



8

101 California Street, Suite 1000, San Francisco, CA 94111-5894

415 397-5600

July 31, 1984  
84042.025

Mrs. Juanita Ellis  
President, CASE  
1426 S. Polk  
Dallas, Texas 75224

Subject: Telecon Transmittal #10  
Comanche Peak Steam Electric Station  
Independent Assessment Program - Phase 3  
Texas Utilities Generating Company  
Job. No. 84042

Dear Mrs. Ellis:

Enclosed please find telecons associated with the Phase 3 Independent Assessment Program.

If you have any questions or desire to discuss any of these documents, please do not hesitate to call either me or Donna Oldag.

Very truly yours,

N. H. Williams  
Project Manager

Attachments

cc: Mr. D. Wade (TUEC) w/attachments  
Mr. S. Treby (USNRC) w/attachments  
Mr. G. Grace (TUEC) w/attachments  
Mr. D. Pigott (Orrick, Herrington & Sutcliffe) w/o  
Mr. S. Burwell (USNRC) w/attachments

8409040089 840731  
PDR ADOCK 05000445  
A PDR

2222  
1/1

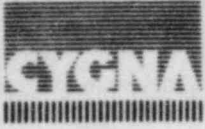




# Communications Report

Company:	Texas Utilities	<input type="checkbox"/> Telecon	<input checked="" type="checkbox"/> Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No:	84042
		Date:	6/21/84
Subject:	Pipe Support Follow-up Questions	Time:	11:20 a.m.
		Place:	Site
Participants:	G. Grace, D. Rencher	of	TUSI
	J. Minichiello		Cygna

Item	Comments	Required Action By
1.	<p><u>MS-1-001-005-S72R</u></p> <p>Cygna did not see evidence that the 5% decrease in I and S had been incorporated. Mr. Rencher stated that the note on the drawing (no warpage) supersedes the CMC and the items may not warp (QC must inspect to this note and certify the support satisfactory). On new vendor certifications (after the memo) the 5% should be incorporated. Texas does plan to update vendor certifications done prior to that memo (Note, QC is responsible for the final determination on the acceptability of warpage and the need for an NCR). Cygna requests clarification on the schedule for incorporating the memo.</p>	
2.	<p>NPSI has stated they are responsible for the pads needing qualification to Appendix G. Their calculations (MS-1-001-003-C72K and MS-1-004-009-C72K) stated Gibbs &amp; Hill is responsible. What organization is responsible for design and what allowables will be used?</p>	
3.	<p><u>MS-1-003-004-C72S</u></p> <p>Cygna requested weld calculations for 1' x 12' x 7' plate to tube steel (both composite section and load transfer) and an assessment of the washer plate stresses.</p>	



# Communications Report

Company: Texas Utilities

Telecon

Conference Report

Project: Comanche Peak Steam Electric Station  
Independent Assessment Program - Phase 3

Job No. 84042

Date: 7/13/84

Subject: Pipe Support Loads

Time: 2:45 p.m.

Place: CES-SF

Participants: J. Finneran

of TUEC

N. Williams

Cygn

J. Minichiello

Cygn

Item	Comments	Required Action By
	<p>Mr. Finneran reviewed Gibbs and Hill's response on the Main Steam Support loads (GTN-69233) and agrees with the Gibbs and Hill response. He explained that the course followed was not the normal course at CPSES, but that it would be occasionally done when G&amp;H made small changes in assumptions for their stress work and found negligible increases in support loads.</p>	

Signed: *D. Wade for NHW*

/ms Page 1 of 1

Distribution: N. Williams, D. Wade, G. Grace, J. Minichiello, S. Treby, J. Ellis, S. Burwell,

Project File



# Communications Report

Company:	Texas Utilities	<input checked="" type="checkbox"/> Telecon	<input type="checkbox"/> Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No:	84042
		Date:	7/3/84
Subject:	G&H Letter GTN-69190 Corrective Action Systems - Surveillance Reports	Time:	3:45 p.m.
		Place:	Boston
Participants:	S. Bibo	of	Cygna
	Borys Czarnorgorski		G&H

Item	Comments	Required Action By
	<p>I called Borys to ask him two questions about Item B of the above referenced letter. I wanted to know how many surveillance reports were actually issued from 1974 through 1977, so I could select a sample for review. I also asked if a log of surveillances had been kept for reports issued from 1974 through 1977, which I could use to select design-related surveillances.</p> <p>Borys told me there were as many surveillance reports from 1974 through 1977 as there were drawings, specifications, and calculations issued. I asked him to explain this and he stated that prior to 1978, surveillances were not done on a "special, as-needed basis." They were nothing more than a QA check of the calculation drawing, or specification to assure compliance with QA requirements. Borys stated that in 1978, the procedure was changed to insure that surveillances are performed on an as-needed basis to track problem areas that have been identified.</p> <p>Borys also stated that due to the nature of the surveillance reports, there was no log prior to 1978. There is a log, however, for surveillance reports issued after 1978.</p>	



# Communications Report

Company:	Texas Utilities	<input checked="" type="checkbox"/> Telecon	<input type="checkbox"/> Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No.	84042
		Date:	7/3/84
Subject:	Value Qualification Issue	Time:	12:00 noon
		Place:	SF
Participants:	G. Grace	of	Ebasco
	L. J. Weingart		CES

Item	Comments	Required Action By
	George Grace called to discuss the value qualification issue (Communications Report 5/24/84, Item 1). George explained that the as-built loads were never transmitted to Fisher, but the value is qualified to the capacity of each snubber. I requested that he provide documentation to support this. I then explained that the upset load for one of the snubbers in AB-1-23B is reported as over 12 KIPS due to an SAM load of 10.6 KIPS. George responded that this line was rerun to address this problem. This was never documented in the QA binder. I requested George to send a copy of the calculation justifying the lower SAM values as well as the input and output of the ADLPIPE run.	G. Grace



# Communications Report

Company:	Texas Utilities	<input checked="" type="checkbox"/> Telecon	<input type="checkbox"/> Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No.	84042
		Date:	7/3/84
Subject:	Load Splits for Double Trunnions	Time:	10:00 a.m.
		Place:	Washington
Participants:	H. Mentel, P. Bogart,	of	Gibbs & Hill
	J. Minichiello		Cygna

Item	Comments	Required Action By
	Cygna asked Gibbs & Hill to describe their standard procedure for dividing loads at double trunnions or shear lugs. Phil Bogart stated that loads are divided 50/50 for trunnions. For shear lugs, it is assumed only 1/2 the lugs take the load when performing the local stress analysis.	



# Communications Report

Company:	Texas Utilities	<input checked="" type="checkbox"/> Telecon	<input type="checkbox"/> Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No:	84042
		Date:	7/3/84
Subject:	Information on ITT Grinnell Procedures Design Control Review	Time:	9:00 a.m.
		Place:	Providence RI
Participants:	S. Bibo	of	CES
	D. Powers		ITT

Item	Comments	Required Action By																
	<p>I called Dave Powers to ask for some information relative to the abbreviations that the Cygna reviewer had included on his checklist during the review at ITT Grinnell design control review.</p> <table border="1"> <thead> <tr> <th><u>Question</u></th> <th><u>Answer</u></th> </tr> </thead> <tbody> <tr> <td>What is EDP?</td> <td>Electronic Data Processing.</td> </tr> <tr> <td>What is ISPAM?</td> <td>Engineering Services QA Manual.</td> </tr> <tr> <td>What is QCES?</td> <td>This is a section of the ESQAM.</td> </tr> <tr> <td>What is QCRS?</td> <td>This is a section of the ESQAM.</td> </tr> <tr> <td>What is QCEA?</td> <td>This is a section of the ESQAM.</td> </tr> <tr> <td>What is QCH?</td> <td>This is a section of the Hanger Division of QA Manual.</td> </tr> <tr> <td>What was the date of P.O. with TUI?</td> <td>October 4, 1976.</td> </tr> </tbody> </table>	<u>Question</u>	<u>Answer</u>	What is EDP?	Electronic Data Processing.	What is ISPAM?	Engineering Services QA Manual.	What is QCES?	This is a section of the ESQAM.	What is QCRS?	This is a section of the ESQAM.	What is QCEA?	This is a section of the ESQAM.	What is QCH?	This is a section of the Hanger Division of QA Manual.	What was the date of P.O. with TUI?	October 4, 1976.	
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# Communications Report

Company:	Texas Utilities	<input checked="" type="checkbox"/> Telecon	<input type="checkbox"/> Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No.	84042
		Date:	6/27/84
Subject:	Design Control Review Inspection Report Logs	Time:	2:00 p.m.
		Place:	Cygnia, SFRO
Participants:	S. Bibo, D. Smedley	of	CES
	D. Lewellen		TUEC

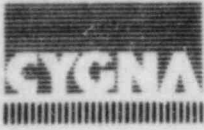
Item	Comments	Required Action By
	<p>I called Donna Lewellen to ask three questions about the inspection record logs (manual and computerized).</p> <ol style="list-style-type: none"> <li>1. Which log is the control log?</li> <li>2. How is the computerizer log updated?</li> <li>3. What is the computerizer log used for?</li> </ol> <p>Ms. Lewellen's responses were as follows:</p> <ol style="list-style-type: none"> <li>1. The manual log is the official QCIR status log.</li> <li>2. The computerized log is updated when unsatisfactory IRs are closed and sent to the permanent plant records vault (PPRV).</li> <li>3. The computerized log is used for tracking and aiding in the retrieval of unsatisfactory IRs. It is used only as an information aid.</li> </ol>	



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Company:	Texas Utilities	<input type="checkbox"/> Telecon	<input checked="" type="checkbox"/> Conference Report
Project:	Comache Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No:	84042
		Date:	6/21/84
Subject:	Data Request - Pipe Support Reviews	Time:	1:15 p.m.
		Place:	Site
Participants:	D. Bleeker	of	DCC
	J. Minichiello		Cygna

Item	Comments	Required Action By
	Cygna requested the following drawings (latest rev. and changes) (BRH) CT-1-076-409-C82R CT-1-076-403-C82R CT-1-014-416-C72R	



# Communications Report

Company:	Texas Utilities	<input type="checkbox"/> Telecon	<input checked="" type="checkbox"/> Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No.	84042
		Date:	6/20/84
Subject:	Data Request - Pipe Support Reviews	Time:	10:30 a.m.
		Place:	Site
Participants:	N. Munoz	of	DCC
	J. Minichiello		Cygna

Item	Comments	Required Action By																														
	<p>Cygna requested copies of the drawings listed below (latest revision, no changes).</p> <p style="text-align: center;"><u>Missing Sketches</u></p> <table border="0"> <tr> <td>SW-2-026-002-J03R</td> <td>AF-1-096-707-S62K</td> </tr> <tr> <td>DO-1-058-002-S53R</td> <td>CT-1-046-019-C92K</td> </tr> <tr> <td>CS-1-014-027-S52K</td> <td>CT-1-048-046</td> </tr> <tr> <td>CC-1-018-003-53R</td> <td>CC-2-087-003-A33A</td> </tr> <tr> <td>SW-064-(056)-007-S22R</td> <td>SF-X-033-010-F52B</td> </tr> <tr> <td>CC-2-10-705-A43R</td> <td>CT-1-006-700-S22S</td> </tr> <tr> <td>SI-1-070-S22A</td> <td>MS-1-034-002-T44S</td> </tr> <tr> <td>CC-1-006-006-C53A</td> <td>CT-1-22-003-S35S</td> </tr> <tr> <td>CC-2-10-705-A43R</td> <td>CT-1-019-008-S32K</td> </tr> <tr> <td>BR-X-044-058-A53R</td> <td>CT-1-55-445-C62R</td> </tr> <tr> <td>SW-2-173-001-A33K</td> <td>DO-1-023-011-433A</td> </tr> <tr> <td>FW-1-98-098-C62S</td> <td>DO-1-067-033-433A</td> </tr> <tr> <td>CT-1-135-419-C72K</td> <td>DO-1-024-011-433A</td> </tr> <tr> <td>CC-1-050-007-A43K</td> <td>CC-2-159-413-A43A</td> </tr> <tr> <td>CT-1-004-009-S32A</td> <td></td> </tr> </table>	SW-2-026-002-J03R	AF-1-096-707-S62K	DO-1-058-002-S53R	CT-1-046-019-C92K	CS-1-014-027-S52K	CT-1-048-046	CC-1-018-003-53R	CC-2-087-003-A33A	SW-064-(056)-007-S22R	SF-X-033-010-F52B	CC-2-10-705-A43R	CT-1-006-700-S22S	SI-1-070-S22A	MS-1-034-002-T44S	CC-1-006-006-C53A	CT-1-22-003-S35S	CC-2-10-705-A43R	CT-1-019-008-S32K	BR-X-044-058-A53R	CT-1-55-445-C62R	SW-2-173-001-A33K	DO-1-023-011-433A	FW-1-98-098-C62S	DO-1-067-033-433A	CT-1-135-419-C72K	DO-1-024-011-433A	CC-1-050-007-A43K	CC-2-159-413-A43A	CT-1-004-009-S32A		
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# Communications Report

Company:	Texas Utilities	<input type="checkbox"/> Telecon	<input checked="" type="checkbox"/> Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 3	Job No:	84042
		Date:	6/21/84
Subject:	Pipe Support Reviews Missing Attachment to TUGCO Response	Time:	3:00 p.m.
		Place:	Site
Participants:	G. Grace	of	TUEC
	J. Minichiello		Cygn

Item	Comments	Required Action By
	Texas supplied the attached calculation (CC-1-028-007-S33R) which was missing from Attachment C of TUGCO's 6/8/84 letter to Cygna.	

84042

REC'D 6/21/84

TEXAS UTILITIES SERVICES INC.  
COMANCHE PEAK S.E.S.

Agent For

DALLAS POWER & LIGHT COMPANY  
TEXAS ELECTRIC SERVICE COMPANY  
TEXAS POWER & LIGHT COMPANY

Filing Code \_\_\_\_\_

Sheet No. 1 Of 9

G & H Job No. \_\_\_\_\_

Date 6-19-84

Calc By GMC

Chg'd/A. prd. By MB 6-21-84

Subject CC-1-028-007-533R

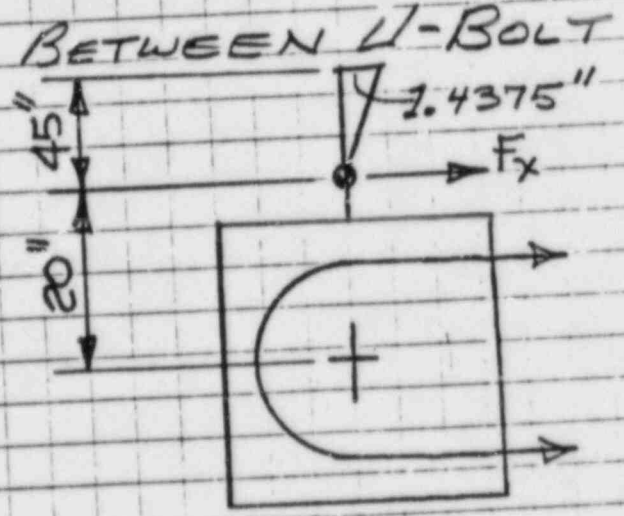
Ref. Desig./Spec. No. \_\_\_\_\_

**OBJECTIVES:** THE CALCULATIONS DATED 3/23/84, BY "A.T.", TO DESIGN U-BOLTS ADDED TO ENHANCE LATERAL STABILITY, HAD AN ERROR IN THE CALCULATIONS. ON PAGE 4 OF 6 OF THE REF'D CALCULATIONS, THE ASSUMED LENGTH OF THE U-BOLT IS NOT CORRECT. THE ERROR IS UNCONSERVATIVE, BUT BECAUSE OF OTHER CONSERVATIVE ASSUMPTIONS MADE ELSEWHERE IN THE CALC'S THE DESIGN IS STILL MORE THAN SUFFICIENT. THE FOLLOWING CALCULATIONS WILL DEMONSTRATE THAT.

**REQUIRED FRICTION BETWEEN U-BOLT AND PIPE**

SWAY STRUT C-C = 45"  
 $F_y = 6018 \# @ \text{EMER.}$

$$\begin{aligned} \therefore F_x &= \tan \theta F_y \\ &= \frac{1.4375''}{45''} (6018 \#) \\ &= 192 \# \end{aligned}$$



$\theta$  IS  $1.82^\circ$ , FOR CONSERVATISM CONSIDER THE MAX SWING OF A STRUT BRACKET  $5^\circ$

$$\therefore F_x = \tan 5^\circ F_y = 526 \#$$

$$\text{TORSION @ } \& \text{ OF PIPE} = 526 \# (20'') = 10,520 \text{ IN} \#$$

SINCE THERE ARE 2 U-BOLTS  $\frac{10520 \text{ IN} \#}{2} = 5260 \text{ IN} \#$  EACH

TEXAS UTILITIES SERVICES INC.  
COMANCHE PEAK S.E.S.

Date 6-19-84

Calc By GMC

Chk'd/Approved By MJB 6-21-84

Subject CC-1-028-007-533R

Agent For  
DALLAS POWER & LIGHT COMPANY  
TEXAS ELECTRIC SERVICE COMPANY  
TEXAS POWER & LIGHT COMPANY

Filing Code \_\_\_\_\_

Sheet No 2 of 9

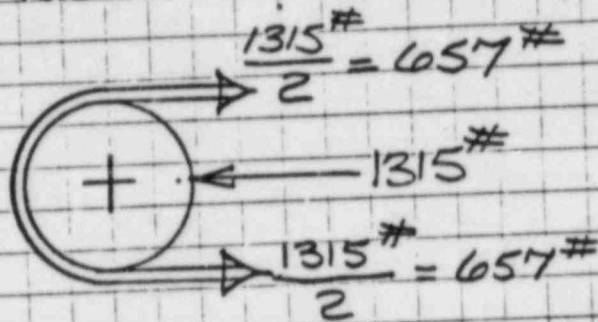
G & H Job No \_\_\_\_\_

Ref. Dwg./Spec. No \_\_\_\_\_

FRICITION REQ'D TO RESIST 5260 IN<sup>#</sup> TORSION

$$\frac{5260 \text{ IN}^{\#}}{\text{PIPE RAD.}} = \frac{5260 \text{ IN}^{\#}}{12 \text{ IN}} = 438^{\#} \text{ TOTAL FRICTIONAL RESISTANCE}$$

FRICITION = 1/3 BEARING, ∴  $438^{\#} (3) = 1315^{\#}$  BEAR'G REQ'D



Use 2:1 FACTOR OF SAFETY

$657^{\#} (2) = 1315^{\#}$  TENSION REQ'D IN EMER. COND.

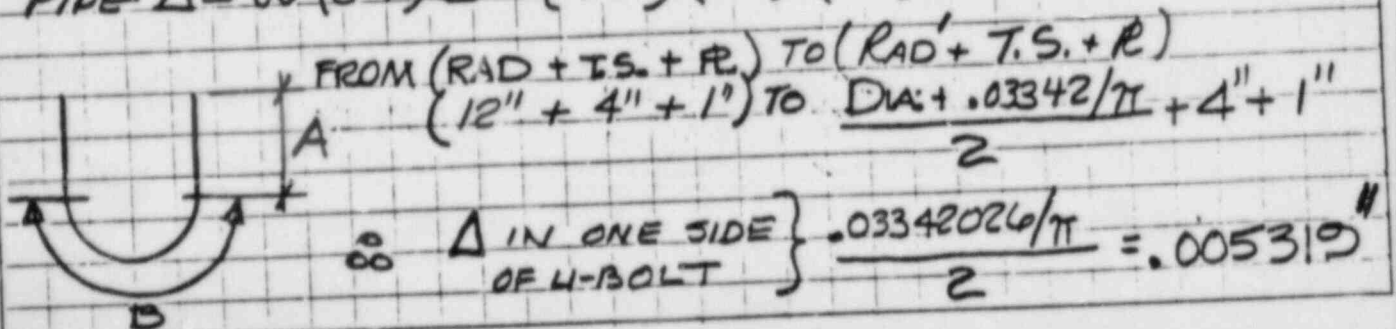
TENSION IN U-BOLT BECAUSE OF:

- a) TEMPERATURE
- b) RADIAL EXPANSION OF PIPE DUE TO PRESSURE
- c) TORQUE ON U-BOLT.

a) TEMPERATURE  $T_{\text{AMBIENT}} = 75^{\circ}$   
 $T_{\text{PIPE}} = 150^{\circ}$

∴  $\delta T = 150^{\circ} - 75^{\circ} = 75^{\circ}$

PIPE  $\Delta = \alpha (\delta T) L = (5.91) (10^{-6}) (75^{\circ}) (\pi D L) = .0334202$



TEXAS UTILITIES SERVICES INC.  
COMANCHE PEAK S.E.S.

Agent For

DALLAS POWER & LIGHT COMPANY  
TEXAS ELECTRIC SERVICE COMPANY  
TEXAS POWER & LIGHT COMPANYDate 6-19-84

Filing Code \_\_\_\_\_

Calc. By GMCSheet No. 3 Of 9Chk'd/Approved By MJB 6-21-84

G &amp; H Job No. \_\_\_\_\_

Subject CC-1-028-007-533R

Ref. Dwg./Spec. No. \_\_\_\_\_

a) CONTINUED

## PORTION B OF U-BOLT

NOTE THAT MSS SP-58, 4.5 STATES THAT PORTIONS OF SUPPORTS IN CONTACT WITH PIPE WILL EXPERIENCE SAME TEMP. AS PIPE.  $^{\circ}$   $^{\circ}$ , SINCE BOTH ARE CARBON STEEL, NO ADD'L PRETENSIONING, WILL RESULT IN PORTION B.

PORTION A, U-BOLT, WILL ELONGATE SOME DUE TO TEMPERATURE. MSS SP-58 STATES THAT THE TEMP. IN THIS AREA IS  $\frac{1}{3}$  OF PIPE OR AMBIENT WHICH EVER IS GREATER.

$$\left(\frac{1}{3}\right)(150^{\circ}) = 50^{\circ} \quad T_{AMB.} = 75^{\circ}$$

$^{\circ}$   $^{\circ}$  CONSIDER NO CHANGE

TEXAS UTILITIES SERVICES INC.  
COMANCHE PEAK S.E.S.

Agent For  
DALLAS POWER & LIGHT COMPANY  
TEXAS ELECTRIC SERVICE COMPANY  
TEXAS POWER & LIGHT COMPANY

Date 6-19-84

Calc By GMC

Chk'd/App'd. By MB 6-21-84

Subject CC-1-028-007-533R

Filing Code \_\_\_\_\_

Sheet No. 4 Of 9

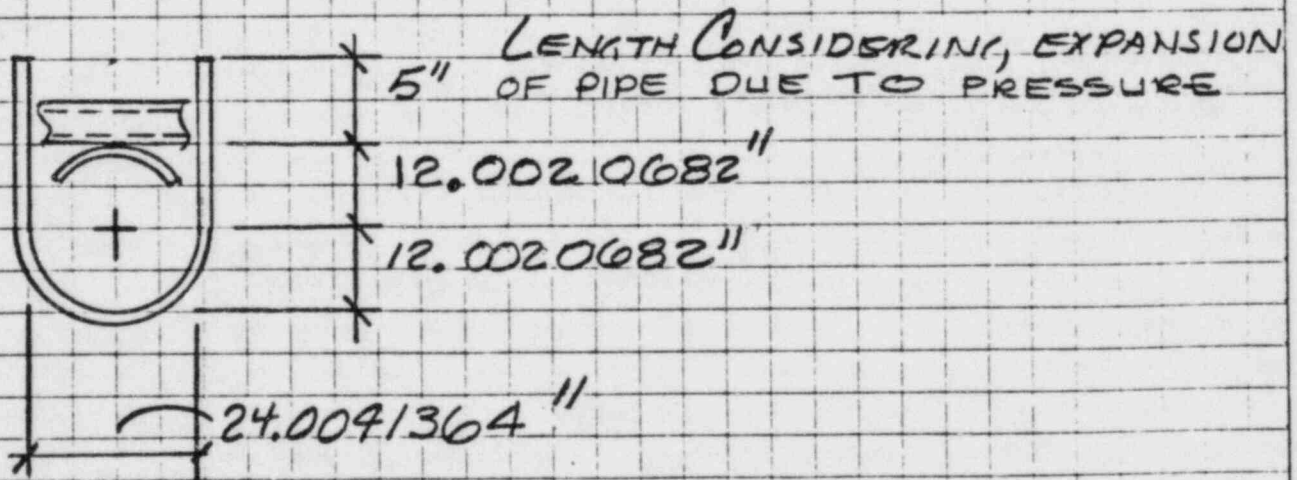
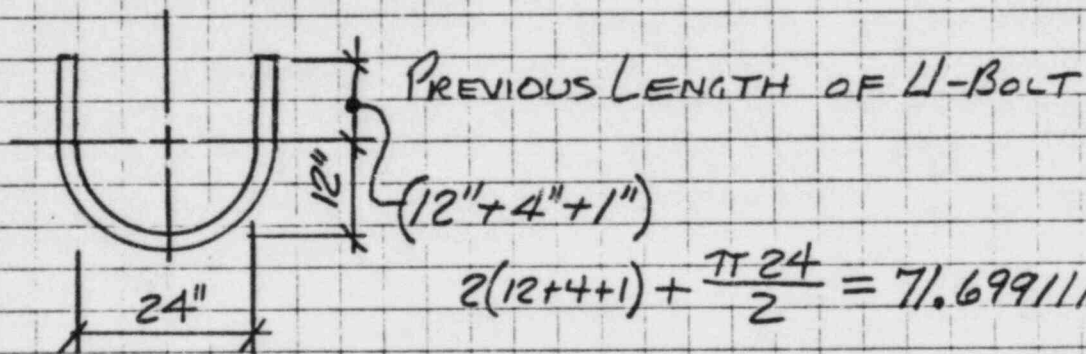
C & H Job No. \_\_\_\_\_

Ref. Dwg./Spec. No. \_\_\_\_\_

b)  $\Delta$  IN U-BOLT DUE TO RADIAL EXPANSION OF PIPE FROM INTERNAL PRESSURE.

$$\Delta R = \frac{p R^2}{E t} \quad \text{ROARK, TABLE 29}$$

$$= \frac{(150 \text{ PSI})(12^2)}{(27.85)(10^6)(.375)} = .0020682 \text{ @ } 150^\circ \text{ F}$$



$$(12.0020682 + 5)(2) + \frac{\pi 24.0041364}{2} = 71.709746$$

$$\Delta = \text{NEW LENG.} - \text{PREV. LENG.} = .01063''$$



TEXAS UTILITIES SERVICES INC.  
COMANCHE PEAK S.E.S.

Agent For  
DALLAS POWER & LIGHT COMPANY  
TEXAS ELECTRIC SERVICE COMPANY  
TEXAS POWER & LIGHT COMPANY

Date 6-19-84Calc By GMCCalc'd/Approved By WAB 6-21-84Subject CC-1-028-007-533R

Filing Code \_\_\_\_\_

Sheet No 5 of 9

G &amp; H Job. No. \_\_\_\_\_

Ref. Dwg./Spec. No. \_\_\_\_\_

C.) TORQUE ON U-BOLT IS 700 IN#  
SOLVE FOR LOAD "P"

$$T = P \left[ R_m \left( \frac{\tan \alpha + f / \cos \theta_n}{1 - f \tan \alpha / \cos \theta_n} \right) + f_c R_c \right]$$

SCHAUMS  
OUTLINE  
SERIES,  
MACHINE  
DESIGN

WHERE:

$$R_m = \text{MEAN RADIUS } (1.347) \left(\frac{1}{2}\right) \left(\frac{1}{2}\right) = .46175$$

$$f = 0.12 \text{ THRD FRICTION}$$

$$f_c = 0.25 \text{ NUT FRICTION}$$

$$R_c = \text{COWAR RADIUS } .625$$

$$\tan \alpha = \frac{\text{LEAD}}{2\pi R_m} = \frac{1/8}{2\pi(.46175)} = .043084$$

$$\cos \theta \text{ WHERE } \theta = 30^\circ \text{ IS } (.866)$$

TEXAS UTILITIES SERVICES INC.  
COMANCHE PEAK S.E.S.Agent For  
DALLAS POWER & LIGHT COMPANY  
TEXAS ELECTRIC SERVICE COMPANY  
TEXAS POWER & LIGHT COMPANYDate 6-19-84Calc by GMC

Chk'd/Approved By \_\_\_\_\_

Subject CC-1-028-007-533R

Filing Code \_\_\_\_\_

Sheet No 6 of 9

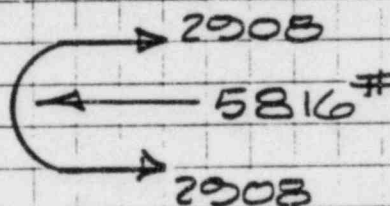
G &amp; H Job No. \_\_\_\_\_

Ref. Dwg./Spec. No. \_\_\_\_\_

c) CONTINUED

$$700 \text{ IN}^\# = P \left[ .46175 \left( \frac{.043084 + \frac{.12}{.866}}{1 - (.12)(.04384)/.866} \right) + .25(.625) \right]$$

$$P = 2908^\#$$



ASSUME THERE IS NO ADD'L PRETENSION  
IN THE U-BOLT DUE TO TEMPERATURE  
OR PRESSURE IN A EMERGENCY  
CONDITION.

$$2908^\# / 657^\# = 4.4 \text{ FACTOR OF SAFETY}$$

## U-BOLT STRESS

THE STRESS IN THE U-BOLT COMES FROM  
THREE CONDITIONS:

1. THERMAL
2. RADIAL PRESSURE
3. TORQUE

$$P = 2908$$

$$\Delta = .005319$$

$$\Delta = .01063$$

$$\Delta = \text{NA}$$

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COMANCHE PEAK S.E.S.

Agent For  
DALLAS POWER & LIGHT COMPANY  
TEXAS ELECTRIC SERVICE COMPANY  
TEXAS POWER & LIGHT COMPANY

Date 6-21-84

Calc By GMC

Calc'd/Approved By \_\_\_\_\_

Subject CC-1-028-007-533R

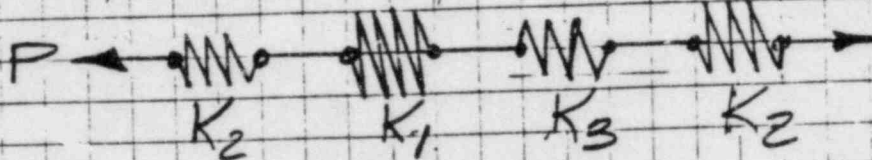
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/ PLATE / U-BOLT / PIPE / PLATE /



$K_1$  U-BOLT  $K_1$

$$\Delta = \frac{PL}{AE} \quad K_1 = \frac{P}{\Delta} \quad \therefore K = \frac{PAE}{PL} = \frac{AE}{L} = \frac{.785(27.7)10^6}{71.699}$$

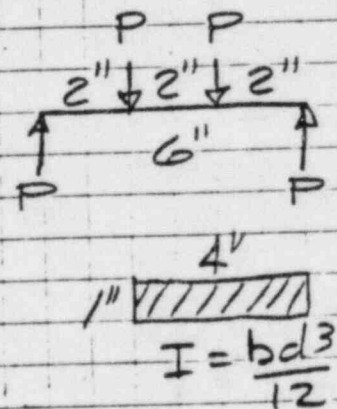
$$K_1 = (3.032) 10^5$$

$K_2$  PLATE  $K_2$

$$\Delta = \frac{Pa}{24EI} (3l^2 - 4a^2)$$

$$K_2 = \frac{P}{\Delta} = \frac{P 24EI}{Pa(3l^2 - 4a^2)} = \frac{24EI}{a(3l^2 - 4a^2)}$$

$$= \frac{24(27.7)(10^6)(.333)}{2[3(6^2) - 4(2^2)]}$$



$$K_2 = 1.2MEC$$

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$K_3$  CONSIDER THE DEFLECTION OF PIPE  $K_3$



$$K_3 = \frac{P}{\Delta}$$

THE  $\Delta$  IN THE PIPE DIAMETER WILL PRODUCE A  $2\Delta$  CHANGE IN U-BOLT LENGTH, IE NUT TO NUT LENGTH

$\Delta$  DUE TO PIPE

ROARK TABLE 31, PP 495

$$\Delta = 6.5 \frac{P}{Et} \left( \frac{R}{t} \right)^{3/2} \left( \frac{L}{R} \right)^{-3/4}$$

$$\begin{aligned} P &= 1000 \text{ \#} \\ R &= 12'' \\ t &= .375 \\ L &= 72'' \\ E &= 27.7 (10^6) \end{aligned}$$

$$\Delta = 6.5 \left( \frac{1000}{27.7(10^6) \cdot .375} \right) \left( \frac{12}{.375} \right)^{3/2} \left( \frac{72''}{12''} \right)^{-3/4} = .02954703$$

$K_{\text{PIPE}} = 1000/\Delta$  HOWEVER WE ARE NOT INTERESTED HERE IN THE STIFFNESS OF THE PIPE ITSELF BUT RATHER HOW IT CONTRIBUTES TO THE  $\Delta$  IN THE U-BOLT. A  $.02954703''$  CHANGE IN PIPE DIA WILL BE  $(2)\Delta$  CHANGE IN U-BOLT  $\phi$

$$K = 1000/2\Delta = .169 \text{ \#} \text{ IN}$$

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$$K_E = \frac{1}{\frac{1}{K_3} + \frac{1}{K_2} + \frac{1}{K_1} + \frac{1}{K_2}}$$

$$= \frac{1}{\frac{1}{.169E5} + \frac{1}{12.04E5} + \frac{1}{3.032E5} + \frac{1}{12.04E5}}$$

↑ PIPE
↑ PLATE
↑ U-BOLT
↑ PLATE

$$= .1559 E 5$$

$$K'' = P/\Delta \quad \Delta = (2)(.005319) + (0.01063) = .021268$$

↑ TEMP
↑ PRESSURE

$$P = \Delta K = .021268 (.1559 E 5) = 331$$

$$331 \# + 2908 \# = 3239 \#$$

↑ TORQUE

$$3239 \# / .551 \text{ IN}^2 = 5879 \text{ PSI @ ROOT AREA}$$

$$5879 < (.6)(32.8 \text{ KSI}) \text{ OR } 5879 / 19680 = 30\%$$

$$w/LCD \quad 5879 \text{ PSI} / 9000 \text{ PSI} \quad (6.5\%)$$