage Measurements

Gentlemen:

Attached herewith is Summary Table 14 for full profile settlement gage measurements in Pipeline 36-OHBC-181/26-OHBC-19 at the subject project.

In reviewing our records, we have discovered an error in the sequence of Summary Table numbering. Please refer to Tables 5A and 5B for pipeline 20-IHCD-169, transmitted to you on April 24, 1979. These tables should be numbered 5B and 5C respectively.

Very truly yours,

W. R. BeJoff

WRB:mc
Enclosures

41 TOWER ROAD · NEWTON UPPER FALLS · MASS. 02164 · 617-244

FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 14
 PIPELINE DESIGNATION: 30-0110C-10
 LOCATION OF READOUT POINT: MICHIGAN SERVICE WATER PUMP STRUCTURE
 ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY BECHTEL POWER CORPORATION: 625.05
 626.03 FT

DISTANCE FROM READOUT POINT (ft)	INVERT ELEVATION (ft)	COMMENTS	ΔY
0	625.85		
20.0	625.83	36" pipe	-0.02
40.0	625.45		-4.92
60.0	625.47		-6.96
80.0	626.01		-6.72
100.0	626.15	28" pipe	-5.28
120.0	626.20		-3.60
140.0	626.20		-3.00
160.0	626.27		-3.00
180.0	626.27		-2.16
200.0	626.16		-2.16
220.0	626.18	Position of probe visually checked at 200 ft	-2.52
240.0	626.18		-0.20
260.0	626.12		-0.24
280.0	626.00		0.0
300.0	625.72		-0.36
320.0	625.50		-2.76
340.0	625.30		-4.44
360.0	625.26	Position of probe visually checked at 340' and 360'	-5.76
380.0	625.11		-5.28
400.0	625.02		-7.08
420.0	624.98		-8.16
440.0	624.94		-8.64
460.0	625.11		-9.12
480.0	625.28		-7.08
			-5.04

SH 5 no 3220-R

MICHIGAN SERVICE WATER PUMP STRUCTURE MICHIGAN



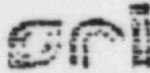
ENGINEERING AND SURVEYING COMPANY

FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 11 PIPELINE DESIGNATION 26-OHHC-19
 LOCATION OF READOUT POINT BASEMENT SERVICE WATER PUMP STRUCTURE
 ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY
 BECHTEL POWER CORPORATION 625.05

DISTANCE FROM READOUT POINT (ft)	INVERT ELEVATION (ft) ΔY	COMMENTS
500.0	625.40	-3.60 field data collected
520.0	625.44	-5.12 (320-620 ft.) on March 22, '79
540.0	625.39	-3.72 (0-300 ft.) on March 23, '79
560.0	625.30	-4.30
580.0	625.25	-5.40
600.0	625.39	-3.72
620.0	625.05	-0.48

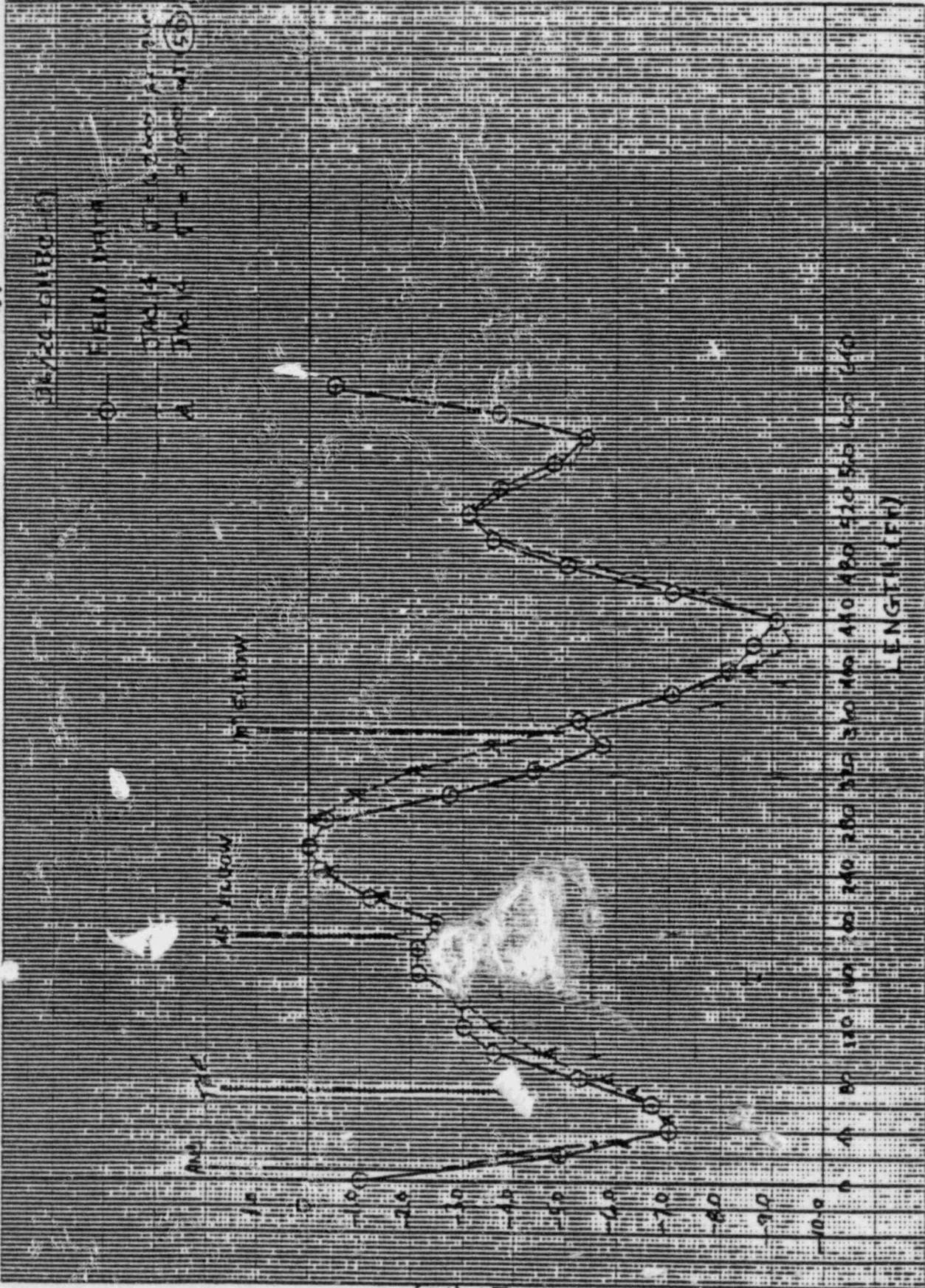
MIDLAND PROJECT - MIDLAND MICHIGAN



BECHTEL POWER CORPORATION

FILE # 222C-R

By: S. KANIHAN (for S. JACOB)
CARD:



SH 7 OF 7

INPUT CARD IMAGES

HEUT	ARD	1	11	21	31	41	51	61	71
SEQ	.	+	+	+	+	+	+	+	+
1	.	RUN							
2	.	RUN							
3	.	HED							
4	.								
5	.								
6	.								
7	.	ANC	7	-2.50					
8	.								
9	.								
10	.		10-3.21			2.25			
11	.		20-6-2.28 2.19			5-8.83 5.7358			
12	.		30-8-2.28			5-8.83			
13	.		40-8-2.28			5-8.83			
14	.	RAD	40	1.0					DISP=-6.96
15	.		50-8-2.28			5-8.83			
16	.		60-8-2.28			5-8.83			
17	.	RAD	60	1.0					DISP= -6.72
18	.		57-5-7.73 5.644			3-11.42 3.9517			
19	.		70-2-4.32 2.36			1-10.08 0.26			
20	.		71-0-9.83 2.792			0-6.88 0.573			OD=26.0, THIK=0.375,
21	.								LBS/FT=278.57
22	.		80-7-3.49 7.241			5-1.95 5.16			
23	.		90-8-2.28			5-8.83			
24	.		100-8-2.28			5-8.83			
25	.		110-8-2.28			5-6.83 5.736			
26	.		120-8-2.28 5.643			5-8.83			
27	.		130-8-2.28			5-8.83			
28	.		140-8-2.28			5-8.83			
29	.	RAD	140	1.0					DISP=-3.00
30	.		150-8-2.28			5-8.83			
31	.		160-8-2.28			5-8.83			
32	.		170-8-2.23			5-8.83			
33	.		180-8-2.23			5-8.83			
34	.		189-7-5.75 133.25			5-2.84			L
35	.		200-10-10.44	-0-0.593					
36	.	RAD	200	1.0					DISP=-2.52
37	.		210-10-0	-0-0.546					
38	.		220-10-0	-0-0.546					
39	.		230-10-0	-0-0.546					
40	.		240-10-0	-0-0.546					
41	.		250-10-0	-0-0.546					
42	.		260-10-0	-0-0.546					
43	.	RAD	260	1.0					DISP=0.0
44	.		270-10-0	-0-0.546					
45	.		280-10-0	-0-0.546					
46	.		290-10-0	-0-0.546					
47	.		300-10-0	-0-0.546					
48	.		310-10-0	-0-0.546					
49	.		320-10-0	-0-0.546					
50	.		330-10-0	-0-0.546					
51	.		340-10-0	-0-0.546					
52	.		350-10-0	-0-0.546					
53	.		354-4-0	-0-0.218					L
54	.		560			6-0			

SNUM # Q 45N42 6/21/79

55	.	RAD	360	1.0		DISP=-5.28
56	.		370		10-0	
57	.		380		10-0	
58	.		390		10-0	
59	.		400		10-0	
60	.		410		10-0	
61	.		420		10-0	
62	.		430		10-0	
63	.		440		10-0	
64	.	RAD	440	1.0		DISP=-9.12
65	.		450		10-0	
66	.		460		10-0	
67	.		470		10-0	
68	.		480		10-0	
69	.		490		10-0	
70	.		500		10-0	
71	.		510		10-0	
72	.		520		10-0	
73	.	RAD	520	1.0		DISP=-3.12
74	.		530		10-0	
75	.		540		10-0	
76	.		550		10-0	
77	.		560		10-0	
78	.		570		10-0	
79	.		580		10-0	
80	.	RAD	580	1.0		DISP=-5.40
81	.		590		10-0	
82	.		600		10-0	
83	.		610		10-0	
84	.		622		12-2.0	
85	.	RAD	622	1.0		DISP=-0.48
86	.	END				

. + + + + + + + + +

86 CARDS IN INPUT DECK
86 CAPDS IN LOAD CASE THRM1
86 CABES IN LOAD CASE WT1

0 WARNINGS
0 ERRORS
0 FATAL ERRORS

DD,PL 93.

FEF SCRACH.

C WAENING 10000000000

QT,KK *ME101.ME101I

ME101I ME101I/FE205

*** CORE CHANGED FROM 35371 TO 41371 DECIMAL WORDS ***

SPECIAL STUDIES

PROJECT MIDLAND 1 & 2 SHEET 1 OF 12
 JOB NO. 7220 PLANT DESIGN GROUP
 SYSTEM: SERVICE WATER SUPPLY SYSTEM
 CALC. NO. 1005 ISO NO. M-169(Q) & M167(Q) REV NO. 3 & 5

A. DESIGN DATA

1) PIPING CLASS SHTS. 7220-M-481(Q)
 REV. 15
 PIPE: 26" STD. WALL
 MATL: SA-155 CL.2, GR. KC-70

2) SOIL & ROCK INSTRUMENTATION
 FULL PROFILE SETTLEMENT
 GAGE DATA - APRIL 79

B. CRITERIA OBJECTIVES
 TO SHOW THAT THE STRESSES
 IN BURIED PIPING DUE TO
 DIFFERENTIAL SETTLEMENT
 MEET THE CODE REQUIREMENT
 ASME SEC. III B & PV CODE
 NC-3652.3(4) EQ. (10a)

$$\frac{i M_D}{Z} \leq 3 S_c$$

C. REFERENCES:

- 1) ASME SEC. III, SUBSECTION NC 1977
- 2) ME 101 RUN: SNUM. Q46G48
(VER. F1) DT. 6-21-79
- 3) S&RT FULL PROFILE
 SETTLEMENT GAGE DATA
 FILE: D-2220-R, DT. 4/24/79
- 4) SK-C-675- SURVEYED
 PIPELINE PROFILES
- 5) YARD PIPING PLANS
 AREA - C M167(Q) REV.5
 AREA - E M169(Q) REV.3
- 6) M-183 82-2(Q) REV.5

D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:
 LINEAR ELASTIC ANALYSIS TO DETERMINE DIFFERENTIAL
 SETTLEMENT STRESSES IN BURIED PIPING

26"-OHBC-55: SERVICE WATER SUPPLY LINE

E. CONCLUSIONS:

$(\sigma_{MAX})_{AT DP (30)} = \frac{i M_D}{Z} = 27,282$; $3 S_c = 52,500$ psi
 EQ. (10a) OF NC-3652.3(4) IS MET. \therefore O.K.

$(\sigma_{MAX})_{AT DP (67)} = \frac{i M_D}{Z} = (4.43)(8545) = 37,857$ psi $< 52,500$ \therefore O.K.
 WITH TEE SIZE THIS TEE SIZE NOT REFLECTED IN COMPUTER RUN.

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	C. BASAVARAJU (FOR S. JACOBS)	<i>Chakravarthy Basavaraju</i>	11-6-80
CHECKED BY	S. KANNAN	<i>S. Kannan</i>	11-7-80
APPROVED BY	A. PATEL	<i>A. Patel</i>	11-8-80

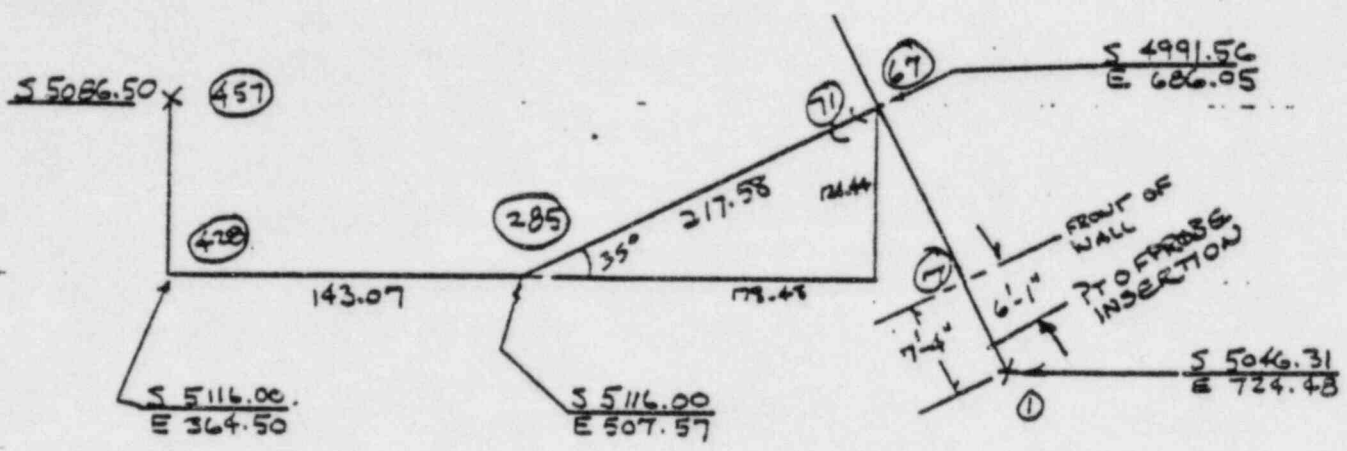
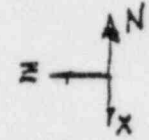
NOTES: Attach sheets if more space is needed.
 P 1230 9-1277A (REV. 11-80)

P 1230 9-1277A



CALCULATION SHEET

ORIGINATOR S. JACOBS DATE 6-19-79 CALC. NO. 1005 REV. NO. _____
 PROJECT MIDLAND 1 & 2 CHECKED Kanna DATE 11-6-80
 SUBJECT 36-0HBC-19 / 26-0HBC-55 JOB NO. 7220 SHEET NO. 2 of 12



① TO ⑥⑦
 S. 5046.31 E. 724.48
 4991.56 686.05

 54.75 38.43
 $TAN^{-1} \frac{54.75}{38.43} = 54.93^\circ$ 35.07°

66.89 66.89
 7.33 -1.25

 59.56' 65.64'
 Subtract 6' FROM DATA
 0 = -6 FT
 20 = 14 FT

⑥⑦ TO ②⑧⑤
 S. 5116.00 E. 686.05
 4991.56 507.57

 124.44 178.48

$TAN^{-1} \frac{124.44}{178.48} = 34.89^\circ$

②⑧⑤ TO ④②⑧
 E 507.57
 364.50

 143.07
 ④②⑧ TO ④⑤⑦
 S 5116.00
 508.50

 29.50

$\frac{217.58'}{284.47'}$
 143.07
 427.54

 29.50
 457.04



CALCULATION SHEET

ORIGINATOR SJ DATE 6-19-79 CALC. NO. 1005 REV. NO. _____
 PROJECT MIDLAND 1 & 2 CHECKED Kanna DATE 11-6-80
 SUBJECT 2G-04B-C-55 JOI NO. 7220 SHEET NO. 3 of 12

$$67 \bar{x} = -59.56 \cos 35^\circ = -48.79'$$

$$67 \bar{z} = 59.56 \sin 35^\circ = 34.16'$$

$$20 \bar{x} = -14.0 \cos 35^\circ = -11.47'$$

$$20 \bar{z} = 14.0 \sin 35^\circ = 8.03'$$

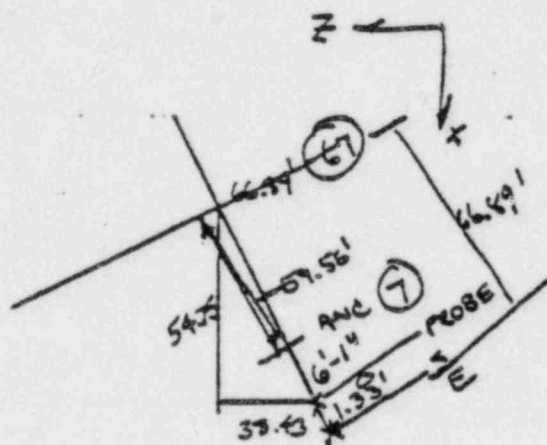
$$30 \bar{x} = -10.00 \cos 35^\circ = -8.19'$$

$$40 \bar{x} = -10.00 \cos 35^\circ = -8.19'$$

$$50 \bar{x} = -10.00 \cos 35^\circ = -8.19'$$

$$60 \bar{x} = -10.00 \cos 35^\circ = -8.19'$$

$$30 \bar{z} = \downarrow \sin 35^\circ =$$



AT DATA PT 20 FT $L = 21.33$ FT FROM S BENCHMARK
 $L = 13' 11''$ FROM ANV (7)

USE (20) FOR DATA PT 20 FT

(7) TO (20) $L = 13' 11''$

$$\begin{aligned} \textcircled{20} \bar{x} &= -13' 11'' \cos 35^\circ = -13.92' (.819) = -11.40' \\ \textcircled{20} \bar{z} &= 13' 11'' \sin 35^\circ = 13.92' (.574) = 7.98 \end{aligned}$$

$$\textcircled{60} = 13' 11'' + 40' = 53' 11'' = 53.92'$$

$$\textcircled{67} = 59.56' - 53.92' = 5.64'$$

$$67 \bar{x} = -5.64' \cos 35^\circ = -4.62'$$

$$67 \bar{z} = 5.64 \sin 35^\circ = 3.23'$$

$$\textcircled{10} \bar{x} = 10' - 6' - 1' = 3' 11'' \cos 35^\circ = -3.21'$$

$$\textcircled{10} \bar{z} = 3.92' \sin 35^\circ = 2.25'$$

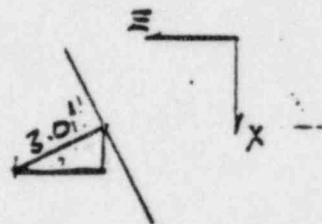


CALCULATION SHEET

ORIGINATOR SJ DATE 6-19-79
 PROJECT MIDLAND 1 & 2
 SUBJECT OHBC - 19 & 55

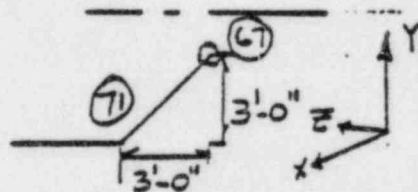
CALC. NO. 1005 REV. NO. _____
 CHECKED [Signature] DATE 11-6-80
 JOB NO. 7220
 SHEET NO. 4 of 12

(70) z = 3.0 ∴ cos 35° = 2.457
 (70) x = 3.0 sin 35° = 1.721
 (70) y = -3.0 FT



217.58	59.56
<u>3.00</u>	<u>4.24</u>
214.58	63.80
	<u>7</u>
	70.80

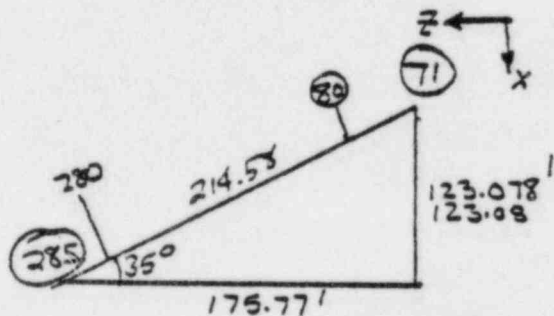
80 - 70.80 = 9.20'



(80) x = 9.20 sin 35° = 5.28'
 (80) z = 9.20 cos 35° = 7.54'
 90 x = 10.0 sin 35° = 5.73'
 90 z = 10.0 cos 35° = 8.19'

280

6 $\frac{214.58}{70.80}$
 285.38



(280) TO 285 L = 5.38

285 x = 5.38 sin 35° = 3.09'
 285 z = 5.38 cos 35° = 4.41'



CALCULATION SHEET

ORIGINATOR SJ DATE 6-19-79 CALC. NO. 1005 REV. NO. _____
 PROJECT MIDLAND 1 & 2 CHECKED Kama DATE 11-6-80
 SUBJECT OHBC-19 & 55 JOB NO. 7220 SHEET NO. 5 of 12

(285) to (428)

143.07 FT

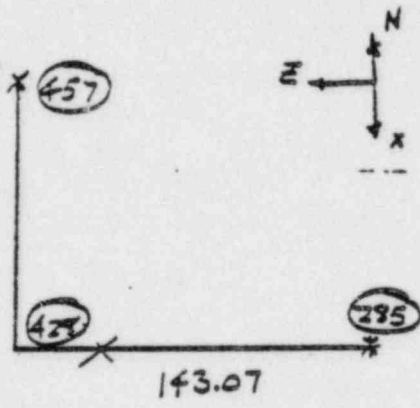
290 TO 420

428 TO 430

29.50

430 TO 450

457 = 7.5'



(431)

ON WELD

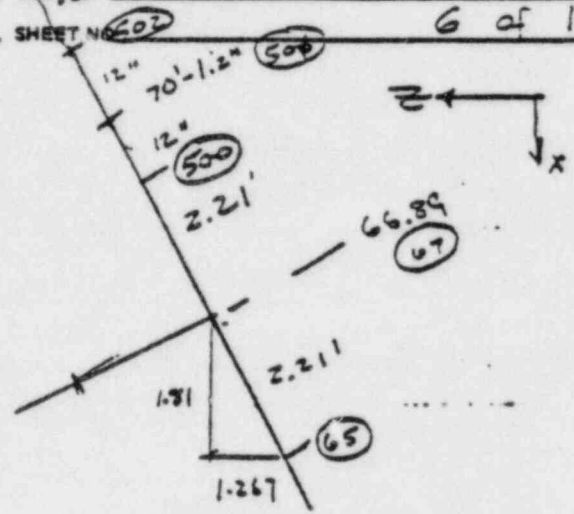
$$1.5(26.0)'' = 39.0'' = 3.25'$$



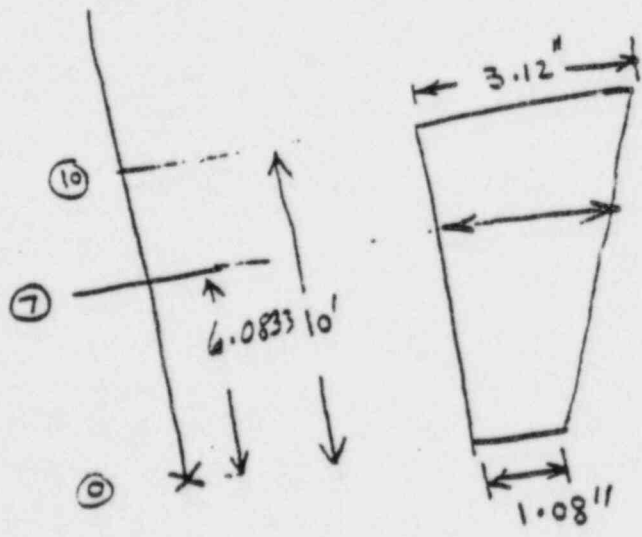
CALCULATION SHEET

ORIGINATOR SJ DATE 6-19-79 CALC. NO. 1005 REV. NO. _____
 PROJECT MIDLAND 1 & 2 CHECKED: [Signature] DATE 11-6-80
 SUBJECT 36-OHBC-55 JOB NO. 7220 SHEET NO. 602 6 of 12

67 RPBIM = 36
 RPTHC = 0.375



INTERPOLATED SETTLEMENT VALUE AT ⑦



$$\Delta_{⑦} = 1.08'' + (2.04'') \left(\frac{6.0833}{10} \right) \approx 2.32''$$



CALCULATION SHEET

ORIGINATOR SJ DATE 6-19-79 CALC. NO. 1005 REV. NO. _____
 PROJECT MIDLAND 1 & 2 CHECKED [Signature] DATE 11-6-80
 SUBJECT 36"-OHBC-19/26 OHBC-55 JOB NO. 7220
 SHEET NO. 7 of 12

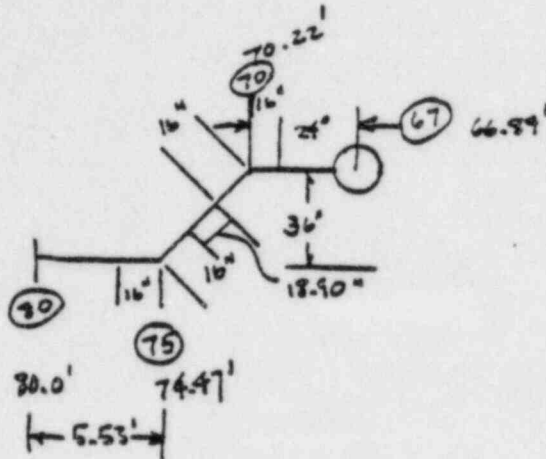
L	ΔY	626.03	
0	625.95		0.96
20	625.62		4.92
40	625.45		6.96"
60	625.47		6.72
80	626.01	5" DOWN 626.45	5.28

(500) @ 77'
 DSP = 5.28

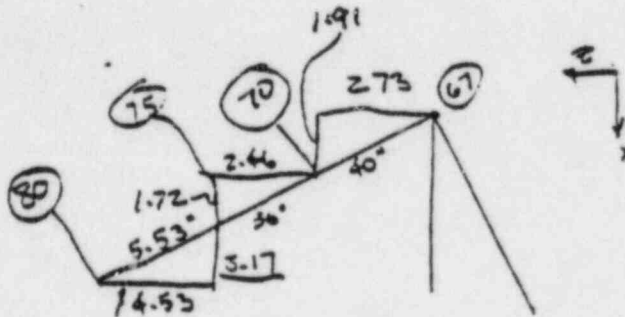


CALCULATION SHEET

ORIGINATOR SJ DATE 6-19-79 CALC. NO. 1005 REV. NO. _____
 PROJECT MIDLAND 1 & 2 CHECKED Kanna DATE 11-6-80
 SUBJECT 26-0480-55 (2/45° EL) JOB NO. 7220 SHEET NO. 8 of 12



$$\begin{array}{r}
 16 \\
 \hline
 24 \\
 \hline
 40'' \\
 36(1.414) = 50.90 \\
 \hline
 - 32.00 \\
 \hline
 18.90
 \end{array}$$

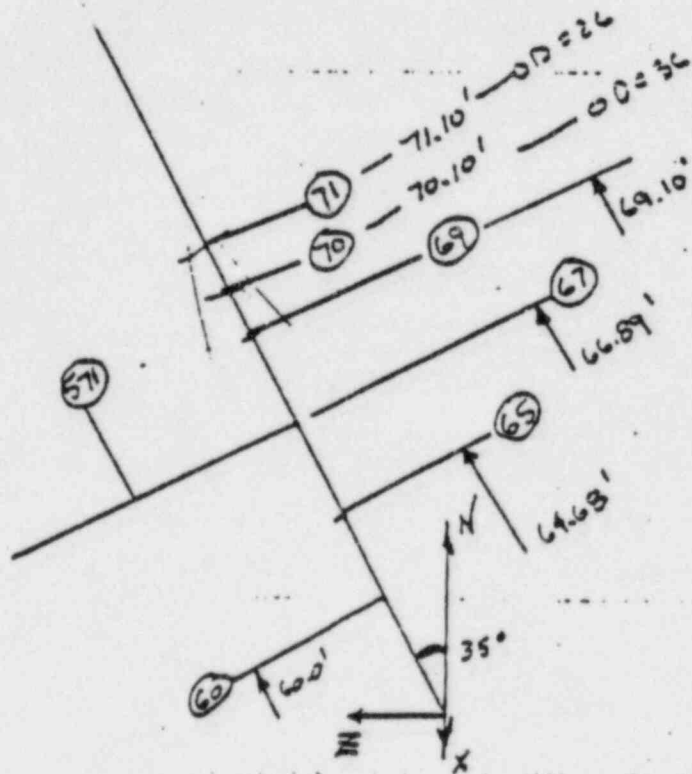




CALCULATION SHEET

ORIGINATOR SJ DATE 6-19-79 CALC. NO. 1005 REV. NO. _____
 PROJECT MIDLAND 1B2 CHECKED hanna DATE 11-6-80
 SUBJECT 36-OHBC-19 JOB NO. 7220 SHEET NO. 9 of 12

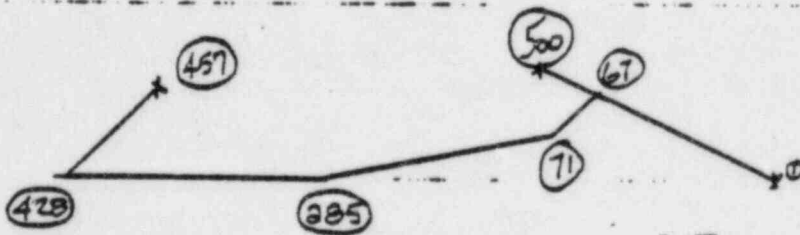
		$\cos 35^\circ$	$\sin 35^\circ$
60 TO 65	$L = 4.68'$	$x = -3.83'$	$y = 2.63'$
65 TO 67	$L = 2.21'$	$-1.81'$	$= 1.27'$
67 TO 69	$L = 2.21'$	$-1.81'$	$= 1.27'$
69 TO 70	$L = 1.0'$	$-0.819'$	$0.57'$
70 TO 71	$L = 1.0'$	$-0.819'$	$0.57'$





CALCULATION SHEET

ORIGINATOR SJ DATE 6-19-79 CALC. NO. 1005 REV. NO. _____
PROJECT MIDLAND 1 & 2 CHECKED Kama DATE 11-6-80
SUBJECT 36-OHBC-19 / 26-OHBC-55 JOB NO. 7220 SHEET NO. 10 of 12



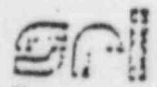
FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 12 PIPELINE DESIGNATION 26-ORBC-X 55
 LOCATION OF READOUT POINT Basement Service Water Pump Structure
 ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY
 BECHTEL POWER CORPORATION 625.94

DP.#	DISTANCE FROM READOUT POINT (ft)	INVERT ELEVATION (ft)	COMMENTS	Settlement ΔY INCHES
	0	625.94	All Field Data Collected on April 7 and 8, 1979	-1.08
	10.0	625.77		-3.12
(30)	30.0	625.49		-6.48
	50.0	625.41		-7.44
	70.0	623.45' 622.90		-6.6
(90)	90.0	622.89		-6.72
	110.0	623.06		-4.68
(130)	130.0	623.12		-3.96
	150.0	623.09		-4.32
(170)	170.0	623.10		-4.2
	190.0	623.06		-4.68
(210)	210.0	623.00		-5.4
	230.0	622.72		-8.76
(250)	250.0	622.57		-10.56
	270.0	622.56		-10.68
(290)	290.0	622.58		-10.44
(310)	310.0	622.55		-10.80
	330.0	622.60		-10.20
	350.0	622.64		-9.72
(370)	370.0	622.78		-8.04
(390)	390.0	622.87		-6.36
	410.0	622.75		-3.40
(431)	430.0	622.81		-7.68
(457)	451.5	623.29		-1.92

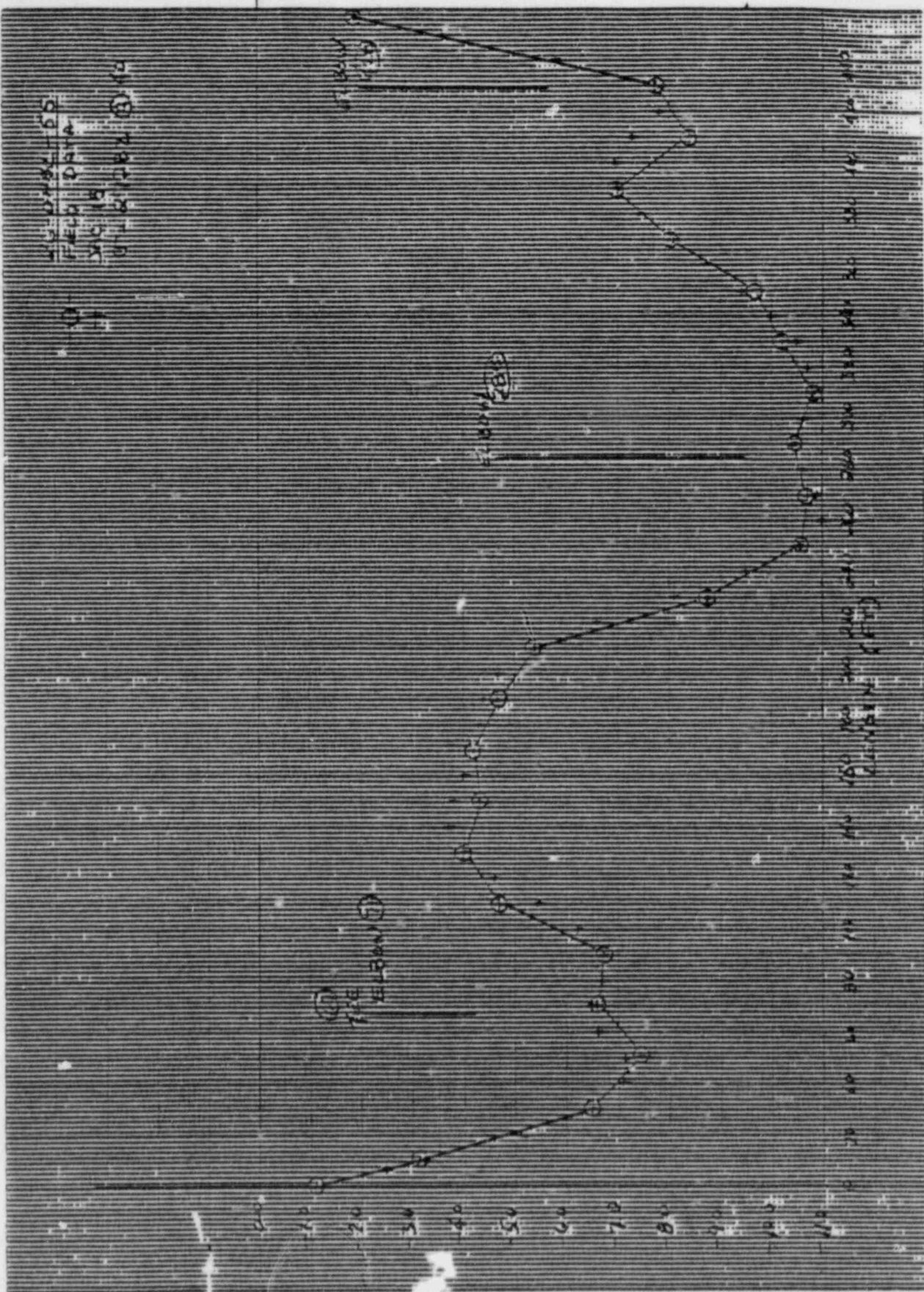
FILE No. 2220-R

MIDLAND PLANT - MIDLAND MICHIGAN



46 1512

K·E 10 X 10 TO THE CENTIMETER 10 X 10 CM
BLANCK & ESSER CO. MADE IN U.S.A.



S. JACOBS 7-16-79

✓ Y (in)

M2101

INPUT CARD IMAGES

LINE NO	1	11	21	31	41	51	61	71
1	+	+	+	+	+	+	+	+
1	BUN					LDCASE=THRM1,		
2	BUN					LDCASE=WT1		
3	HED					TITLE=MIDLAND SERV WTR PUM		
4						TO 2M01858 26-CH2C-55,		
5						PROJNC=7220,PRCENC=1005,		
6						UNITS=2,CCDE=231573,USER=		
7	ANC	7	-2.5			E=27.5E6,CD=36.0,THIK=0.3		
8						RA=0.9,2B=0.9,RC=0.9		
9		10-3.21		2.25				
10		20-8.19		5.74				
11		30-8.19		5.74				
12	RAD	30	1.0			DISP=-6.48		
13		40-8.19		5.74				
14		50-8.19		5.74				
15		60-8.19		5.74				
16		67-4.62		3.23				
17		500-8.19		5.74				
18	EAD	500	1.0			DISP=-5.28		
19		67 71 1.721	-3.0	2.457	L	CC=26.0,THIK=0.375,		
20						LES/FT=278.5		
21		80 5.28		7.54				
22		90 5.74		8.19				
23	RAD	90	1.0			DISP=-6.72		
24		100 5.74		8.19				
25		110 5.74		8.19				
26		120 5.74		8.19				
27		130 5.74		8.19				
28	RAD	130	1.0			DISP=-3.94		
29		140 5.74		8.19				
30		150 5.74		8.19				
31		150 5.74		8.19				
32		170 5.74		8.19				
33	PAD	170	1.0			DISP=-4.20		
34		180 5.74		8.19				
35		190 5.74		8.19				
36		200 5.74		8.19				
37		210 5.74		8.19				
38	RAD	210	1.0			DISP=-5.4		
39		220 5.74		8.19				
40		230 5.74		8.19				
41		240 5.74		8.19				
42		250 5.74		8.19				
43	PAC	250	1.0			DISP=-10.56		
44		260 5.74		8.19				
45		270 5.74		8.19				
46		280 5.74		8.19				
47		255 3.09		4.41	L			
48		290		5.0				
49	RAD	290	1.0			DISP=-10.44		
50		300		10.0				
51		310		10.0				
52	RAD	310	1.0			DISP=-10.8		
53		320		10.0				
54		330		10.0				

	340		10.0		
	350		10.0		
	360		10.0		
	370		10.0		
RAD	370	1.0			DISP=-8.04
	380		10.0		
	390		10.0		
PAD	390	1.0			DISP=-6.96
	400		10.0		
	410		10.0		
	420		10.0		
	428		6.0	L	
	431-3.25				
RAD	431	1.0			DISP= -7.68
	440-8.75				
	450-10.0				
	457-7.5				
PAD	457	1.0			DISP=-1.92
END					
	+	+	+	+	+

73 CARDS IN INPUT DECK
73 CARDS IN LOAD CASE THRM1
73 CARDS IN LOAD CASE WT1

0 WARNINGS
0 ERRORS
0 FATAL ERRORS

12.

PACH.
ENG 10000000000

*ME101.ME101I

*** ME101I/FEBOS
CHANGED FROM 35371 TO 41371 DECIMAL WORDS ***

PROJECT: MIDLAND UNIT - 1 SHEET OF
 JOB NO.: 7220 PLANT DESIGN GROUP
 SYSTEM: CONDENSATE WATER LINE
 CALC. NO.: 1006 IEN NO. M-167 (Q) REV. NO. 6

<p>A. DESIGN DATA:</p> <p>1. PIPING CLASS SHEET: M-AB1 Rev. 15 (HBC-Rev. 12) PIPE: 10" SCH. 40 Mat'l.: ASME SA106 Gr. B C.S.</p> <p>2. Soil & Rock INSTRUMENT. FULL PROFILE SETTLEMENT GAGE DATA SUMMARY - JAN. 13 '79</p>	<p>B. CRITERIA/OBJECTIVES</p> <p>To show that the stresses in buried piping due to differential settlement meet the code requirement ASME Sect. III, NC-3652.3(b)</p> <p>Eq. 10a: $\frac{iM_s}{Z} \leq 3S_c$</p> <p>C. REFERENCES:</p> <ol style="list-style-type: none"> ASME - SECT. III, SUBSECTION-NC ME101 Run: JAC16 (JUM Q13F16 (VER. F2) 6-23-79) 34 RI - FULL PROFILE SETTLEMENT GAGE DATA - JAN. 13 '79 SURVEYD PIPELINES PROFILE: SK-C-650 Rev. A YARD PIPING PLAN - "AREA-C" M-167 (Q) Rev. 6
--	---

D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:

DIFFERENTIAL SETTLEMENT STRESSES IN BURIED PIPING
 ME101 - LINEAR ELASTIC ANALYSIS

LINE No: 10"-OHBC-27 - SERVICE WATER SUPPLY HEADER FROM 26"-OHBC-55 TO "TRAIN-B" DIESEL GENERATOR COOLERS (142 E-25B)

E. CONCLUSIONS:

At data point 2B - $\sigma_{Max} = \frac{iM_s}{Z} = 21910$; $3S_c = 45000 \text{ psi}$

Eq 10a of NC-3652.3 (b) is Met \therefore OK

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	VINHSON NGUYEN (FOR J. JACOBS)	<i>[Signature]</i>	11-6-80
CHECKED BY	C.F. MARUT	<i>[Signature]</i>	11-7-80
APPROVED BY	A. PATEL	<i>[Signature]</i>	11-8-80

P 12310 8/12/74

NOTE: Attach sheets if more space is needed
 P 12310 8/12/74 GKWH/D

FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 6 PIPELINE DESIGNATION 10-OBBC-27

NOTE: SEE FIGURE No. 1 FOR LOCATION OF PIPELINE AND READOUT POINT

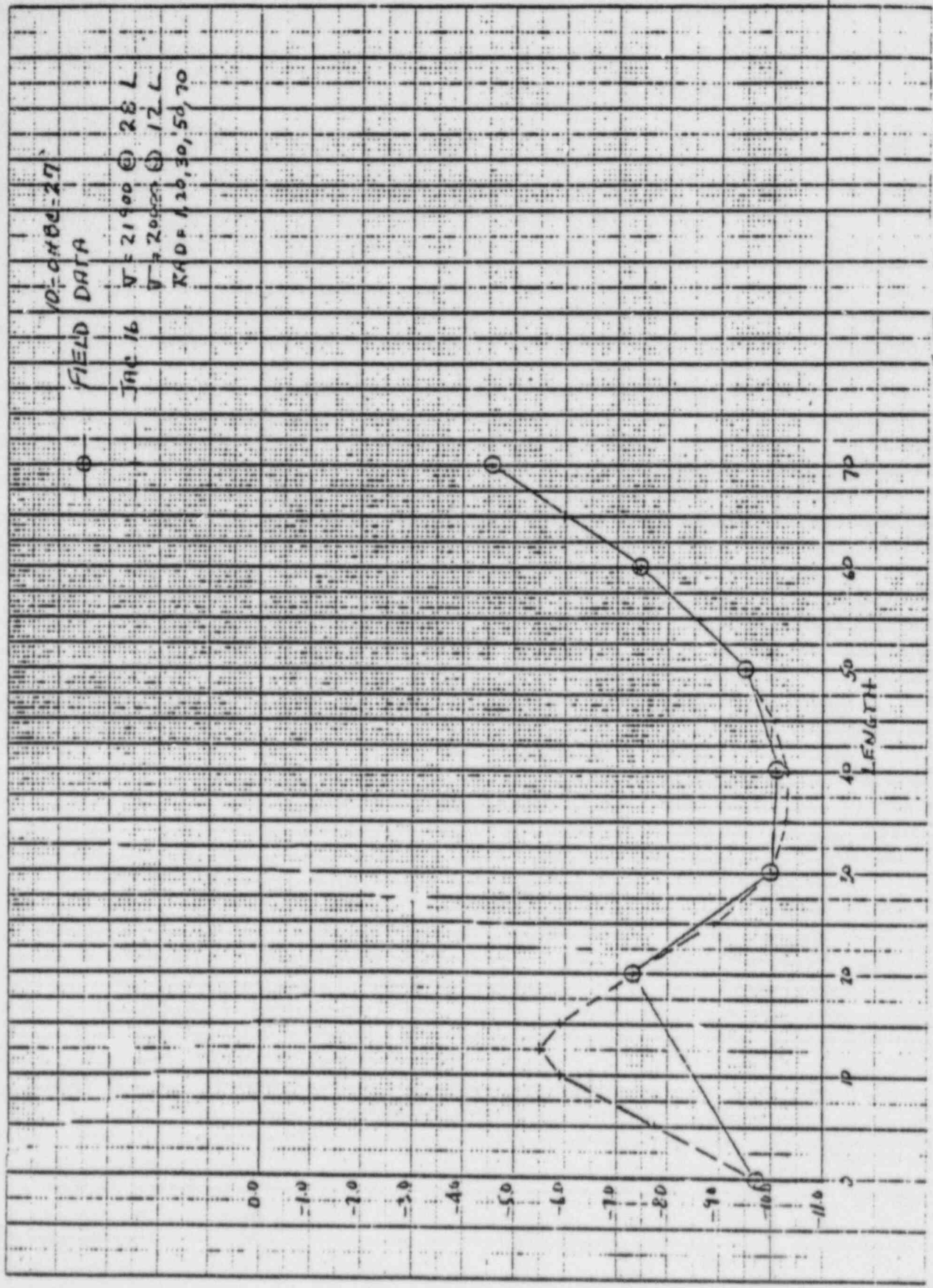
DISTANCE FROM READOUT POINT (FT.)	INVERT ELEVATION (FT.)	DISPLACEMENTS	COMMENTS	DATA POINT
0	623.27	2.16	11-13-79	1
20.0	623.47	7.32"	No reading taken at 10.0 ft	20
30.0	623.25	9.96"		30
40.0	623.24	10.08"		40
50.0	623.29	9.48"		50
60.0	623.46	7.44"		60
70.0	623.70	4.56"		70

— MIDLAND PLANT — MIDLAND, MICHIGAN	DIESEL GENERATOR BUILDING
--	---------------------------

FILE No. 2220-R

46 1512

16-Σ 18 X 18 TO THE CENTIMETER 18 X 18 CM
REPROD. BY GSA/GPO WASH DC 20540



10-0MB0-27

FIELD DATA

JAN 16 V = 21900 @ 28 L

V = 20000 @ 12 L

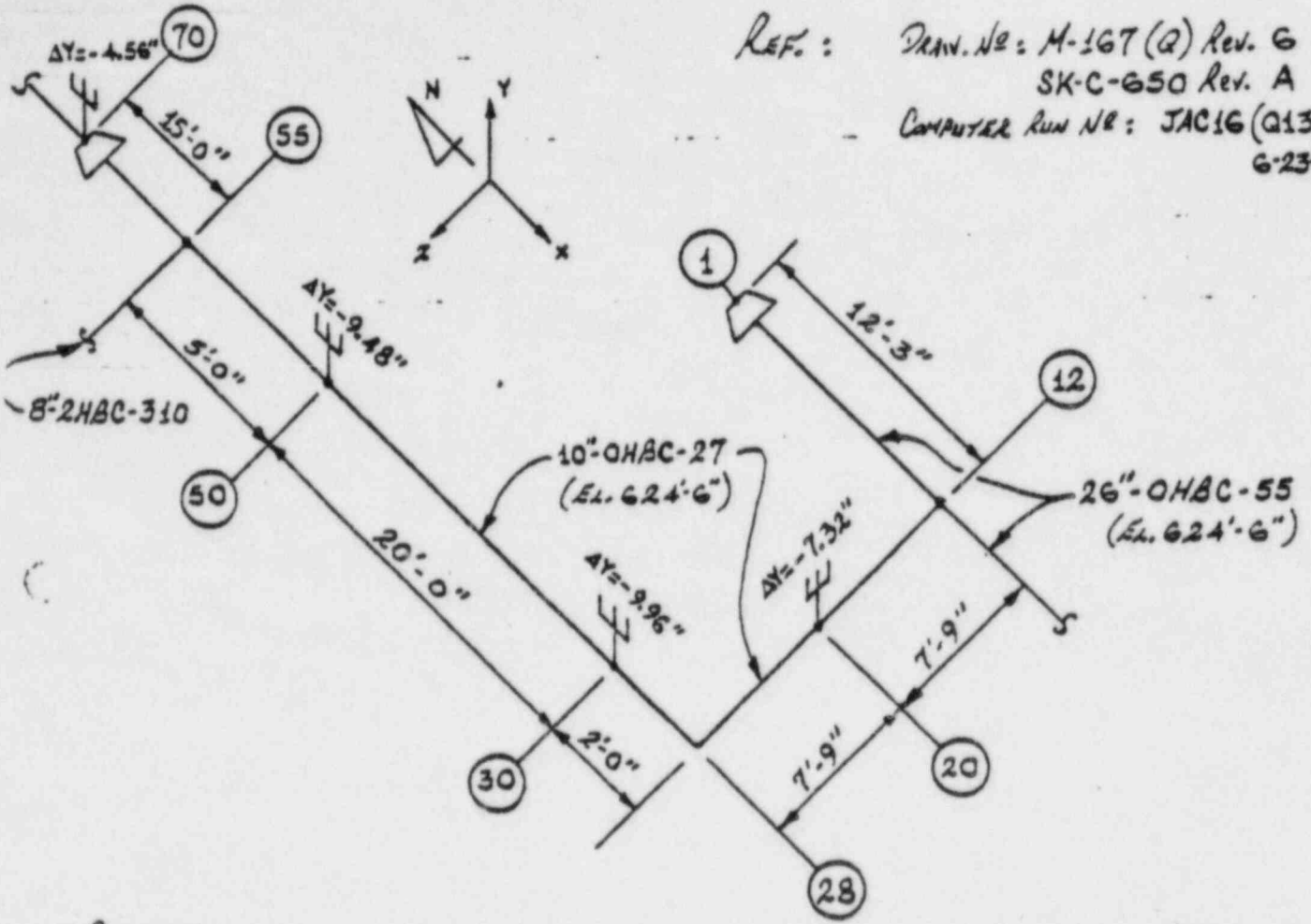
KADR 1, 20, 30, 50, 70

S. JACOBS 7-16-79



CALCULATION SHEET

ORIGINATOR Vishwan Nagesan DATE 11-6-80 CALC. NO. 1006 REV. NO. _____
 PROJECT MIDLAND UNIT - 1 CHECKED C.F. Murat DATE 11-7-80
 SUBJECT LINE No: 10"-OHBC-27 JOB NO. 7220
 SHEET NO. _____



REF.: DRAW. No: M-167 (Q) Rev. G
 SK-C-650 Rev. A
 COMPUTER RUN No: JAC16 (Q13F16
 6-23-79)

COMMENTS :

1. From dt. pt. 1 to dt. pt. 12, pipe properties should be 26" (26"-OHBC-55) and NOT pipe properties of 10", as input.
2. At dt. pt. 12, should be a "SWEEPLET" (JIF = 5.22) and NOT "ELBOW", as input
3. At dt. pt. 55 should be a "WELD-TEE" (JIF = 1.97)
4. CODE = SC374 and NOT CODE = B31S73, as input, No effect



CALCULATION SHEET

ORIGINATOR Vicki Lou Snyder DATE 11-6-80 CALC. NO. 1006 REV. NO. _____
 PROJECT MIDLAND UNIT - 1 CHECKED C.F. Martin DATE 11-7-80
 SUBJECT LINE N^o : 10" - OHAC - 27 JOB NO. 7220
 SHEET NO. _____

Materials =
 10" - OHAC - 27 | 26" - OHAC - 55
 ASME - SA-106 | ASME - SA-155
 Gr. B C.S. | Gr. KC-70 C.S.
 $\phi D = 10.75"$ | $\phi D = 26.0"$
 Thick = 0.365" | Thick = 0.375"
 $Z = 29.90 \text{ in}^3$ | $Z = 190.60 \text{ in}^3$
 Ratio $Z = 6.37$

Settlement Stress of 10" pipe as in computer run	$\left\{ \begin{array}{l} 3115 \leftarrow @ 5; 5T \rightarrow 489 \\ 6230 \leftarrow @ 10; 10T \rightarrow 978 \\ 6853 \leftarrow @ 12A \rightarrow 1076 \\ 17853 \leftarrow @ 12BA \rightarrow 2803 \\ 19297 \leftarrow @ 12M; MA \rightarrow 3029 \\ 19985 \leftarrow @ 12E \rightarrow 3137 \end{array} \right.$	$\left. \begin{array}{l} \text{New Settlement Str.} \\ \text{of 26" pipe} \\ \text{Divided by a} \\ \text{ratio of } 6.37 \end{array} \right\}$	
			$\left. \begin{array}{l} 16375 \end{array} \right\} \left\{ \begin{array}{l} \text{Multiply SIF} = 5.22 \\ (3137 \times 5.22) \end{array} \right.$
			$10884 \leftarrow @ 55; 55T \rightarrow 21441 \left\{ \begin{array}{l} \text{Multiply SIF} = 1.97 \\ (10884 \times 1.97) \end{array} \right.$

Maximum Settlement Stress is 21910 psi @ 2BE as in compute.



CALCULATION SHEET

PAGE 6 OF 6

ORIGINATOR Vishwan Nanyan DATE 11-6-80 CALC. NO. 1006 REV. NO. _____
 PROJECT Model Unit CHECKED C.F. Marat DATE 11-7-80
 SUBJECT Stress Int. Factor for Smeared JOB NO. 7220 SHEET NO. _____

Ref.: "STRESS INTENSIFICATION FACTOR AND STRESS INDICES FOR RUNNER FORGE SMEARED"

Notation = R → Mean Radius of Run Pipe → $(D-T) \div 2$
 r → " " " Branch Pipe → $(d-t) \div 2$
 t → Thickness " " "
 T → " " Run "
 F_1 → 1.6, for an-weld insert weld
 F_2 → $(0.5 + r/R)$, or 1.0, whichever maximum
 F_3 → $1.0 + 0.05(r-3)$, or 1.0, " "

where = 26" Sch. 40 (Run Pipe) $D = 26"$; $T = 0.375$ $R = 12.8125"$
 10" Sch. 40 (Branch Pipe) $d = 10.75"$; $t = 0.365$ $r = 5.1925"$

$$\begin{aligned} (R/T)^{2/3} &= 10.529 & (r/R)^{1/2} &= 0.637 \\ (t/T) &= 0.973 & (r/R) &= 0.405 \\ F_1 &= 1.6 & F_2 &= 1.0 \\ F_3 &= 1.0 + 0.05(r-3) \rightarrow F_3 = 1.11 \end{aligned}$$

Equations = $i_1 = 0.45(R/T)^{2/3}(r/R)^{1/2}(t/T)(F_1)(F_3) \rightarrow i_1 = 5.22$

$$i_{2a} = [0.17(R/T)^{2/3} + 0.25] (t/T)(F_2)(F_3) \rightarrow i_{2a} = 5.22$$

$$i_{2b} = 3.53$$

$$i_3 = i_5 = 1.0$$

$$i_4 = 0.40(R/T)^{2/3}(F_2)(F_3) \rightarrow i_4 = 4.67$$

$$i_6 = 0.80(R/T)^{2/3}(r/R)(F_3) \rightarrow i_{6a} = 3.79$$

$$i_{6b} = 1.5$$

Apply SIF = 5.22 @ 12

ME101

INPUT CARD IMAGES

1	11	21	31	41	51	61	71	80
+	+	+	+	+	+	+	+	+
BUN								
RUN								
HED								
ANC	1	-9.72						
	55.0							
	105.0							
	12-2.25							
	15			2.75				
	20			5.0				
HAD	20	1.0						
	25			5.0				
	28			2.75				
	30-2.0							
PAD	30	1.0						
	35-5.0							
	40-5.0							
	45-5.0							
	50-5.0							
EAD	50	1.0						
	55-5.0							
	60-5.0							
	65-5.0							
	70-5.0							
PAD	70	1.0						
END								
+	+	+	+	+	+	+	+	+

30 CARDS IN INPUT DECK
 30 CARDS IN LOAD CASE THRM1
 30 CARDS IN LOAD CASE WT1

0 WARNINGS
 0 ERRORS
 0 FATAL ERRORS

01.

CRASH.

*ME101.ME101I

011*** ME101I/EEBCE

DE CHANGED FROM 32400 TO 41500 DECIMAL WORDS ***



PIPING ANALYSIS CHECK AND COVER SHEET
SPECIAL STUDIES

PROJECT: MIDLAND SHEET OF
 JOB NO. 7220 PLANT DESIGN GROUP
 SYSTEM: SERVICE WATER MAIN RETURN LINE
 CALC. NO. 2 ISO NO. M-167 (Q) REV NO. 5

A. DESIGN DATA:

1) PIPING CLASS SHTS.
 7220-M-481(Q) REV 15.
 PIPE: 26" - .375" NOM. WALL
 MATL: ASTM-A165, CL 2
 KG. 70.

2) SOIL & ROCK INSTRUMENTATION.
 FULL PROFILE SETTLEMENT
 GAGE DATA - (JANUARY '79)

B. CRITERIA/OBJECTIVES:
 TO SHOW THAT THE STRESSES IN BURIED PIPING DUE TO DIFFERENTIAL SETTLEMENT MEET THE CODE REQUIREMENT. ASME SEC. III B & PV CODE NC-3652.3(b) EQ (10a) (1977)
 $\frac{\sigma_{MAX}}{2} \leq 3 S_c$

C. REFERENCES:
 1) ASME SEC III, SUBSECTION NC 1977.
 2) ME 101 RUN: VERSION F2.
 SNUM Q 37 M 52 DT 6/25/79
 3) S & R I FULL PROFILE
 SETTLEMENT GAGE DATA
 FILE: D-2220-R DT 1/25/79
 4) SK-C-675 SURVEYED PIPELINE
 5) YARD PIPING PLANS PROFILES.
 AREA-C M167(Q) REV 5.

D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:
 LINEAR ELASTIC ANALYSIS TO DETERMINE DIFFERENTIAL SETTLEMENT STRESSES IN BURIED PIPING.
 26" IWB-2 SERVICE WATER RETURN LINE.

E. CONCLUSIONS:
 $(\sigma_{MAX})_{AT\ 2P.20} = \frac{\sigma_{MD}}{2} = 6100$; $3 S_c = 47100$ p.s.i.
 EQ (10a) OF NC 3652.3(b) IS MET \therefore OK.

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	S. KANNAN (FR K. SWAMY)	<i>S. Kannan</i>	11-7-80
CHECKED BY	C. BASAVARAJU	<i>Chandrasekhar Basavaraju</i>	11-8-80
APPROVED BY	A. PATEL	<i>A. Patel</i>	11-8-80

NOTES: Attach sheets if more space is needed.
 P-1238 9/12/74 GKWR/RFD

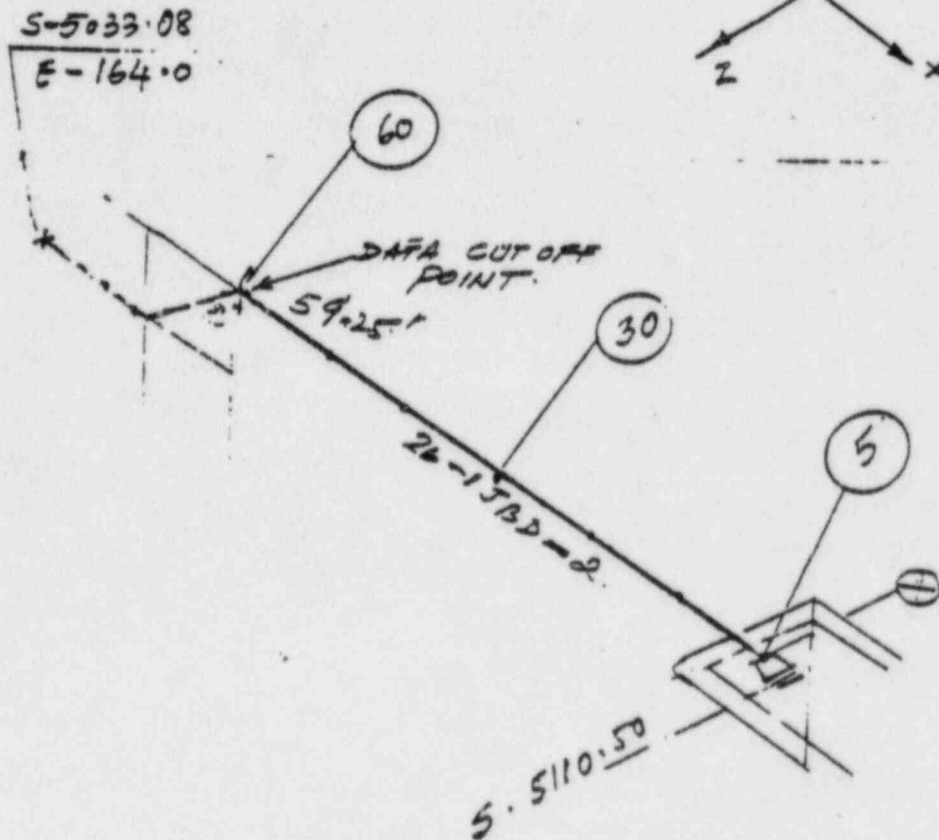
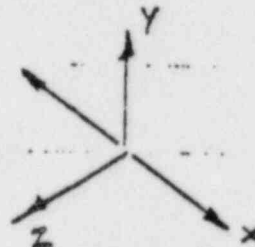
P-1238 9/12/74



CALCULATION SHEET

ORIGINATOR K. V. SWAMY DATE 6/22/79 CALC. NO. 2 REV. NO. _____
 PROJECT MIDLAND. CHECKED E. B. Swamy DATE 11/8/80
 SUBJECT 26-1JBD-2 JOB NO. 7220-001. SHEET NO. 1

SERVICE WTR. MAIN. RETURN LINE TO
 D/G. BLDG. UNIT-1. TURB. BLDG.



DESIGN.
 PRESS^g = 110 psig
 TEMP = 146 °F

JBD = CLASS
 MATL = ASTM A-155 CL 2,
 KC 70
 0.375 WALL. (NOM)

FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 1 PIPELINE DESIGNATION 26-1.111-2

NOTE: SEE FIGURE No. 1 FOR LOCATION OF PIPELINE AND READOUT POINT

623.45'
623.63'

DISTANCE FROM READOUT POINT * (FT.)	INVERT ELEVATION (FT.)	CORRECTIONS	
		St	INCH
0	623.01	0.4	1.92
10.0	623.07	0.28 ✓	1.56 ✓
20.0	623.12	0.33 ✓	2.96 ✓
30.0	623.14	0.51 ✓	3.72
40.0	623.14	0.31 ✓	3.72
50.0	623.14	0.31 ✓	3.72
59.25	623.13	0.32 ✓	3.84 ✓

FILE No. 2220-R

— MIDLAND PLANT — MIDLAND, MICHIGAN	DIESEL GENERATOR BUILDING
--	---------------------------

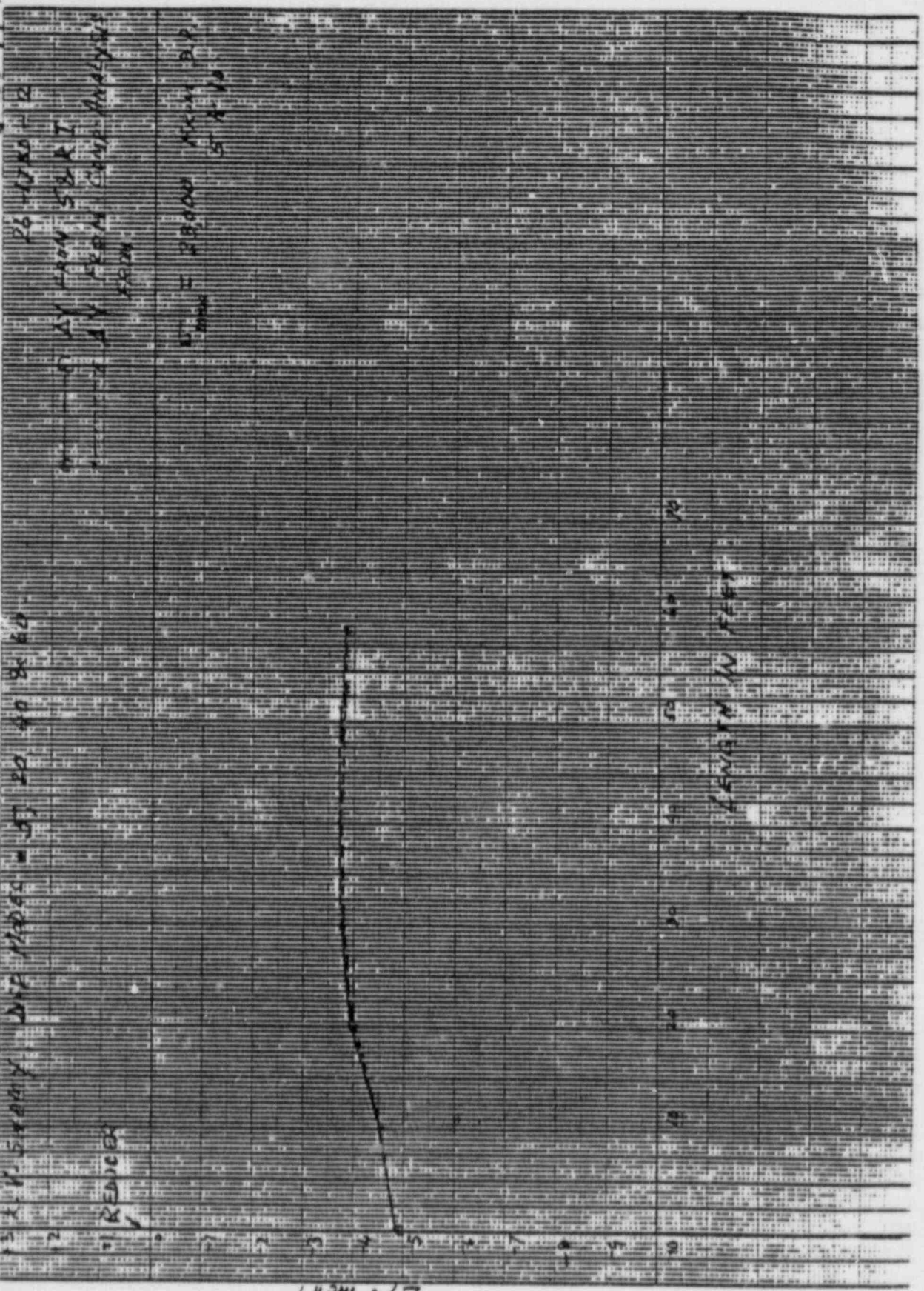
* READ OUT POINT IS ON REDUCER AT D.P.S.

461512

T

K&E 10 X 10 TO THE CENTIMETER
K&E P.O. & SUPPLY CO. NEW YORK, N.Y.

6-25-79



26-1700-12

AV FROM SURT

AV FROM CIVIL ANALYSIS
FROM

AV FROM SURT
5-1-79

ΔY (INCH)

LEVEL IN FEET

SNUM # C 3TME 2 6/22/77

ME101

INPUT CARD IMAGES

1	11	21	31	41	51	61	71	8
+	+	+	+	+	+	+	+	
***M-167 REV-6 AND SK-C-650								
HED								
RUN								
RUN								
ANC 5		-4.92						
	10	-10						
	20	-10						
RAD 20		1.						
	30	-10						
	40	-10						
RAD 40		1.						
	50	-10						
	60	-9-3						
RAD 60		1.						
END								
+	+	+	+	+	+	+	+	

TITLE=MIDLAND 26-1JBD-2,
PEOBNO=2, PROJNO=07220,
UNITS=2,USER=KVS,CCDE=SC374,
LDCASE=THRM1
LDCASE=WT1
E=27.9E6,OD=26,THIC=.375,
LBS/FT=320.1,THERM=0,RA=.999
RB=.999,RC=.999,

DISP=-3.96

DISP=-3.72

DISP=-3.84

19 CARDS IN INPUT DECK
19 CARDS IN LOAD CASE THRM1
19 CARDS IN LOAD CASE WT1

0 WARNINGS
0 ERRORS
0 FATAL ERRORS

L 99.

SCACH.

M *ME101.ME1011

1011*** ME1011/FEB05
CRE CHANGED FROM 35400 TO 41400 DECIMAL WORDS ***

RECHT

SPECIAL STUDIES

PROJECT: MIDLAND - UNIT 1 SHEET 1 OF 9
 JOB NO. 7220 PLANT DESIGN GROUP
 SYSTEM: CONDENSATE WATER LINE
 CALC. NO. 1001 ISO NO. M-167(Q) REV NO. 5

<p>A. DESIGN DATA:</p> <p>1) PIPING CLASS SHTS. 7220-M-481(Q) REV. 15. PIPE: 20" STD. WALL MATL: A-358 GR. 304 CL. 2 OR A-312 TP. 304.</p> <p>2) SOIL & ROCK INSTRUMENTATION FULL PROFILE SETTLEMENT GAGE DATA - APRIL 1979</p>	<p>B. CRITERIA/OBJECTIVES</p> <p>TO SHOW THAT THE STRESSES IN BURIED PIPING DUE TO DIFFERENTIAL SETTLEMENT MEET THE CODE REQUIREMENT.</p> <p>ASME SEC III, NC-3652.3(b) EQ. (102) $\frac{L \cdot M_D}{Z} \leq 3 S_c$.</p> <p>C. REFERENCES:</p> <p>1) ASME SEC. III, SUBSECTION NC, 1977 2) ME 101 RUN: SNUM: Q42P2E (VER. F1) DT 6-18-79 3) S&RI FULL PROFILE SETTLEMENT GAGE DATA FILE: D-2224-R DT. 4/24/79 4) SK-C-675 - SURVEYED PIPELINE PROFILES. 5) YARD PIPING PLAN - AREA C M-167(Q)</p>
---	---

D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:

DIFFERENTIAL SETTLEMENT STRESSES IN
BURIED PIPING - ME 101 - LINEAR ELASTIC ANALYSIS

20" - 1HCD-169 : CONDENSATE MU & FILL FROM
CONDENSATE STORAGE TANK.

E. CONCLUSIONS:

$(\sigma_{MAX})_{AT\ 20\ GAGE} = \frac{L \cdot M_D}{Z} = 29,838\ psi ; 3 S_c = 50,400\ psi$

EQ (102) OF NC-3652.3(b) IS MET. \therefore O.K.

IN CHECK REVIEW IT WAS FOUND THAT σ_{MAX} OF 22225 PSI WAS REPORTED EARLIER (BY ERROR)

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	C. BASAVARAJU (FOR S. JACOBS)	<i>Chakrapani Basavaraju</i>	11-5-80
CHECKED BY	S. KANNAN	<i>S. Kannan</i>	11-7-80
APPROVED BY	A. PATEL	<i>A.S. Patel</i>	11-8-80

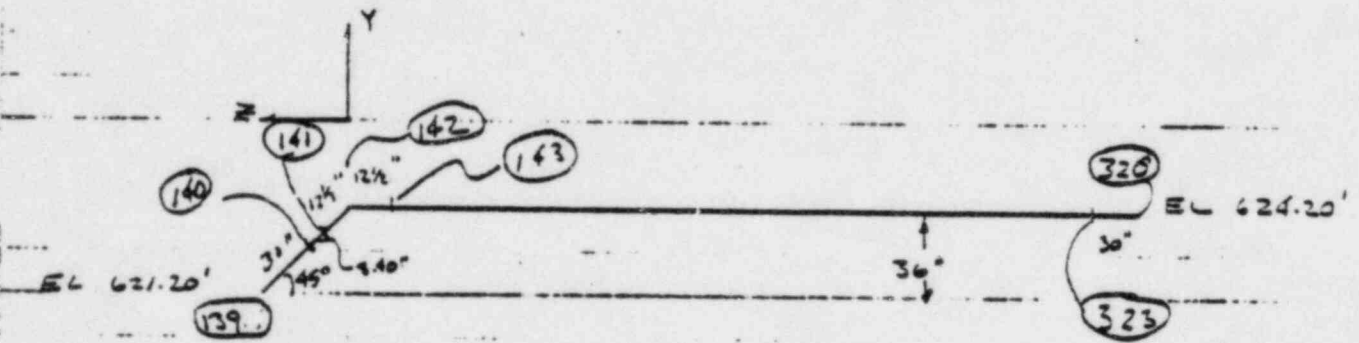
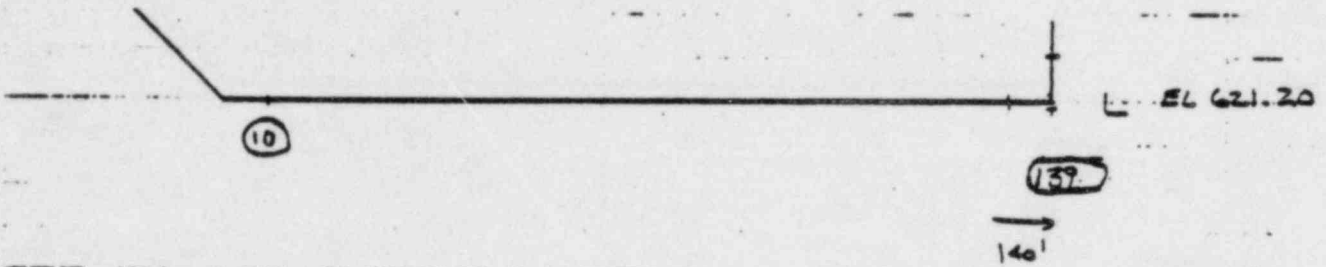
P 1238 9/12/74

NOTE: Attach sheets if more space is needed.
 P 1238 9/12/74 (KXV:HEU)



CALCULATION SHEET

ORIGINATOR SJ DATE 6-5-79 CALC. NO. 1001 REV. NO. _____
 PROJECT MIDLAND CHECKED KVS. DATE 7.11.79
 SUBJECT 20" - 1 HCD 169 JOB NO. 7220
 SHEET NO. 2 of 9

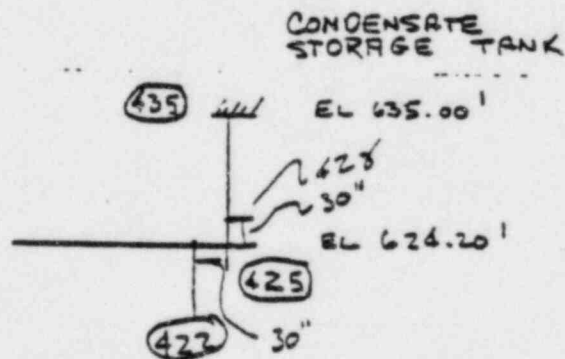
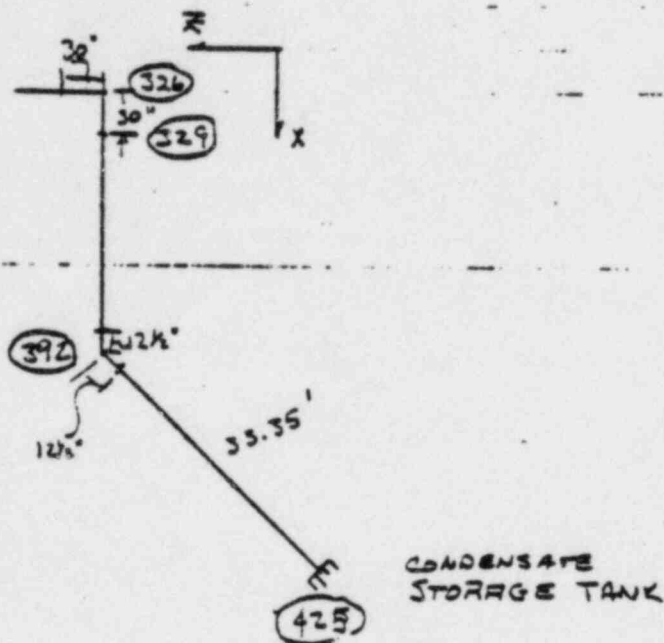


90° ELL 30" RAD-
 45° ELL 12 1/2" DIM
 $42.5 \cos 45^\circ = 30.05$



CALCULATION SHEET

ORIGINATOR SS DATE 6-6-79 CALC. NO. 1001 REV. NO. _____
PROJECT MIDLAND CHECKED KPS DATE 7.11.79
SUBJECT 20-1HCD-169 JOB NO. 7220
SHEET NO. 3 of 9





CALCULATION SHEET

ORIGINATOR SJ DATE 7-11-79 CALC. NO. 1001 REV. NO. _____
 PROJECT MIDLAND CHECKED KVS DATE 7-11-79
 SUBJECT 20" - IHCD - 169 JOB NO. 7220
 SHEET NO. 4 of 9

Check length of (370) to (420)

S. $\begin{array}{r} 5261.35 \\ \underline{5237.76} \\ 23.59 \end{array}$ E $\begin{array}{r} 431.75 \\ \underline{408.00} \\ 23.75 \end{array}$

L = 33.35'

(320) to (370)

S. $\begin{array}{r} 5237.76 \\ \underline{5172.25} \\ 65.51 \end{array}$

(139) to (320)

E $\begin{array}{r} 408.00 \\ \underline{221.00} \\ 187.00 \end{array}$

(1) to (147.5) 139

S. $\begin{array}{r} 5033.08 \\ \underline{5172.25} \\ 139.17 \end{array}$

TOTAL LENGTH

$$33.35 + 65.51 + 187.00 + 139.17 = 425.03$$



CALCULATION SHEET

ORIGINATOR SJ DATE 7-11-79 CALC. NO. 1001 REV. NO. _____
 PROJECT MIDLAND CHECKED KVS DATE 7-11-79
 SUBJECT 20" - IHC D-169 JOB NO. 7220
 SHEET NO. 5 OF 9

DESIGN RUN

135°F

AUSTENITIC STEEL.

$$E_{70} = 28.3 \times 10^6 \text{ PSI}$$

$$E_{200} = 27.7 \times 10^6 \text{ PSI}$$

$$THERM_{150} = 1.0090$$

$$E_{135} = \frac{135-70}{200-70} [28.3-27.7] \times 10^6 + 27.7 \times 10^6 = 28.0 \text{ EI}$$



CALCULATION SHEET

ORIGINATOR SJ DATE 7-11-79 CALC. NO. 1001 REV. NO. _____
 PROJECT MIDLAND CHECKED KIM DATE 7/11/79
 SUBJECT 20-1 HCD-169 JOB NO. 7220
 SHEET NO. 6 of 9

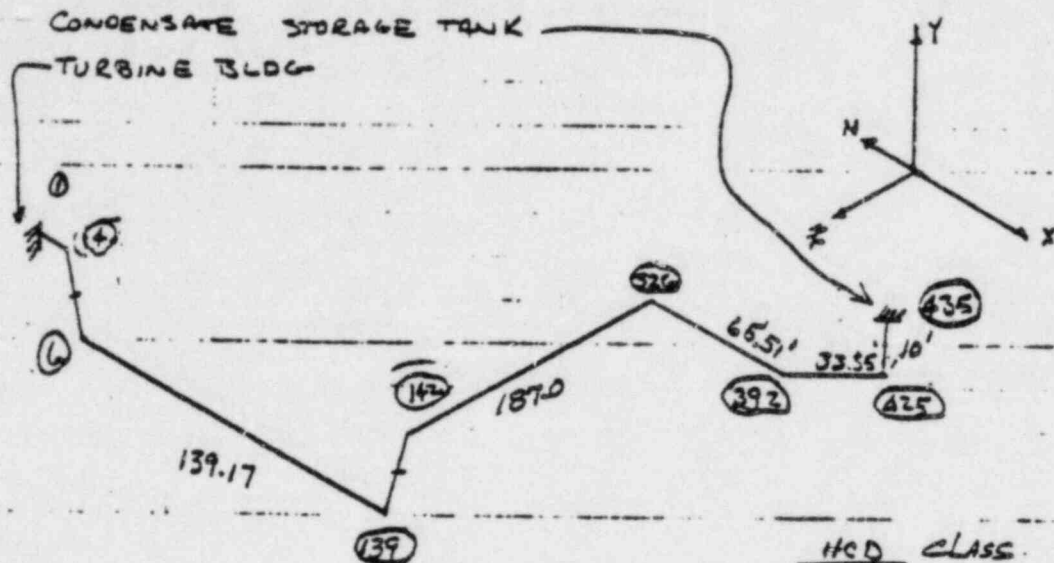
DISPLACEMENT LOADING

DISTANCE FT	DISPLACEMENT IN.		
	APRIL 10, 79	APRIL 9, 79	
0	0.24"	0.24"	
20	3.24	9.12"	← 20
40	2.88	2.64	
60	1.92	1.56	← 70
80	2.28	2.04	
100	3.24	3.00	
120	2.16	1.20	← 130
140	-9.0	-	
158.5	3.96	3.96	
180	1.20	0.96	
200	-0.96	-1.20	← 210
220	-0.84	-1.08	
240	0.06	-0.24	
260	0.36	0.36	
280	1.80	1.68	
300	1.56	1.92	
320	-1.68	-3.24	
340	-1.20	0.84	
360	0.84	1.08	
380	1.20	1.56	
400	0.24	0.24	
420	-2.76	-2.64	

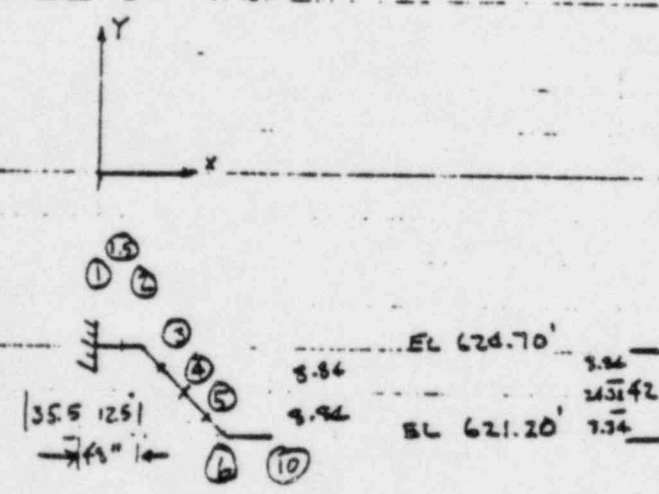


CALCULATION SHEET

ORIGINATOR SJ DATE 7-11-79 CALC. NO. 1001 REV. NO. _____
 PROJECT MIDLAND CHECKED K. Neway DATE 7/11/79
 SUBJECT 20" - 1 HCD-169 JOB NO. 7220
 SHEET NO. 7 of 9



HCD CLASS.
 150 PSI 500°F
 ASTM A 358 GR 304 CL2.
 HCD = STD WALL THK
 AUSTENITIC S. STEEL.
DESIGN
 25 PSI 135°F.



8.84 8.94 12.5
 | 42" |

CHUCK MC 9550

FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

Sh. 8 of 9

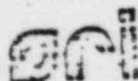
4/24/79

TABLE No. 53 PIPELINE DESIGNATION 20-TW-160
 LOCATION OF READOUT POINT Basement Service Water Pump Structure
 ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY
 BECHTEL POWER CORPORATION 624.68

DISTANCE FROM READOUT POINT DP # (ft)	DESIGN INVERT ELEVATION (ft)	INVERT ELEVATION (ft)	COMMENTS	SETTLEMENT
				ΔY INCHES.
0	624.7	624.68	All Field Data Collected	- 0.00 on April
(20) 20.0	621.2	620.93	9 and 10, 1979	- 2.24
40.0		620.96		- 2.88
(60) 60.0		621.04		- 1.92
80.0		621.01		- 2.28
(100) 100.0		620.93		- 3.24
(120) 120.0		621.02		- 2.16
140.0		621.95		ALONG SLOPE.
(160) 158.5	624.2	623.87		- 3.96
180.0		624.10		- 1.20
(200) 200.0		624.25		0.96
(220) 220.0		624.27		0.84
240.0		624.15		- 0.06
260.0		624.17		- 0.36
(280) 280.0		624.17		- 1.80
(300) 300.0		624.05		- 1.56
(320) 320.0		624.07		1.68
340.0		624.34		+ 1.20
(360) 360.0		624.30		- 0.84
(380) 380.0		624.13		- 6.2
400.0		624.10		- 0.024
(420) 420.0		624.18	Distance to elbow at condensate storage tanks is approx. 426 ft. as measured by hose graduations.	2.76"

FILE No. 2220-R

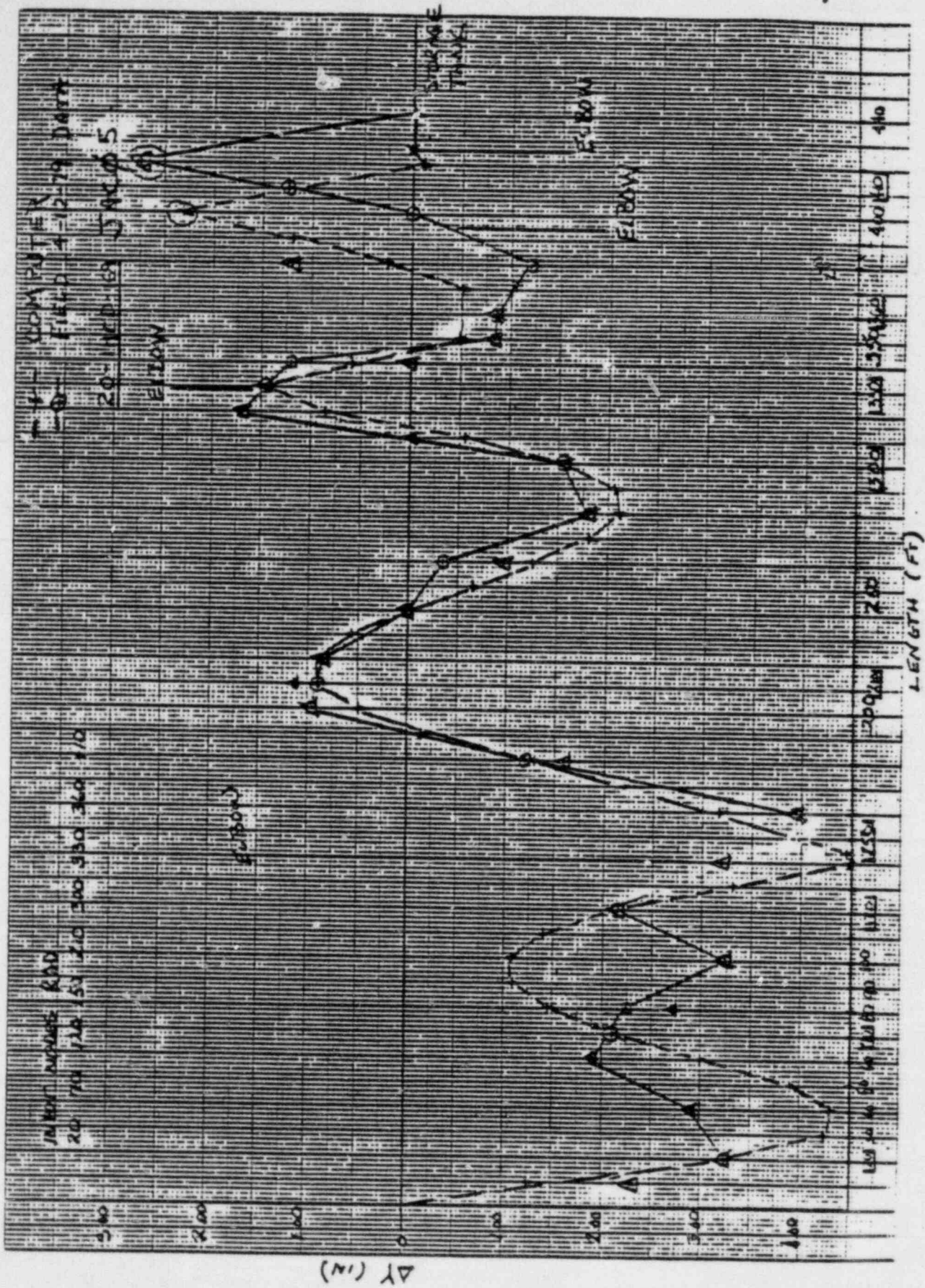
MIDLAND PLANT - MIDLAND MICHIGAN



GEOTECHNICAL INSTRUMENTATION ENGINEERING

46 1512

NO-E 10 X 10 TO THE CENTIMETER
KUPFFER & ESSER CO. MADE IN GERMANY



COMPUTER FIELD 4-12-79 DATA
20-11-69 JACOBS

ELBOW

ELBOW

ELBOW

A

B

LENGTH (FT)

INCHES 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190

130 140 150 160 170 180 190 200

Δr (in)

STORAGE TANK

ME101

SMUNIT 84226

6/13/72

INPUT CARD IMAGES

	11	21	31	41	51	61	71	80	
	+	+	+	+	+	+	+	+	
RUN						LDCASE=THRM1,			
RUN						LDCASE=WT1,			
HED						TITLE=MIDLAND 1 TURBINE BLDG			
						TO COND STG LINE 2C-1HCD-169,			
						PROJNO=7220,PROENO=1007,			
						UNITS=2,CODE=831S73,			
						USER=SJ2771			
ANC	1	-				E=28.3E6,OD=20.00,THIC=0.375,			
						RA=0.9,RE=0.9,RC=0.9,			
						LES/FT=204.27,THERM=0.0			
	24-0							L	
	3 0-8.84	-0-8.84							
	41-0.16	-1-0.16							
	51-0.16	-1-0.16							
	6 0-8.84	-0-8.84						L	
	102-6.0								
	2010-0								
RAD	20	1.						DISP=-3.24 ✓	
	3010-0								
	4010-0								
	5010-0								
	6010-0								
RAD	60	1.						DISP=-1.92 ✓	
	7010-0								
	8010-0								
	9010-0								
	10010-0								
RAD	100	1.						DISP=-3.24 ✓	
	11010-0								
	12010-0								
RAD	120	1.						DISP=-2.16 ✓	
	13010-0								
	1399-0							L	
	140	1-9.21	-1-9.21						
	142	1-2.84	-1-2.84					S	
	150		-9-0						
	160		-10-0						
RAD	160	1.						DISP=-3.96 ✓	
	170		-10-0						
	180		-10-0						
	190		-10-0						
	200		-10-0						
RAD	200	1.						DISP=0.96 ✓	
	210		-10-0						
	220		-10-0						
RAD	220	1.						DISP=0.84 ✓	
	230		-10-0						
	240		-10-0						
	250		-10-0						
	260		-10-0						
	270		-10-0						
	280		-10-0						
RAD	280	1.						DISP=-1.8 ✓	
	290		-10-0						

55	.		300						
56	.	RAD	300			-10-0			
57	.		310	1.				DISP=-1.56 ✓	
58	.		320			-10-0			
59	.	RAD	320			-10-0			
60	.		323	1.				DISP= 1.68 ✓	
61	.		326			-3-6.0			
62	.		329			-2-6.0	L		
63	.		330			0-6.0			
64	.		340			10-0			
65	.		350			10-0			
66	.		360			10-0			
67	.	RAD	360		1.			DISP=-0.84 ✓	
68	.		370			10-0			
69	.		380			10-0			
70	.	RAD	380		1.			DISP=-1.2 ✓	
71	.		390			10-0			
72	.		391			0-11.5			
73	.		392			1-0.5			
74	.		393			0-8.84			L
75	.		400			4-11.03			
76	.		410			7-0.84			
77	.		420			7-0.84			
78	.	RAD	420		1.			DISP=2.76 ✓	
79	.		422			1-0.73			
80	.		425			1-9.21			
81	.		428		5-0				L
82	.		435		5-0				
83	.	ANC	435		2.76				
84	.	END						RA=0.9, RB=0.9, RC=0.9	

84 CARDS IN INPUT DECK
 84 CARDS IN LOAD CASE THRM1
 84 CARDS IN LOAD CASE WT1

 0 WARNINGS
 0 ERECS
 0 FATAL ERRORS

PL 93.

SCRACH.
 WARNING 100000000000

XX ME101.ME101I

ME101I*** ME101I/EEBOS
 CORE CHANGED FROM 35371 TO 41371 DECIMAL WORDS ***

BECHTEL

SPECIAL STUDIES

PROJECT	MIDLAND - UNIT ONE	SHEET	OF
JOB NO.	7220	PLANT DESIGN GROUP	
SYSTEM	SERVICE WATER		
CALC. NO.	222	ISO NO.	M-169
		REV NO.	

A. DESIGN DATA

1) PIPING CLASS SHEETS. 7220-M-481 (Q)
REV. 15
PIPE: 26" STD. WALL, 36" STD. WALL
MATRL: ASME SA-155 CLASS 2, GR. KC-70

2) SOIL & ROCK INSTRUMENTATION
FULL PROFILE SETTLEMENT
GAGE DATA - APRIL 1979

B. CRITERIA/OBJECTIVES

TO SHOW THAT THE STRESSES IN BURIED PIPING DUE TO DIFFERENTIAL SETTLEMENT MEET THE CODE REQUIREMENTS.

ASME SECTION III, NC-3652.3 (b)
EQ. (10a) $\frac{i M_b}{Z} \leq 3 S_c$

C. REFERENCES:

1) ASME SEC. III, SUBSECTION NC
2) ME 101 RUN: SNUM# Q23P53 (VERSION P-2/6/79) DATED: 8/9/79
3) S & RI FULL PROFILE SETTLEMENT GAGE DATA FILE # D-2220-R DATED: 4/24/79.
4) BECHTEL DRAWING # SK-C-675. SURVEYED PIPELINE PROFILES.
5) BECHTEL DRAWINGS: M-168, M-166, M-169, M-183-SH-2 REV. S, C-1146.

D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:

DIFFERENTIAL SETTLEMENT STRESSES IN BURIED PIPING - ME 101 - LINEAR ELASTIC ANALYSIS

36"/26" - OHBC-16 : SERVICE WATER RETURN HEADER FROM REACTOR BLDG. & AUX. BLDG. TRAIN A TO VALVE 21.

E. CONCLUSIONS:

$(\sigma_{max})_{AT D.P. (330)} = \frac{i M_b}{Z} = 15,246 \text{ psi}; 3 S_c = 52,500. \text{ psi.}$

EQ. (10a) OF NC-3652.3 (b) IS NOT EXCEEDED. ∴ OK

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	E.F. MARUT (for K.V. SWAMY)	E.F. MARUT (for K.V. SWAMY)	11-6-80
CHECKED BY	S. K ANNAN	<i>S. K Annan</i>	11-7-80
APPROVED BY	A. PATEL	<i>A. Patel</i>	11-8-80

NOTE: Attach sheets if more space is needed.
P 1238 9/12/74

P 1238 9/12/74



CALCULATION SHEET

ORIGINATOR S. V. ... DATE 6/10/77 CALC. NO. 222 REV. NO. _____
 PROJECT "IDLAIN" CHECKED [Signature] DATE 11-7-80
 SUBJECT 26-04BC-16. - ... JOB NO. 7274-1001 SHEET NO. 1

PIPING AT DIESEL GENER BLDG:

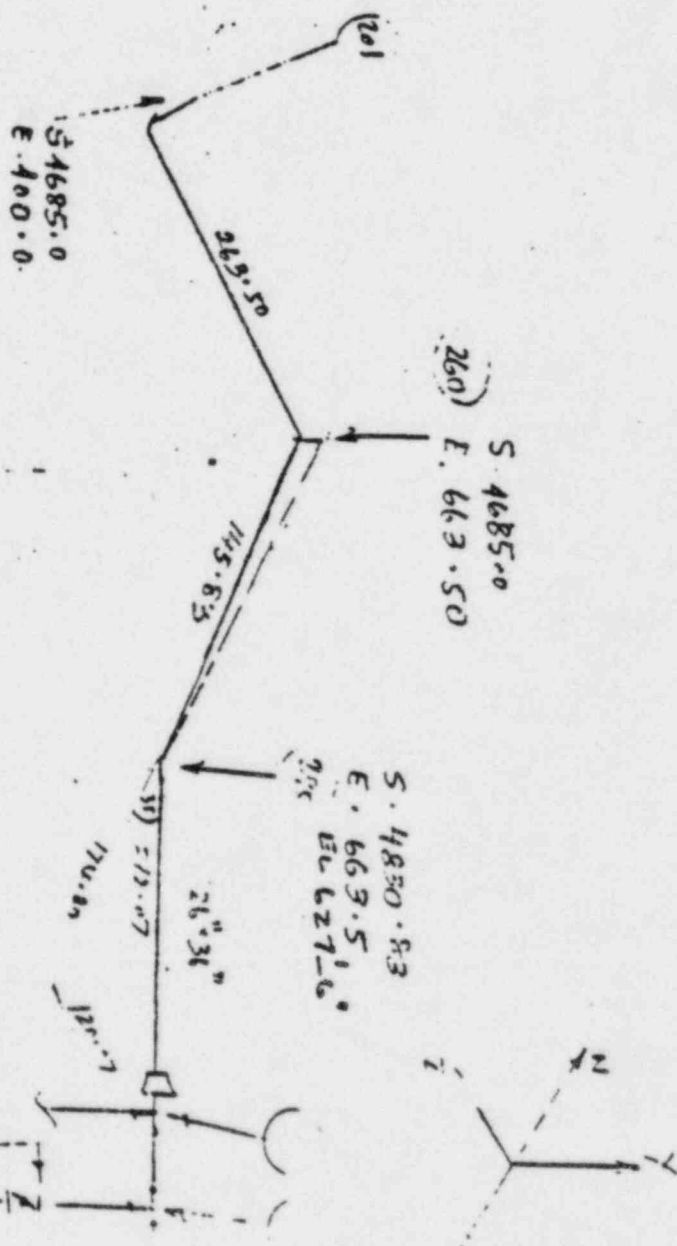
26-04BC-16.

Sw 35 = 0.57357
 Gas 35 = 0.81915
 Sw 15 = 0.81915
 Gas 15 = 0.57357
 Total = 2.208

TOTAL LENGTH = 621.14

ABC: C/lois
 MAT: H/NE SA-106-G
 TEMP: 147°F
 PRESS: 105 psia
 Design

67





CALCULATION SHEET

ORIGINATOR K. V. SIMANY DATE _____ CALC. NO. 222 REV. NO. _____
 PROJECT MIDLAND UNIT 1 CHECKED Mune DATE 11-7-80
 SUBJECT 36/26-OHEC-1A JOB NO. 07220
 SHEET NO. _____

L	FEET		(INCH)	D-P.	REMARKS	
	DES INV. EL	PROFILE	ΔY			
0	626.03	626.06	0.36	355		
10		626.03	0	350	TEE @ 12'-3"	
30		625.94	-1.08	345		
50	626.45	626.25	-2.4	340	34.5' ANCHOR (P.M.)	
70		626.17	-3.36	335	TEE @ 46.32'	
90		626.17	-3.36	330	*	
110		626.33	-1.44	325	*	
130		626.51	+0.72	320		
150		626.52	+0.84	315	*	
170		626.46	+0.12	310		
190		626.33	-1.44	305		
210	626.45	626.17	-3.36	300		
230	35'	626.40	626.01	-4.68	295	*
250		626.32	625.92	-4.80	290	
270		626.23	625.87	-4.32	285	
290		626.14	625.83	-3.72	280	
310		626.05	625.78	-3.24	275	*
330		625.96	625.70	-3.12	270	
350		625.88	625.55	-3.96	265	
370		625.70	625.35	-4.2	260	
390			625.34	-4.32	255	*
410			625.29	-4.92	250	
430			625.21	-5.88	245	
450			625.18	-6.24	240	
470			625.17	-6.36	235	
490			625.18	-6.24	230	*
510			625.26	-5.28	225	
530			625.33	-4.44	220	
550			625.45	-3.0	215	
570			625.56	-1.68	210	*
590			625.39	-2.12	205	

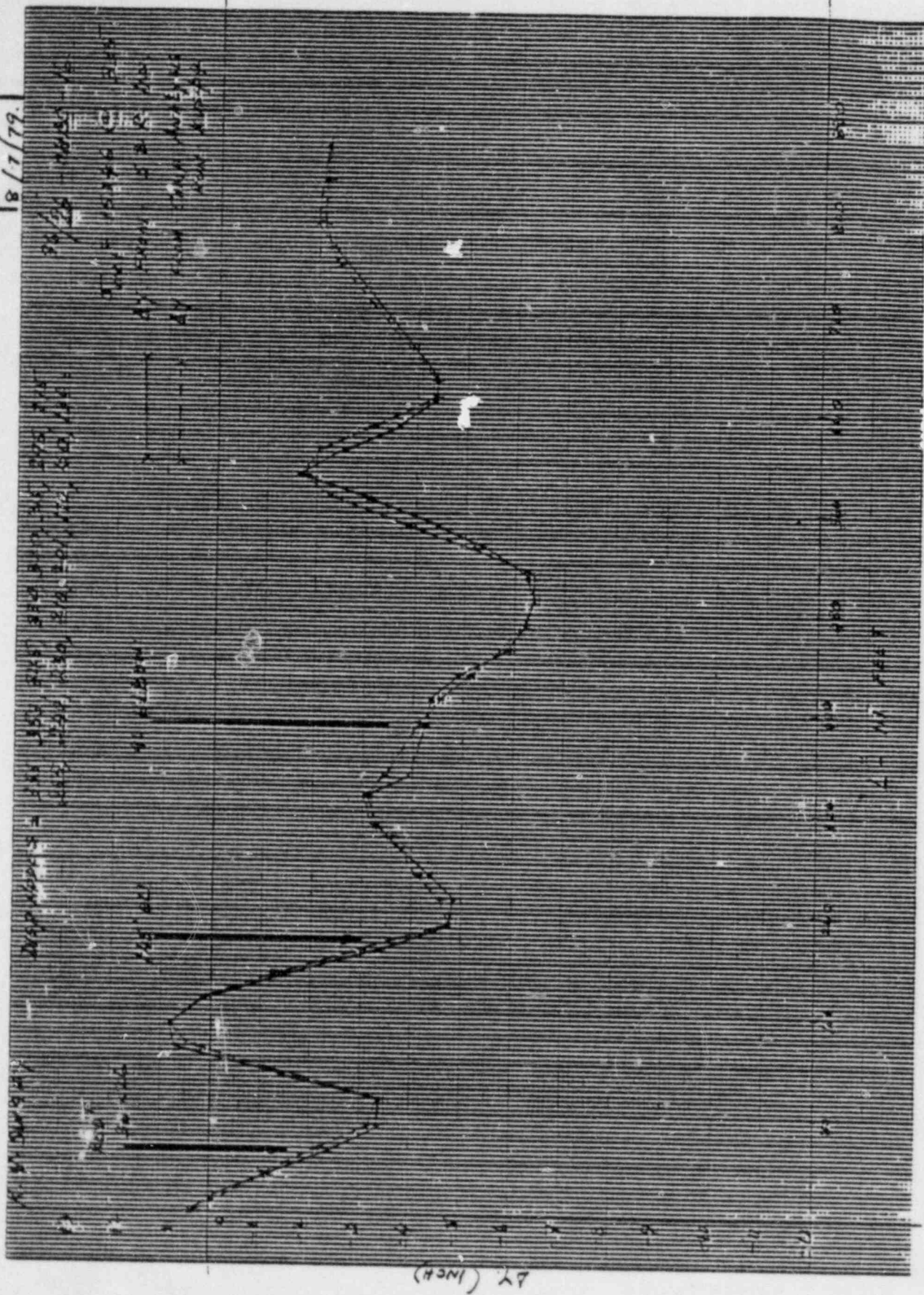
SLOPE



K&E 10 X 10 TO THE CENTIMETER 10 X 10 CM
REUFFEL & SEIGER CO. MADE IN U.S.A.

46 1512

8/17/79



4/24/79

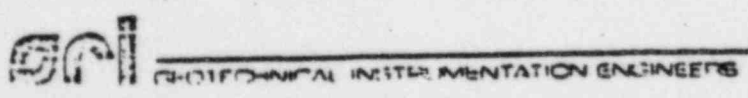
FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 13 PIPELINE DESIGNATION 26-ORBC-16
 LOCATION OF READOUT POINT Basement Service Water Pump Structure
 ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY
 BECHTEL POWER CORPORATION 626.06

DISTANCE FROM READOUT POINT		INVERT ELEVATION	COMMENTS
D.P. IN RUN (ft)	(ft)	(ft)	ΔY O/S.P. (IN.)
355	0	626.06	All Field Data Collected on April 3 and 4, 1979
	10.0	626.03	
345	30.0	625.94	-1.08
	50.0	626.25	
	70.0	626.17	
330	90.0	626.17	-3.36
	110.0	626.33	
320	130.0	626.51	+0.36
315	150.0	626.52	+0.84
	170.0	626.46	
	190.0	626.33	
	210.0	626.17	
295	230.0	626.01	-4.68
	250.0	625.92	
	270.0	625.87	
	290.0	625.83	
275	310.0	625.78	-3.24
	330.0	625.70	
	350.0	625.55	
	390.0	625.35	Note 40 ft. increment
255	410.0	625.34	-4.32
	430.0	625.29	
	450.0	625.21	
240	470.0	625.18	-6.24
	490.0	625.17	

FILE No. 2220-R

MIDLAND PLANT - MIDLAND MICHIGAN



4/24/79

FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 13

PIPELINE DESIGNATION 26-OHBC-16

LOCATION OF READOUT POINT Reservoir Service Water Pump Structure

ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY
BECHTEL POWER CORPORATION 626.06

DISTANCE FROM READOUT POINT D.P. IN RUN (ft)		INVERT ELEVATION (ft)	COMMENTS
230	510.0	625.18	ΔY DISP. (IN.)
	530.0	625.25	-6.24
	550.0	625.33	
	570.0	625.43	
210	590.0	625.56	
	610.0	625.49	-1.68
	630.0	625.40	
201	653.0	623.31	-4.32

FILE NO 2170-R

MIDLAND PLANT - MIDLAND MICHIGAN

ME101

INPUT CARD IMAGES

INPUT CARD SEQ	1	11	21	31	41	51	61	71
1	***M-109	REV-5	AND C-1146G	REV-0				
2	HED							
3						TITLE=MIDLAND 36/26-UMBI		
4						SERVICE WATER RETURN,		
5						PROBNO=222, PROJNO=07220		
6	RUN					UNITS=2, USER=KVS, CODE=SI		
7	RUN					LOCASE=THRM1		
8	ANC	355		0.36		LOCASE=WT1		
9						E=27.9E6, OD=36, THIC=.37'		
10						1 LBS/FT=566.0, THERM=0, RA:		
11		353	-5-1.94		-7-4.468	RB=.999, RC=.999,		
12	RAD	353		1.0				
13	RAD	353			1.0			
14		350	-1-8.64		-2-5.49	RPOIAM=36.0, RPTHIC=.37'		
15		352	1-9.71		-1-3.2			
16		350345	-16-4.6		11-5.6			
17	RAD	345		1.		DISP=-1.08		
18		345343	-10-1.5		7-1.1			
19		342	-1-9.71		1-3.2	RPOIAM=36.0, RPTHIC=.375		
20		342344	1-2.053		1-8.07			
21		342340	-1-9.71		1-3.2			
22		335	-14-6.48		10-2.17	1 OD=26.0, THICK=.375,		
23						LBS/FT=320.1		
24		330	-16-4.6		11-5.6			
25	RAD	330		1.		DISP=-3.36		
26		325	-16-4.6		11-5.6			
27		320	-16-4.6		11-5.6			
28	RAD	320		1.		DISP=0.36		
29		315	-16-4.6		11-5.6			
30	RAD	315		1.		DISP=0.84		
31		310	-16-4.6		11-5.6			
32		305	-16-4.6		11-5.6			
33		300	-16-4.6		11-5.6			
34		295	-16-4.6		11-5.6			
35	RAD	295		1.		DISP=-4.68		
36		290	-18-0					
37		285	-20-0					
38		280	-20-0					
39		275	-20-0					
40	RAD	275		1.		DISP=-3.24		
41		270	-20-0					
42		265	-20-0					
43		260	-40-0					
44		255	-20-0					
45	RAD	255		1.		DISP=-4.32		
46		250			20-0			
47		245			20-0			
48		240			20-0			
49	RAD	240		1.		DISP=-6.24		
50		235			20-0			
51		230			20-0			
52	RAD	230		1.		DISP=-6.24		
53		225			20-0			
54		220			20-0			

55	.	215			20-0		
56	.	210			20-0		
57	.	RAO 210	1.				DISP=-1.68
58	.	207			20-0		
59	.	205			20-0		
60	.	201			23-0	L	
61	.	RAO 201	1.				DISP=-4.32
62	.	201195	-10-6.0	-2-9.0		L	
63	.	190			28-0		
64	.	180			67-9.0	L	
65	.	170	-4-9.0		1-9.0	L	
66	.	RAO 170	1.				DISP=-2.28
67	.	160			25.0		
68	.	150			20-0		
69	.	RAO 150	1.				DISP=-2.16
70	.	140			21-0		
71	.	130			20-0		
72	.	RAO 130	1.				DISP=-2.16
73	.	120			14-3.0		
74	.	END					

74 CARDS IN INPUT DECK
74 CARDS IN LOAD CASE THRM1
74 CARDS IN LOAD CASE WT1

0 WARNINGS
0 ERRORS
0 FATAL ERRORS

00, PL 93.

REE SCRACH.

CT, XM #ME101.4E1011

ME1011 ME1011/FEB05
*** CORE CHANGED FROM 35400 TO 41400 DECIMAL WORDS ***

PROJECT MIDLAND - UNIT ONE SHEET OF
 JOB NO. 7220 PLANT DESIGN GROUP
 SYSTEM: SERVICE WATER
 CALC. NO. 1004 ISO NO. M-169 & M-167 REV NO. 4

<p>A. DESIGN DATA</p> <p>1) PIPING CLASS SHEETS. 7220-M-481 (Q) REV. 15 PIPE: 26" STD. WALL MATL: ASME SA-155 CLASS 2, Gr. KC-70</p> <p>2) SOIL & ROCK INSTRUMENTATION FULL PROFILE SETTLEMENT GAGE DATA - APRIL 1979</p>	<p>B. CRITERIA OBJECTIVES</p> <p>TO SHOW THAT THE STRESSES IN BURIED PIPING DUE TO DIFFERENTIAL SETTLEMENT MEET THE CODE REQUIREMENTS.</p> <p>ASME SECTION III, NC-3652.3 (b) EQ. (10a) $\frac{L M_0}{Z} \leq 3 S_c$</p> <p>C. REFERENCES:</p> <p>1) ASME SEC. III., SUBSECTION NC 2) ME 101 RUN: SNUM # Q38L52 (VERSION F-2/6-15-79) DATED: 7/2/79 3) S & RI FULL PROFILE SETTLEMENT GAGE DATA FILE # D-2220-R, DATE: 1/24/79 4) BECHTEL DRAWING #SK-C-675. SURVEYED PIPELINE PROFILES. 5) BECHTEL DRAWINGS: M-167, C-1146, M-169, M-183-SH 2 REV. 5.</p>
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D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:

DIFFERENTIAL SETTLEMENT STRESSES IN BURIED PIPING - ME-101 - LINEAR ELASTIC ANALYSIS.

26" - OHBC-54 : SERVICE WATER RETURN FROM UNIT #1 TURBINE BUILDING TO 36" - OHBC-16.

E. CONCLUSIONS:

$$(\sigma_{MAX})_{AT \text{ DP } (400)} = \frac{L M_0}{Z} = 21,665 \text{ psi}; 3 S_c = 52,500 \text{ psi}$$

EQ. (10a) OF NC-3652.3 (b) IS NOT EXCEEDED. ∴ OK

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	E.F. MARUT (for S. JACOBS)	E.F. Marut (for S. JACOBS)	11/6/80
CHECKED BY	S. KANNAN	<i>[Signature]</i>	11/7/80
APPROVED BY	A. PATEL	<i>[Signature]</i>	11/8/80

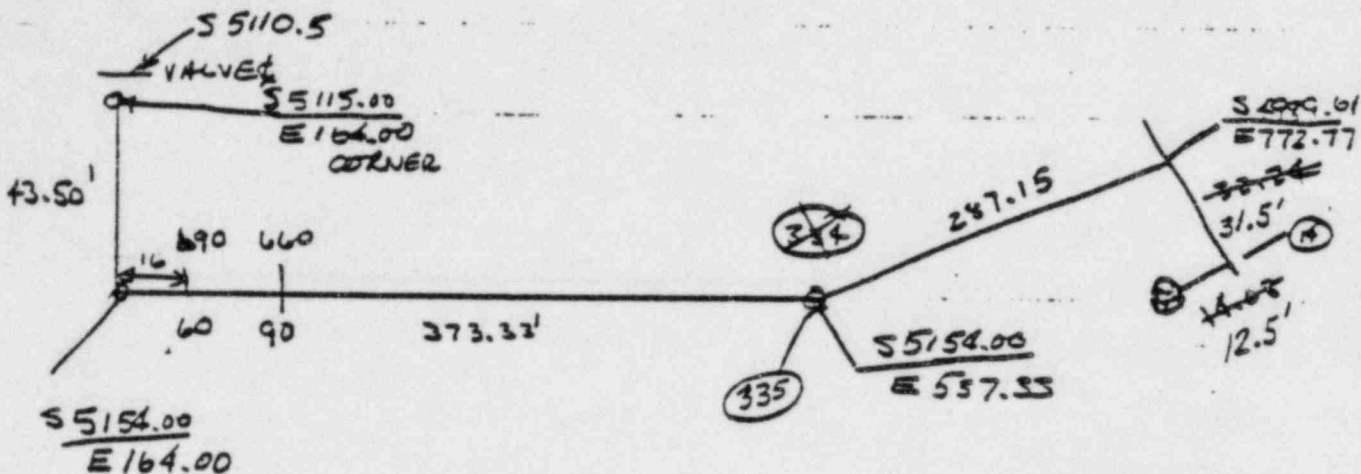
NOTES: Attach sheets if more space is needed
 P 12,319-12/74 (REVISED)

P 12319 9/12/74



CALCULATION SHEET

ORIGINATOR S.J. DATE 7-21-79 CALC. NO. 1004 REV. NO. _____
 PROJECT MIDLAND UNIT 1 #2 CHECKED WILLIAMS DATE 11-7-90
 SUBJECT DATA CHK 26-0148C-54 JOB NO. 07220 SHEET NO. 11



L	ΔY	L	ΔY	ΔL	ΣL
40	-6.24			16	
50	-8.98			14.08	
60	-6.72	690	-6.48	32.24	46.32
70	-5.64	680		287.15	333.47
80	-4.92	670		373.33	706.80
90	-4.44	660	-4.44	43.50	750.30
100	-3.84	650	-3.60		
110	-3.84	640	-3.60		
120	-3.12	630			
130	-2.64	620	-3.12	0.48	
140	-2.16	610			
150	-1.92	600	-2.28	0.36	
160	-2.28	590			
170	-2.58	580	-2.40	0.48	
180	-3.60	570			
190	-3.96	560	-3.36	0.60	
200	-4.92				
210	-5.40	540	-4.44	0.96	
220	-6.36				
230	-6.96	520	-5.40	-1.56	
240	-7.44				
245	-7.20	500	-6.36	-0.84	

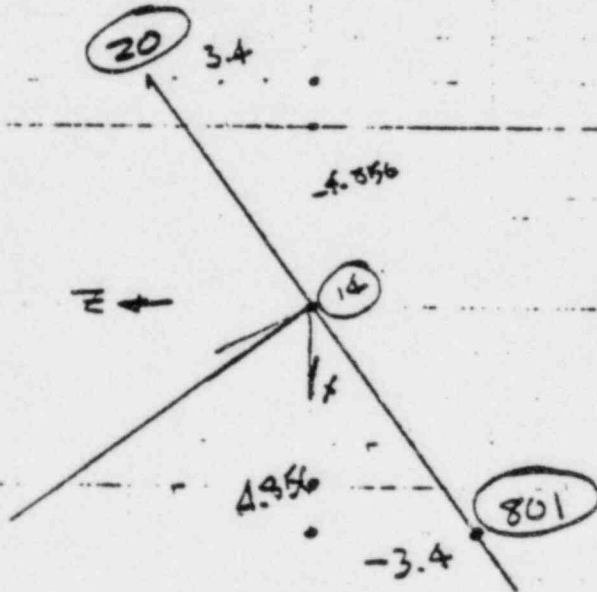


CALCULATION SHEET

ORIGINATOR S.J. DATE 7-21-79 CALC. NO. 1004 REV. NO. _____
 PROJECT MIDLAND UNIT 1 #2 CHECKED [Signature] DATE 11-7-80
 SUBJECT DATA CHK 26-OHBC-54 JOB NO. 07220 SHEET NO. 2/

E 772.77	S 5154.00
<u>537.33</u>	<u>4989.61</u>
235.44	164.39

L = 287.15
 46.32
1.24
 334.71 ^{OR} 333.47



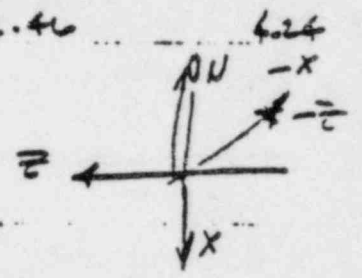


CALCULATION SHEET

CALC. NO. 1004 REV. NO. _____
 ORIGINATOR S.J. DATE 7-21-79 CHECKED hmm DATE 11/7/79
 PROJECT MIDLAND UNIT 1 & 2 JOB NO. 07220
 SUBJECT _____ SHEET NO. 3/

	ΔX	ΔY	ΔZ	L
80.00	250	-25-6.6 25.55	-36-10.1 35.84	$L=34.75$ 44.83
35.17	255	-11-5.6 11.47	-16-4.6 16.38	20.0
	256	-1-8.64	3-0	
30.93		1.72	2.46	4.24

80
44.83
 35.17



FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

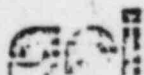
4/24/79

TABLE No. 11 PIPELINE DESIGNATION 26-ORBC-54
 LOCATION OF READOUT POINT Basement Service Water Pump Structure
 ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY
 BECHTEL POWER CORPORATION 626.06

D.P. IN RUN.	DISTANCE FROM READOUT POINT (ft)	INVERT ELEVATION (ft)	COMMENTS	
				ΔY DISP. (IN.)
	0	626.06	All Field Data Collected on April	
20	20.0	626.04	5 and 6, 1979	-0.12
	40.0	626.15		
60	60.0	622.99		-5.52
	80.0	622.86		
100	100.0	622.71		-8.88
120	120.0	622.60		-10.2
140	140.0	622.62		-9.96
	160.0	622.70		
	180.0	622.85		
	200.0	622.95		
	220.0	623.05		
240	240.0	623.10		-4.2
	250.0	623.06		
280	280.0	622.95		-6.0
	300.0	623.00		
320	320.0	623.16		-3.48
340	340.0	623.16		-3.48
360	360.0	623.20		-3.00
	380.0	623.16		
400	400.0	623.10		-4.2
420	420.0	623.25		-2.4
	440.0	623.25		
460	460.0	623.22		-2.76
	480.0	623.01		

MIDLAND PLANT - MIDLAND MICHIGAN

FILE No. 2220-R



BECHTEL POWER CORPORATION

4/24/79

FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 11

PIPELINE DESIGNATION: 26-ORBC-54

LOCATION OF READOUT POINT: Basement Service Water Pump Structure

ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY BECHTEL POWER CORPORATION: 626.06

DISTANCE FROM READOUT POINT (ft)		INVERT ELEVATION (ft)	COMMENTS
<small>D.P. IN RUN</small>			ΔY D.S.P. (IN)
500	500.0	622.92	
520	520.0	623.00	-6.36
	540.0	623.08	-5.40
	560.0	623.17	
580	580.0	623.25	
600	600.0	623.26	-2.4
	620.0	623.19	-2.28
	640.0	623.15	
	660.0	623.08	
690	690.0	622.91	-6.48

FILE No. 2220-R

MIDLAND PLANT - MIDLAND MICHIGAN

SNUM 035LE2 7/21/74

ME101

INPUT CARD IMAGES

INPUT CARD	1	11	21	31	41	51	61
SEQ	+	+	+	+	+	+	+
1	RUN						LDCASE=THRM1,
2	RUN						LDCASE=WT1
3	HED						TITLE=MIDLAND SERVICE
4							TURN 26-CHEC-54,
5							PROJNC=7220,PRCBNO=1
6							USER=BJ,UNITS=2,CODE
7	ANC	1	0.36				E=27.9E6,OD=36.0,THI
8							LBS/FT=565.57,THERM=
9							RA=0.9,RB=0.9,RC=0.9
10		14-8.076		-11.53			
11		20-4.856		3.4			
12	RAD	20	1.				DISP=0.12
13		30-8.1926		5.736			
14		40-3.1926		5.736			
15		46-5.186		3.63			
16		800-5.186		3.63			OD=26.0,THIK=0.375,
17							LBS/FT=278.57
18		46 51 1.72	-3.	2.46	L		OD=26.0,THIK=0.375,
19							LBS/FT=278.57
20		603.41		7.73			
21	RAD	60	1.0				DISP=-5.52
22		705.736		8.192			
23		80 5.736		8.192			
24		10011.47		16.38			
25	RAD	100	1.				DISP=-8.88
26		12011.47		16.38			
27	RAD	120	1.0				DISP=-10.2
28		14011.47		16.38			
29	RAD	140	1.0				DISP=-9.96
30		16011.47		16.38			
31		18011.47		16.38			
32		20011.47		16.38			
33		22011.47		16.38			
34		24011.47		16.38			
35	RAD	240	1.0				DISP=-4.2
36		26011.47		16.38			
37		28011.47		16.38			
38	RAD	280	1.0				DISP=-6.0
39		30011.47		16.38			
40		32011.47		16.38			
41	RAD	320	1.0				DISP=-3.48
42		3357.73		11.03	L		
43		340		6.53			
44	RAD	340	1.				DISP=-3.48
45		360		20.0			
46	RAD	360	1.				DISP=-3.
47		380		20.0			
48		400		20.0			
49	RAD	400	1.				DISP=-4.2
50		420		20.0			
51	RAD	420	1.0				DISP=-2.4
52		440		20.0			
53		460		20.0			
54	RAD	460	1.				DISP=-2.76

55	.	480		20.0	
56	.	500		20.0	
57	.	RAD 500	1.0		DISP=-6.36
58	.	520		20.0	
59	.	RAD 520	1.		DISP=-5.4
60	.	540		20.0	
61	.	560		20.0	
62	.	580		20.0	
63	.	RAD 580	1.0		DISP=-2.4
64	.	600		20.0	
65	.	RAD 600	1.0		DISP=-2.28
66	.	620		20.0	
67	.	640		20.0	
68	.	660		20.0	
69	.	690		30.0	
70	.	RAD 690	1.0		DISP=-6.48
71	.	14801 4.856		-3.4	
72	.	END			
.	+	+	+	+	+

72 CARDS IN INPUT DECK
 72 CARDS IN LOAD CASE TRM1
 72 CARDS IN LOAD CASE WT1

0 WARNINGS
 0 ERRORS
 0 FATAL ERRORS

CD,PL 93.

SEE SCRACH.

BT,KH *ME101.ME101I

ME101I ME101I/FEB05
 ** CORE CHANGED FROM 35400 TO 41400 DECIMAL WORDS ***

PROJECT: MIDLAND -- UNIT 1 SHEET 1 OF 4
 J. NO. 7220 PLANT DESIGN GROUP
 SYSTEM: SERVICE WATER RETURN
 CALC. NO. _____ IEO NO. M-167(Q) REV NO. 5

A. DESIGN DATA

1) PIPING CLASS SHTS.
 7220-M-481(Q) REV. 14
 PIPE: 8" SCH. 40; (OD) = 8.625"
 E = 0.322"
 MATL: SA-106 GR. B

2) SOIL & ROCK INSTRUMENTATION
 FULL PROFILE SETTLEMENT
 GAGE DATA, JANUARY 79

B. CRITERIA/OBJECTIVES

TO SHOW THAT SETTLEMENT
 STRESSES IN BURIED PIPING
 ARE WITHIN CODE ALLOWABLES

ASME SEC. III NC 3652.3(L)
 EQ. (10a), 1977

$$\frac{iM_D}{Z} \leq 3S_c$$

C. REFERENCES:

- 1) SK-C-650 SURVEYED PIPE LINE PROFILES.
- 2) YARD PIPING PLAN-AREA C M-167(Q)
- 3) S & RI DATA, FILE: D-2220-2, DT 1/23/79
- 4) ASME B & PV CODE, SEC. III, 1977.
- 5) ME 101 RUN: VER. 64, 6-12-80
 SNUM: Q14K34 DT 11-8-80
 (VER. 64)

D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:

STRESSES IN BURIED PIPING DUE TO DIFFERENTIAL
 SETTLEMENT - LINEAR ELASTIC ANALYSIS.

8" - 14BC-311; SERVICE WATER RETURN FROM DIESEL
 GENERATOR COOLER

E. CONCLUSIONS:

$$\sigma_{MAX DP (25)} = \frac{iM_D}{Z} = 23,783 \text{ psi}; 3S_c = 45,000 \text{ psi}$$

EQ. (10a) OF NC-3652.3(L) IS MET, ∴ OK.

P 123B 9/12/74

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	C. BASAVARATU	<i>Chakravarthy Basavarathu</i>	11-8-80
CHECKED BY	VINH SON NGUYEN	<i>Vinh Son Nguyen</i>	11-8-80
APPROVED BY	A. PATEL	<i>A. Patel</i>	11-3-80

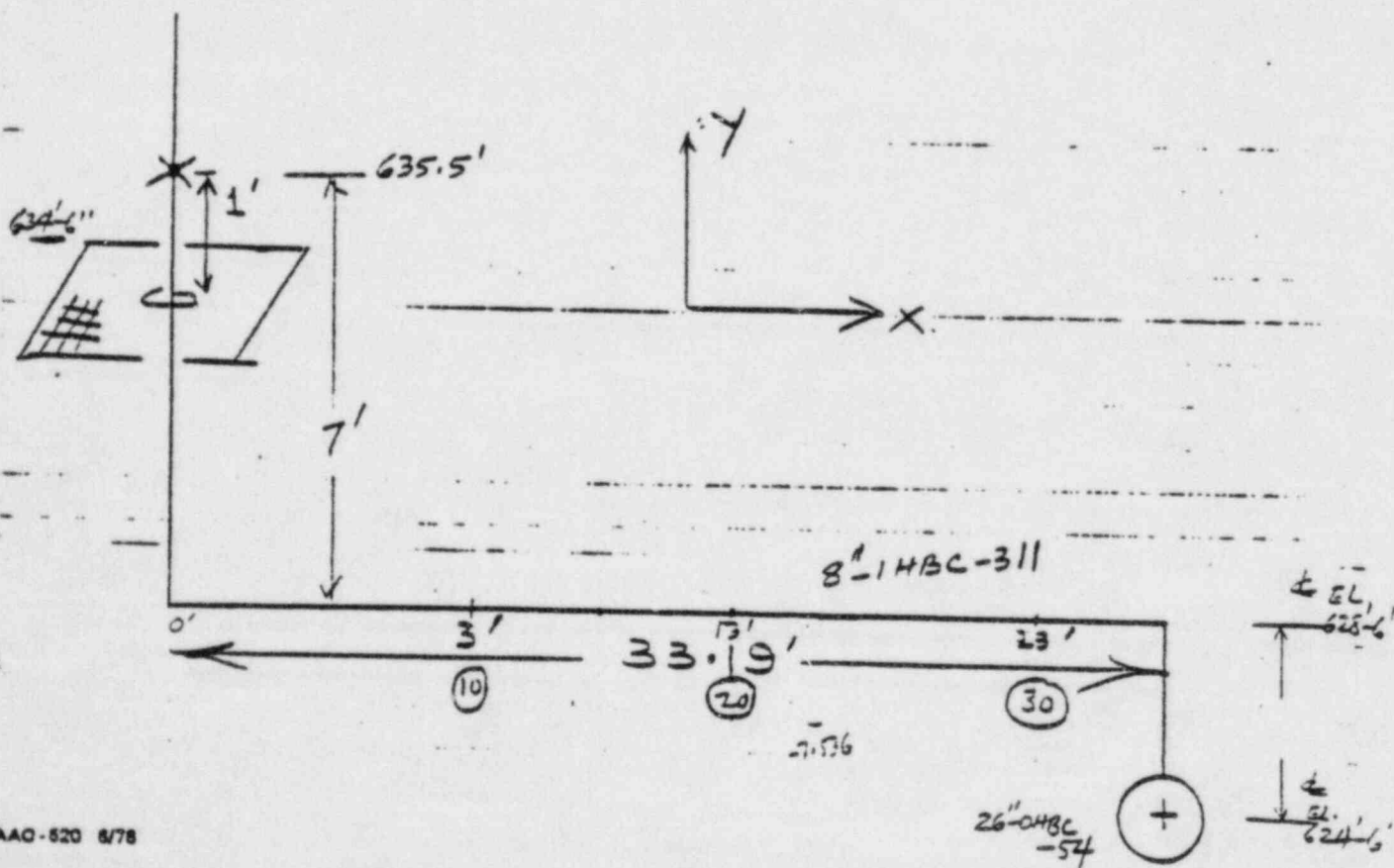
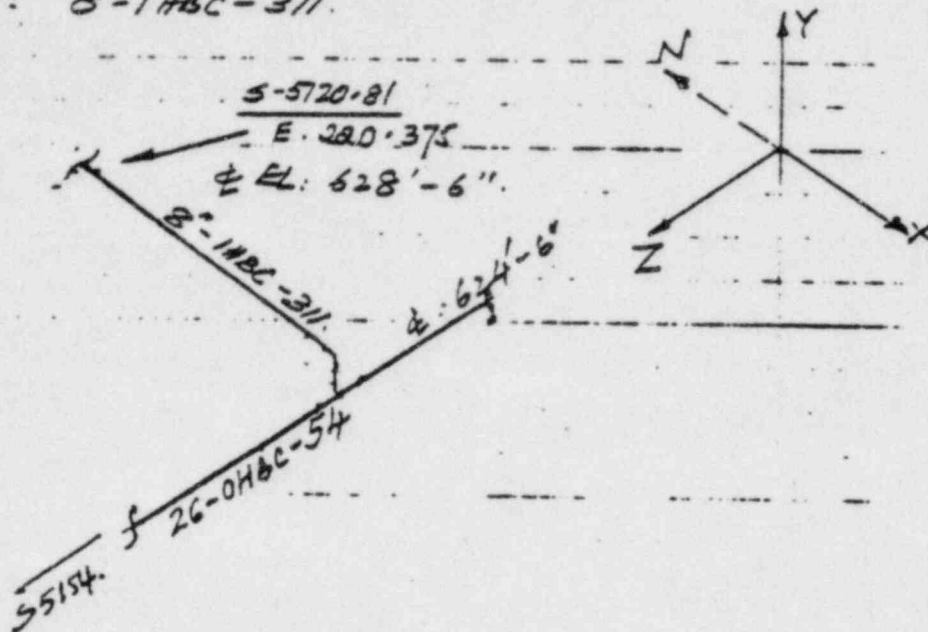
NOTE: Attach sheets if more space is needed
 P 123B 9/12/74 GKWR/ED



CALCULATION SHEET

ORIGINATOR K. V. Swamy DATE 6/25/79 CALC. NO. _____ REV. NO. _____
 PROJECT MIDLAND - UNIT 1 CHECKED K. Nanyen DATE 11-8-80
 SUBJECT BURIED PIPING UNDER D.G.R JOB NO. 7220
 SHEET NO. 2 of 4

BLDG. LINE: 8-1HBC-311.



FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

SL 3 of 4

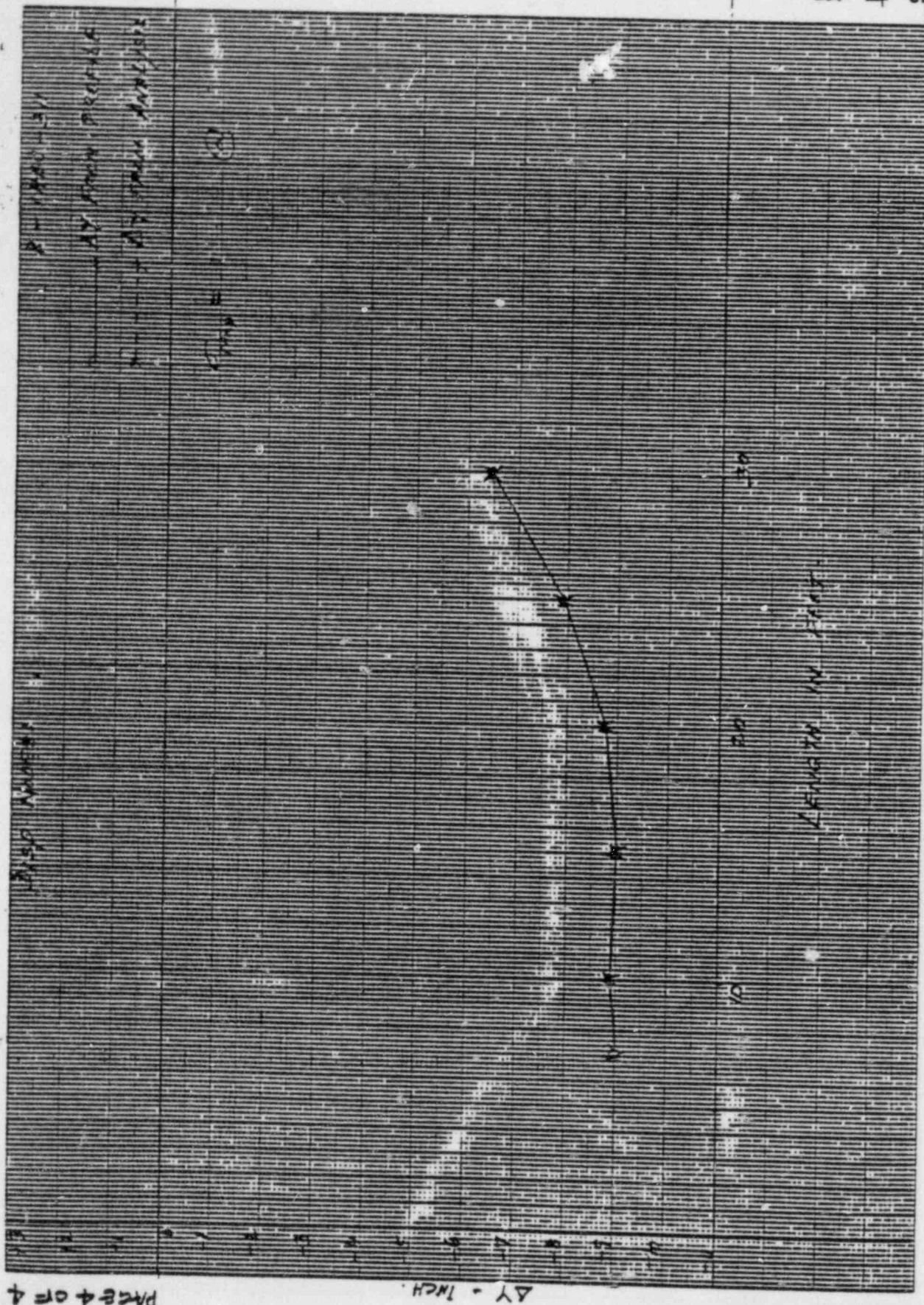
TABLE No. 8A PIPELINE DESIGNATION 8-1HBC-311
 LOCATION OF READOUT POINT See Attached Figure 7
 ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY
 BECHTEL POWER CORPORATION 634.75

SEPT. 11, 1979

DISTANCE FROM READOUT POINT (ft)	INVERT ELEVATION (ft) DESIGN	COMMENTS	ΔY INCHES
(7) 0	634.75 635.5	All field data collected on	-9
(10) 10	627.43 628.17	Sept. 11, 1979	-8.88
(15) 15	627.42		-9
(20) 20	627.44		-8.76
(25) 25	627.51		-7.92
(30) 30	627.63 ✓		-6.48

MIDLAND PLANT - MIDLAND MICHIGAN

FILE No. 2220-R



PKR 4 OF 4

ΔY - INCH

ME101

INPUT CARD IMAGES

INPUT CARD	1	11	21	31	41	51	61	71
SEQ	*	+	+	+	+	+	+	+
1	***	M=107 REV.8	AND SK-C-650	---	SEPT 79 DATA			
2	WED							
3								
4								
5	RUN							
6	ANC	7		-9.0				
7								
8		10	3=0					
9	RAD	10		1.0				
10		15	5=0					
11	RAD	15		1.0				
12		20	5=0					
13	RAD	20		1.0				
14		25	5=0					
15	RAD	25		1.0				
16		30	5=0					
17	RAD	30		1.0				
18	END							
	*	+	+	+	+	+	+	+

18 CARDS IN INPUT DECK
18 CARDS IN LOAD CASE THRM1

0 WARNINGS
0 ERRORS
0 FATAL ERRORS

FREE SCRACH.
AC WARNING 100000000000

XBT, KM ME101, ME101I

ME101I ME101I/FEB05
*** CORE CHANGED FROM 37044 TO 43044 DECIMAL WORDS ***



**PIPING ANALYSIS CHECK AND COVER SHEET
SPECIAL STUDIES**

PROJECT: MIDLAND Unit - 2 SHEET OF
 JOB NO. 7220 PLANT DESIGN GROUP
 SYSTEM: CONDENSATE WATER LINE
 CALC. NO. 1008 ISO NO. M-167 (Q) REV NO. 8

<p>A. DESIGN DATA:</p> <p>1. PIPING DATA SHEET: M-481 Rev. 1B (HBC-Rev. 1A)</p> <p>Pipe: 8" SCH. 40 Mat'l.: ASME-SA106 Gr. B C.S.</p> <p>2. Soil & Rock INSTRUMENTATION - FULL PROFILE SETTLEMENT GAGE DATA SUMMARY - SEPT. 11 '79</p>	<p>B. CRITERIA/OBJECTIVES:</p> <p>To show that the stresses in buried piping due to differential settlement meet the code requirement.</p> <p>ASME Sect. III, NC-3652.3 (b) Eq. 10a: $\frac{iM_D}{Z} \leq 3S_c$</p> <p>C. REFERENCES:</p> <ol style="list-style-type: none"> ASME Sect. III, SUBSECTION-NC ME101 Run: VSNGO (SNUM: Q44L06 (VER. 04) - 4/12/80 11-8-80) S&R1- FULL PROFILE SETTLEMENT GAGE DATA - SEPT. 11 '79 SURVEYED PIPELINES PROFILE: SK-C-650 Rev. B YARD PIPING PLAN - AREA-C M-167 (Q) Rev. B
---	--

D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:

DIFFERENTIAL SETTLEMENT STRESSES IN BURIED PIPING
ME-101 - LINEAR ELASTIC ANALYSIS

LINE NO: 8"-2HBC-82 - SERVICE WATER OUTLET FROM
DIESEL GENERATOR COOLER - 2E-25A

E. CONCLUSIONS:

At data point 15 - $\sigma_{Max} = \frac{iM_D}{Z} = 14347$; $3S_c = 45000 \text{ psi}$

Eq. 10a or NC-3652.3 (b) is Met \therefore OK

P-1238 8/12/74

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	VINHON NGUYEN		11-8-80
CHECKED BY	CHAKRAPANI BASAVARAJU		11-10-80
APPROVED BY	A. PATIL		11-10-80

NOTES: Attach sheets if more space is needed.
P-1238 8/12/74 GKV/RPD



CALCULATION SHEET

CALC. NO. 1008 REV. NO. _____

ORIGINATOR Vishala Nguyen DATE 11-8-80

CHECKED E. Barman DATE 11-10-80

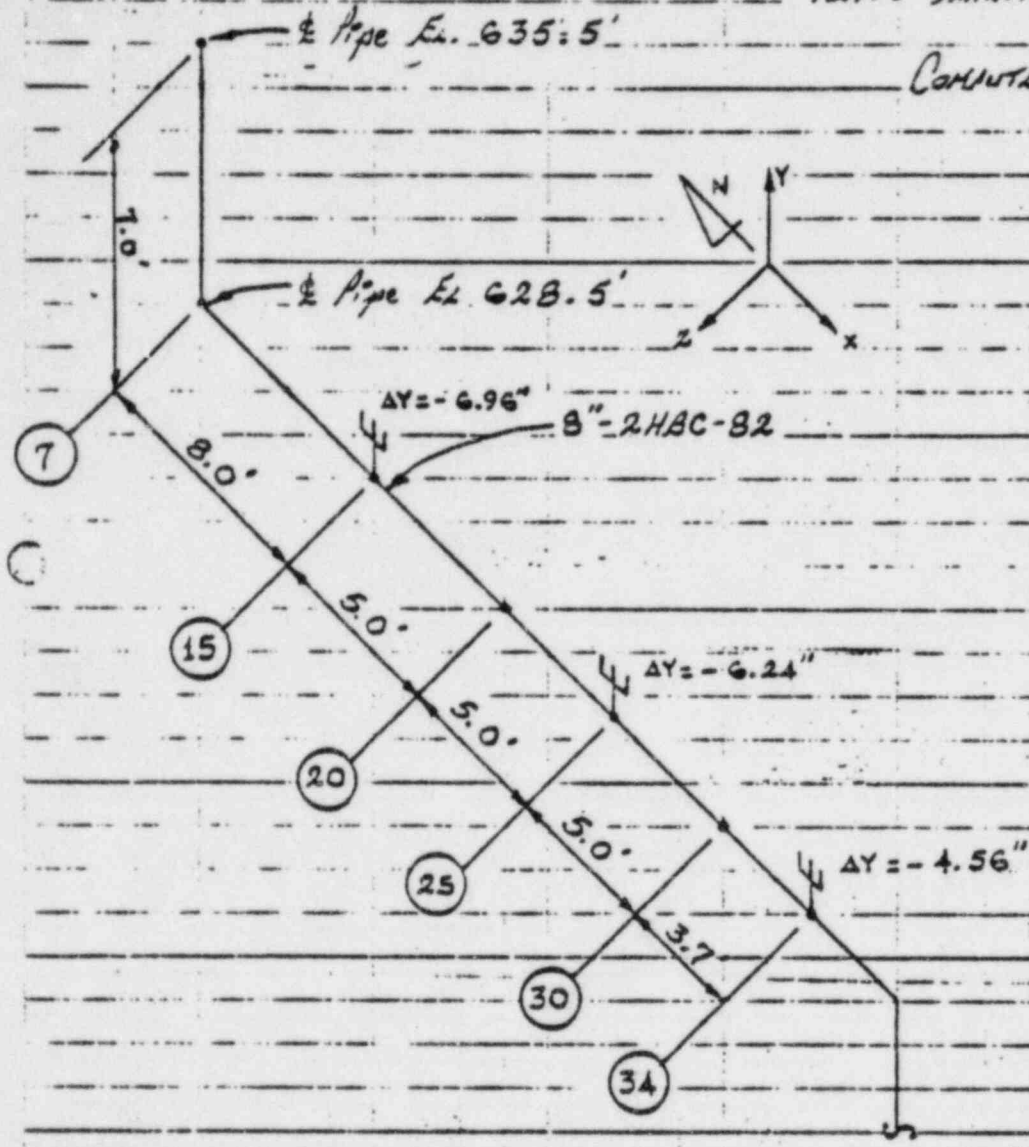
PROJECT MIDLAND UNIT - 2

JOB NO. 7220

SUBJECT LINE No: 8"-2HAC-82

SHEET NO. _____

REF.: DRAW. No: M-167(Q) Rev. B
SK-C-650 Rev. A
COMPUTER RUN No: VSNGC
(SUM Q)



FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 98 PIPELINE DESIGNATION 8-248C-82
 LOCATION OF READOUT POINT See Attached Figure 7
 ELEVATION OF PIPELINE INVERT AT READOUT POINT AS SURVEYED BY
 BECHTEL POWER CORPORATION 634.96

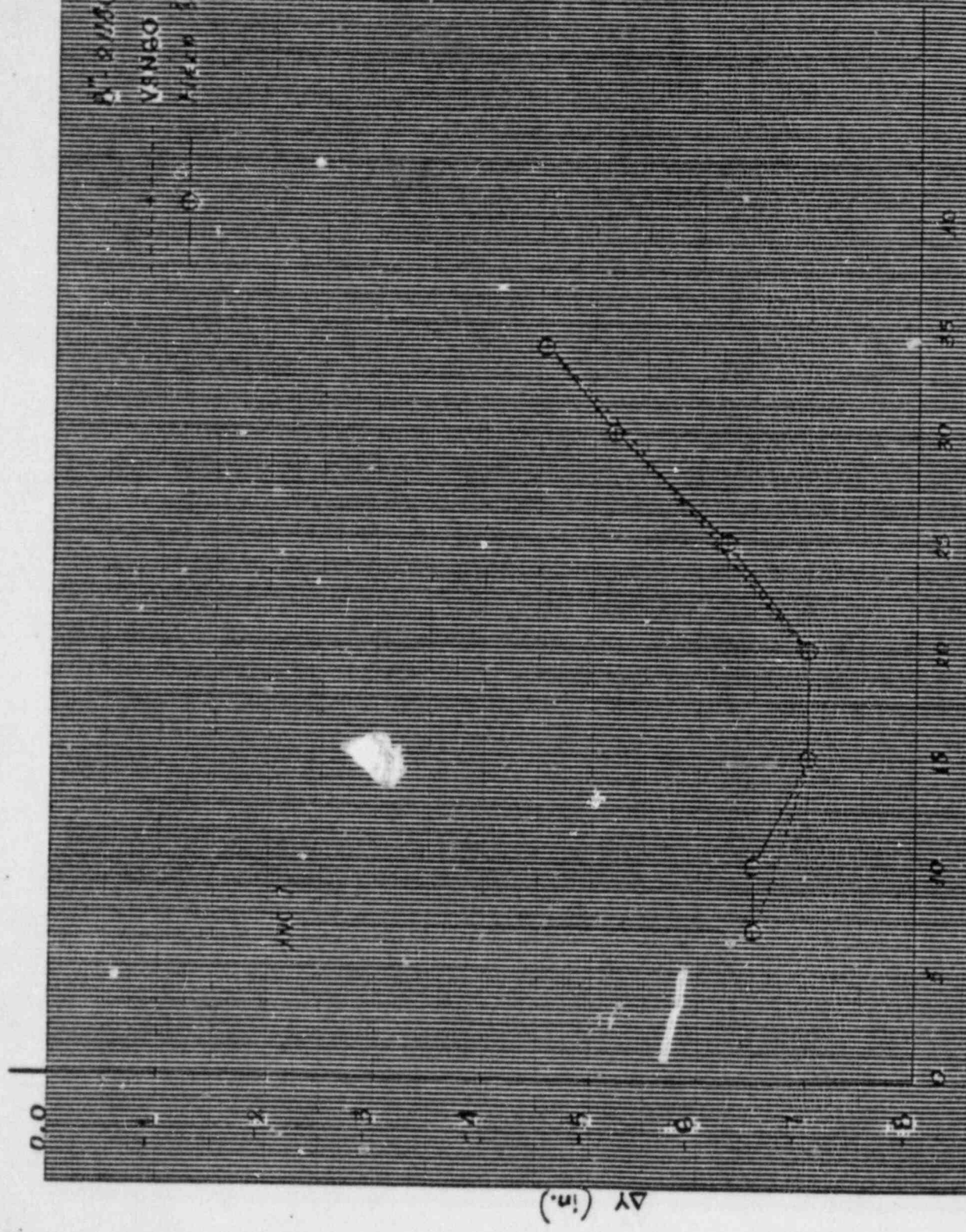
DISTANCE FROM READOUT POINT (ft)	INVERT ELEVATION (ft)	COMMENTS	SETTLEMENT	DATA POINT
0	634.96	All field data collected on	-6.48	7
10	627.63	September 11, 1979	-6.48	10
15	627.59		-6.96"	15
20	627.59		-6.96"	20
25	627.65		-6.24"	25
30	627.74		-5.16"	30
33.7	627.79		-4.51"	34

MIDLAND PLANT - MIDLAND MICHIGAN



P. 104 1110 444-078

87-8/180-52
VANGO (DANLOG-128-80)
KIKER 3/1/44



ALUMINUM (FT.)

ΔY (in.)

ME101/G4

ME101

INPUT CARD IMAGES

INPUT	1	11	21	31	41	51	61	71
1	*	*	*	*	*	*	*	*
2	*							
3	***	REF. DRAW. NO.:	M=167 (G) REV.:	B	LINE NO.:	B*-2HAC=22		
4	*							
5	***	REF.:	SOIL & ROCK INSTRUMENTATION	*FULL PROFILE SETTLEMENT GAGE				
6	***	SUMMARY	TABLE NO.:	98	= DATA COLLECTED ON:	SEPT. 11, 1979		
7	*							
8	HED							
9	*					TITLE= SERVICE WATER OUTL		
10	*					FR. DIESEL GEN. COOLER 22		
11	*					USER=VINHSON,		
12	*					PROJNO=7220, PROJNO=1008,		
13	RUN					UNITS=2, CODE=3C374,		
14	RUN					LOCASE=THRM01,		
15	ANC	7				LOCASE=WT01,		
16	*					OD=8.625, THICK=0.322,		
17	*					LBS/FT=50.24,		
18	*					E=27.9E6, THERM=0.0,		
19	*	10	3.0			RA=0.9, RB=0.9, RC=0.9,		
20	*	15	5.0					
21	RAD	15		1.0		DISP=6.96,		
22	*	20	5.0					
23	*	25	5.0					
24	RAD	25		1.0		DISP=6.24,		
25	*	30	5.0					
26	*	34	3.7					
27	RAD	34		1.0		DISP=4.56,		
28	END							
29	*							
30	*							

30 CARDS IN INPUT DECK
 30 CARDS IN LOAD CASE THRM01
 30 CARDS IN LOAD CASE WT01

0 WARNINGS
 0 ERRORS
 0 FATAL ERRORS

SEE SCRACH.
 : WARNING 100000000000

IT, KM *ME101,ME101I

*ME101I*** ME101I/FEB05
 * CORE CHANGED FROM 37644 TO 43044 DECIMAL *CORES ***

PROJECT	MIGLAND - UNIT ONE	SHEET	OF
JOB NO.	7220	PLANT DESIGN GROUP	
SYSTEM	SERVICE WATER		
CALC. NO.	1000	ISS. NO.	M-167
		REV. NO.	

<p>A. DESIGN DATA</p> <p>1) PIPING CLASS SHEETS. 7220-M-481 (Q) REV. 15 PIPE: 8" SCH. 40 MATRL: ASME SA-106, Gr. B</p> <p>2) SOIL & ROCK INSTRUMENTATION FULL PROFILE SETTLEMENT GAGE DATA - APRIL 1979</p>	<p>B. CRITERIA/OBJECTIVES</p> <p>TO SHOW THAT THE STRESSES IN BURIED PIPING DUE TO DIFFERENTIAL SETTLEMENT MEET THE CODE REQUIREMENTS.</p> <p>ASME SECTION III, NC-3652.3 (b) EQ. (10a) $\frac{i M_0}{z} \leq 3 S_c$.</p> <p>C. REFERENCES:</p> <p>1) ASME SEC. III, SUBSECTION NC 2) ME 101 RUN; SNUM # Q13P12 (VERSION F-2/6/1979) DATED: 6/26/79 3) S & RI FULL PROFILE SETTLEMENT GAGE DATA FILE # D-2220-R, DATED: 4/24/79. 4) BECHTEL DRAWING # SK-C-650 SURVEYED PIPELINE PROFILES. 5) BECHTEL DRAWINGS: M-167 Rev. 7.</p>
---	--

D. DESCRIPTION OF ANALYSIS/STUDY PERFORMED:

DIFFERENTIAL SETTLEMENT STRESSES IN BURIED PIPING - ME-101 - LINEAR ELASTIC ANALYSIS

8" - 1HBC-81 : SERVICE WATER INLET TO DIESEL GENERATOR COOLER 1E-25B.

E. CONCLUSIONS:

$$(\sigma_{max})_{AT \phi} = \frac{i M_0}{z} = 17,655 \text{ psi} ; 3 S_c = 45,000 \text{ psi.}$$

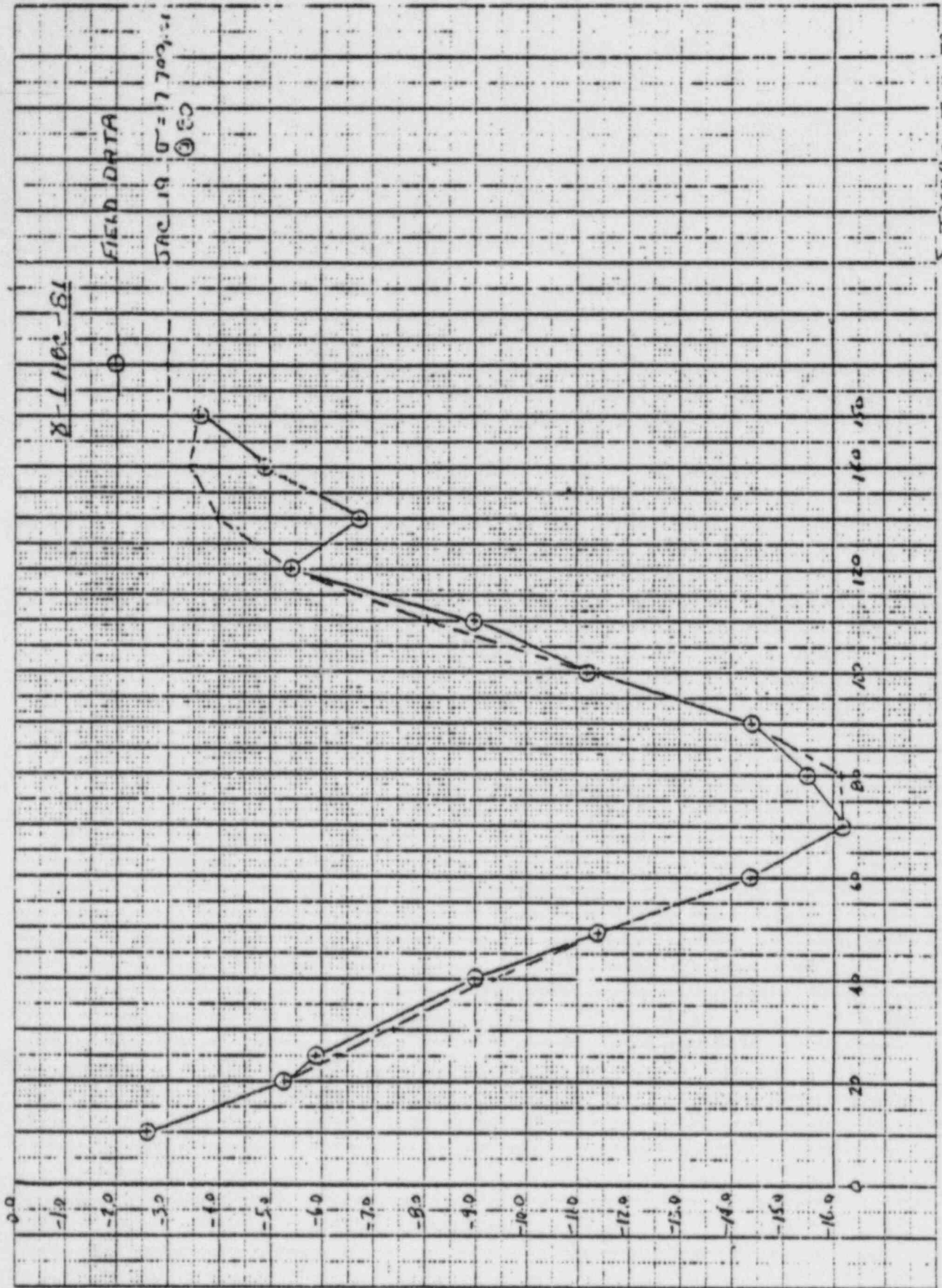
EQ. (10a) OF NC-3652.3 (b) IS NOT EXCEEDED. ϕ OK

ACTION	NAME	SIGNATURE	DATE
CALCULATION BY	E. F. MARUT (for S. JACOBS)	E. F. Marut (for S. JACOBS)	11-6-80
CHECKED BY	G. KANNIAN	G. Kannian	11-7-80
APPROVED BY	A. PATEL	A. Patel	11-8-80

NOTES: Attach sheets if more space is needed.
P 1230 9/12/78

46 1512

160 X 10 TO THE CENTIMETER MARKS IN CM
BLUPFEL & LSSER CO. MADE IN U.S.A.

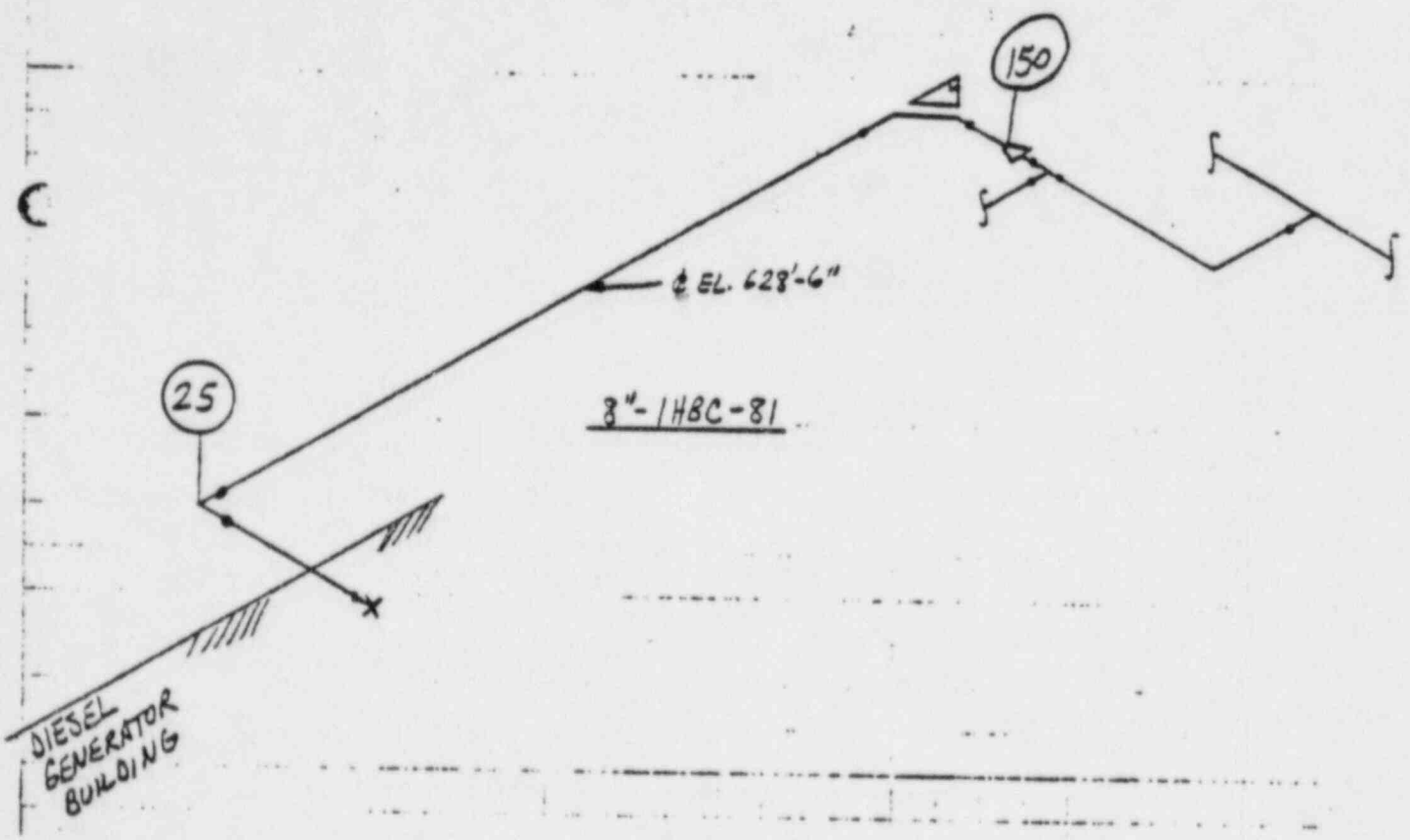
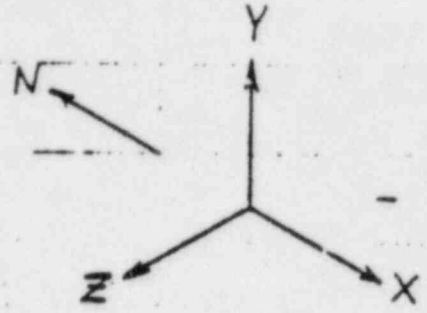


S. JACOBS 7-16-79



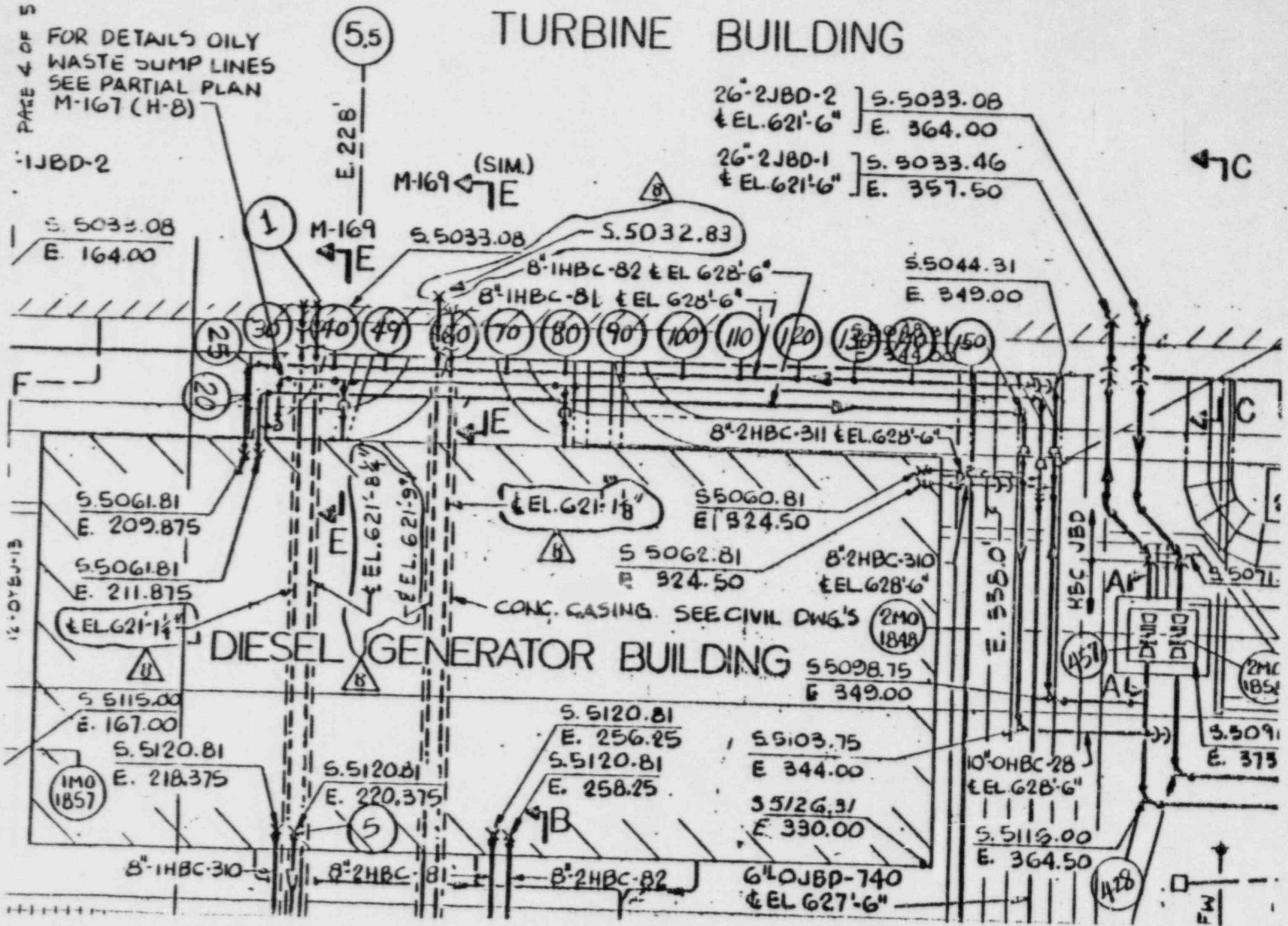
CALCULATION SHEET

ORIGINATOR E.F. MARUT (for S. JACOBS) DATE 11/6/80 CALC. NO. 1010 REV. NO. _____
PROJECT MIDLAND UNIT 1 CHECKED [Signature] DATE 11-7-80
SUBJECT 8"-14BC-81 DIFFERENTIAL SETTLEMENT JOB NO. 7220 SHEET NO. _____



FOR DETAILS ONLY
WASTE DUMP LINES
SEE PARTIAL PLAN
M-167 (H-8)

TURBINE BUILDING



FULL PROFILE SETTLEMENT GAGE DATA SUMMARY

TABLE No. 7 PIPELINE DESIGNATION B-1FEC-81

NOTE: SEE FIGURE No. 1 FOR LOCATION OF PIPELINE AND READOUT POINT
1-12-79

D.P. IN RUN	DISTANCE FROM READOUT POINT (FT.)	INVERT ELEVATION (FT.)	COMMENTS ΔY DISP. (IN.)
	0	635.28	1-12-79
20 ✓	20.0	627.73	No reading taken at 10.0 ft. -5.28 ✓
	24.67	627.68	
	40.0	627.42	
49 ✓	48.83	627.22	- 11.4 ✓
	60.0	626.97	
70 ✓	70.0	626.82	- 16.2 ✓
	80.0	626.88	
90 ✓	90.0	626.97	- 19.4 ✓
	100.0	627.24	
	110.0	627.42	
120 ✓	120.0	627.72	- 5.4 ✓
	130.0	627.61	
	140.0	627.76	
150 ✓	150.0	627.87	- 3.6 ✓

FILE No. 2220-R

— MIDLAND PLANT — MIDLAND, MICHIGAN	DIESEL GENERATOR BUILDING
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ME101

INPUT CARD IMAGES

T	1	11	21	31	41	51	61	71
.	+	+	+	+	+	+	+	+
.	RUN							
.	RUN							
.	HED							
.								
.	ANC		-2.64					
.								
.	RAD	20-10.0						
.		20	1.0					
.		25-5.00						
.		30						
.		40						
.		49						
.	RAD	49	1.0					
.		60						
.		70						
.	RAD	70	1.0					
.		80						
.		90						
.	RAD	90	1.0					
.		100						
.		110						
.		120						
.	RAD	120	1.0					
.		130						
.		140						
.		150						
.	RAD	150	1.0					
.	END							
.	+	+	+	+	+	+	+	+

31 CARDS IN INPUT DECK
 31 CARDS IN LOAD CASE THRM1
 31 CARDS IN LOAD CASE WT1

0 WARNINGS
 0 ERRORS
 0 FATAL ERRORS

PL 93.

SCRACH.

<M *ME101.ME101I

E101I*** ME101I/FE05