TEXAS UTILITIES GENERATING COMPANY

SKYWAY TOWER • 400 NORTH OLIVE STREET, L.B. 81 • DALLAS, TEXAS 75201

BILLY R. CLEMENTS
VICE PRESIDENT, NUCLEAR OPERATIONS

June 15, 1984
TXX-4198

Mr. Richard P. Denise, Director
Division of Reactor Safety and Projects
U.S. Nuclear Regulatory Commission, Region IV
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

Docket Nos. 50-445
50-446

COMANCHE PEAK STEAM ELECTRIC STATION
UNITS 1 AND 2
WELDING ALLEGATIONS TRANSMITTED
BY LETTER OF APRIL 23, 1984
File No.: 10125

Dear Mr. Denise:

By letter dated April 23, 1984 from Richard P. Denise to Michael D. Spence, the Nuclear Regulatory Commission ("NRC") Staff requested a response to ten questions related to activities at Comanche Peak Steam Electric Station ("CPSES") concerning interpass temperature, preheat and pipe support H-CC-1-SB-038-010-3. While the Staff's letter requested a response within 30 days, to accommodate the extensive testing needed to respond thoroughly to the concerns, Texas Utilities Generating Company ("TUGCO") requested and received an extension until June 15, 1984 to file its response (phone conversation between M. H. Philips and D. M. Hunnicutt). TUGCO's response to each question is set forth in the attached.

We trust you will find this information helpful in expediting closure of these issues. Please advise if you require further information.

Very truly yours,

Billy R Clements

BRC/tlg

cc: Mr. John Collins
U.S. NRC - Region IV
D. M. Hunnicutt
T. A. Ippolito
G. Mizuno

ATTACHMENT

RESPONSE TO STAFF QUESTIONS REGARDING INTERPASS TEMPERATURE, PREHEAT AND PIPE SUPPORT H-CC-1-SB-038-010-3

By letter dated April 23, 1984 from Richard P. Denise to Michael D. Spence, the Nuclear Regulatory Commission ("NRC") Staff requested a response to ten questions related to activities at Comanche Peak Steam Electric Station ("CPSES"). Texas Utilities Generating Company's ("TUGCO") response to each question is set forth below:

A. Interpass Temperature Control

Question 1

Your assessment of whether welders conform to Brown & Root Welding Procedure 11032 requiring the use of temperature indicating crayons to verify interpass temperatures. Your answer should provide any necessary supporting documentation and should explicitly address welds of materials requiring Charpy impact testing.

Response 1

Welding Procedure Specification ("WPS") 11032 states that "preheat and interpass temperature (above 150°F) shall be checked using temperature indicating crayons or an approved equal." This requirement was imposed to provide assurance that (1) preheat above 150°F (elevated preheat) is established and (2) elevated preheat is maintained between passes (minimum interpass temperature).

The requirement for use of temperature indicating crayons ("tempsticks") or an approved equal was not intended to apply to the lower preheat temperature (60°F) or the maximum interpass temperature (500°F) set forth in WPS 11032. Indeed, 60°F tempsticks are impractical (they would melt on contact with the body). (Lower preheat requirements are addressed in detail in Section B, Preheat.) With regard to the conservatively established maximum interpass temperature of 500°F (for design purposes regarding carbon steel attachments, the maximum interpass temperature could have been as high as 700°F), it has been demonstrated through numerous tests conducted by the Welding Engineering Department that using normal welding techniques and the welding parameters of WPS 11032, this maximum interpass temperature will not be exceeded, or even closely approached.[1] (See e.g., oral testimony of W.E. Baker and M.D. Muscente given during the Operating Licensing hearings, February 23, 1984 at Tr. 10008-10011.) Accordingly, tempsticks are not required to assure that the maximum interpass temperature is not exceeded.

In sum, the requirement set forth in WPS 11032 regarding the use of tempsticks applies to limited situations involving (1) preheat temperatures above 150°F (elevated preheat) and (2) elevated preheat between passes (minimum interpass temperature).

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1 It should also be noted that welders develop a "feel" for when the assembly they are welding gets too hot; it would be very uncomfortable to work on an assembly or structure that is over 500°F.

While this was the initial intent of this requirement, the precise wording in WPS 11032 is not clear. Accordingly, WPS 11032 is being revised to clarify this requirement.

To determine compliance with this requirement, welders at CPSES who had welded attachments to the main steam and feedwater piping systems where Charpy impact values are required were interviewed. (The interviews were conducted with assurances that no adverse action would be taken regardless of responses to questions.) All welders interviewed stated that where elevated preheat was required, they verified preheat temperatures using tempsticks prior to commencement of welding. Further, all stated that they used tempsticks to verify minimum interpass temperatures, however, not necessarily after every pass. Welders who did not use tempsticks to check minimum interpass temperature after each pass stated that judgment was used to determine whether the weld material had cooled excessively between passes. (The results of these interviews are attached, Attachment A.)

In sum, all welders interviewed stated that they complied with the requirement of WPS 11032 regarding use of tempsticks to verify elevated preheat. However, some did not always comply with the requirement regarding use of tempsticks to verify minimum interpass temperatures. Rather, while they were aware of the need to maintain minimum interpass temperatures, some welders at times used judgment instead of tempsticks.

Question 2

If you conclude that temperature judgment or "feel" is an adequate basis for judging interpass temperature or for judging the need for the use of temperature indicating crayons, your answer should provide the detailed basis for such conclusion, along with any necessary supporting documentation.

Response 2

Based on the interviews with welders, we have concluded that in some instances welders relied on judgment to determine the need to preheat between passes (minimum interpass temperature) rather than using a tempstick or other approved equal as required by WPS 11032. However, we believe that as a welder gains experience relative to how long it takes for a weld to cool, the welder in some situations is able to judge with an adequate degree of accuracy whether there is a need to preheat between passes, e.g., where the welder is making multiple passes of a fairly uniform nature with no interruptions or significant delays between passes. (In this regard, tests conducted by the Welding Engineering Department reflect that while the temperature of a weld drops rapidly from extremely high temperatures to around 300-400°F, thereafter the rate of decrease slows significantly and even tends to stabilize for several minutes in the range of 200 to 250°F.)

In short, while TUGCO does not contend that "temperature judgment or feel" demonstrates procedural compliance with the requirement concerning use of tempsticks, from a public health and safety perspective TUGCO believes that on Charpy impacted materials there is reasonable assurance that limits on preheat between passes were not exceeded.

Question 3

For any weld on Charpy materials for which adequate interpass temperature controls cannot be confirmed, you should provide a technical assessment of the need for additional testing or corrective action.

Response 3

As stated above, TUGCO maintains that there is reasonable assurance that on Charpy impacted materials neither minimum nor maximum interpass temperature limits as specified in WPS 11032 were exceeded. However, in order to evaluate the safety impact related to this issue, testing was performed to determine the effect, if any, of exceeding the requirements of minimum or maximum interpass temperatures.

Effect of Exceeding Maximum Interpass Temperatures

All drawings for attachments to piping requiring Charpy impact values were reviewed to obtain worst case conditions for heat input. Mock-ups simulating the three "worst case" conditions were welded in a deliberate attempt to exceed maximum interpass temperatures (see Attachment B, Figures 1-5).

Mock-up No. 1 (Figures 1 and 2 of Attachment B) simulated a pipe support with a pipe stanchion welded directly to the process pipe. The weld joint used was a full penetration groove weld in order to maximize the amount of weld metal deposited.

Mock-up No. 2 (Figures 1 and 3 of Attachment B) also simulated a pipe support with a pipe stanchion welded directly to the process pipe. The stanchion was fillet welded to the pipe (completely around).

Mock-up No. 3 (Figures 4 and 5 of Attachment B) simulated a pipe support where a lug is welded to the process pipe. This configuration was selected purposely in a deliberate attempt to exceed the 500^{o}F interpass temperature. (The lug provides a relatively small volume of material to disperse the welding heat.)

All three mock-ups were welded such that welding parameters which effect heat input (and could, thereby cause high interpass temperatures) were deliberately exceeded in an effort to achieve maximum interpass temperatures. For example, welding was purposely conducted using an extreme weaving technique up to 300 percent wider than permitted by WPS 11032 for Mock-up Nos. 1 and 2 and up to 200 percent wider than allowed for Mock-up No. 3. In addition, all assemblies were preheated to 200^{o}F, and this preheat was maintained throughout welding to slow the cooling rate and maximize interpass temperatures. In addition, weld passes were made as quickly as possible with only minimum interpass cleaning.

The results of these tests showed that for Mock-up Nos. 1 and 2, interpass temperatures did not even approach the maximum interpass temperature specified in WPS 11032. For Mock-up No. 3, however, on the lug side of the joint, an interpass temperature of 650°F was recorded. (See Figure 5 of Attachment B). This temperature was achieved only after preheating the joint to 200°F, depositing beads three times as wide as permitted by WPS 11032 and violating the numerous other parameters affecting heat input.

To test the impact of this elevated interpass temperature, Charpy V-notch tests of the joint were conducted. The results (Figure 6 of Attachment B) reflect that even at these extreme conditions, the Charpy impact values from Mock-up No. 3 exceeded the minimum requirements.

Based on the results of these tests (where every effort was made to exceed the interpass temperature of 500°F) and the inherent skill and experience of the welders (see note 1, supra), it can be concluded that tempsticks are not necessary to assure that the interpass temperature of 500°F is not exceeded during normal production welding of carbon steel attachments. Further, the tests reflect that even when extreme measures were taken to violate WPS requirements in order to achieve maximum interpass temperatures greater than permitted by the WPS, the minimum requirements for Charpy impact were not exceeded.

Effect of Exceeding Minimum Interpass Temperatures

A second test was performed to evaluate the impact, if any, of violating minimum interpass temperatures. The test specimen was SA333 Gr. 6 material, 1.531 inches thick, and beveled for a full penetration weld. The test specimen dimensions were 12 inches long and 12 inches wide. WPS 11032 was used to perform the welding, except that the test plate was chilled to 32^{o}F prior to welding, and cold water was used to cool the specimen after each of the 23 passes to achieve interpass temperatures on each pass below the required 200^{o}F minimum. Minimum interpass temperatures achieved during the test are shown on Figure 7 of Attachment B. After the specimen was welded, samples were removed for tensile, side bend, and Charpy impact testing. Results of all testing indicate that the weld completed under these extreme conditions met all applicable requirements (see Figures 8, 9 and 10 of Attachment B).

In sum, TUGCO believes that with regard to Charpy impacted materials there is reasonable assurance that minimum and maximum interpass temperature limits are not being exceeded at CPSES. However, even if in some isolated instances these limits are exceeded, the testing noted above reflects that material properties are not changed to the extent that safety would be adversely impacted. Accordingly, no further testing or evaluation is necessary.

Question 4

For any weld for which interpass temperature control, in full conformance with applicable procedures, cannot be demonstrated, explain in detail why this deficiency was not recorded and corrected as part of the applicable QC program and why this deficiency was not identified and corrected by the Applicant's QA program.

Response 4

As previously noted, although TUGCO believes that there is reasonable assurance that interpass and preheat temperature limits were not exceeded, some welders stated that at times they used judgment or "feel" instead of a tempstick in assessing the need to reestablish elevated preheat between passes. This is a violation of WPS 11032.

While Applicants have attempted to structure their QA/QC program to be as thorough as possible, we also recognize that there will be instances when violations of procedures are not detected. The instances discussed above are examples of this. QC inspectors do conduct random verification of interpass temperature; however, it cannot be determined why these violations were not detected by QC or QA. In any event, all welders will be reindoctrinated in procedural requirements for use of temperature indicating crayons where elevated preheat and minimum interpass temperatures are specified. Further, QC will more closely monitor this requirement in their random inspections.

B. Preheat

The Staff's concern regarding preheat relates to the practice at CPSES "in which welders used temperature 'judgment' to assess the need for preheat, whereas applicable procedures called for preheat at 60^{o}F (Brown & Root Welding Procedure 11032) or 70^{o}F (Brown & Root Welding Procedure 10046)." (Letter from Denise to Spence at p. 1 (April 23, 1984), noted above.) (As to any concerns with elevated preheat, as noted above, interviews with welders reflect that tempsticks are used to check elevated preheat temperatures.)

Questions 1 and 2

Your assessment of the significance of the welders' use of subjective judgment to determine whether preheat is required. Your answer should provide any necessary supporting documentation including a discussion of the technical basis underlying the preheat requirement contained in the Brown & Root Welding Procedures.

If you conclude that temperature judgment or "feel" is an adequate basis for determining the need for preheat, your answer should provide the detailed basis for such conclusion, along with any necessary supporting documentation.

Responses 1 and 2

The preheat requirements of concern here (non-elevated preheat) are set forth in WPS 11032 at 60°F and WPS 10046 at 70°F. To assure compliance with these requirements at CPSES, welders preheat the base metal to a "hand warm" condition when the temperature is below 60°F. During the warmer months of the year, e.g., May through October, the ambient temperature is above 60°F, and such preheating is not necessary.

Discussions with welders at CPSES reflect adherence to this practice, and the Staff apparently does not contend otherwise. This practice complies with the preheat requirements of WPS 11032 and WPS 10046 which require preheats of 60°F and 70°F, respectively. Preheating the base metal to a "hand warm" condition assures that it is at least equal to body temperature (98.6°F).

In short, practice at CPSES provides reasonable assurance that the requirements of WPS 11032 and 10046 regarding preheat of 60°F and 70°F, respectively, are met.

Question 3

For any weld for which adequate preheat cannot be confirmed, you should provide a technical assessment of the need for additional testing or corrective action.

Response 3

TUGCO maintains that the preheat requirements at issue here have been met. Preheating until the metal is "hand warm" is an acceptable technique and is used by the welders at CPSES.

In addition, the Brown & Root Welding Engineering staff at CPSES has performed numerous tests to determine what effect, if any, welding without preheat would have on the strength and ductility of carbon steel materials. These tests were performed on materials that were cooled to 32°F. The results reflect that the tensile and ductility properties of these materials were not adversely affected. (See e.g., Figures 7-10 of Attachment B. The results of other tests are available at the CPSES site for review by the NRC as necessary.) Accordingly, no additional testing or corrective action is warranted.

Question 4

For any weld for which preheat in full conformance with applicable procedures cannot be demonstrated, explain in detail why this deficiency was not recorded and corrected as part of the applicable QC program and why this deficiency was not identified and corrected by the Applicant's QA program.

Response 4

As previously noted, TUGCO maintains that welders at CPSES comply with welding procedure requirements for preheat by using the "hand warm" technique.

C. Support H-CC-1-SB-038-010-3

Question 1

Provide an evaluation of whether this support, in its current condition, is satisfactory for service. Your answer should provide a detailed technical basis for your conclusion, along with any necessary supporting documentation.

Response 1

The two welds on the subject support (the concern giving rise to this question) have been inspected and accepted by QC. Further, an analysis of the two welds has been performed (Attachment C) which demonstrates that the two welds are loaded only to 3 and 7.4 percent of capacity. In view of the acceptable condition of the welds as documented by a QC inspection and the analysis which shows that the loads on these welds are extremely small, no further evaluation or testing is warranted.

Question 2

If the adequacy of this support cannot be confirmed, you should provide your plans for additional testing or corrective action.

Response 2

As noted above, the adequacy of the support has been confirmed. Accordingly, no further action is warranted.

ATTACHMENT A

May 15, 1984

INTEROFFICE MEMO

To: W.E. Baker

From: B. Wright

Subj: Welders' Interviews

The following listed welders are those who welded attachments to the Mainsteam and Feedwater piping systems where Charpy impact valves are required. The following questions were asked regarding welding on these systems and the welders' responses follow:

1. Did you use a tempstick to check for elevated preheat?

2. When elevated preheat was required, did you use a tempstick to check preheat between passes (minimum interpass temperature)?

3. Did you use a tempstick to assure maximum interpass temperature was not exceeded?

4. If the answer to Question 3 is "No," why not?

Welder Symbol Answer

BMJ -
1. Yes.
2. Yes. Fairly often, but not every pass; used judgment.
3. Yes.
4. NA

CEI -
1. Yes.
2. Yes.
3. Yes.
4. NA

CDR -
1. Yes.
2. Yes. Intermittently during welding; used judgment.
3. Yes.
4. NA

CHA - 1. Yes.
2. Yes.
3. Yes.
4. NA

AGW - 1. Yes.
2. Yes.
3. Yes.
4. NA

BSH - 1. Yes.
2. Yes. Intermittently during welding; used judgment.
3. Yes.
4. NA

BLT - 1. Yes.
2. Yes. Intermittently during welding; used judgment.
3. No.
4. Welder used his judgment and the fact that he was having to preheat every 3rd pass; therefore, due to the thickness of the metal, he knew he was not getting near the 500°F interpass temperature.

BTO - 1. Yes.
2. Yes, but only after an extended break in welding; used judgment other times.
3. Yes.
4. NA

BYE - 1. Yes.
2. Yes.
3. Yes.
4. NA

BIN - 1. Yes.
2. Yes. Fairly often, but not every pass; used judgment.
3. No.
4. Welder experience was used and the balanced welds and had some grinding time between passes that allowed the material to cool so that the interpass temperature of 500°F could not have been reached.

CBH - 1. Yes.
2. Yes. Intermittently; used judgment.
3. Yes.
4. NA

BZR - This welder only tacked-up lugs on one hanger and did not weld-out any.

BSK - 1. Could not remember on these specific systems, but said he always preheats material over 1-1/4 inches in thickness and uses a tempstick. Pipe is over 1-1/4 inches in thickness in this case.
2. Yes, but only if interrupted or after a break; used judgment other times.
3. No.
4. Welder said he used judgment; because of the thickness of the material and his method of welding (balancing welds around pipe) the 500°F interpass temperature could not be reached.

BYY - 1. Yes.
2. Yes, but only if interrupted or after a break; used judgment other times.
3. No.
4. Welder used his judgment by the way the characteristics of the molten puddle would change indicating a built-up of heat in the parent material, i.e., control and undercut. He also balanced welds around pipe to keep heat input and distortion low.

AIL - 1. Yes.
2. Yes, but only if interrupted or after a break; used judgment other times.
3. Yes.
4. NA

BPS - 1. Yes.
2. Yes, but only if interrupted or after a break; used judgment other times.
3. No.
4. Welder used his judgment; due to the size of the fillet welds (5/16 inch) and the thickness of the material on the pipe there was not enough continuous welding to produce an interpass temperature of over 500°F.

AHX - 1. Yes.
2. Yes, but only if interrupted or after a break; used judgment other times.
3. Yes.
4. NA

AKD - 1. Yes.
2. Only welded two partial passes on one support on these systems. Checked maximum interpass temperature with a tempstick but used judgment that minimum interpass was okay.
3. Yes.
4. NA

BWY - 1. Yes.
2. Yes.
3. Yes.
4. NA

B. Wright

B. Wright
Asst. Project Welding Engineer

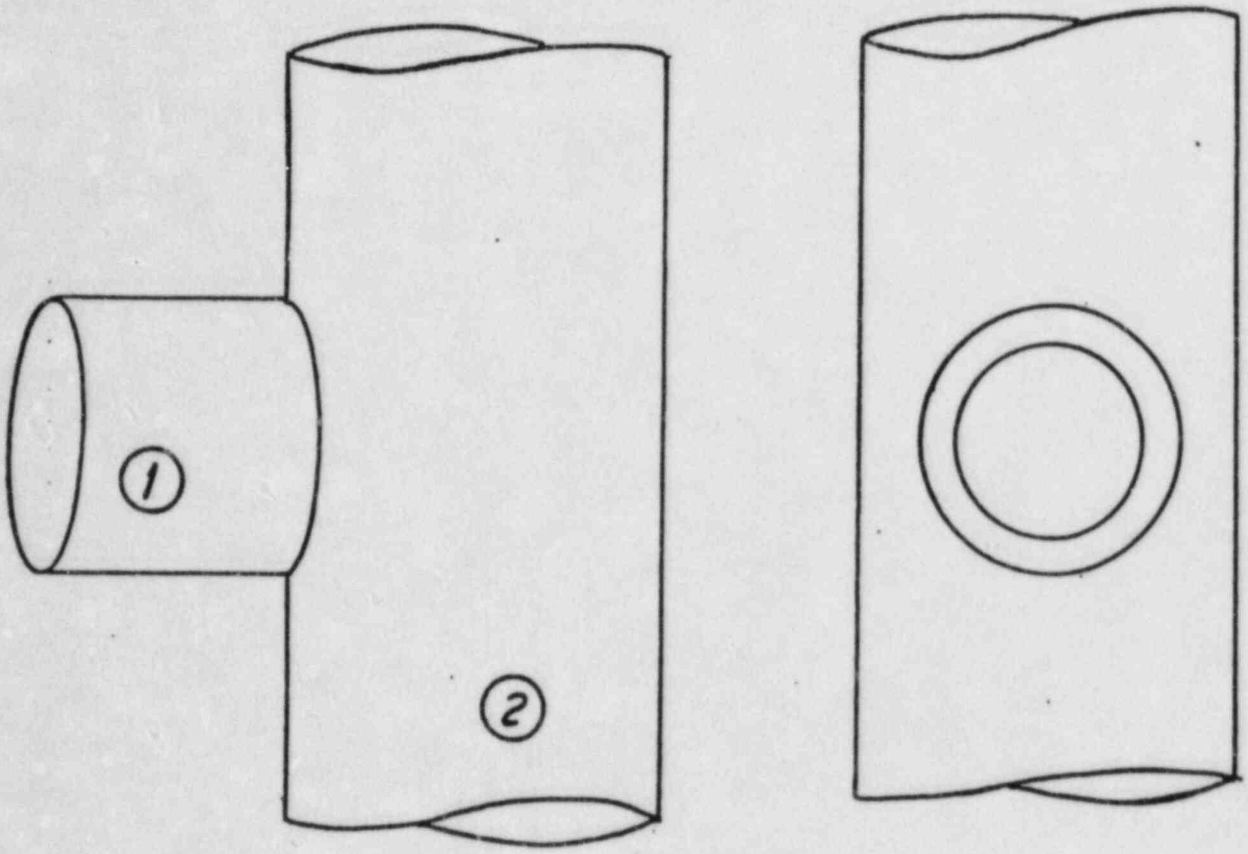
ATTACHMENT B

Tests Regarding Maximum and Minimum Interpass Temperatures

FIGURE 1

MATERIAL DETAILS

MOCK-UP NO.1 and NO.2



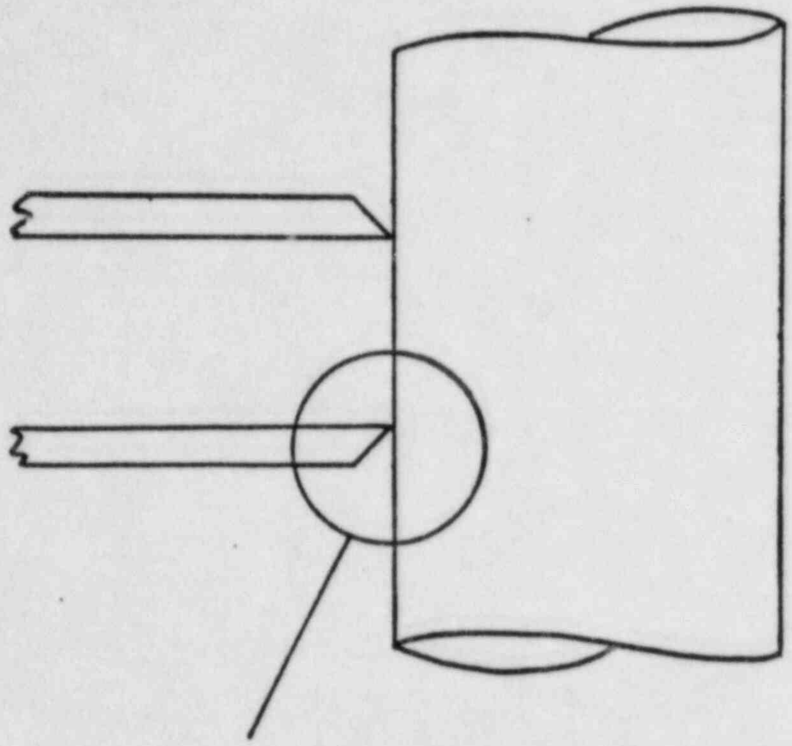
(1) - Stanchion
12" Schedule 80 Pipe
SA-333, Grade 6

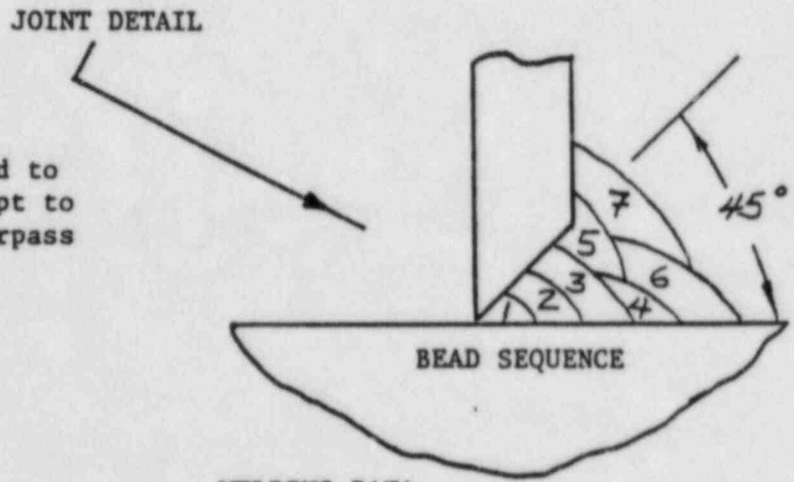
(2) - Process Pipe
18" Schedule 80 Pipe
SA-333, Grade 6

FIGURE 2

MOCK-UP NO.1

FULL PENETRATION JOINT DETAILS





NOTE: Assembly preheated to 200°F in an attempt to exceed 500°F interpass temperature.

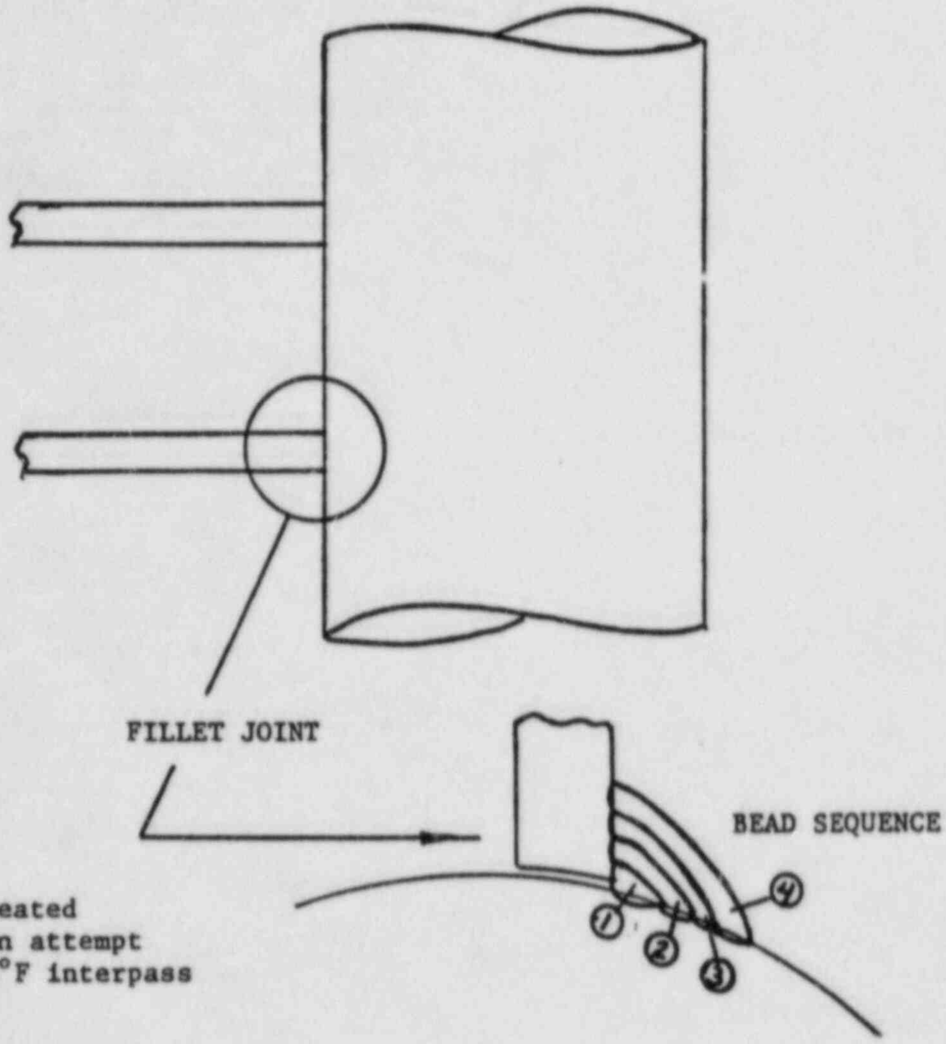
WELDING DATA

Pass	Electrode		Amps	Volts	Bead Width	IP Temperature(°F)	
	Type	Size				Stanchion	Pipe
1	E705-2	3/32"	170	12	3/16"	200	200
2	E705-2	1/8"	180	12	3/8"	250	220
3	E7018	1/8"	125	22	1/2"	250	250
4	E7018	1/8"	140	24	5/8"	260	240
5	E7018	1/8"	[illegible]	24	1"	260	220
6	E7018	1/8"	140	24	3/4"	220	200
7	E7018	1/8"	150	24	3/4"	220	200

FIGURE 3

MOCK-UP NO.2

FILLET WELD JOINT DETAILS



NOTE: Assembly preheated to 200°F in an attempt to exceed 500°F interpass temperature.

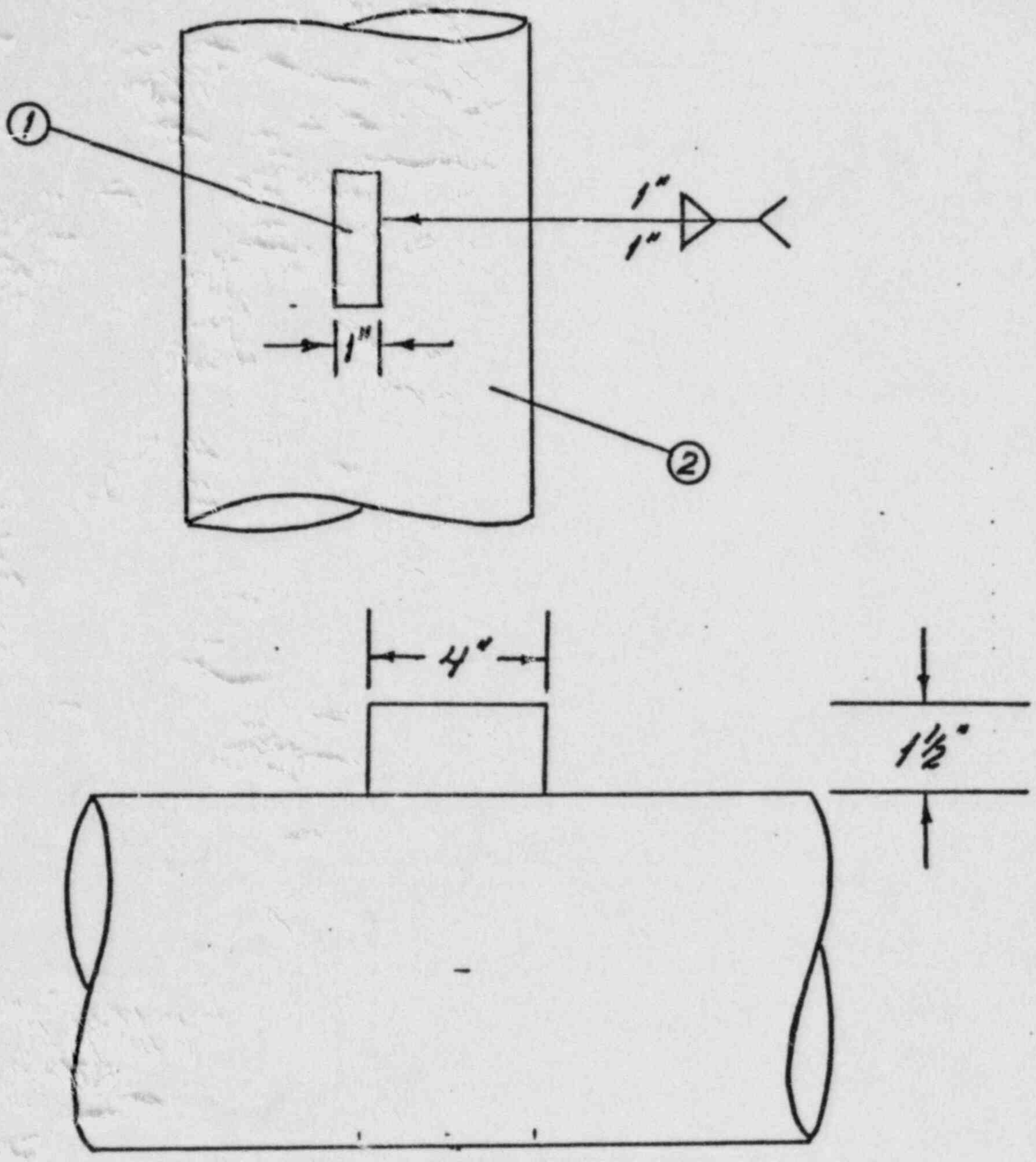
WELDING DATA

Pass	Electrode		Amps	Volts	Bead	IP Temperature (°F)	
	Type	Size			Width	Stanchion	Pipe
1	E7018	1/8"	125	23	3/8"	270	200
2	E7018	1/8"	140	24	5/8"	275	250
3	E7018	1/8"	180	24	1"-1 1/4"	230	200
4	E7018	1/8"	190	24	2"	220	220

FIGURE 4

MOCK-UP NO.3

LUG WELDED TO PIPE



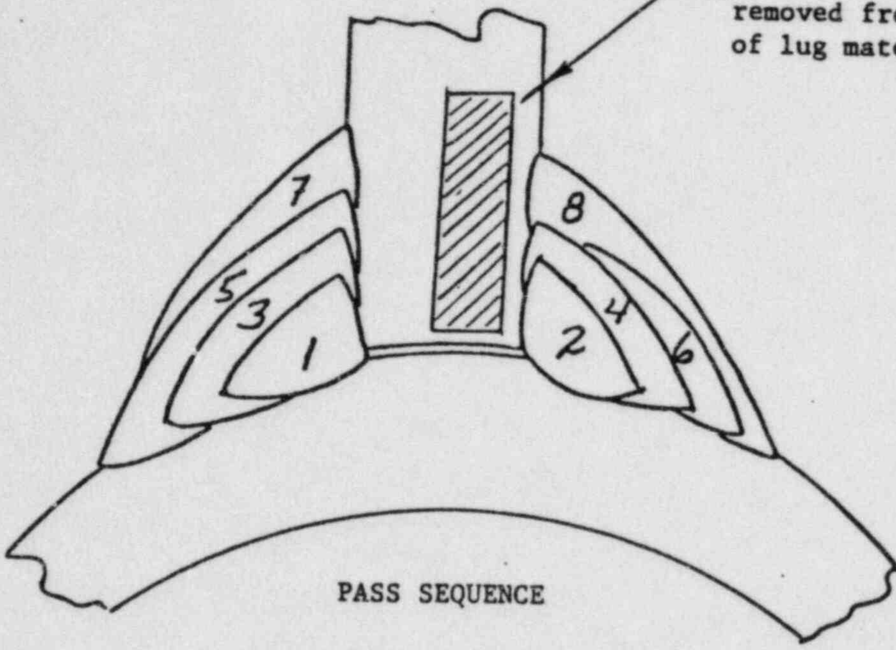
(1) — Lug material SA-333, Grade 6

(2) — Pipe material 18" Schedule 80
SA-333, Grade 6

FIGURE 5

MOCK-UP NO.3

WELDING DETAILS



PASS SEQUENCE

WELDING DATA

Pass	Electrode		Amps	Volts	Bead Width	IP Temperature (°F)	
	Type	Size				Lug	Pipe
1	7018	1/8"	160	23	3/8"	350	250
2	7018	1/8"	160	23	5/8"	440	280
3	7018	1/8"	170	24	7/8"	500	270
4	7018	1/8"	170	24	1"	570*	360
5	7018	1/8"	180	24	1 3/8"	520*	390
6	7018	1/8"	180	24	7/8"	550*	380
7	7018	1/8"	180	24	7/8"	620*	400
8	7018	1/8"	180	24	1 1/2"	650*	440

NOTE: Assembly preheated to 200°F in attempt to purposely exceed 500°F interpass temperature

* Interpass temperature on lug side of assembly exceeded 500°F while depositing passes 4 through 8.

FIGURE 6

CHARPY V-NOTCH TEST RESULTS

SPECIMEN	LATERAL EXPANSION		FT. LBS.	
	SPEC *	ACTUAL	SPEC *	ACTUAL
1B	40	67	NR	100
1M	40	83	NR	170
1T	40	72	NR	124

Test temperature 32°F

* Per ASME Section III, Subsection NC

NR - Not required

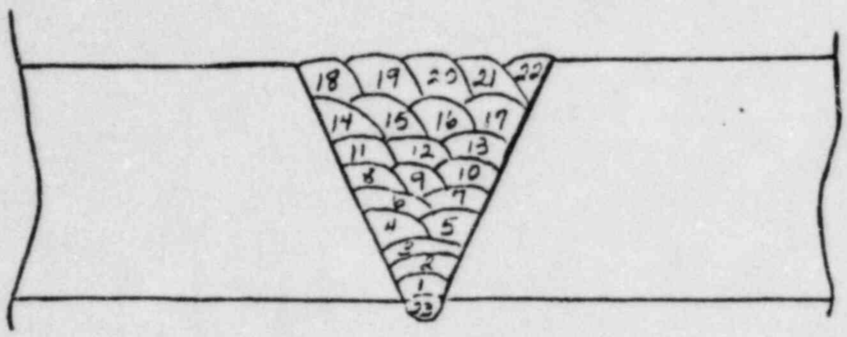
Base Material SA333 Grade 6 (Spec. Type and/or Gr.) L1442 (Heat #) 1.531" (Thickness)

to Same (Spec. Type and/or Gr.) Same (Heat #) Same (Thickness)

Filler Material E7018 (Type) 1/8-53150 (Heat/Lot) 3/32-53143 (Heat/Lot)

WO # 0008

FIGURE 7



SPECIMEN # 1

PAGE 1 OF 2

PASS	ROD SIZE	AMPS	VOLTS	TRAVEL	BEAD WIDTH	INTERPASS TEMP	COMMENTS
1	3/32	110	22	4½ IPM	3/16"	Preheat 32°F	
2	1/8	150	23	3¼ IPM	3/8"	85°F	
3	1/8	155	24	4 IPM	7/16"	150°F	
4	1/8	155	23	6 IPM	3/8"	170°F	
5	1/8	155	23	5 IPM	3/8"	180°F	
6	1/8	155	23	4 IPM	1/2"	130°F	
7	1/8	155	23	3½ IPM	1/2"	140°F	
8	1/8	155	23	4 IPM	7/16"	130°F	
9	1/8	155	23	5 IPM	3/8"	150°F	
10	1/8	155	23	4½ IPM	1/2"	130°F	
11	1/8	155	23	5½ IPM	3/8"	135°F	
12	1/8	155	23	3½ IPM	1/2"	150°F	
13	1/8	155	23	3½ IPM	1/2"	135°F	
14	1/8	155	23	6½ IPM	3/8"	145°F	
15	1/8	155	23	5½ IPM	3/8"	140°F	
16	1/8	155	23	6½ IPM	5/16"	145°F	
17	1/8	155	23	5½ IPM	3/8"	140°F	
18	1/8	135	21	3½ IPM	1/2"	145°F	

Spec. Type and/or Gr. | Heat # | Thickness | Type | Heat/Lot

to Same — Spec. Type and/or Gr. | Same — Heat # | Same — Thickness | 3/32-53143 — Heat/Lot

SPECIMEN # 1

PASS	ROD SIZE	AMPS	VOLTS	TRAVEL	BEAD WIDTH	MAX INTERPASS TEMP	COMMENTS
19	1/8	135	21	4 IPM	7/16"	140°F	
20	1/8	135	21	4½ IPM	3/8"	130°F	
21	1/8	135	21	5½ IPM	3/8"	125°F	
22	1/8	140	22	5 IPM	3/8"	150°F	
23	1/8	155	23	6 IPM	7/16"	100°F	Back weld

FIGURE 8

Brown & Root, Inc. HOUSTON, TEXAS	PQR No. WO #0008	Rev.
SUPPLEMENTAL TEST RESULTS		

Side Bend Test

Specimen #	Test Results
SB #1	Satisfactory
SB #2	Satisfactory
SB #3	Satisfactory
SB #4	Satisfactory

Specimens prepared, tested and inspected per QW-160, QW-163 and QW-462.2.

QC Witness: D. Bell

Test conducted by: Fred Nichols Lab. No. CP 5-22-84

Address:

per ASME Section IX Date 5-22-84

We certify that the statements in the record are correct and that the test welds were prepared, welded and tested in accordance with the above listed PQR and per requirements of the listed code/standard(s).

Signed Brown & Root, Inc.

Date 5-22-84 By B. Wright

WO #0008

Brown & Root, Inc.

MATERIALS ENGINEERING LABORATORY
TENSILE TESTING LOG

RF-103.20-08

LABORATORY TEST NO. CP 5-22-84 WORK ORDER NUMBER NA

TEST TECHNICIAN H. Porter DATE 5-22-84

SPECIMEN NO.	SIZE	AREA	YIELD LOAD	ULTIMATE LOAD	YIELD STRENGTH (PSI)	TENSILE STRENGTH (PSI)	% EL.	R.A. DIA.	% R.A.	FRACTURE LOCATION
#1	.667	.8224	55700	70800	67729	86089	31	NA	NA	Base Metal
	1.233									
#2	.684	.8885	59700	75300	67192	84750	31	NA	NA	Base Metal
	1.299									

WITNESSED BY:
C C Wainwright 5/22/84

FIGURE 9

FIGURE 10

WO #0008

MATERIALS ENGINEERING LABORATORY
CHARPY IMPACT LOG

RF-103.20-07

1 1

Laboratory Test No. CP 5-22-84 Date 5-22-84

Test Technician H. Porter

Specimen Size and Type 10MM x 10MM "V" Notch

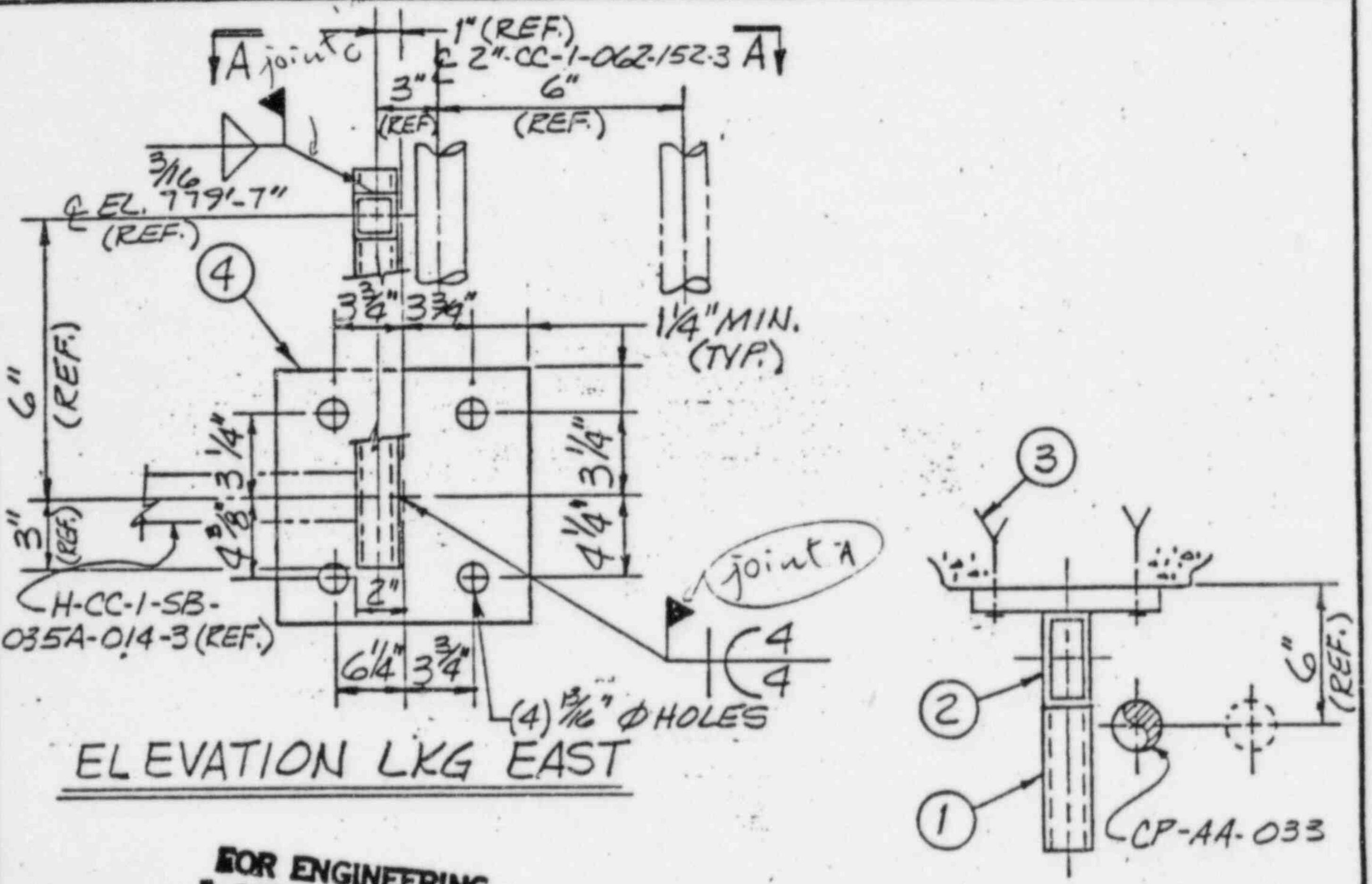
Test Temperature and Medium +32^{0} F Ice and Water

Specimen No.	Energy in ft. lbs.	Lateral Expansion in 0.000"	Percent Shear
1W	99	65	NA
2W	90	53	NA
3W	115	68	NA
1H	121	71	NA
2H	115	69	NA
3H	120	69	NA
1B	167	70	NA
2B	172	75	NA
3B	135	69	NA
		WITNESSED BY:	
		C E Wainwright 5/22/84	

ATTACHMENT C

Analysis Regarding Pipe Support H-CC-1-SB-038-010-3

ITEM NO.	QTY REQD	MATERIAL DESCRIPTION	MATERIAL DESIG.
1	1	TS. 2 x 2 x .250 x 0'-7" LG (CUT TO SUIT)	A500, GR.B
2	1	TS. 4 x 2 x .250 x 1'-1" LG (CUT TO SUIT)	A500, GR.B
3	4	3/4 x 7" HILTI-KWIKBOLT (4" MIN. EMB)	
4	1	PL. 3/4" THK. (SEE ELEVATION VIEW.)	SA-36



FOR ENGINEERING & OFFICE USE ONLY

NOTES:

1. FOR GEN. NOTES, SEE CP-AA-001.
2. ITEMS 1, 2, 3 & 4 WERE ITEMS 4, 5, 3 & 6 ON CMC 35896, REV. 6 RESPECTIVELY

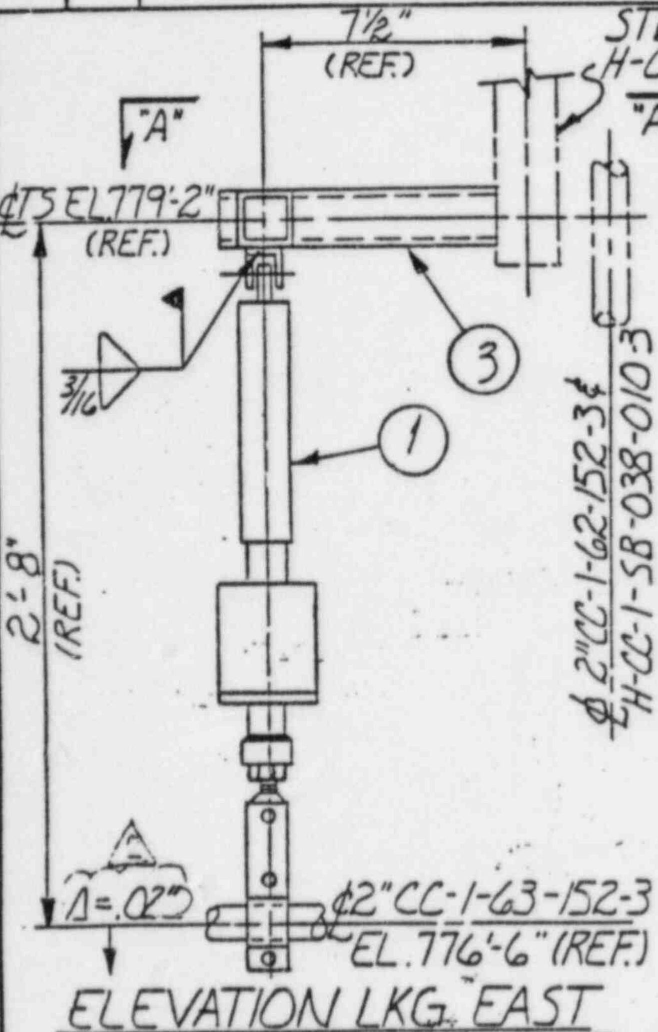
REV	DATE	DWN	CHKD	APPR	DESCRIPTION
1	2-22-83	E.C.	OG	KW	FINAL REVIEW: INC. CMC #35896 - REV. 6 & REDRAWN
					RELEASED FOR CONSTRUCTION

PROB. #	DATA PT.	DESIGN LOADS (LBS) SERVICE LEVEL LIMITS A	B	C	PIPE MVMT. (INCHES)
—	—				
	VERT.	—	—	—	.03
+N, E, UP	N-S	35	39	43	.00
-S, W, DN.	E-W	32	36	40	.00

TEXAS UTILITIES SERVICES INC.
COMANCHE PEAK STEAM ELECTRIC STATION
PIPE SUPPORT ENGINEERING

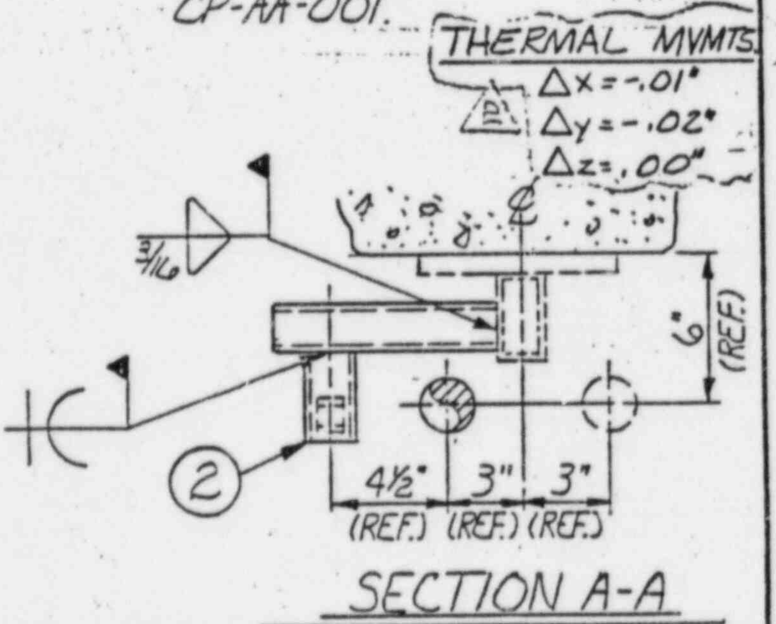
DRAWING NO.	REV.	SHT
H-CC-1-SB-038-010-3	1	1 -OF- 1

ITEM NO.	QTY REQD	MATERIAL DESCRIPTION	ASME DESIG.
1	1	SNUBBER SMA-1/4-PC CC=24 3/4" CS=2 HS=2 w/SPC-06-020	
2	1	T.S. 2 x 2 x .250 x 0'-6" LG. (CUT TO SUIT)	A500 GR B
3	1	T.S. 2 x 2 x .250 x 0'-10" LG. (CUT TO SUIT)	A500 GR B



DESIGN LOADS (lbs.)
LEVEL B: Y=10
LEVEL C: Y=20

NOTES:
1. FOR GEN. NOTES SEE CP-AA-001.



REV	DATE	DWN	CHKD	APPR	DESCRIPTION
2	2-15-83	E.C.	OG		FINAL REVIEW & REVISED AS NOTED
					RELEASED FOR CONSTRUCTION
1	6.11.81	B.S.	RWE	SHR	REDESIGNED & REDRAWN

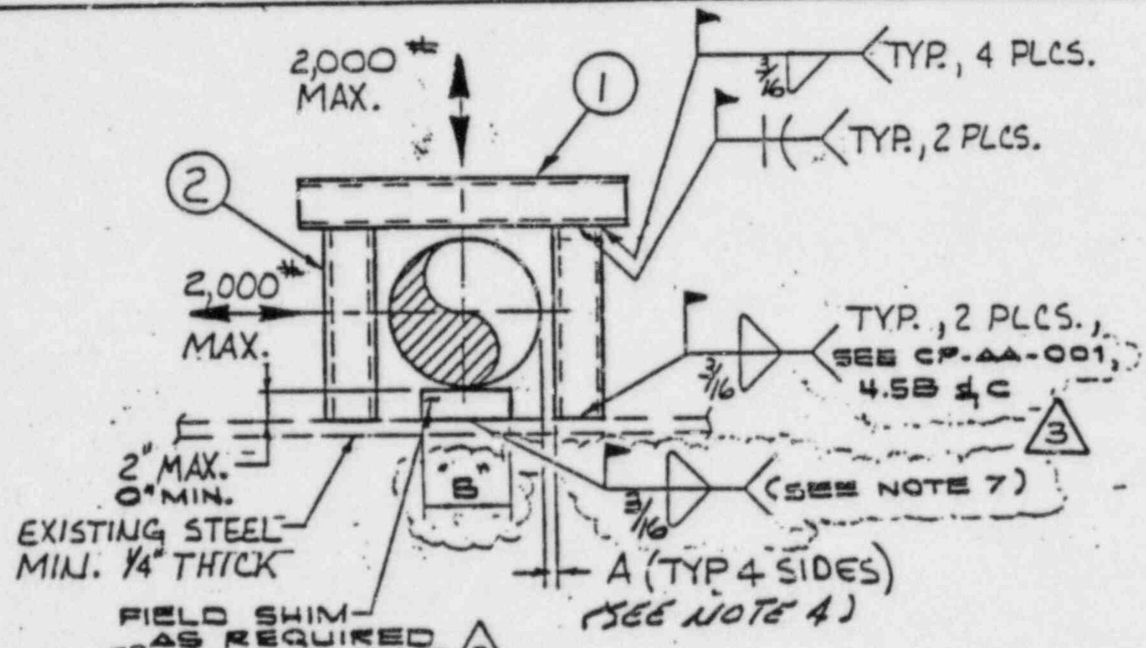
FOR ENGINEERING & OFFICE USE ONLY

TEXAS UTILITIES SERVICES INC.
COMANCHE PEAK STEAM ELECTRIC STATION
PIPE SUPPORT ENGINEERING

NUCLEAR SAFETY RELATED PIPE SUPPORT

DRAWING NO. H-CC-1-SB-035A-014-3 | REV. 2 | SHT 1 OF 1

ITEM NO.	QTY REQD	MATERIAL DESCRIPTION	ASME DESIG.
1	1	T.S. 2x2x.250x0'-9" LG. (CUT TO SUIT)	A-500 GR.B
2	2	T.S. 2x2x.250x0'-5" LG. (CUT TO SUIT)	A-500 GR.B



NOTES:

1) FOR GENERAL NOTES SEE CP-AA-001
2) SUPPORT GOOD ONLY FOR 2" & SMALLER PIPE
3) SUPPORT IS GOOD FOR ANY ORIENTATION
4) "A" DIMENSION = 1/16" EXCEPT IN GRAVITY DIRECTION "A" = 0
5) SHIM WIDTH "B" (MIN.) = PIPE O.D. - 1/4" (3)
6) SUPPORT GOOD FOR 2,000# MAX. LOADS.
7) SHIM IS OPTIONAL. IT MAY BE WELDED AS SHOWN, OR INSTALLED PER PROCEDURE. (3)

REV	DATE		DWN	CHKD	APPR	DESCRIPTION
3	8-10-83		DR	[illegible]	KW	REVISED AS NOTED
2	8-4-83		RWE	OG	KW	REVISED AS NOTED
1	6-30-83		aw	RWE	KW	REVISED AS NOTED
0	12-10-80		B.K.	DWM	[illegible]	RELEASED FOR CONSTRUCTION

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FOR ENGINEERING OFFICE USE ONLY

TEXAS UTILITIES SERVICES INC.
COMANCHE PEAK STEAM ELECTRIC STATION
PIPE SUPPORT ENGINEERING

NUCLEAR SAFETY RELATED PIPE SUPPORT

DRAWING NO. CP-AA-033 | REV. 3 | SHT 1 -OF- 1

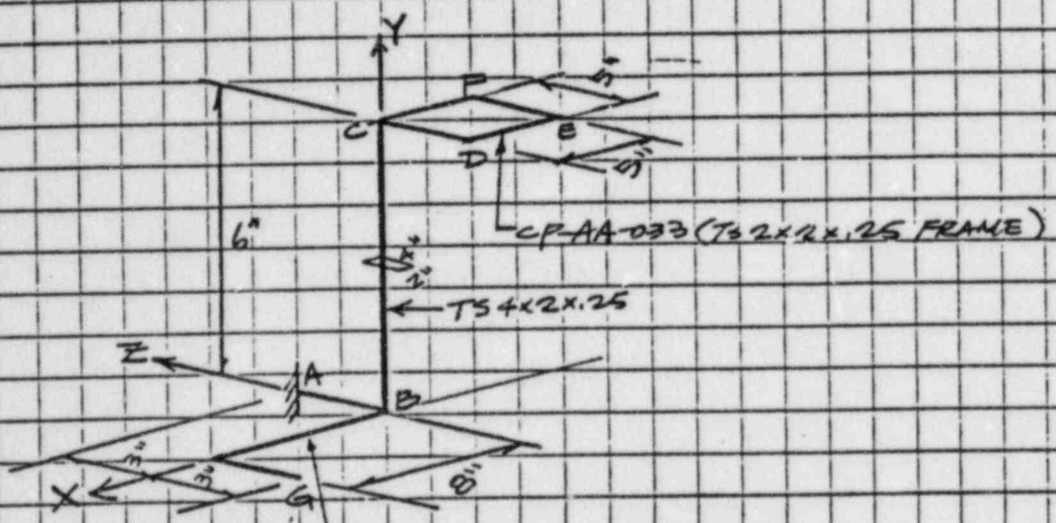
FORM DHE-5

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

Date 5-4-84
Calc By DYC
Chk'd/Apprd. By DS 5-7-84
Filing Code ______
Sheet No. 1 of 6
G & H Job. No. ______

Subject REVIEW SUPPORT. H-CC-1-SB-038-010-3 R/1 Ref. Dwg/Spec. No. ______

REF.



STEEL SUPPLIED BY — H-CC-1-SB-035A-014-3
TS 2×2×.25 & SNUBBER SMA-1/4: C-C = 24 3/4"

ASSUMPTIONS & NOTES:

1). ALL DIMENSIONS SHOWN ON SKETCH ARE VERIFIED IN THE FIELD.

2). USE ZPA SEISMIC ACCELERATION VALUE FOR EQUIVALENT STATIC MEMBER WEIGHT CALCULATION DUE TO RIGIDITY OF THE STRUCTURE. — RESPONSE SPECTRUM BY G & H FIG 1399-A

@ EL. 779'-7"	X DIRECTION	.25G
SSE	Y DIRECTION	.5G + 1G = 1.5G
.04 DAMPING	Z DIRECTION	.25G

3). IT IS CONSERVATIVE TO ASSUME MEMBER WT. FROM A TO E ACTING @ JT. E & MEMBER WEIGHT FROM B TO G ACTING @ JT. G FOR CHECKING WELD CAPACITY @ JT. A

4). FRICTION LOAD IS NEGLIGIBLE SINCE PIPE MOVEMENT IS LESS THAN 1/16". — REF. 3 SECT. II P. 1 OF 15

5.) THIS CALC. IS TO DETERMINE THE WELD CAPACITY USED @ JT. A & C BY USING LEVEL "C" LOAD COMPARE W/ LEVEL "B" ALLOWABLES.

TEXAS UTILITIES SERVICES INC.
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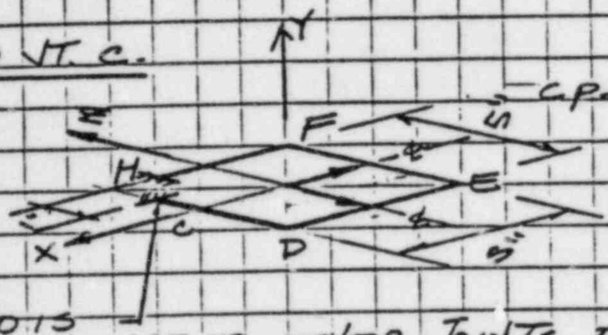
G & H Job. No.
Subject REVIEW SUPPORT: H-CC-1-SB-038-010-3 R/1 Ref. Dwg./Spec. No.

REF.

WELD @ JT. C.



THIS WELD IS CRITICAL COMPARE TO OTHER JOINTS D, E, F & H.

WT. OF THIS FRAME =

	LENGTH(in);	UNIT WT.(#/FT)	TOTAL (#)
TS 2x2x.25	4x5=20	5.41	9

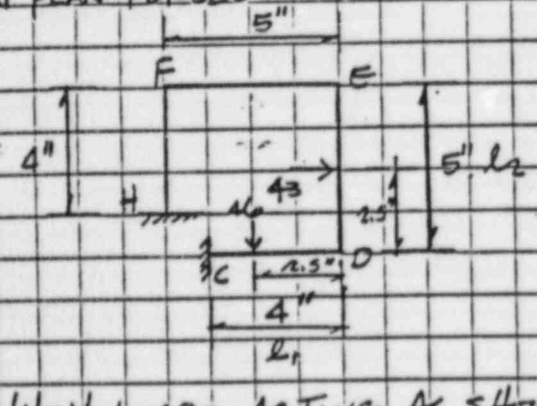
EQUIVALENT STATIC LOAD. $Fx = 9 \times .25 = 3^{\#}$
$FY = 9 \times 1.5 = 13.5^{\#}$
$Fz = 9 \times .25 = 3^{\#}$

PIPE LOAD = LEVEL 'C' LOAD (#)

$Fx = 43$; $FY = 0$; $Fz = 40$

TOTAL LOAD : $Fx = 3+43 = 46$; $FY = 13.5$; $Fz = 3+40 = 43$

IN PLAN FORCES =



MOMENT DISTRIBUTION METHOD.

FEM.

$$-M_{ED} = M_{DE} = \frac{Pl}{8} = \frac{43 \times 5}{8} = 27^{\#-''}$$ AISC 7th ED. P. 2-203

$$M_{CD} = \frac{Pab^2}{l^2}$$

$$= \frac{46 \times 1.5 \times 2.5^2}{4^2}$$

WHEN LOADS ACTING AS SHOWN MAX. MOMENT OCCURRED @ JT. C. $= 27^{\#-''}$

$$M_{DC} = \frac{Pa^2b}{l^2} = \frac{46 \times 1.5^2 \times 2.5}{4^2}$$

$$= 16^{\#-''}$$

FORM DHE-5

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

Date 5-4-84
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Subject REVIEW SUPPORT: H-CC-1-SB-038-010-3 R/1
Filing Code ______
Sheet No. 3 Of 6
G & H Job. No. ______
Ref. Dwg./Spec. No. ______

REF.

WELD @ JT. C (CONT'D)

DISTRIBUTION FACTOR BASED ON RELATIVE STIFFNESS.

$K_{FH} = \frac{I/\ell_1}{I/\ell_1 + I/\ell_2} = \frac{\ell_2}{\ell_1+\ell_2} = \frac{5}{5+4} = .56$

$K_{FE} = 1 - .56 = .44$

$K_{EF} = \frac{5}{5+5} = .5$

$K_{ED} = 1 - .5 = .5$

$K_{DE} = \frac{4}{5+4} = .44$

$K_{DC} = 1 - .44 = .56$

M_Y =

JOINT	F		E		D		C
MEMBER	FH	FE	EF	ED	DE	DC	CD
D.F.	.56	.44	.5	.5	.44	.56	1.
F.E.M.				-27	27	-16	27
D.M				-3	-5	-6	-3.0
			15	15			
		8			8		
	-4	-4			-3	-5	-2.5
			-2	-2			
			2	2			
Σ	-4	4	15	-15	27	-27	22

ASSUMING OUT OF PLAN FORCE FY ACTING @ JT. E & ONLY JT. C RESISTS THIS FORCE & ITS' CAUSED MOMENT M_x & M_z.

$M_x = 13.5 \times 4 = 54$ (#-11) ; $M_z = 13.5 \times 5 = 68$ (#-11)

SUMMARY OF REACTIONS @ JT. C. (#-11, #)

$F_x = 46$; $F_y = 13.5 \approx 14$; $F_z = 43$ (CONSERVATIVE)
$M_x = 54$; $M_y = 22$; $M_z = 68$

FORM DHE-5

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COMANCHE PEAK S.E.S.
Agent For
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TEXAS ELECTRIC SERVICE COMPANY
TEXAS POWER & LIGHT COMPANY

Date 5-4-84
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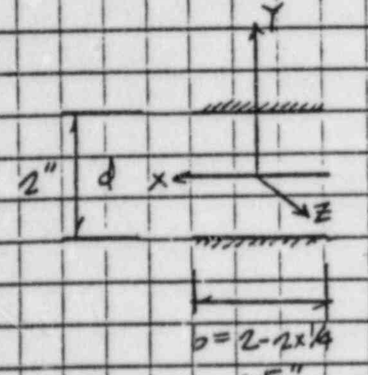
Subject REVIEW SUPPORT - H-CC-1-SB-038-010-3 R/1 Ref. Dwg./Spec. No.

Filing Code
Sheet No. 4 of 6
G & H Job. No.

REF

WELD @ JT. C (CONT'D)

WELD PROPERTIES



$L_W = 2 \times b = 2 \times 1.5 = 3$ IN

$S_{WX} = b \times d = 2 \times 1.5 = 3$ IN²

$S_{WY} = b^2/3 = 1.5^2/3 = .75$ IN²

$J_W = (b^3 + 3bd^2)/6$
$= (1.5^3 + 3 \times 1.5 \times 2^2)/6$
$= 3.56$ IN³ — 3. SECT XI P. 5 OF 20

$C_{WX} = d/2 = 2/2 = 1$; $C_{WY} = b/2 = \frac{1.5}{2} = .75$ IN

$$F_R = \left[\left(\frac{F_Z}{L_W} + \frac{M_X}{S_{WX}} + \frac{M_Y}{S_{WY}}\right)^2 + \left(\frac{F_X}{L_W} + \frac{M_Z C_{WX}}{J_W}\right)^2 + \left(\frac{F_Y}{L_W} + \frac{M_Z C_{WY}}{J_W}\right)^2\right]^{1/2}$$

$$= \left[\left(\frac{43}{3} + \frac{54}{3} + \frac{22}{.75}\right)^2 + \left(\frac{46}{3} + \frac{68 \times 1}{3.56}\right)^2 + \left(\frac{14}{3} + \frac{68 \times .75}{3.56}\right)^2\right]^{1/2}$$

= 73 #/IN % OF CAPACITY USED 73/2386 = 3% — 3 SECT XI P. 11 OF 20 ←

FORM DHE-5

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

Date 5-4-84
Calc By DYC
Chk'd/Appr'd. By DS 5-7-84

Filing Code
Sheet No. 5 of 6
G & H Job. No.

Subject REVIEW SUPPORT = H-CC-1-SB-038-010-3 R/1 Ref. Dwg./Spec. No.

REF.

WELD @ JT. A (SEE NOTE 3 ON PAGE 1) UNIT: IN-LBS

MEMBER WEIGHT:

	ITEM	LENGTH (IN)	UNIT WT (#/FT)	TOTAL (#)
@ JT. E	CPAA-033	20	5.41	9
	TS 4X2X.25	7	8.81	5
				Σ 14
@ JT. G	TS 2X2X.25	3+8	5.41	5
	SMA 1/4 ¢ SPC-06.020	—	5.6+6.1	12
				Σ= 17

EQUIVALENT STATIC MEMBER WEIGHT DUE TO ZPA

	Fx	FY	Fz
@ JT. E	14X.25=4	14X1.5=21	14X.25=4
@ JT. G	17X.25=5	17X1.5=26	17X.25=5

PIPE LOAD FROM H-CC-1-035A-014-3 ; FY=20 (LEVEL 'C')

TOTAL LOAD	Fx	FY	Fz
@ JT. E	4+43=47	21	4+40=44
@ JT. G	5	20+26=46	5

FORM DHE-5

TEXAS UTILITIES SERVICES INC.
COMANCHE PEAK S.E.S.
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G & H Job. No.

Subject: REVIEW SUPPORT = H-CC-1-SB-038-010-3 R/1
Ref. Dwg./Spec. No.

	REF.
WELD @ JT. A (CONT'D)	

REACTIONS @ JT. A (# & #-11)

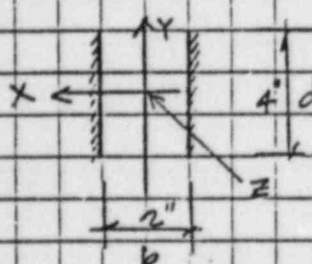
$F_x = 47+5 = 52$, $F_y = 21+46 = 67$, $F_z = 44+5 = 49$

$M_x = 21\times8 + 44\times6 + 46\times6 = 708$

$M_y = 47\times8 + 44\times5 + 5\times6 + 5\times8 = 666$

$M_z = 47\times6 + 21\times5 + 46\times8 = 755$

WELD PROPERTIES.



$L_w = 2\times d = 2\times4 = 8$ IN — REF: 3. SECT. XI p. 5 OF 20

$S_{wx} = d^2/3 = 4^2/3 = 5.33$ IN²

$S_{wy} = b\times d = 2\times4 = 8$ IN²

$J_w = (d^3 + 3b^2d)/6 = (4^3 + 3\times4\times2^2)/6 = 18.67$ IN³

$C_{wy} = d/2 = 4/2 = 2$ IN, $C_{wx} = b/2 = 2/2 = 1$"

$$F_R = \left[\left(\frac{F_z}{L_w} + \frac{M_x}{S_{wx}} + \frac{M_y}{S_{wy}}\right)^2 + \left(\frac{F_x}{L_w} + \frac{M_z C_{wy}}{J_w}\right)^2 + \left(\frac{F_y}{L_w} + \frac{M_z C_{wx}}{J_w}\right)^2\right]^{1/2}$$

$$= \left[\left(\frac{49}{8} + \frac{708}{5.33} + \frac{666}{8}\right)^2 + \left(\frac{52}{8} + \frac{755\times2}{18.67}\right)^2 + \left(\frac{67}{8} + \frac{755\times1}{18.67}\right)^2\right]^{1/2}$$

$= 244$ #/" — REF: 3. SECT. XI p. 11 OF 20

Allow .4 x Fy x EFFECTIVE THROAT
= .4 x 32800 x .25 = 3280 #/"

% OF CAPACITY USED 244/3280 = 7.4% ←