REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8404190224 DOC.DATE: 84/04/05 NOTARIZED: NO DOCKET #
FACIL:50-275 Diablo Canyon Nuclear Power Plant, Unit 1, Pacific Ga 05000275
50-323 Diablo Canyon Nuclear Power Plant, Unit 2, Pacific Ga 05000323

AUTH.NAME	AUTHOR AFFILIATION
SCHUYLER,J.O.	Pacific Gas & Electric Co.

RECIP.NAME	RECIPIENT AFFILIATION
KNIGHTON,G.W.	Licensing Branch 3

SUBJECT: Forwards response to issues identified during 840228-29 audit exit interview re analysis & qualification of annulus structure framing sys.Ack of receipt of matl requested.

DISTRIBUTION CODE: B001S COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 12
TITLE: Licensing Submittal: PSAR/FSAR Amdts & Related Correspondence

NOTES:J Hanchett 1cy PDR Documents. 05000275
J Hanchett 1cy PDR Documents. 05000323

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	NRR/DL/ADL	1	0	NRR LB3 BC	1	0
	NRR LB3 LA	1	0	SCHIERLING,H 01	1	1
INTERNAL:	ELD/HDS2	1	0	IE FILE	1	1
	IE/DEPER/EPB 36	3	3	IE/DEPER/IRB 35	1	1
	IE/DQASIP/QAB21	1	1	NRR/DE/AEAB	1	0
	NRR/DE/CEB 11	1	1	NRR/DE/EHEB	1	1
	NRR/DE/EQB 13	2	2	NRR/DE/GB 28	2	2
	NRR/DE/MEB 18	1	1	NRR/DE/MTEB 17	1	1
	NRR/DE/SAB 24	1	1	NRR/DE/SGEB 25	1	1
	NRR/DHFS/HFEB40	1	1	NRR/DHFS/LQB 32	1	1
	NRR/DHFS/PSRB	1	1	NRR/DL/SSPB	1	0
	NRR/DSI/AEB 26	1	1	NRR/DSI/ASB	1	1
	NRR/DSI/CPB 10	1	1	NRR/DSI/CSB 09	1	1
	NRR/DSI/ICSB 16	1	1	NRR/DSI/METB 12	1	1
	NRR/DSI/PSB 19	1	1	NRR/DSI/RAB 22	1	1
	NRR/DSI/RSB 23	1	1	REG FILE 04	1	1
	RGN5	3	3	RM/DDAMI/MIB	1	0
EXTERNAL:	ACRS 41	6	6	BNL(AMDTS ONLY)	1	1
	DMB/DSS (AMDTS)	1	1	FEMA-REP DIV 39	1	1
	LPDR 03	2	2	NRC PDR 02	1	1
	NSIC 05	1	1	NTIS	1	1
NOTES:		1	1			

TOTAL NUMBER OF COPIES REQUIRED: LTTR 55 ENCL 48

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

PACIFIC GAS AND ELECTRIC COMPANY

PG and E — 77 BEALE STREET • SAN FRANCISCO, CALIFORNIA 94106 • (415) 781-4211 • TWX 910-372-6587

J. O. SCHUYLER
VICE PRESIDENT
NUCLEAR POWER GENERATION

April 5, 1984

PGandE Letter No.: DCL-84-133

Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington D.C. 20555

Re: Docket No. 50-275, OL-DPR-76
Docket No. 50-323
Diablo Canyon Units 1 and 2
Audit of Unit 2 Annulus Design

Dear Mr. Knighton:

The NRC Staff performed an audit of the Diablo Canyon Unit 2 annulus design on February 28 and 29, 1984. Enclosed are PGandE responses to issues identified during the audit exit interview pertaining to analysis and qualification of the annulus structure framing system in Units 1 and 2.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Sincerely,

J O Schuyler

Enclosure

cc: D. G. Eisenhut
J. B. Martin
H. E. Schierling
Service List

B001
1/1

ENCLOSURE

PGandE RESPONSE TO ISSUES IDENTIFIED DURING NRC TECHNICAL AUDIT OF UNIT 2 ANNULUS DESIGN ON FEBRUARY 28-29, 1984

ISSUE 1

To address the issues raised in recent anonymous allegations, the NRC Staff suggested that the following items be considered by the Diablo Canyon Project (by generic calculations or example). The items pertain to the analysis and qualification of the annulus structure framing system in Units 1 and 2.

a. Temperature differentials that occur in the transient conditions during plant startup and shutdown

b. Local temperature differentials in supporting structural members of the framing system caused by the thermal environment in the supported pipe

c. Local temperature effects due to jet impingement

RESPONSE 1

a. Startup and Shutdown Conditions

The temperature variation in the annulus area during startup and shutdown was reviewed for Diablo Canyon and other comparable operating plants. During operation, the design temperature inside the containment is 120°F. Based on the fan cooler capacity of Diablo Canyon and operating experience at other plants, it is likely that during refueling the temperature in the annulus area will be between 80 and 90°F. Considering the time between heating and cooling the annulus steel and the concrete crane wall (thermal inertia), a conservative estimate of the temperature differential between the two structural elements would be 40°F. If a steel member is restrained axially by infinitely rigid supports, the induced axial stress due to a uniform temperature change of 40°F over the entire length of the member would be 7.54 ksi ($\sigma = \alpha E \Delta T = (6.5)(10)^{-6}(29)(10)^{6}(40) = 7.54$ ksi).

If the flexibility of restraining supports or members is considered, the induced axial stress in the restrained member would be reduced. For example, if the stiffness of the supports is twice the stiffness of the restrained member, the resulting stress would be 2/3 of the fully restrained case, or 2/3 (7.54) = 5.03 ksi. Considering the actual geometry of the annulus structure and the crane wall, this latter condition would be an upper limit on the

incremental axial stresses in the annulus steel resulting from the transient thermal differential between the annulus structure and the crane wall.

The self-limiting characteristics of secondary stresses are recognized by the prevalent industry codes, such as ANSI and ASME, which permit higher stress allowables when load combinations include thermal effects. Specifically, the ANSI Code allows the stresses to be increased over normal limits by a factor of 1/3 to 1/2. The FSAR does not mention the specific loading condition involving transient thermal effects during plant startup and shutdown. However, if the FSAR loading combination applicable to the containment's internal structure during normal operating conditions is considered, the condition only includes DE and not DDE or Hosgri. For axial loads where the normal allowable stress for A-36 material is 0.6 fy, or 21.6 ksi, the permissible 1/3 increase is, therefore, 7.2 ksi. This is greater than the computed maximum incremental stress due to a 40°F differential temperature. The inclusion of the transient thermal effect and simultaneous increase in stress allowable will, therefore, result in a stress condition that is less restrictive than the loading condition which ignores the transient effect.

b. <u>Local Pipe Effects</u>

The air temperature in the annulus area is controlled by the HVAC system. With a conservative estimate of 7.6 air changes per hour and circulation in the annulus area equal to or greater than the average circulation inside the containment structure, there is sufficient mixing of air so that the temperature will be nearly uniform. The only deviation would be localized in the vicinity of a hot pipe attachment.

The temperature of structural members in the vicinity of hot pipe attachments decreases very rapidly within a short distance from the pipe. Examples of this are shown in the Attachment. Even though the temperatures in the annulus area are somewhat different from temperatures under which these data were gathered, several important points are applicable. First, the temperature of steel attachments to the piping at the outer surface of the insulation indicates that about half of the temperature differential between the pipe surface and the air takes place in the insulation. In the annulus area, a similar reduction would be expected. Second, the temperature reduces very rapidly beyond the insulation. As indicated in the earlier discussion associated with the temperature differential between the annulus steel and the crane wall, a 40°F differential over the entire length of a structural framing member causes an increase in stress of less than 1/3 of the allowable working level stresses. Considering the rapid reduction in temperature of the steel attachments beyond the insulation, and the further temperature reduction in the cooler ambient air, the average temperature change over the entire length of a structural framing member is expected to be considerably less than 40°F. This is particularly true for the rigid structural steel pipe supports which are efficient conductors of heat and which, in turn, are attached to major structural steel members of considerable length (17 ft. long or more). Therefore, the inclusion of this condition with other normal operating loads with the attendant increase in stress allowables does not produce a more restrictive load combination.

c. Jet Impingement Thermal Effects

From previous investigations, it has been determined that there are only two locations where jets can strike structural members of the annulus framing system Unit 1. The Unit 2 evaluation is still in progress. At one of these locations, the postulated jet is far enough away from the impacted member (column 8) such that the surface temperature of the member is only about 170°F. As discussed in the previous items, such a localized rise in temperature will not result in a controlling condition.

In the second location, the postulated jet is potentially very close to the member (column 6, approximate elevation 111'). Considering the worst scenario of a continuous jet spraying directly on the member, rather than the more realistic case of an intermittent jet spray, the surface temperature of the member would be approximately 500°F. This condition will cause axial growth and some bowing of the column.

The axial growth can take place virtually unrestrained. The only members attached to this column are in horizontal planes at elevations 101', 106', 117', and 140'. The members at the lower three elevations are steel members which have very small resistance to vertical movement at the column location. Therefore, these members move with the column and induce virtually no load in the column or in themselves. The column supports a 20-in. thick concrete slab at elevation 140'. This slab offers very little resistance to the vertical growth of the column (approximately 1/4 to 3/8 in.) since it is simply supported at the crane wall. The minor resistance that does exist results from the slab being supported by adjacent columns not subjected to the jet. The flexural stiffness of the slab spanning between these columns is negligible compared to the axial stiffness of the column, thereby allowing the column to move vertically. This mode of behavior (axial growth), therefore, is not a design controlling condition.

The bowing behavior has also been investigated for this very conservative case of the jet spraying directly on the column. For this relatively simple case, definition of the temperature gradient is very difficult. Rudimentary calculations indicate that there is a possibility of some local yielding at two support points of the column at elevations 106' and 117'. Excluding the bowing behavior, the stress in the column at these points is relatively low. The combined effect of axial and bending stresses, including the jet pressure as expressed by the AISC interaction equation, produces a stress ratio of only 0.62 compared with the allowable limit of 1.0. When the bowing effect is included, this ratio may exceed 1.0, but the conditions are still acceptable from an engineering point of view and still meet the requirements in the FSAR as discussed below. In actual behavior, some local yielding may develop from the imposition of the thermally induced stresses with the other stresses, but this yielding will simply relieve the thermal stresses. The column will continue to perform its function of providing vertical support for all attached members. This is true since the column is adequately braced by the annulus structure at elevations 106' and 117', and the axial stress in the column, excluding thermal loads, is only 14.3 ksi.

The FSAR states that for the load combinations which involve thermal loads associated with postulated pipe break, "Thermal loads are neglected when it can be shown that they are secondary and self-limiting in nature and where the material is ductile." The above discussion describes a condition where the thermal loads are secondary and self-limiting. Since the columns in the annulus structure are fabricated from low carbon steel, the material is ductile. This satisfies the requirements in the FSAR to neglect the thermal loads.

ISSUE 2

One connecting bolt was identified as having been qualified by using the 8th Edition of the AISC Code, whereas the licensing criterion specifies the use of the 7th Edition.

RESPONSE 2

During the technical audit, the NRC Staff observed that the 8th Edition of AISC Code was used in qualifying one of the annulus steel brace connections. This was found in calculation 2123C-5. The case was discovered during an attempt to compare the qualification methods of member connections adopted by Unit 1 with those used by Unit 2.

It was noted during the audit that:

a. Use of the AISC Code, 8th Edition, was an isolated case.

b. Calculation 2123C-5 is based upon the very conservative assumptions that bolt threads are included in the shear plane and that the connection was a friction type.

However, a field walkdown conducted on March 2, 1984, revealed that the threads are excluded from the shear plane. Also, the as-built drawing indicates that the bolts are A325-X, and thus, a bearing type connection. Based on the above data, the brace connection is also qualified to the AISC Code, 7th Edition. The changes have been incorporated in the calculations.

A further investigation was conducted to determine how extensively the AISC Code, 8th Edition, was used in the annulus steel evaluation. A complete review was performed of the Unit 1 annulus steel calculations pertaining to final qualification analysis. From this investigation, it was found that no other calculations contained the AISC Code, 8th Edition, as a reference. Calculation 2123C-5 has been corrected to indicate the proper reference.

ISSUE 3

The following QA issues were identified in Unit 2 annulus calculations:

a. A single originator's name was on certain calculation sheets that appeared (based on distinct differences in handwriting) to have been prepared by

two different individuals. It also appeared that the name of the other originator was erased. The original checker's date also appeared to have been erased and new dates entered.

b. A few calculation sheets updated to Rev. 1 showed evidence of voiding the sheet by drawing an "X" across the sheet and writing "void." However, the "X" and "void" notations were subsequently erased, returning the calculation sheet to a valid status.

RESPONSE 3

a. The sheets in question were part of a calculation which was started by one engineer and only partially completed before the engineer was temporarily transferred to a different assignment. To complete the task, a second engineer continued the calculations. This engineer reviewed the partially completed work by the previous engineer and, upon agreeing with it, decided to adopt that work as his own and entered his name as the originator. This is consistent with Diablo Canyon engineering procedures. He then completed the calculation and gave it to the original checker. When the checker reviewed the entire calculation, including the previous work, to make sure it was acceptable for any changes made, he signed the new sheets with the appropriate date and also revised the dates on the earlier partially completed sheets to indicate that the entire calculation was checked again. This is also consistent with Diablo Canyon engineering procedures. The NRC Staff auditors reviewed the final calculation and found it to be acceptable in its present form.

b. PGandE has investigated the situation and, based on a discussion with the originator and checker, found the following:

The originator and the checker said that the calculation under consideration was made early in the annulus verification analysis (Phase I). However, when the final qualfication analyses of the annulus were made, following the development of the final vertical floor response spectra (Phase II), the checker reviewed the Phase I calculations and concluded that they could not be used for all of the Phase II work. Therefore, he decided to void them and have the originator generate a new calculation. Upon consultation between the originator and the checker, the originator pointed out that the original calculation should not be voided since it was applicable to all Phase I work and also to some of the special cases in Phase II work. Also, since new calculations were made for Phase II where Phase I calculations could not be used, it was correct not to void the original calculation. Therefore, based on the agreement between both the originator and the checker, the calculations were reinstated to a valid status.

Attachment

TEMPERATURE DISTRIBUTION DATA

The following report describes a survey made to determine temperature distribution on various types of Grinnell-engineered pipe supports.

The temperatures of the supports were measured with iron-constantan thermocouples.

The insulation, 4-in. thick combination, in two layers and covered with canvas, was removed to permit the tack welding of the thermocouples to the pipe supports. All insulation was replaced 20 hours before any readings were taken.

The following pages present the results of this survey, with a sketch of the assembly and a temperature differential chart.

SINGLE ROD ASSEMBLY

Sixteen (16) thermocouples were tack welded to a Grinnell Fig. 224 Forged Alloy Pipe Clamp at the positions indicated in Figure #1.

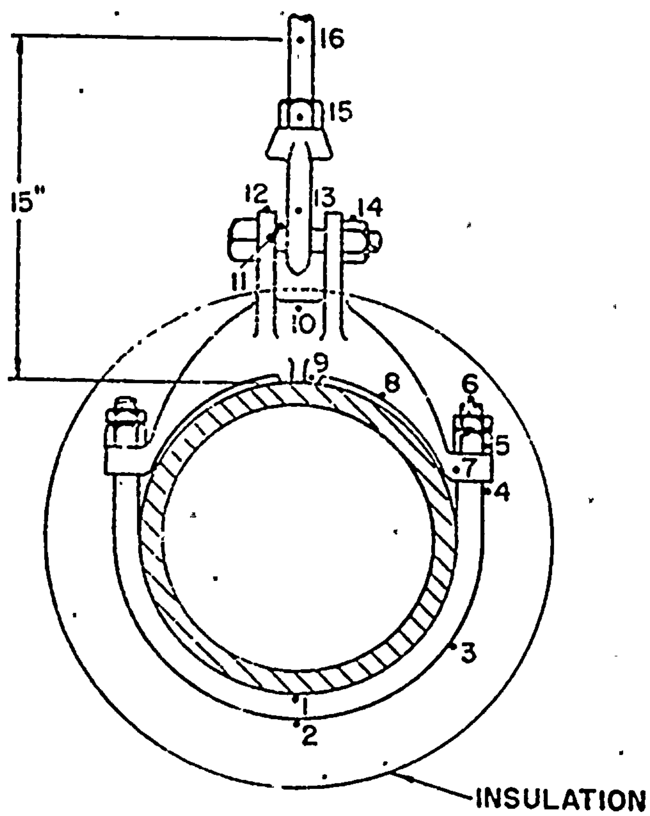
Because of the irregular sections of this assembly, the temperatures cannot be conclusively plotted against the distance from the pipe; hence, no graph showing differentials is included.

The average temperatures in degrees Fahrenheit were:

Steam temperature - 905°
Ambient Temperature - 90°

Thermocouple #1 - 888°	#6 - 736°	#11 - 255°
2 - 858	7 - 745	12 - 310
3 - 792	8 - 655	13 - 132
4 - 803	9 - 575	14 - 272
5 - 749	10 - 508	15 - 113
		16 - 90

Figure #1



RISER CLAMP

One (1) thermocouple was attached to the pipe, nine (9) to the clamp (one of these tacked close to the one on the pipe), one (1) on the nut of one of the clamp bolts, and one (1) on the eye rod. The positions were as indicated in Fig. #1. Figure #2 shows temperature differentials.

The average temperatures in degrees Fahrenheit were:

Steam temperature - 900°
Ambient temperature - 83°

Thermocouple #1 - 885°	#5 - 451°	#9 - 257°
2 - 857	6 - 349	10 - 211
3 - 664	7 - 306	11 - 219
4 - 573	8 - 269	12 - 115

Figure #1

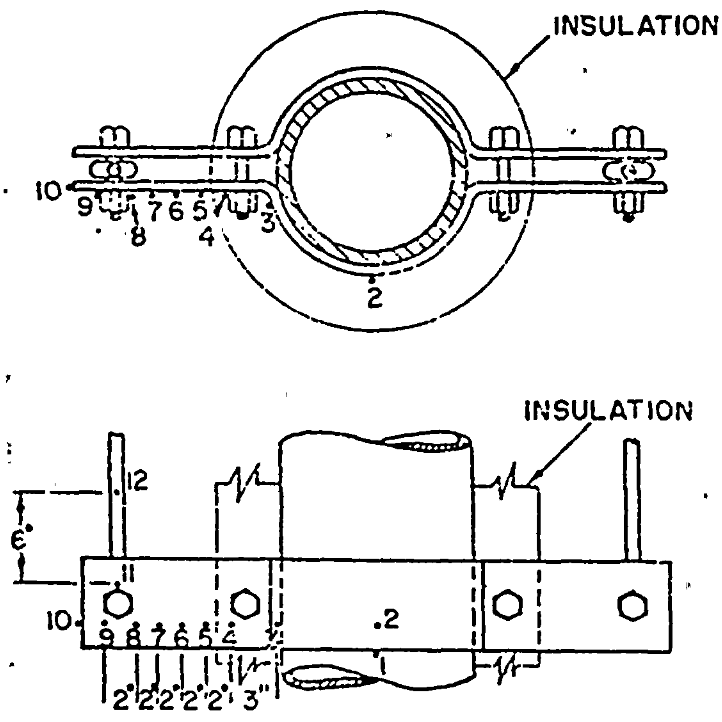
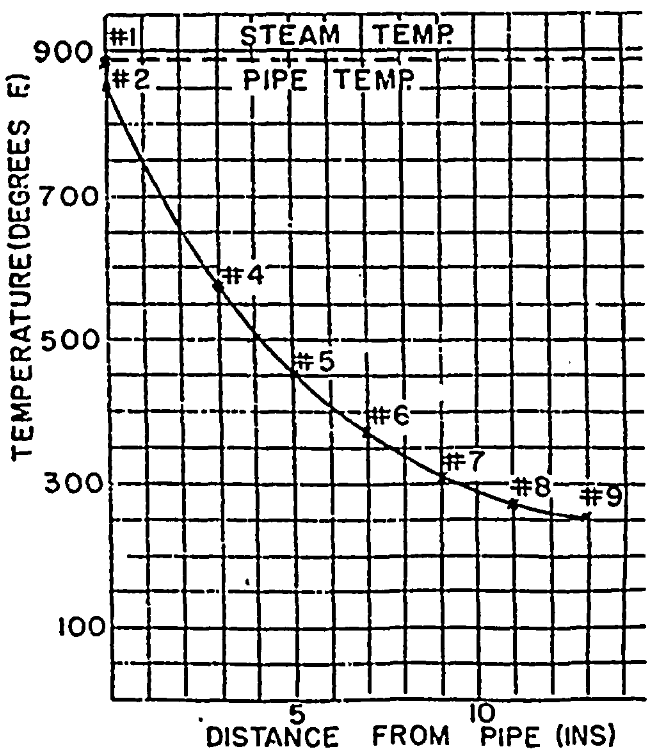


Figure #2



TRAVEL STOP

Two (2) thermocouples were tack welded to the pipe, seven (7) to one of the side plates, one (1) to the eye bolt nut, one (1) on the outside edge of the bottom plate, one (1) on the eye of the eye bolt, and two (2) on the supporting rod, at the distances indicated on Figure #1. Temperature differentials are shown in Figure #2.

The average temperatures in degrees Fahrenheit were:

Steam temperature - 890°
Ambient temperature - 90°

Thermocouple #1 - 886°	#6 - 361°	#11 - 167°
2 - 873	7 - 279	12 - 167
3 - 818	8 - 238	13 - 145
4 - 682	9 - 214	14 - 108
5 - 477	10 - 183	15 - 97

Figure #1

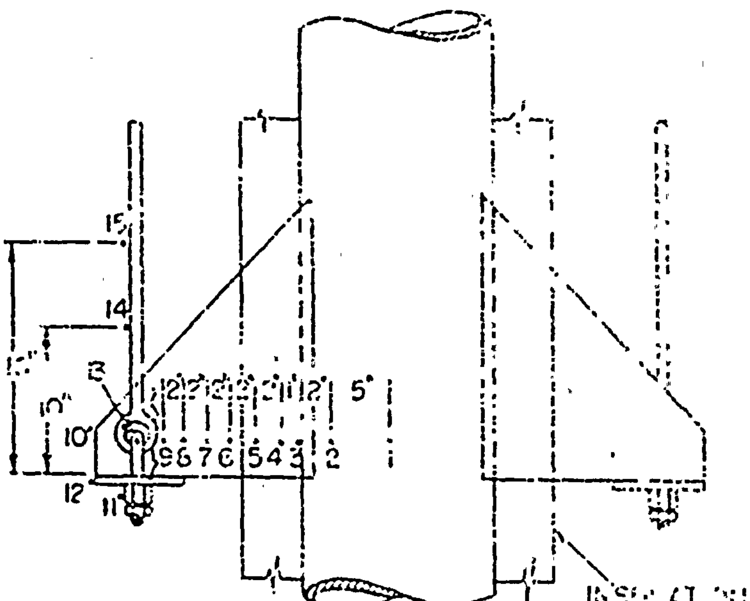
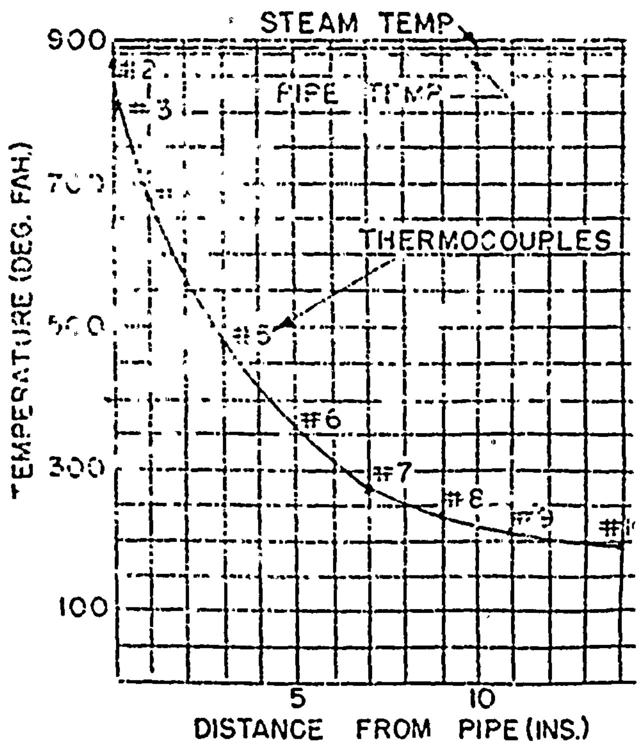


Figure #2



TRAPEZE ASSEMBLY

This support consists of a pipe covering protection saddle and two channels, as shown in Figure #1.

Two (2) thermocouples were tacked on the pipe, four (4) on the protection saddle, four (4) on the channel, one (1) on a rod nut, and three (3) on one rod, at the distances indicated. Figure #2 represents the temperature differential.

The average temperatures in degrees Fahrenheit were:

Steam temperature - 900°
Ambient temperature - 90°

Thermocouple	#1 - 897°	#6 - 386°	#11 - 94°
	2 - 872	7 - 259	12 - 94
	3 - 736	8 - 180	13 - 90
	4 - 681	9 - 147	14 - 90
	5 - 542	10 - 93	

Figure #1

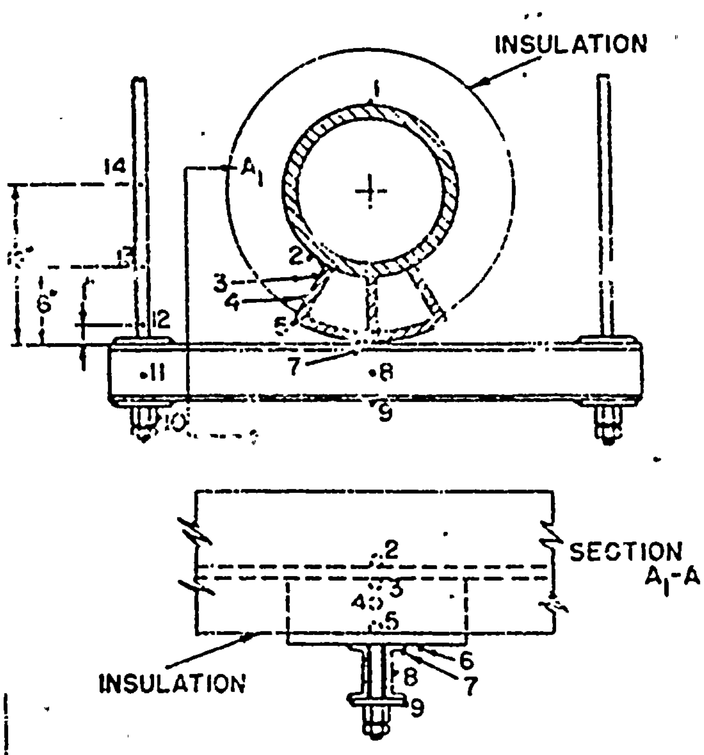
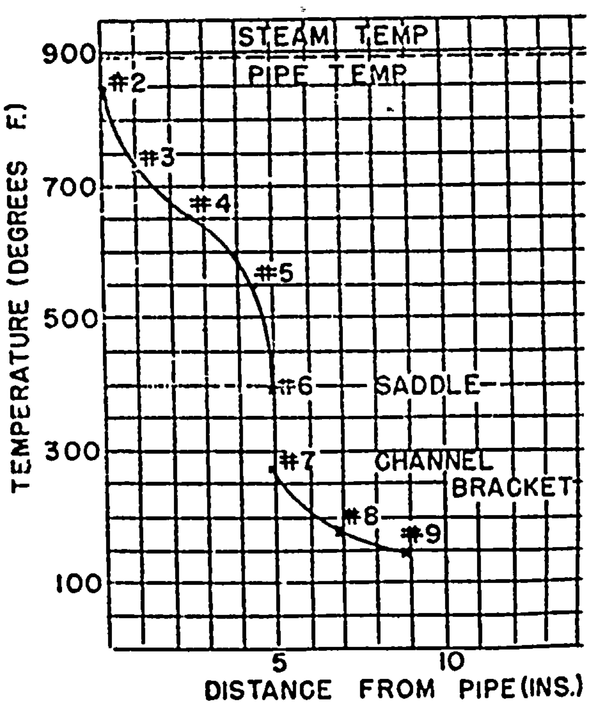


Figure #2



GUIDE

Two (2) thermocouples were tack welded to the pipe, four (4) to the protection saddle, and one (1) to the adjacent beam. The positions of the thermocouples were as indicated in Figure #1. Figure #2 is the temperature differential chart.

The average temperatures in degrees Fahrenheit were:

Steam temperature - 900°
Ambient temperature - 88°
Thermocouple #1 - 897°
2 - 888
3 - 799
4 - 703
#5 - 553°
6 - 453
7 - 148

Figure #1

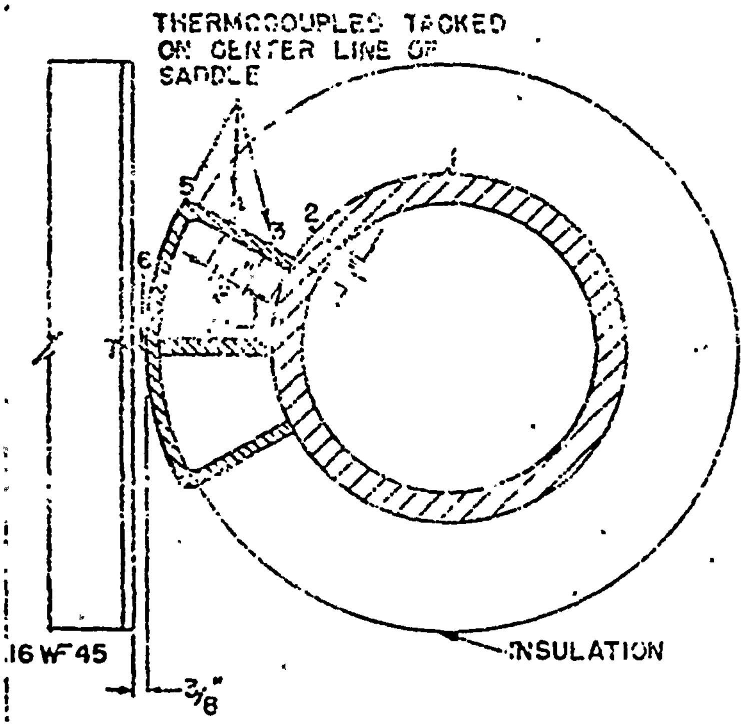


Figure #2