572,

CASE

(CITIZENS ASSN. FOR SOUND ENERGY)

RELATED CORRESPONDENCE

1426 S. Polk
Dallas, Texas 75224

214/946-9446

June 8, 1984

Mr. Michael D. Spence
President
Texas Utilities Generating Company
Skyway Tower
400 North Olive Street, L.B. 81
Dallas, Texas 75201

Dear Mr. Spence:

Subject: In the Matter of
Texas Utilities Generating Company, et al
Comanche Peak Steam Electric Station,
Units 1 and 2
Docket Nos. 50-445 and 50-446

Attachment to CASE's 6/7/84 Letter re:
Barriers to Settlement
On Design and Design QA Issues

We are attaching a copy of TUGCO's response to Cygna's 3/30/84 Telecon questions regarding allowables and safety factors for Richmond Inserts.

This document was referenced on page 5, item 2, of our 6/7/84 letter to you under subject of Barriers to Settlement on Design and Design QA Issues. It was inadvertently omitted when we mailed our 6/7/84 letter.

Sincerely,

CASE (Citizens Association for Sound Energy)

Juanita Ellis

(Mrs.) Juanita Ellis
President

cc: Service List in Dockets 50-445 and 50-446
(With attachments to Board Members, parties, and Docketing and Service only)

D503

84042 P.F.
Incoming Corr.

TEXAS UTILITIES GENERATING COMPANY

P. O. BOX 1002 · GLEN ROSE, TEXAS 76043

PROJECT FILE

May 2, 1984

CYGNA [illegible] 84042
JOB NO.: 84042
DATE LOGGED: 5/4/84
LOG NO.: #11
FILE: 2.1.1 Inc. CR
[illegible] FILE: 2.1 Inc. CR Log

CYGNA Energy Services
101 California Street
Suite 1000
San Francisco, California 94111

Attention: Ms. Nancy Williams, Project Manager

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION
CYGNA REVIEW QUESTIONS

Reference: Popplewell (TUGCO) to Williams (CYGNA) letter dated April 19, 1984

Dear Ms. Williams:

In reference (1) TUGCO stated that several responses required further review. In addition, CYGNA has asked several new questions. Provided in this letter are responses to previous and new CYGNA questions, a status of TUGCO responses and a correction to a previously supplied TUGCO response.

Due to the many responses that TUGCO has committed to provide and the new CYGNA questions asked, TUGCO is providing, below, the status of our responses that we believe to be correct as of April 27, 1984. In addition, attached are TUGCO's responses to the following CYGNA questions:

1. All CYGNA questions of March 30, 1984, telephone conversation between D. Rencher (TUGCO) and J. Minichiello (CYGNA).

2. CYGNA question 1 of April 23, 1984, telephone conversation between D. Rencher (TUGCO) and J. Minichiello (CYGNA).

3. CYGNA question 1 (a,b,c,d) of March 19, 1984, of Reference (1) above. (TUGCO committed to provide response the week of April 23, 1984)

CYGNA QUESTION/TUGCO RESPONSE STATUS

The following are all of TUGCO's outstanding commitment items that have not been answered by this letter or the letter of reference (1), all other items are considered complete:

1. CYGNA question (2) of March 16, 1984 of Reference (1) above, TUGCO to provide response by May 10.

2. CYGNA question (5) of March 19, 1984 of Reference (1) above, TUGCO to provide results of testing regarding U-bolt and pipe diametrical expansion.

3. CYGNA question 2(b) of March 22, 1984 of Reference (1) above, TUGCO to provide response later.

4. CYGNA questions 2 and 3 of April 23, 1984, telephone conversation between D. Rencher (TUGCO) and J. Minichiello (CYGNA).

CYGNA should note that a correction is required in TUGCO's previous response reference (1), CYGNA question (4) of March 19, 1984, regarding the local effect of a U-bolt through a tube steel beam. TUGCO stated that no local deformation or failure of this member would occur because the member has already resisted its maximum load and no deformations have occurred, and the CYGNA calculations provided did not adequately account for the rounded corners of the tube steel and the area under the nut. TUGCO stated that washer plates would be added, this however, is incorrect. TUGCO believes that due to the reasons cited above adding additional washer plates is unnecessary.

If there are any further questions, comments, or discrepancies, please contact me or Mr. George Grace at the CPSES site (Ext. 500).

Very truly yours,

TEXAS UTILITIES GENERATING COMPANY
ENGINEERING DIVISION

L. M. Popplewell
Project Engineering Manager

LMP/lp
Attachments
cc: D. Wade
J. Finneran
File

March 30, 1984 Telecon

CYGNA QUESTION:

1. CYGNA requested response to the following four comments:

   A. In reviewing the allowables for Richmond inserts (Appendix 3 to Spec. 2323-SS-30), CYGNA has noted allowables which do not match those suggested by Richmond. In response to an Action Item, TUSI provided CYGNA with test reports. CYGNA is aware that the Richmond data is based on 3000 psi concrete, while the TUSI data is for 4000 psi concrete. CYGNA, however, still has the following questions:

      i. How were the Tables in SS-30, Appendix 3, developed, since only a shear test was done?

      ii. How were the spacings determined?

      iii. How do the safety factors in SS-30 compare to those suggested by Richmond (3:1) for tension?

FOR LAWYER'S ATTENTION ONLY
NOT DISCOVERABLE

TUGCO RESPONSE:

Ai, iii. Recommended allowable loads by the Richmond Screw Anchor Co. are based on tension tests conducted at the Polytechnic Institute of Brooklyn in 1957. Two tension tests each were performed on 1" Ø and 1½" Ø inserts in concrete test blocks with moderate reinforcement with the following results:

	1" Ø	1½" Ø
Avg. Conc. Strength	2850 psi	2950 psi
Avg. Ultimate Load	25050#	65000#*
Failure Mode	Conc. pullout	Bolt threads

*Ultimate strength of 1½" Ø insert mechanism or of concrete failure cone not determined.

Richmond's recommended allowable loads are based on their average ultimate test loads and a factor of safety which has varied over the years, i.e.,

Richmond Bulletin	Recommended Allowable Tension Load (Factor of Safety) 1" Ø	1½" Ø
#6, 1961	11.0^k(2.3)	25^k(2.6)
#6, 1971	10.0^k(2.5)	25^k(2.6)
#6, 1975	$8.2/^k$(3.0)	21.67^k(3.0)

Design Approach - It was recognized that the CPSES 4000 psi design concrete strength, being significantly greater than the nominal 3000 psi concrete used in the Richmond tests, would result in higher ultimate capacities for the inserts than the Richmond test values. It was also evident very early in construction that the concrete strengths actually being achieved were between 4500 and 5000 psi, which would further increase the ultimate capacity of the inserts. In addition, the heavier surface reinforcement used in the actual construction at CPSES as compared to that used in the test blocks for the Richmond tests would tend to result in yet higher concrete pullout cone tensile strengths. The design approach used was to calculate the ultimate insert capacity based on 4000 psi using the ultimate concrete tension value $4\phi\sqrt{f'c}$ over the projected area of the postulated cone pullout, where Ø = 0.65 as recommended in ACI 349, Appendix B and, checking for an equivalency to the actual test results. Because of the conservatism inherent in discounting the high concrete strength test values being achieved and the effects of heavier surface rebar described above, a factor of 2 was applied to these values to establish allowable loads. On this basis there is good agreement between the Richmond test values and the calculated ultimate load:

A. Allowable Tensile, Ø = 0.65 f'c = 4000, Safety Factor = 2

Size	Richmond Test Load	Calculated Ultimate Load	Allowable Load
1"Ø	25.05^k	23.1^k	11.5^k
1½"Ø	65^k	62.6^k	31.3^k for A325/A490 28.1^k for A307/A36

However, the tabulated values in A above, do not consider that the Richmond test results would indicate an actual Ø = 0.84 and that f'c at CPSES was significantly higher. A more accurate safety factor considering these higher values is shown in B:

B. Estimated Ultimate Tensile Loads & Safety Factors

Size	Ø	Allowable Load	Est. Ult. Loads & (Safety Factors) 4000 psi	4500 psi	5000 psi
1"Ø	.84	11.5^k	29.8^k(2.6)	31.6^k(2.7)	33.4^k(2.9)
1½"Ø	.84*	31.3^k (w/A325,A490 Bolt)	80.9^k(2.6)	85.8^k(2.7)	90.4^k(2.9)
	.84*	28.1^k (w/A307,A36 Bolt)	80.9^k(2.9)	85.8^k(3.0)	90.4^k(3.2)

*Used 1"Ø value as calculated Ø of 0.79 for 1½"Ø based on bolt thread failure not concrete pullout.

Thus the actual minimum safety factors range from 2.6 to 2.9 for 4000 psi concrete to 2.9 to 3.2 for 5000 psi concrete. An evaluation of the concrete strength tests indicates that the actual minimum design strength of concrete produced at CPSES is approximately 4500 psi.

A similar approach was taken to establish allowable shear values for the 1"Ø and 1½"Ø Richmond inserts. Shear tests conducted by Richmond in 1965 on 1"Ø inserts an average load at failure of 27 kips. Failure mode was by shearing of the bolts. Allowable shear values were established based on AISC bolt values for the materials used, but were not permitted to exceed the allowable tension loads in A, above. As shear tests did not involve concrete failure, the concrete shear capacity of the insert could only be estimated using f'c = 4000 psi and assuming Ø = 0.84 as for tensile loads discussed above. Finally, shear tests conducted in 1983 on 1½" Ø inserts indicated that ultimate capacities were governed by bolt material, and varied between 88.1 and 95.4 kips. Ultimate capacity of the insert and of concrete in shear were not reached.

C. Allowable and Ultimate Shear Capacities and (Safety Factors

Size	Material	Allowable Loads		Est. Ult. Conc. Shear Strength 4000 psi/Ø=0.84	Test Ult. Load
		Richmond	CPSES		
1"Ø	A-307	8.0^k	7.85^k	29.7^k (3.8)	—
1"Ø	A-325	—	11.5^k	29.7^k (2.6)	—
1½"Ø	A-307	18.0^k	17.67^k	80.5^k (4.6)	88.1-95.4 (5.0 - 5.4)
1½"Ø	A-325	—	26.51^k	80.5^k (3.0)	88.1-95.4 (3.3 - 3.6)

FOR LAWYER'S ATTENTION ONLY
- NOT DISCOVERABLE -

To put the factors of safety utilized for the Richmond anchors at CPSES in perspective, it is useful to look at the factors of safety required by the FSAR (and NRC Standard Review Plan) for steel and concrete structures. (See FSAR paragraphs 3.8.3.3.2, 3.8.3.3.3, 3.8.3.5.2 and 3.8.3.5.4). These safety factors can be as low as 1.56 for concrete and 2.0 for steel under normal and upset load conditions when compared to the ultimate strength of the materials.

To further evaluate the significance of the factors of safety for the CPSES Richmond inserts, their reliability should be considered. The manufacturing process for the inserts furnished for CPSES use is controlled by QA/QC procedures to assure that the anchor material and fabrication conforms to or exceeds requirements necessary to assure material capability to meet capacity requirements. Construction procedures and tolerance requirements are controlled by site QA/QC regulations. Failures to meet these procedures and requirements are visually identified upon removal of concrete forms. When out-of-tolerance placement or improperly consolidated concrete around the insert is observed, corrective action or abandonment of the insert is required.

FOR LAWYER'S ATTENTION ONLY
— NOT DISCOVERABLE

Aii. In those cases where Richmond Inserts have overlapping stress cones the allowables have been determined in accordance with Section B.4 of Appendix B - Steel Embedments, ACI-349.

See Attached sheets numbered 11, 12, and 13 for typical calculations.

FOR LAWYER'S ATTENTION OMLY
NOT DISCOVERABLE

Gibbs & Hill, Inc.	Job No. 2323	Client TUGCo
Subject RICHMOND INSERT CAPACITIES		
Calculation Number SCS-228C SET #1	Sheet No. 11	

Revision	Original Item	Date	Rev. 1	Date	Rev.	Date	Rev.	Date	Rev.	Date
Checking Method #			1							
Preparer			RS	4.23.84						
Checker			JB	4-24-84						

DETERMINATION OF ALLOWABLE LOADS FOR 1½"ϕ RICHMOND INSERTS SPACED 10" AND 12" ON CENTERS IN A TWO BOLT PATTERN FOR TABLE I, APPENDIX 3 (PAGE 9 OF 10) IN SPECIFICATION 2323-SS-30.

BASED ON CODE REQUIREMENTS FOR NUCLEAR SAFETY RELATED CONCRETE STRUCTURES - - ACI-349-80 APPENDIX B, SECTION B.4, THE DESIGN PULLOUT STRENGTH OF CONCRETE IN TENSION IS:

$$P_d = 4\phi\sqrt{f'_c}\,A_e$$

WHERE: $\phi = 0.65$

$f'_c = 4000$ psi (SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE)

A_e = EFFECTIVE STRESS AREA WHICH IS DEFINED BY THE PROJECTED AREA OF STRESS CONE RADIATING TOWARD THE ATTACHMENT FROM THE BEARING EDGE OF THE ANCHOR.

Checking Method #

F-166, 7-82

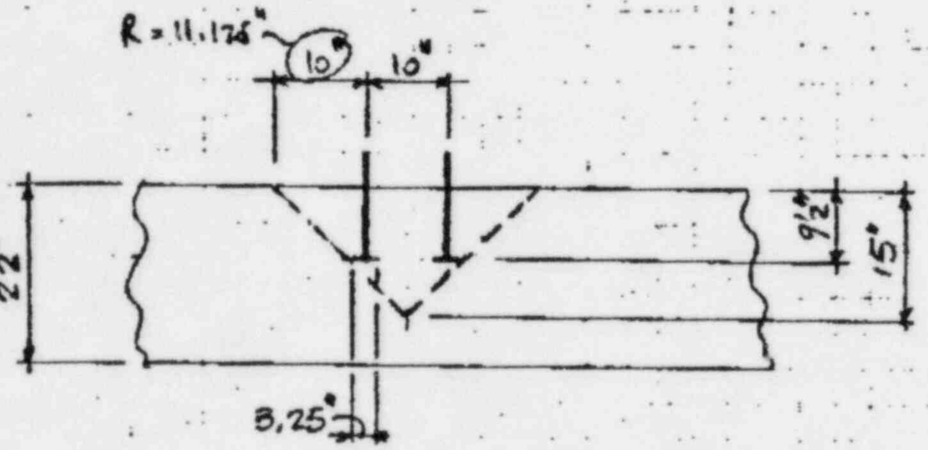
Gibbs & Hill, Inc. Job No. 2323 Client TUGCo

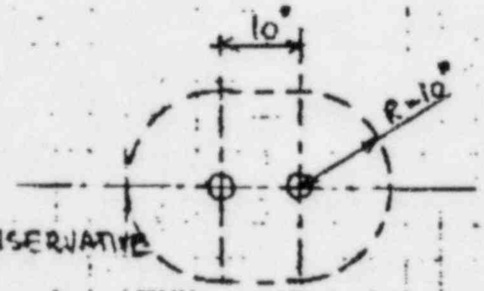
Subject RICHMOND INSERT CAPACITIES

Calculation Number SCS - 228C SET #1 Sheet No. 12

Revision	Original Issue	Date	Rev. 1	Date	Rev.	Date	Rev.	Date	Rev.	Date	
Checking Method #		X	1	X		X		X		X	
Preparer			RS	4-23-84							
Checker			JB	4-24-84							

$1\frac{1}{2}$" φ INSERT SPACED AT 10" C/C BOTH WAYS





USE OF R = 10" IS CONSERVATIVE

$$A_e = \left[\pi (10.0)^2 + 2 \times 10 \times 10\right] - \frac{2\pi}{4}(3.25)^2 = 497.57 \text{ in}^2$$

$$P_d = 4 \times 0.65 \times \sqrt{4000} \times 497.57 = 81819.63^{\#} \quad \text{FOR 2 INSERTS}$$

FOR ONE INSERT $P_d = \frac{81819.63}{2} = 40909.8^{\#}$

APPLYING A SAFETY FACTOR OF 2,

$$P_d = \frac{40909.8}{2} = 20454^{\#}$$

USE 20.45 k

Checking Method #
1. Line-by-line checking
2. Alternate Calculation Results compared
3. Identical Calculation Results compared
4. Compare inputs and results of computation with corresponding inputs and results of similar cases

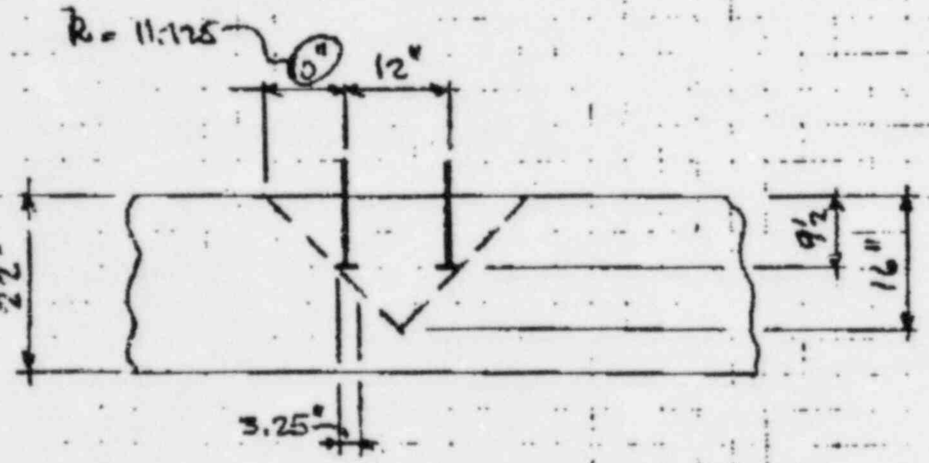
Gibbs & Hill, Inc. Job No. 2323 Client TUGCo

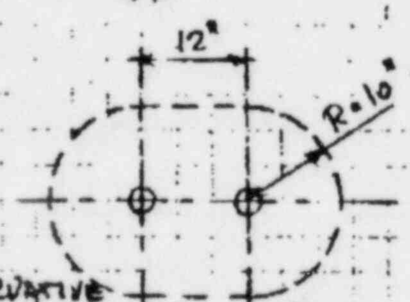
Subject RICHMOND INSERT CAPACITIES

Calculation Number SCS-228C SET #1 Sheet No. 13

Revision	Original Issue	Date	Rev. 1	Date	Rev.	Date	Rev.	Date	Rev.	Date	
Checking Method			1								
Preparer			RS	4-23-84							
Checker			JB	4-24-84							

1½" φ INSERT SPACED AT 12" c/c BOTH WAYS





USE OF R=10" IS CONSERVATIVE

$$A_e = \left[\pi(10.0)^2 + (2 \times 12 \times 10)\right] - \frac{2\pi}{4}(3.25)^2 = 537.57 \text{ in}^2$$

$$P_d = 4 \times 0.65 \times \sqrt{4000} \times 537.57 = 88397.17^{\#} \text{ FOR 2 INSERTS}$$

FOR ONE INSERT $P_d = \frac{88397.17}{2} = 44198.5^{\#}$

APPLYING A SAFETY FACTOR OF 2

$$P_d = \frac{44198.5}{2} = 22100^{\#}$$

USE 22.1 k

Checking Method #
1. Line-by-line checking
2. Alternative Calculation: Results compared
3. Previous Calculation: Results compared
4. Compare inputs and results of computer with corresponding inputs and results of similar studies

F-166, 7-82

CYGNA QUESTION:

1B. In reviewing supports inside and outside containment, CYGNA has noted use of through bolts for certain cases (MS-1-002-001-S72R, for example). In each case, the bolts are checked against appropriate Code allowables.

i. Who is responsible for checking the spacing between bolts, concrete edge distance and minimum thickness of concrete allowed?

ii. Who is responsible for checking the concrete element (possible local failure, shear, bearing)?

iii. Please provide documentation showing the above checks have been done by the responsible party.

TUGCO RESPONSE:

The use of through bolts is employed on a case-by-case basis as required by the detail being designed. As such, Gibbs & Hill, the A/E, did not provide generic design criteria for their use. Gibbs & Hill has designed, reviewed, and approved their own use of through bolts in accordance with (i) and (ii) above.

For details concerning through bolts designed by other organizations (i.e., PSI, ITT, NPSI, etc.), Gibbs & Hill has or will be provided with loads and details to establish acceptability of the building structure. All through bolt designs will be reviewed specifically or generically to determine their acceptability prior to fuel loading. This was anticipated as part of the design course. Since (i) and (ii) above are a continuing action representative documentation of these design checks may be seen in attached calculation book SRB-15BC, Set 1, Sheets 22, 23, 24, 25 and 33 through 38.

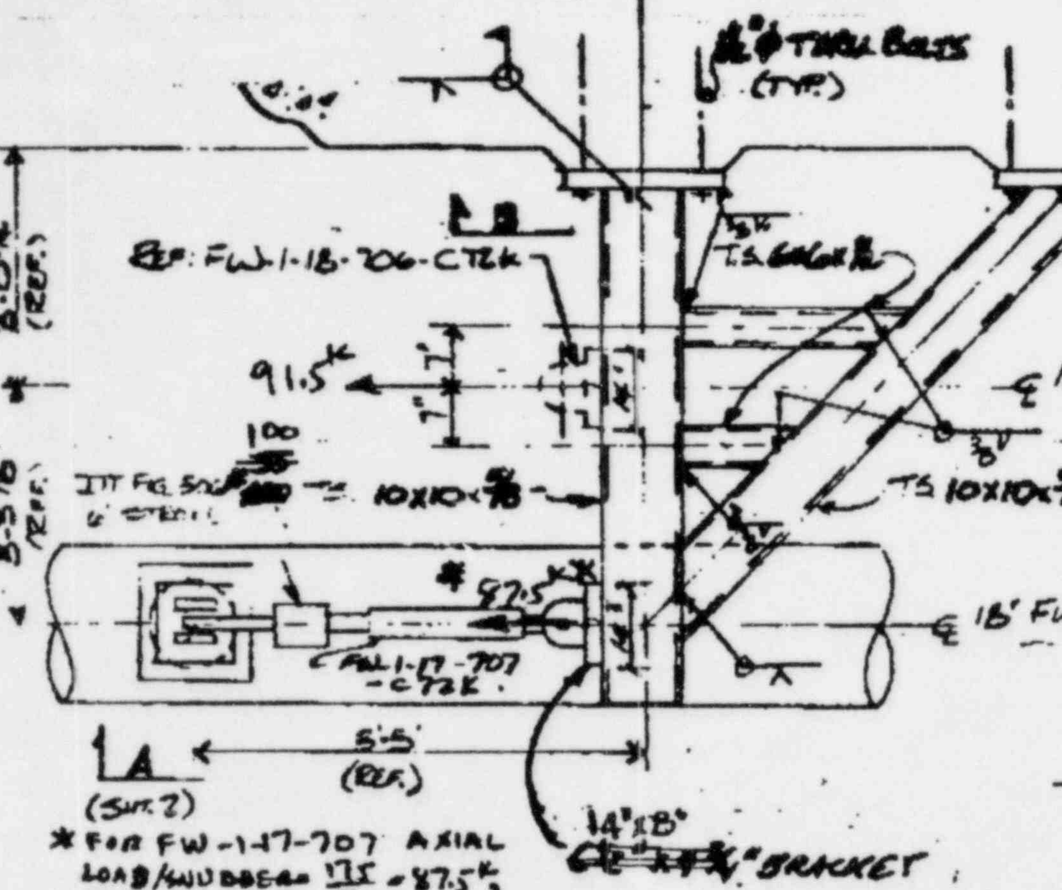
CALC. BY B.Bradley 7/17/87

CHK'D/APPRD. BY H. Lee

FOR AS-BUILT DESIGN SEE SH. 101 TO 122

SHEET 1 OF 3

REV. 4



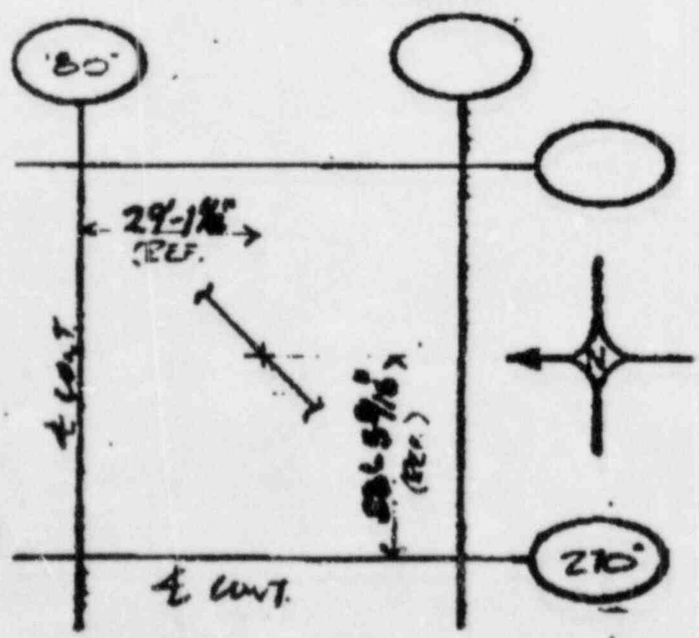
REV. 2 PKB DATE 9/19/83 CHKD. BY SPN DATE 9-21-83 REV. A

* FOR FW-1-17-707 AXIAL LOAD/SNUBBER = 175/2 = 87.5K, AS PER A.M. MEMO & AM-M-A157, DATED 4-11-82

PLAN AT EL. 888'-0 (REF.)

G&H JOB NO: 2323 CLIENT: TUSI
CALC. NO: SRB158C, SET 1
SHEET NO: 22
PREPARED BY: KN DATE: 4-12-82
VERIFIED BY: DGP DATE: 4-16-82

NOTE: THE SUPPORT RELEASED FOR WELDED ATTACHMENT ONLY RETURN DWG. TO ENGR. FOR INCORPORATION OF FINAL DESIGN.



LOCATION PLAN

PIPE MAT'L	SA-333 Gr. 6	REF. DWGS.	STRESS ISO.	REV
			MI-3208-07	J
INSUL. THK.	2		FAB. ISO.	REV
			FW-1-RB-02	E

MECHANICAL	REV	ELECTRICAL	REV
MI-506	B	E1-502-5	2
STRUCTURAL	REV	H.V.A.C.	REV
S-534	2	MI-557	5

DATA PT	SUPPORT LOADS KIPS					PIPE MVTS (INCHES)
8	DESIGN	SERVICE LEVEL LIMITS A	B	C	D	
VERT.						2'
N-S		14.85	14.85	29.7	35.5	-.45'
E-W		14.85	14.85	29.7	35.5	.21'

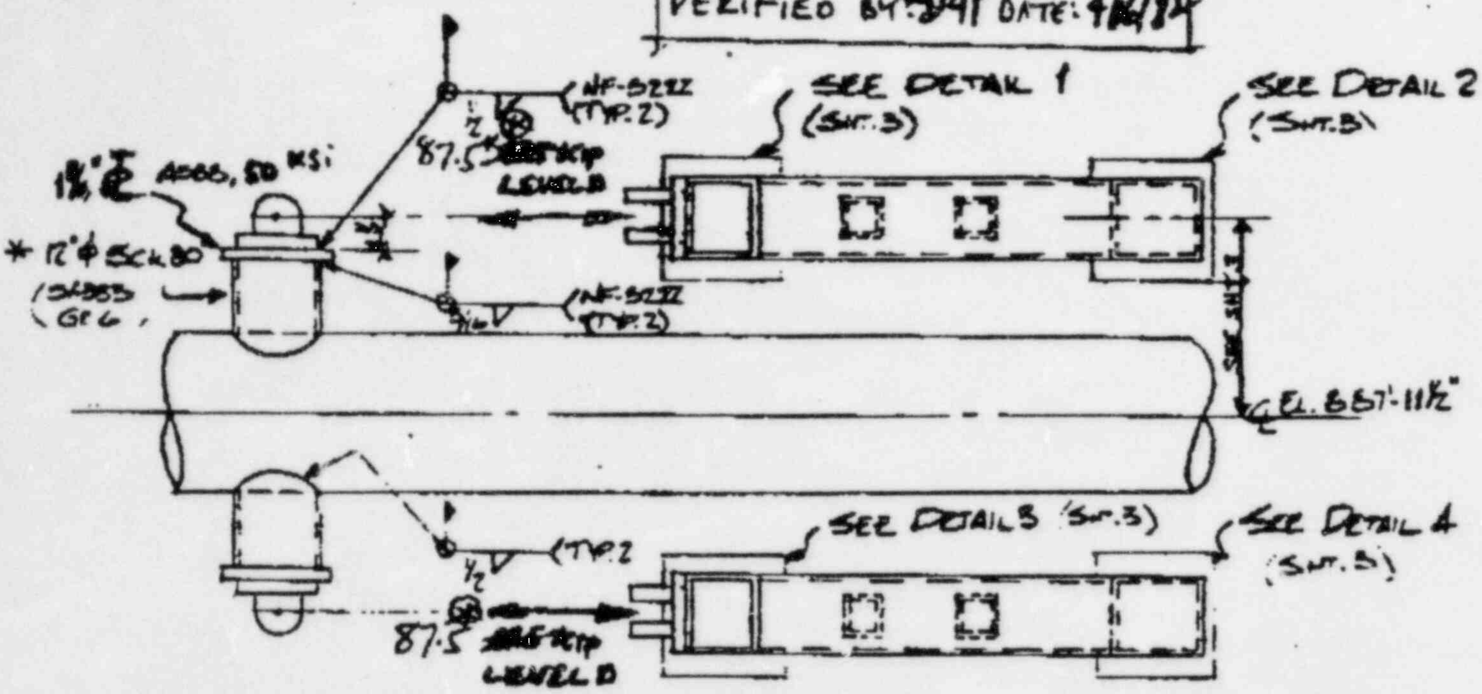
NOTE +N,E UP -S,W DN — AUTHORIZED NUCL. INSP. YES [X] NO [ ]
ASME CODE CLASS III/2

SUPPORT NO. FW-1-17-707-CT2K REV. 0

Calc. By BBWoolley 4/1/82

Ck'd/Apprd. By H. L&Z

G&H JOB No. 2323 CLIENT TU31
CALC No. SRB158C SET 1
SHEET No. 23
PREPARED: BK:KN DATE: 4.12.82
VERIFIED BY: DGP DATE: 4/.../82



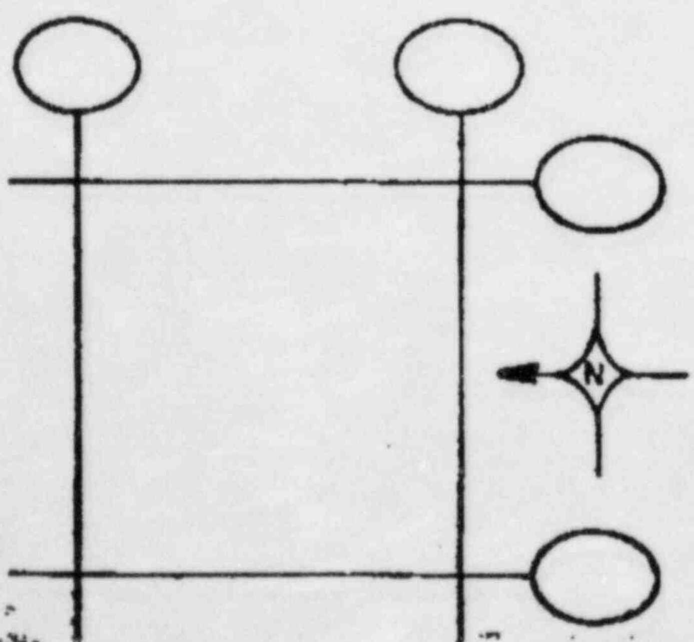
SECTION A-A

⊛ REVISED LOAD - SEE NOTE *, SH. 22

* IMPACT TEST REQD.

PREP. BY PKB DATE 9/19/83 CHKD. BY SPN DATE 9.21.83 CHECK METHOD	REV. 4

FOR AS-BUILT DESIGN SEE SH. 101 TO 122 — REV. 4



LOCATION PLAN

D.P.E.		REF DWGS	STRESS ISO	REV
MAT.				
INSUL. THK			FAB ISO	REV

MECHANICAL	REV	ELECTRICAL	REV
STRUCTURAL	REV	H.V.A.C	REV

DATA PT	SUPPORT LOADS (LBS)					PIPE MVTS (INCHES)
	DESIGN	SERVICE LEVEL LIMITS A	B	C	D	
VERT						
N-S						
E-W						

NOTE +N,E,UP -S,W,DN	AUTHORIZED NUCL. INSP. YES ☐ NO ☐ ASME CODE CLASS ______

SUPPORT NO. RW-1-17-707-C76K REV. 0

TEXAS UTILITIES SERVICES INC.
COMANCHE PEAK S.E.S.
Agent For
DALLAS POWER & LIGHT COMPANY
TEXAS ELECTRIC SERVICE COMPANY
TEXAS POWER & LIGHT COMPANY

Date ______

Calc By G.R. Adams

Chk'd/Apprd. By ______

Subject FW-1-017-707-C72K/FW-1-017-706-C72K

Ref. Dwg./Spec. No. ______

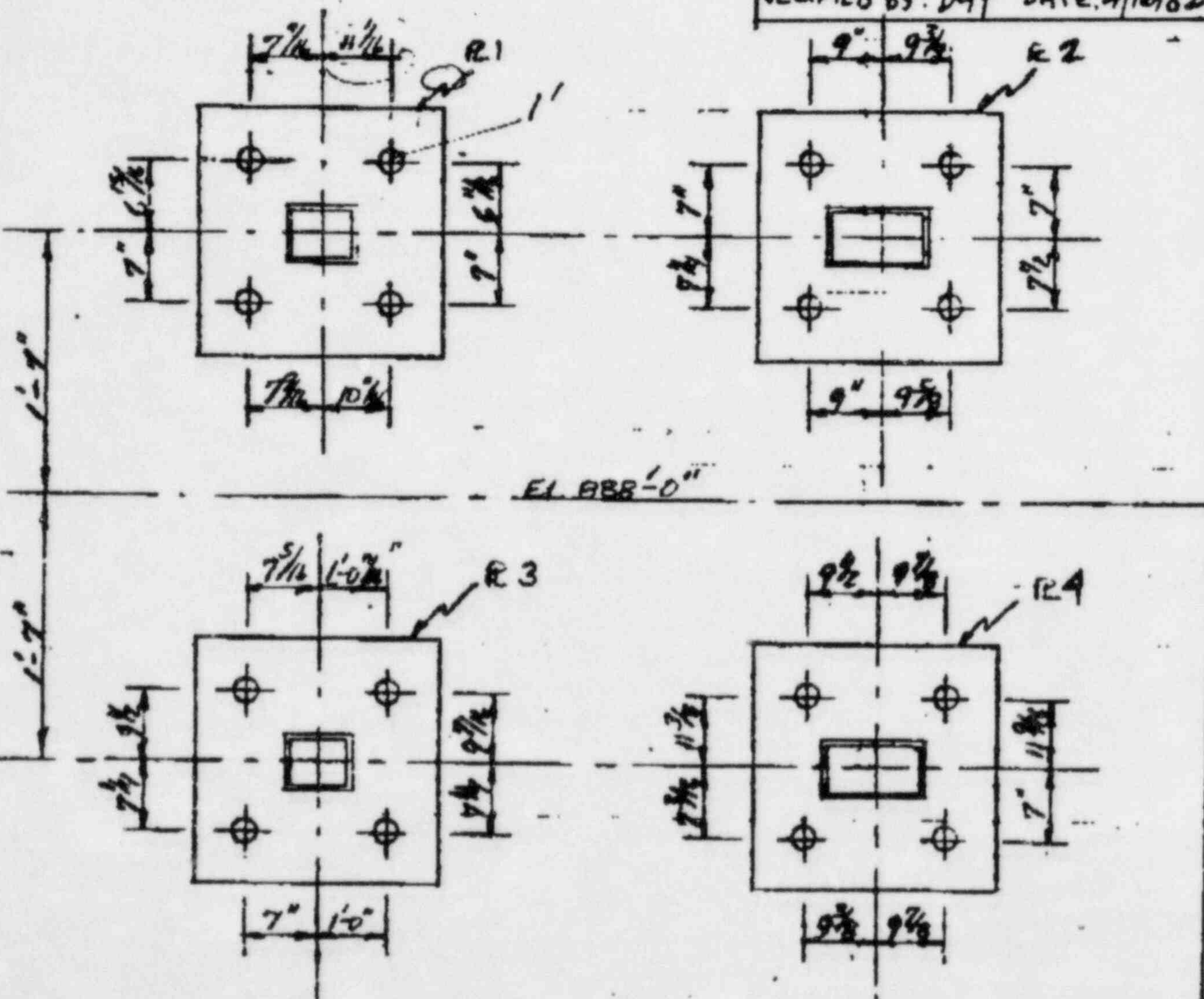
File Code ______

Sheet No. 3 of 3

G & H Job No. ______

18

G&H JOB NO: 2323 CLIENT: TUSI
CALC. NO: BRB 158C. SET 1
SHEET NO. 24
PREPARED BY: KN DATE: 4.12.82
VERIFIED BY: DGP DATE: 4/16/82



SECTION B-B

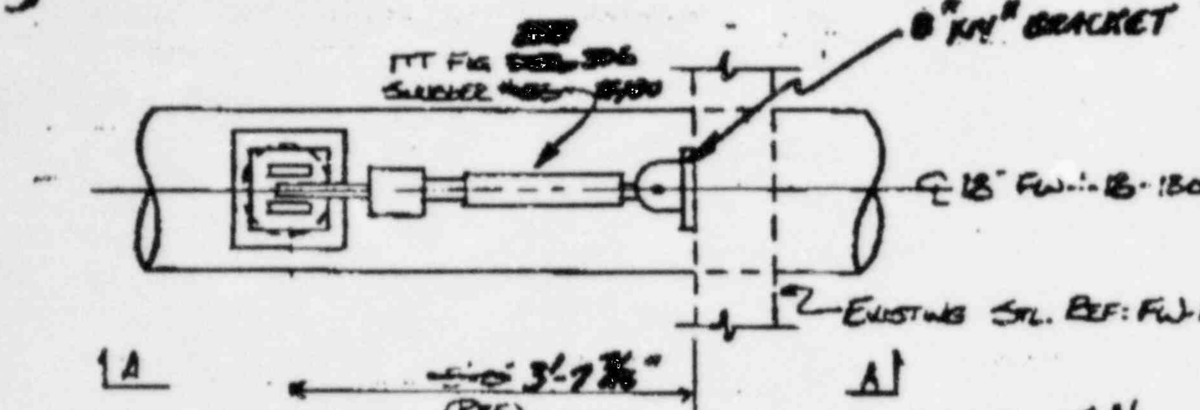
For as-built bolt location see sh. 110
REV. 4

PREP. BY SPN	REV.
DATE 9-19-83	4
CHKD. BY FKB	
DATE 9/21/83	
CHECK METHOD	

CALC BY [illegible] WADLEY 2/18/81

CHK'D/APPRD. BY H. L. [illegible]

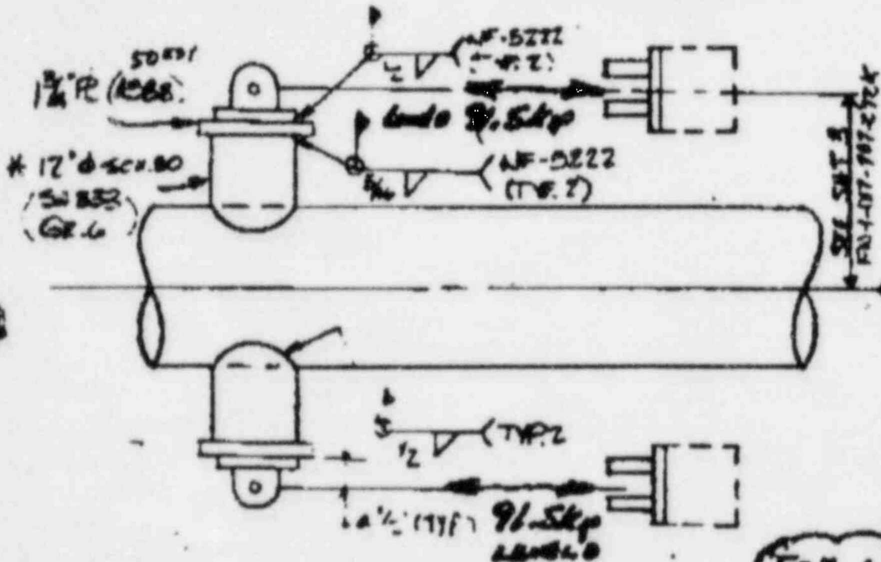
PKB		A
9/19/83		
SPH		
9.21.83		



PLAN AT EL. 888-0 (REF.)

N

G&H JOB No: 2323 CLIENT: TUSI
CALC. No: SRB 158 C - SET 1
SHEET No. 25
PREPARED BY: KN DATE 4/12/82
VERIFIED BY: DGP DATE 4/16/82



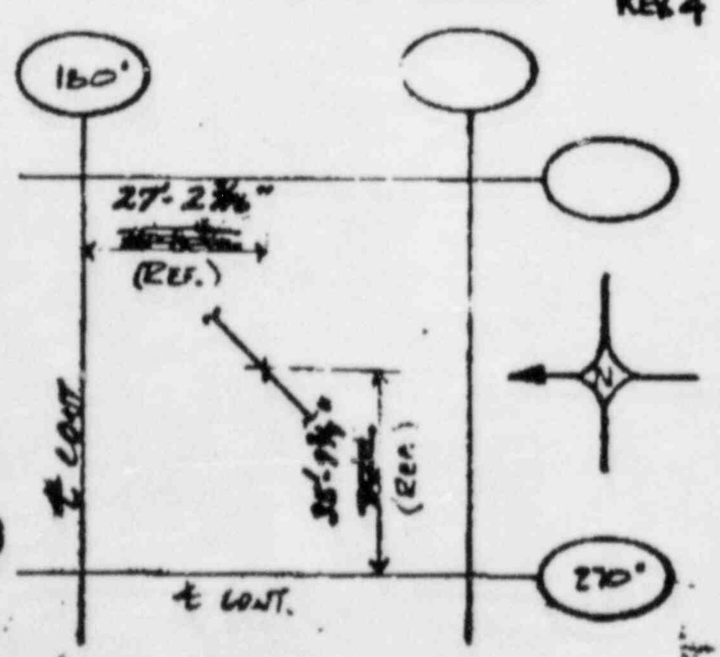
SECTION A-A

* IMPACT TEST REQ'D

NOTE: THIS SUPT. RELEASED FOR WELDED ATTACHMENT ONLY. RETURN PKG. TO ENGR FOR INCORPORATION OF FINAL DESIGN.

FOR AS-BUILT DESIGN, SEE SH. 101 TO 122

REV. 4



LOCATION PLAN

PIPE MAT'L	SA-333 Gr. 6	REF DWGS.	STRESS ISO.	REV
			M1-3203-04	1
INSUL. THK.	2"		FAB ISO	REV
			FW-1-RB-04	2

MECHANICAL	REV	ELECTRICAL	REV
M1-506	8	E1-502-5	2
STRUCTURAL	REV	H.V.A.C	REV
S1-534	2	M1-502	3

DATA PT	SUPPORT LOADS (LBS)					PIPE MVTS (INCHES)
7	DESIGN	SERVICE LEVEL LIMITS A	B	C	D	
VERT						2.97"
N-S		13,430	13,430	26,870	[illegible]	1.88"
E-W		13,450	13,430	26,870	[illegible]	1.95"

NOTE +N,E UP. -S,W DN	AUTHORIZED NUCL. INSP. YES [X] NO [ ]
	ASME CODE CLASS III/2

SUPPORT NO. FW-1-18-706-C72K REV. 0

Gibbs & Hill, Inc. Job No. 2323 Client TUSI

Subject F.W. PIPING - WATER HAMMER PIPE SUPPORTS, R.B.1

Calculation Number SRB-158 C, SET 1 Sheet No. 23

Revision	Orig. Issue	Date	Rev. 4	Date	Rev.	Date	Rev.	Date	Rev.	Date
(Status)	I		I							
Preparer	DW	4-9-82	SPN	9.19.83						
Checker	DGP	4-16-82	PKB	9/21/83						

DESIGN OF BASE PLATES AND ANCHORAGE

(A) PLATES '1 AND 3' { PLATE 3 - DESIGNED HERE, SAME DESIGN USED FOR '1' }

(1) THE MAXIMUM STRESS IN BASE PLATE:

FROM THE COMPUTER OUTPUT

SRB-149P, SET 6 - 'J 1085' AND 'ITERATION 4',

WE HAVE, IN ELEMENT 12 [NODES 68, 70, 86, 84]

THE MAX PRINCIPAL STRESS = 31.982 KSI

< 41 KSI ∴ O.K.

Rev.4 — For as-built design See sh. 101 TO 122

(2) THE FORCES IN BOLTS:

FROM THE 'REACTION FORCES' AT THE END OF 'ITERATION 4' ABOVE REFERENCE

NODE	TENSION
10	75.46 K
29	9.45 K
99	60.5 K
109	6.65 K

Checking Method #
1. Line by line checking
2. Alternative Calculation Results compared
3. Method of Calculation Results compared
4. Compare inputs and results of computer with corresponding inputs and results of similar cases.

Gibbs & Hill, Inc. Job No. 2323 Client TUSI

Subject F.W. PIPING - WATER HAMMER PIPE SUPPORTS, R.B. 1

Calculation Number SRB - 158 C, SET 1 Sheet No. 34

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date
Checking Method #	1	X		X		X		X		X
Preparer	DVK	4-9-82								
Checker	DGP	4-16-82								

∴ TMAX IS IN BOLT # 3 = 76.46 K
(NODE 19) (SEE SH 33 AND)

SHEAR IN BOLT # 3 = 11.3 K (SH 32)

DESIGN OF ANCHORAGE:

A.B ARE $1\frac{1}{2}$"Ø THRD BOLTS (MATERIAL OF BOLTS IS ASTM A193-GR B-7)

MATERIAL A193-B7 HAS IDENTICAL STRESS PROPERTIES AS THAT OF A320 (SEE SRB-154C, SET 1, REV SH 69)

A TENSILE OF $1\frac{1}{2}$"Ø BOLT = 1.405 IN^2

ANCHOR BOLT AREA: (SRB-123C, SET 1 SH 7)

AREA REQUIRED FOR TENSION,

$$A_t = \frac{T_B}{.16 f_u} = \frac{76.46}{75.2} = 1.02 \ \square''$$

AREA REQUIRED FOR SHEAR,

$$A_V = \frac{V_B}{0.5 f_u} = \frac{11.3}{0.85 \times 105 \times 0.55} = 0.23 \ \square''$$

Checking Method #
1. Line by line checking
2. Alternative Calculation Results compared
3. Identical Calculation Results compared
4. Computer inputs and results of computer with corresponding inputs and results of similar series.

F-166, 4-81

Gibbs & Hill, Inc.	Job No. 2323	Client	TUSI

Subject F.W. PIPING — WATER HAMMER PIPE SUPPORTS, R.B. 1

Calculation Number SRB-123C, SET 1   Sheet No. 35

Revision	Original Issue	Date	Rev. 4	Date	Rev.	Date	Rev.	Date	Rev.	Date
Quality Class	1		1							
Preparer	D.K.	4-9-82	S.P.N.	9.19.83						
Checker	DGP	4-16-82	PKB	9/21/83						

∴ TOTAL AREA REQUIRED:

$\Sigma A = 1.02 + 0.23 = 1.25\square'' < 1.405\square''$ O.K.

For as built design see Sh. 101 TO 122 ~ Rev. 4

② MINIMUM CAPACITY (SRB-123C, SET 1, SH 7)

EFFECT DUE TO TENSION AND SHEAR

IN BOLT:

$T_B + V_B <$ { TENSILE CAPACITY OF BOLT; PULLOUT STRENGTH OF CONC; ANCHORAGE CAPACITY }

Checking Method #

F-166, 4-81

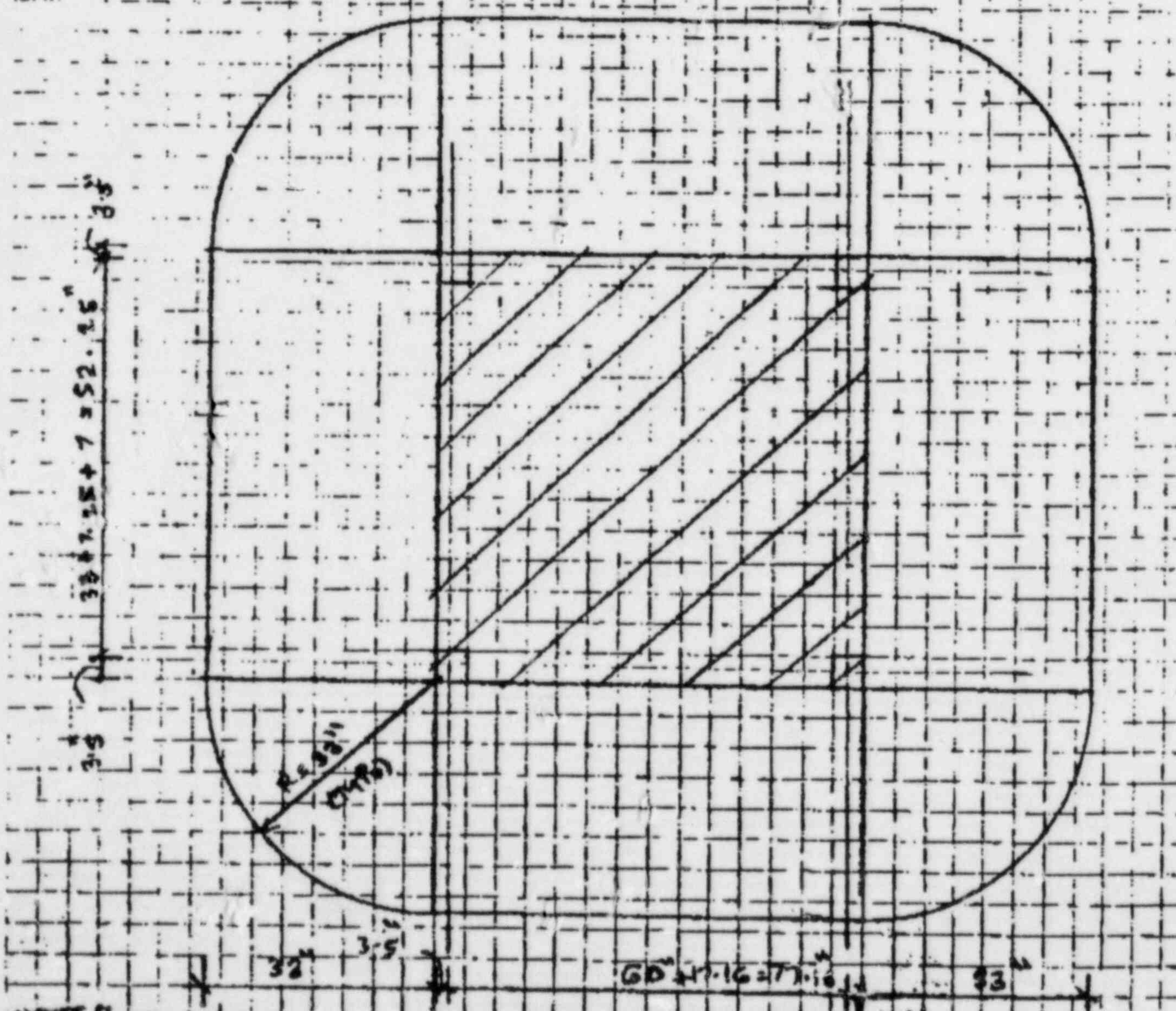
Gibbs & Hill, Inc. Job No. 2323 Client TUSI

Subject F.W. - PIPING - WATER HAMMER PIPE SUPPORTS, R.S. 1

Calculation Number SRB-158 C, SET 1 Sheet No. 35

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date
(Identity letter)	1	X		X		X		X		X
Preparer	DLK	4-9-82								
Checker	DGP	4-16-82								

PULL-OUT CAPACITY OF CONCRETE



NOTES:

① ANCHOR PLATES ASSUMED 7"x7"x

② THE PULL-OUT CAPACITY IS CALCULATED FOR ALL

Checking Method #

F-166, 4-81

Gibbs & Hill, Inc. Job No. 2323 Client TUSI

Subject F.W. PIPING - WATER HAMMER PIPE SUPPORTS, R.B.1

Calculation Number SRB-158C, SET 1 Sheet No. 37

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date
Checking Method #	1									
Preparer	DW	4-9-82								
Checker	DGP	4-16-82								

16 BOLTS, SUBTRACTING THE COMMON AREA

SHARED [(1.80.25+7) x (77.16+7) = 4086.48 □"]

NOW, EFFECTIVE AREA = 2 x 59.45 x 33 + 2 x 84.16 x 33

+ $\pi \times 33^2$

= 12886.25 □"

∴ PULL-OUT LOAD = $4\phi\sqrt{f'_c} \times A_R$

= 4 x 0.85 x $\sqrt{4000}$ x 12886.25

= 2771 0.99 K

= 173.19 K/BOLT > 87.76 K/BOLT

O.K.

(3) ANCHORAGE CAPACITY

ASSUME ANCHOR 2" x 7" x 7" AND $1\frac{5}{8}$" φ HOLE,

NET AREA OF ANCHOR PL = (7x7) - $\frac{1}{4}$ x π x 1.625^2

∴ A_{NET} = 46.93 □"

MAX TENSION IN BOLT = 76.46 K

SHEAR = 11.2 ∴ ΣT + V = 87.76 K

$\frac{T_{BOLT}}{A_{NET}} = \frac{87.76}{46.93} = 1.87$ KSI

Checking Method #
1. Line-by-line checking
2. Alternative Calculation Results compared
3. Standard Calculation Results compared
4. Compare inputs and results of computer with corresponding inputs and results of similar codes.

F-166, 4-81

PETELECOPY TO H. DEEM 3-2-84

Gibbs & Hill, Inc. Job No. 2323 Client TUGCO

Subject F.W. PIPING - WATER HAMMER PIPE SUPPORTS, SET 1

Calculation Number FRB - 158 C, SET 1 Sheet No. 38

Revision	Initial	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date
	J									
Preparer	DVK	9.3.82								
Checker	DGT	6-16-82								

$w = 4.87\ k/_{in}$

$M = \frac{19.87 \times 3.5^2}{2} = 11.45\ ^{in-k}$

$t = \sqrt{\frac{6 \times 11.45}{1 \times 41}} = 1.3 < 2''$

∴ O.K.

∴ USE ANCHOR PL 2" × 7" × 7

CONCLUSION:

THE LOADS ARE ACCEPTABLE

FOR LATTER'S INFORMATION - NOT DISCOVERABLE

Checking Method #
1. Line-by-line checking
2. Alternative Calculation Results compared
3. Identical Calculation Results compared
4. Compare inputs and results of computer with corresponding inputs and results of similar cases.

F-166, 4-81