OP
P3
LEO 223

M. W. KELLOGG COMPANY

3-3-77 Rev. 11
2-14-77 Rev. 1
1-21-77

5.

Q.A. INSTRUCTION

NUMBER 98

PROCEDURE FOR INSPECTION OF EXISTING CONCRETE EXPANSION ANCHORS IN HANGER INSTALLATION

The following attached procedure is to be used to provide instructions for personnel performing inspections of existing concrete expansion anchors.

This instruction will not become a part of Engineering specifications, but remain a Q.A. Instruction.

J.P. Runyan
Field Q.A./Q.C. Manager

JPR/ss

FOR INFORMATION ONLY

REVISION 111 7-27-77
REVISION 11 3-3-77
REVISION 1 2-14-77
REVISION: 0
DATE: 1-17-77
X90-20

PREPARED BY: C. A. SCANNELL (ENG)
J. P. RUNYAN (QA/QC)
(M. W. KELLOGG)

APPROVED BY: M. Taylor
Pullman Kellogg John H. Ryan 1/21/77

PROGRAM FOR INSPECTION AND ACCEPTANCE OF EXISTING CONCRETE EXPANSIONS ANCHORS IN PIPE HANGER INSTALLATIONS

DIABLO CANYON POWER PLANT (UNITS I & II)

PURPOSE

To determine the integrity of each anchor installation on each support and thus accept or reject. If rejected, then repair or replace.

SCOPE

This program will define the following: (Ref. CHART 1)

I. Hangers that are to have anchors inspected.

II. Means to provide hanger drawings.

III. Procedure for inspection of concrete anchors.

IV. Hanger identification and inspection assignments.

V. The acceptance criteria.

VI. Suggested methods of rework.

VII. The means to perform rework.

VIII. The acceptance of reworked anchors.

IX. The completion and submittal of program to P.G. & E.

APPARATUS

Refer to PERFORMANCE PROCEDURE, SECTION III.

PERFORMANCE PROCEDURE

I. Hangers to have anchors inspected.

A. Large Bore design Class I, PG&E Code Class A, B, C & Section I.

B. Large Bore design Class I, PG&E Code Class E.

C. Large Bore design Class II, PG&E Code Class E. (Individually identified by PG&E only.)

1. P.G. & E.

2. Grinnell

D. Small Bore design Class I, PG&E Code Class A, B, C & Section I.

E. Small Bore design Class I, PG&E Code Class E.

F. Anchor installations previously inspected in accordance with the requirements of "Inspection Procedure for Installed Flush Sheel Concrete Anchors," by T. E. Niemi will be reviewed by the inspection coordinator to the requirements of this procedure. He will do one of the following: (1) accept as is, (2) issue for reinspection, or (3) rework to comply with the acceptance criteria of Section V of this program.

G. Unit II anchor installations inspected by QC (M.W. Kellogg) and having complied with hold point items 2 and 3 of the "Support Inspection Process Sheet," CA Form F-65, Rev. 4, are to be excluded from this program.

H. Hanger installations employing the use of anchors on plates that experience, under all conditions, no forces other than compression will be excluded from this program. In this situation the anchor is never subjected to pull out or shear forces as a result of hanger loading.

II. Means to provide hanger drawings.

The Hanger Drawing Control Department will review every Unit I & II hanger drawing on file pertaining to each of the categories listed in Section I above. All hanger drawings incorporating the use of concrete expansion anchors will be extracted and reviewed for the latest revision; any pending Minor

Variation or current As Built must be used if it concerns anchors. A copy will be made of each hanger drawing reflecting the latest anchor requirements. The copies of the drawings will then be separated into groups by area and elevation and given to the Inspection Coordinator.

III. Procedure for inspection of existing concrete anchors. (See REFERENCE A)

IV. Hanger identification and inspection assignements.

The Inspection Coordinator will direct the program for locating and identifying each hanger within an area and elevation. He will issue the hanger drawings to M. W. Kellogg personnel and they will in turn locate and identify the hanger. Identification will be made by marking the base plate with the hanger symbol using either permanent ink or paint markers.

If it appears that scaffolding may be required for inspection, it will then be noted on the drawing. The drawings will then be separated into sub-groups by confinement and returned to the Inspection Coordinator.

The Inspection Coordinator in conjunction with the Production Coordinator will arrange for scaffolding and assign inspection teams to confinements. These teams will then perform inspections as defined in the Performance Procedure, Section III (See REFERENCE A).

V. Acceptance criteria.

Upon completion of the inspection and documentation of each support according to Performance Procedure, Section III (See

REFERENCE A), the auditor will attach the hanger drawing to the Anchor Inspection Check List[1] sheet, or sheets; thus making a package. The package will then be given to the Inspection Coordinator for his review, he will do one of the following: (1) accept as is, according to criteria within this section, (2) reject and request rework per Sections VI and VII, or (3) when not clearly defined by acceptance criteria or in any other way questionable, submit to QA/QC Manager or his appointee for his disposition.

The QA/QC Manager or his appointee will, upon receipt and review of the package from the Inspection Coordinator, either return it to the Inspection Coordinator with defined rework, accept it as is, or transmit to P.G. & E. for their disposition.

Failure of one or more anchor installations to meet the following requirements will result in the necessity to rework.

A. Expander plug driven dimensions.

Plug depths are to be within the following minimum and maximum tolerances to be acceptable for each anchor recorded on the Anchor Inspection Check List.

TABLE I

SEE PAGE 4A OF 8 FOR TABLE 1.

FOR INFORMATION ONLY

[1] Performance Procedure, Section III - Reference A, Attachment 3

REV. 3-3-77 [initials]
REV. 7-27-77** [initials]

ACCEPTANCE CRITERIA

OFFICE & REWORK

TABLE I

MEASURED WITH GAUGE

SIZE	HILTI MIN.	HILTI FULL**	HILTI MAX.	PHILLIPS MIN.	PHILLIPS FULL**	PHILLIPS MAX.
1/2	2 22/32	2 27/32	3 3/32	* 23/32	2 25/32	2 29/32
5/8	3 3/32	3 11/32	3 19/32	* 26/32	3 13/32	3 20/32
3/4	* 1 16/32	3 29/32	4 7/32	1 3/32	4 1/32	4 6/32
7/8	-------	-------	-------	1 13/32	4 8/32	4 14/32

---

* MEASURED WITHOUT GAUGE

SIZE	HILTI MIN.	HILTI FULL**	HILTI MAX.	PHILLIPS MIN.	PHILLIPS FULL**	PHILLIPS MAX.
1/2	31/32	1 6/32	1 12/32	23/32	1 5/32	1 9/32
5/8	1 3/32	1 13/32	1 19/32	26/32	1 12/32	1 19/32
3/4	1 16/32	1 30/32	2 4/32	1 4/32	1 25/32	1 30/32
7/8	-------	-------	-------	1 14/32	2 7/32	2 13/32

FOR INFORMATION ONLY

Add 2" to the above dimensions when alternate test gauge was used, refer to Reference A, Attachment 6.

*Measurement taken from top of shield to top of plug, refer to reference A, Paragraph 6.3.8.

B. Angular misalignment of anchor.

0^{o} - 5^{o} Deviation from perpendicular to the plane of the plate is acceptable.

6^{o} - 15^{o} Is acceptable provided the anchor is otherwise unmodified and the expander plug is driven to "Full" dimension in Table 1.

$+15^{o}$ Is unacceptable.

C. Anchors with thread end cut off.

Both Phillips and Hilti are acceptable if the thread end is cut off provided there are at least four (4) full threads remaining. In addition, the plug must be driven to within the "Min" and "Max" dimensions for Hilti anchors and within the "Max" and "Full" dimensions for Phillips anchors given in Table 1. It is also necessary to be within the 0^{o} - 5^{o} range (Reference Paragraph B, above), and no other modifications have been discovered.

D. The following miscellaneous conditions are unacceptable.

1. Stripped threads in anchor preventing bolt tightening.
2. Plate interference with bolt installation or removal.
3. Loose anchors.
4. Anchors with incorrect expander plug.

FOR INFORMATION ONLY

E. Undersized anchors (diameter).

When an anchor is found to be undersized, the Anchor Inspection Check List will indicate this condition. The Inspection

Coordinator will submit all such drawing packages to the QA/QC Manager or his appointee for disposition to rework or transmit to P.G. & E. for their disposition.

F. All packages containing one or more inaccessible anchors will be submitted to the QA/QC Manager or appointee by the Inspection Coordinator for transmittal to P.G. & E. for disposition.

G. Unmodified anchors overembedded 1/2 inch or less are acceptable.

VI. The suggested methods of rework.

When an anchor installation is determined unacceptable by the acceptance criteria Section V, then rework will result. The following are suggested methods of rework to be employed.

A. Install a new anchor either a kwik bolt (Hilti) or a wedge anchor (Phillips) of the same bolt diameter as the originally required anchor. The relocation installation will be made in accordance with ESD-223, paragraph 3.2.1.2 and the shield of the unacceptable anchor may be considered comparable to grout if left installed. This may be done by drilling through the plate and into the concrete and installing to manufacturer's recommended procedure.

B. Remove the unacceptable anchor and replace with a new one of the size originally required. A Hilti expansion anchor may be removed by drilling through the plug and extracting same. The anchor shield is then readily removed. A Phillips expansion anchor may be removed by using an all

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thread rod with threads removed from one end. Thread this modified rod into the anchor slowly and thereby extract the anchor shield. Remove the plug from hole. In both Hilti and Phillips anchor removal, either the base plate will have to be removed, or the hole in the plate enlarged enough to remove the unacceptable anchor.

C. If due to inaccessibility the rework described in Paragraphs A and B, above, cannot be performed, contact the Chief Field Engineer or his appointee for disposition.

VII. The means to perform rework.

The Inspection Coordinator will initiate the issuance of any and all rework. He will log the rework package out to the Production Coordinator who will determine which type of rework (See Section VI) can be employed with the most expediency and best results. The Production Coordinator will then assign fitter work crews to rework items per Section VIII.

VIII. Acceptance of reworked anchors.

When rework requires the installation of a new anchor, the fitter performing the work shall notify the QC auditor. The auditor will witness the installation of the anchor assuring that the requirements of ESD-223, Paragraph 3.2.1.1 and Paragraph 3.2.1.2 and the attached QA Instruction, Number 97 are met.

When the installation is complete, the auditor will indicate "Rework Complete", stamp "Accept", initial and date the Anchor Inspection Check List; he will then return the Anchor Inspection Check List and hanger drawing to the Inspection Coordinator for incorporation into the final package.

IX. The completion and submittal of program to P.G. & E.

When all inspection and required rework is complete, the "Accept" packages will be segregated by area and elevation, indexed and boxed.

Indexing will be numerically by hanger symbol number.

These boxes will then be transmitted to P.G. & E.

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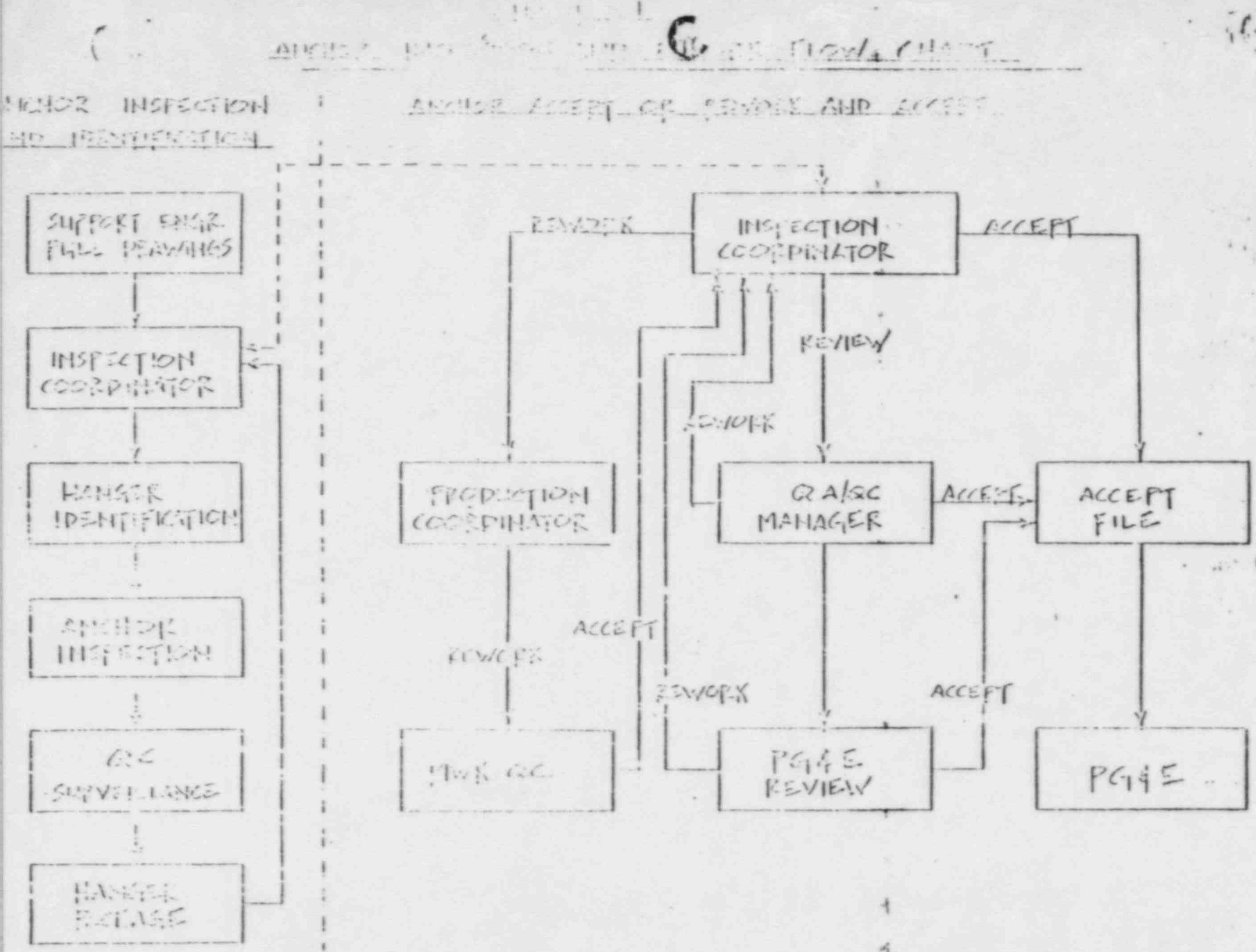

FOR INFORMATION
ONLY

1.

ATTACHMENT 5

PGandE RESOLUTION SHEET

IDVP FILE NO: 1016

1. Description of Concern

[X] Open Item with future action by PGandE
[ ] Deviation
[ ] Class ___ Error
Description:
RLCLOUD ASSOCIATES IS CONCERNED THAT THE CONCRETE ANCHOR ALLOW ON PG&E DWG. 054162 DO NOT AGREE WITH DCM-M9, APPENDIX C.

2. Significance of Concern

[ ] Discrepancy Report # ______________ initiated
[ ] Nonconformance Report # ______________ initiated
[X] Discrepancy Report or Nonconformance Report not required.
[ ] Yes [X] No Are there any (generic) items?
Comments: CORRECT DESIGN CRITERIA FOR CONCRETE ANCHORS CANNOT BE DETERMI

3. Description of Resolution

ADDRESS THE DIFFERENCES BETWEEN THE TWO STANDARDS AND PROVIDE THE SAFETY FACTORS REPRESENTED IN DWG. 054162

4. Description of Physical Modifications

[ ] Yes [X] No Will physical modifications be required?
Scheduled Completion Date:
Description:

ONLY

Task Leader Michael Yim 6/18/82 Date

JK McCall
Group Leader Jathy A. Mony 6/24/82 Date

DCVP PROCEDURE NO: 2
REVISION: 2
DATE: 4-16-82

ATTACHMENT 6

PGandE Completion Sheet
IDVP File No: ____

1. Description of Concern

[X] Open Item with future action by PGandE
[ ] Deviation
[ ] Class __ Error
Description: RL CLOUD ASSOCIATES IS CONCERNED THAT THE CONCRETE ANCHOR ALLOWABLE ON PG&E DWG 054162 DO NOT AGREE WITH DCM-M9, APPENDIX C.

2. Significance of Concern

[ ] Discrepancy Report # ______________ initiated
[ ] Nonconformance Report # ______________ initiated
[X] Discrepancy Report or Nonconformance Report not initiated
[ ] Yes [X] No Are they any related (generic) items?
Comments:
CORRECT DESIGN CRITERIA FOR CONCRETE ANCHOR CANNOT BE DETERMINED

3. Description of Completion

ADDRESS THE DIFFERENCES BETWEEN THE TWO STANDARDS AND PROVIDE SAFETY FACTORS REPRESENTED IN DWG. 054162

4. Description of Physical Modifications

[ ] Yes [X] No Were physical modifications required?
Completion Date:
Description:

ONLY

Task Leader [signature] 6/18/82
Date

Group Leader [signature] 6/24/82
Date

Verification Program Manager ______________ ______________
Date

PACIFIC GAS AND ELECTRIC COMPANY
ENGINEERING DEPARTMENT
DESIGN CALCULATION COVER SHEETS

File No. 52.7.11.5.8
Calculation No. EOI 1016

Project Diablo Canyon Date 6-23-82

Engineering Discipline CIVIL

Structure, System, or Component ELECTRICAL RACEWAY SUPPORTS

Type of or Purpose of Design Calculations
RESOLVE RLCA EOI 1016

No. of Sheets 36

SAR change required ( ) Yes (X) No
(Nuclear Projects only)

	Signature	Discipline/Dept	Date
Preparer	Michael [illegible]	Civil	6/23/82
Checker	[illegible]	CIVIL	6/23/82
Approval:			
Discipline Engineer (if required)	Fathy A. Morsy	CIVIL	7/6/82
Group Leader/Supervisor			

Record of Revisions

Rev.No.	Date	Reason for Revision	Rev.by	Checked by	Approval Engr	Approval GL/Supr

3-11/21/80

Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

GENERAL COMPUTATION SHEET

SHEET NO. 1 OF 36 SHEETS
JOB FILE NO. 52.7.11.5.8
LOCATION

SUBJECT EOI 1016
Diablo Canyon Power Plant Project

MADE BY Mike Yan DATE 6/16/82 CHECKED BY MNP APPROVED BY

TABLE OF CONTENT

SUBJECT EOI 1016
Diablo Canyon Power Plant Project

MADE BY Mike Yaw DATE 6/16/82 CHECKED BY MNP APPROVED BY

I. Objective:

This documentation is to resolve a RLCA Open Item (EOI 1016).

Robert L. Cloud Associates is concerned that the concrete anchor allowables on P.G.&E. drawing 054162 Rev. 3 do not agree with those on DCM-M9, Appendix C, Rev. 7; therefore, the correct design criteria for concrete anchor cannot be determined (See Appendix A). This documentation will address the difference between the two standards and will provide the safety factors represented in drawing 054162.

Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

GE ERAL COMPUTATION HEET

SHEET NO. 3 OF 26 SHE
JOB FILE NO. 52.7.11.5.
LOCATION

SUBJECT EOI 1016
Diablo Canyon Power Plant Project

MADE BY Mike Yam DATE 6/16/82 CHECKED BY MNP APPROVED BY

I. Resolution:

Drawing 054162 (see Appendix B) is a P.G.&E. Engineering standard which was first developed in 1973. It provides guidelines for the use of concrete anchors within P.G.&E. system, including those used in Diablo Canyon Project.

Design Criteria Memorandum DCM-M9, Rev. 4 w issued in November 1981 for design verification of class pipe supports in Diablo Canyon.

Whereas DCM-M9 was developed to insure compliance with NRC I-E Bulletin 79-02 for pipe supports, Engineering standard Dwg. 054162 provides reasonably conservative allowable loads for all other applications of concrete anchors thorough out the P.G.&E. system, including the Diablo Canyon Project.

Test results of various anchor types and siz have been assembled (see Appendix C). Results of 4

Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

GENERAL COMPUTATION SHEET

SHEET NO. 4 OF 36 SHEET
JOB FILE NO. 52.7.11.5.8
LOCATION

SUBJECT EOI 1016
Diablo Canyon Power Plant Project
MADE BY Mike Yan DATE 6/18/82 CHECKED BY MNP APPROVED BY

I. Resolution (Cont.)

concrete anchor sizes have been plotted for graphic presentation (see Appendix D). Based on the data available, the average safety factors of allowable loads on Dwg. 054162 for all the anchor sizes other than pipe supports used in Diablo Canyon Project have been summarized in table below:

Anchor Diameters (inch)	Safety Factors									
	f'c = 2 ksi		f'c = 3 ksi		f'c = 4 ksi		f'c = 5 ksi *		f'c = 6 ksi	
	P	S	P	S	P	S	P	S	P	S
1/4	7.75	5.86	9.02	7.13	8.21	7.57	7.72	8.44	6.90	9.07
3/8	7.34	7.55	7.20	7.10	7.12	7.68	6.6	8.42	5.87	8.90
1/2	5.55	7.84	6.01	7.42	6.15	7.52	6.15	7.33	6.09	6.97
5/8	4.51	8.78	4.72	7.12	5.03	7.92	4.55	7.57	3.85	7.09
3/4	4.30	7.95	4.64	6.83	5.05	8.14	4.66	7.93	4.19	7.54

* No test data available for 5 ksi concrete. Safety factors obtained by interpolating test data of 4 ksi & 6 ksi strength concrete

Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

GENERAL COMPUTATION SHEET

SHEET NO. 5 OF 36 SHEETS

JOB FILE NO. 52.7.11.5

LOCATION

SUBJECT EDI 1016
Diablo Canyon Power Plant Project

MADE BY Mike Yen DATE 6/16/82 CHECKED BY MNP APPROVED BY

III. APPENDIX

a. APPENDIX A

File No. 1016

Sht. 6/36

ERROR AND OPEN ITEM SHEET

APPENDIX A

1. Classification

☐ Error

or

☒ Open Item

Error Classification

☐ Class (A, B, C, or D)

2. Description

The anchor allowables on PGandE drawing 054162 Revision 3 do not agree with those on DCM-M9, Appendix C, Revision 7.

3. Significance

The correct design criteria for anchor bolts cannot be determined.

4. Recommendation

PGandE to address the differences between the two standards.

5. Reported

☒ PGandE Transmittal Date 2/11/82

☐ NRC Ref. & Date

6. Final Resolution

Hunter Long 2/4/82
Signed/Date

Edward Denison 2/11/82
Project Engineer/Date
Prior to Release

Project Administrator/Date

CONC,
EXP.
ANCHOR
sht. 7/3

ROBERT L. CLOUD ASSOCIATES, INC.
125 UNIVERSITY AVENUE
BERKELEY, CALIFORNIA 94710
(415) 841-9296

RECEIVED BY R. R. FRAY
MAR 1 0 1982
D.C. VERIFICATION
PROGRAM MANAGER
log # 105

APPENDIX A

March 10, 1982

F 105-4

Mr. Roy Fray
Diablo Canyon Verification
Program Manager
Pacific Gas and Electric Company
77 Beale Street
San Francisco, CA 94106

Dear Mr. Fray:

Please address EOI 1016 by listing the safety factors represented in drawing 054162.

Yours truly,

Edward Denison

Edward Denison

ONLY

Sht. 8/3

ROBERT L. CLOUD ASSOCIATES, INC.
125 UNIVERSITY AVENUE
BERKELEY, CALIFORNIA 94710
(415) 841-9296

RECEIVED BY R. R. FRAY

APR 19 1982

D.C. VERIFICATION
PROGRAM MANAGER

Log #184

APPENDIX A

April 16, 1982

P 105-4

Mr. Roy Fray
Diablo Canyon Verification
Program Manager
Pacific Gas and Electric Company
77 Beale Street
San Francisco, CA 94106

Dear Mr. Fray:

Please find attached a list of documents that Robert L. Cloud Associates needs to have formally transmitted from PGandE for the Seismic Verification Program.

Yours truly,

Edward Denison

Edward Denison

Attachment

Request Number 163

Sht. 9/3

To Roy R. Fray
Diablo Canyon
Verification Program Manager

Request No. 163

Requested by Edward Denison

Date 4/16/82

APPENDIX A

Attention of:

(X) Civil/E.P. Wollak

( ) Drawings and Records/D.E. Peazant

( ) Electrical/W. Vahlstrom

( ) I&C/T.N. Crawford

( ) Mechanical Systems/R.M. Laverty

( ) Piping/M.R. Tresler

(X) R. Fray - EOI 1016

Please provide the following Drawings/Documents for use in the Diablo Canyon Verification Program:

safety factors represented in drawing 054162

ATTACHMENT 1

DCVP PROCEDURE NO: 1
REVISION: 1
DATE: 3-4-82

TO: E.P. WOLLAK

APPENDIX A

FROM: Verification Program Manager

FILE: M&NE - 1.061 Cloud Seismic Verification Program

SUBJECT: Request for Information for a DCVP consultant.
Consultant: Robert L. Cloud Associates, Inc. Request No: 163

A. Please supply the following information:

1. See attached Request for Information

2.

3.

4.

B. Name of Requester RLCA/Dennis Peazant Extension Please notify by Telepho only as soon as request fulfilled; Ext. 3377

C. Date of Request 4/16/82

D. Form of Request: Telephone ______ Letter (attached) X

E. Remark:

ATTACHMENT 2

DCVP PROCEDURE NO: —
REVISION: 1
DATE: 3-4-82

File No. 52.7.11.4.3

Sht. 11/31

TO: Verification Program Manager

FROM:

FILE: M&NE - 1.061 Cloud Seismic Verification Program

SUBJECT: Request for information for a DCVP Consultant.
Consultant: Robert L. Cloud Associates, Inc. Request No: 163

A. List of information attached:

1. Safety factors represented in PG&E Dwg 054162
2. Plots of test data
3. References of test data
4.

B. Name of Person Supply Information Mike Yan Extension 8-4879

C. Name of Person Checking Information Neeraj Punglia Extension 8-6220

D. Remarks:

Design Drafting
82-3690

PACIFIC GAS AND ELECTRIC COMPANY

GENERAL COMPUTATION SHEET

SHEET NO. 12 OF 36 SHEET
JOB FILE NO. 52.7.11.5.8
LOCATION

SUBJECT EOI 1016
Diablo Canyon Power Plant Project

MADE BY Mike Yam DATE 6/16/82 CHECKED BY MNP APPROVED BY

II. APPENDIX

b. APPENDIX B

ONLY

APPENDIX B sht.

A. DESIGN

A.1.0 APPLICATIONS

A.1.1 Concrete expansion anchors should not be used indiscriminately. For important work, bolts should preferably be cast-in-place, welded, or grouted in drilled holes or in cast-in-place sleeves. Where those types of installation are for good reason impractical, expansion anchors may be used.

A.1.2 Provisions of this standard shall apply to the shell or stud type expansion anchors designated in Part B.

A.1.3 Anchors must be at least 1/2" diameter when used for structural connections or for anchorage of pipes, conduits or ducts greater than 2" diameter.

A.1.4 Anchors shall not be installed in prestressed concrete elements nor used to connect concrete elements which must have a specified value of fire resistance.

A.1.5 Embedded length of anchor shall be exclusive of thickness of grout pad or other overlay.

A.2.0 ALLOWABLE LOADS

A.2.1 Allowable loads shown in Table A, as modified by the provisions of this standard, shall apply to anchors installed in ordinary concrete.

A.2.2 For concrete strength between 2 ksi and 6 ksi, linear interpolation in Table A may be used. For concrete strength greater than 6 ksi, use 6 ksi allowable values. For sound concrete of unknown strength, use 2 ksi values.

A.2.3 Allowable load values given in this standard shall not be increased because of short duration of loading (e.g., for wind or seismic loads).

A.2.4 For anchors subjected to continuous or frequent (more than 500 times per year) reversal of loading, allowable loads shall be 1/3 of the allowable values given in this standard.

A.2.5 Allowable loads given in this standard are intended for use at "working load" levels. For "ultimate" or "limit" load design purposes, twice these values may be used.

A.2.6 Anchors installed in lightweight aggregate concrete shall have allowable loads equal to those provided for anchors in ordinary concrete with $f'_c = 2$ ksi.

A.2.7 Allowable loads of anchors of 1/2" or larger diameter may be increased by 50% if proof loading is done according to the instructions given in Part B.

A.2.8 If center to center spacing of anchors is less than 12 diameters and/or if distance from edges of concrete to center of anchor is less than 6 diameters, the allowable loads shall be reduced in accordance with the following formulae:

$$P_D = 2.25\, P_A \frac{N}{N+6} \frac{E}{E+3} \qquad S_D = 1.5\, S_A \frac{E}{E+3}$$

Where: P_D = allowable pullout load reduced for edge distance and/or spacing.
P_A = allowable pullout load from Table A
S_D = allowable shear load reduced for edge distance
S_A = allowable shear load from Table A
N = no. of diameters of anchor spacing ($6 \le N \le 12$): if $N>12$, use $N=12$
E = no. of diameters of edge distance ($3 \le E \le 6$): if $E>6$, use $E=6$

Anchor spacing shall be not less than 6 times nominal diameter of anchor. Edge distance shall be not less than 3 times nominal diameter nor less than 3 inches. If edge of concrete is chamfered, edge distance shall be measured from nearest edge of chamfer.

APPROVED BY	REV.	DATE	DESCRIPTION	DWN.	CHKD.	APVD.
[illegible]	2	11-16-78	GENERAL REVISION REDRAWN SHEETS 3 & 4 ADDED	JF	BC	[illegible]

GM	
SUPV.	MC
DS&N.	SA, AA
DWN	JF
CHKD.	BC
O.K.	MC
DATE 4-17-73	SCALE NONE

ENGINEERING STANDARD

CONCRETE EXPANSION ANCHORS FOR STATIC AND SEISMIC LOADING

DEPARTMENT OF ENGINEERING
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

SUPERSEDES
SUPERSEDED BY -
SHEET NO. 1 OF 4 SHEETS
DRAWING NUMBER 054162 REV. 3
MICROFILM

A.2.9 For anchors which will be subjected simultaneously to pullout and shear forces, the allowable load values used must satisfy the following formula (Figure 1):

$$\left(\frac{P_C}{P_D}\right)^{5/3} + \left(\frac{S_C}{S_D}\right)^{5/3} \geq 1$$

Where P_D, S_D = allowable loads (pullout, shear), reduced for spacing or edge distance if appropriate

P_C, S_C = allowable loads to be used in cases where pullout and shear loads may occur simultaneously

Note: For convenience in calculation, exponents in the above formula may, conservatively, be reduced to 1.0.

TABLE A
ALLOWABLE LOAD (KIPS) ON EXPANSION ANCHORS

NOMINAL DIAMETER (INCH)	CONCRETE STRENGTH, fc'									
	2 ksi		3 ksi		4 ksi		5 ksi		6 ksi	
	P	S	P	S	P	S	P	S	P	S
1/4	.25	.30	.275	.30	.30	.30	.325	.30	.35	.30
3/8	.40	.54	.50	.60	.60	.67	[illegible]	.73	.80	.80
1/2	.70	.74	.87	.89	1.05	1.04	1.23	1.19	1.40	1.34
5/8	1.20	1.00	1.50	1.25	1.80	1.50	2.10	1.75	2.40	2.00
3/4	1.80	1.50	2.35	1.80	2.90	2.10	3.45	2.40	4.00	2.70
7/8	2.50	2.00	3.35	2.35	4.20	2.70	5.05	3.05	5.90	3.40
1	3.30	2.50	4.30	2.90	5.50	3.30	6.60	3.70	7.70	4.10
1 1/4	5.30	3.40	6.65	3.95	8.00	4.50	9.35	5.10	10.70	5.70

NOTE: P, PULLOUT; S, SHEAR
For expansion anchors installed in lightweight aggregate concrete, assume f'c = 2 ksi.
See par. A.2.6.

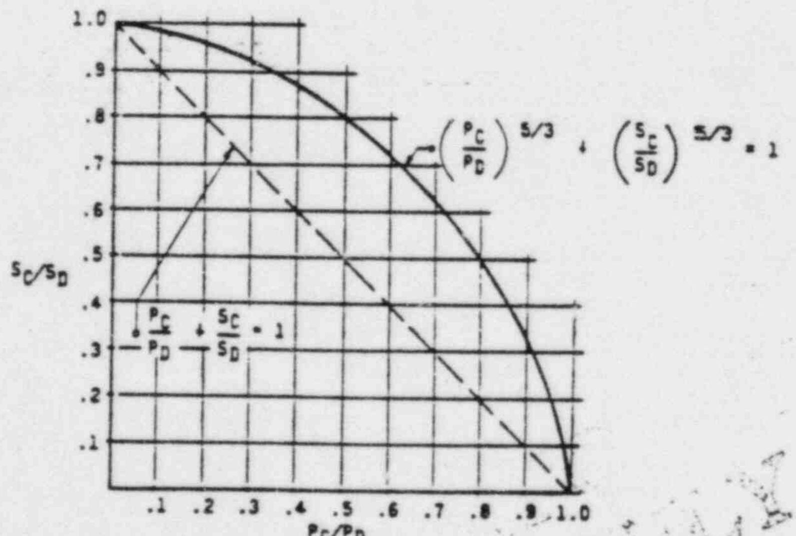

FIGURE 1
REDUCTION FACTORS FOR COMBINED PULLOUT AND SHEAR

CONCRETE EXPANSION ANCHORS FOR STATIC AND SEISMIC LOADING	PG&E CO.	DRAWING NUMBER 054162	REV. 3
	SHEET 2 OF SHEETS	MICROFILM	

8. INSTALLATION

8.1.0 APPLICATIONS

8.1.1 Provisions of this standard shall apply to the following concrete expansion anchors. Other expansion anchors shall not be used without specific authorization of the Engineer.

SHELL ANCHORS: • PHILLIPS SELF-DRILLING, PHILLIPS NONDRILLING, DIAMOND, HILTI HDI, RAWL SABER-TOOTH.

STUD ANCHORS: • KWIK-BOLT, PARABOLT, PHILLIPS WEDGE, PHILLIPS SLEEVE, WEJ-IT ANKR-TITE.

• PHILLIPS STUD ANCHOR may be used in sizes up to 3/4" diameter.

• WEJ-IT (original style, with spade-shape wedges) may be used, provided embedment is 125% of that shown in Table B, with 50% of the allowable load values shown in Table A.

8.1.2 Anchors must be at least 1/2" diameter when used for structural connections or for anchorage of pipes, conduits or ducts greater than 2" diameter.

8.1.3 Anchors shall not be installed in prestressed concrete elements nor used to connect concrete elements which must have a specific value of fire resistance.

8.2.0 INSTALLATION

8.2.1 Installation of anchors shall be according to manufacturer's instructions as to tools, torque and tightening procedure.

8.2.2 If a hole cannot be drilled to the correct depth (e.g., if reinforcing steel is encountered while drilling), a new hole shall be drilled. There shall be at least 1/2" of sound concrete between abandoned hole and new hole. If an unused hole is within 4.5 nominal diameters of an expansion anchor, center to center, the unused hole shall be filled with grout or with an expanded anchor.

8.2.3 If axis of a drilled hole deviates from normal to concrete surface by more than 5° the hole shall not be used unless specifically authorized by the Engineer.

8.2.4 Minimum required embedment, for shell type anchors, is equal to the length of shell. For most shell anchors the shell may be recessed not more than 1/4 of the nominal diameter. Installed shells recessed to greater depths shall not be used unless specifically authorized by the Engineer.

Minimum required embedment for stud type anchors is given in Table B.

Embedment length is exclusive of thickness of any grout pad or other overlay.

8.2.5 Anchors shall be installed according to manufacturer's instructions. If, after starting from finger-tightened position, anchor slips more than 10% of minimum required embedment while being tightened, one of the following remedial actions shall be taken:

a. Remove bolt or nut, reset anchor, repeat tightening;

b. Remove anchor, substitute larger diameter or longer anchor;

c. Drill new hole and install additional anchor which satisfies the requirements of this standard.

8.2.6 Anchor spacing, center to center, shall be not less than 6 times nominal diameter of anchor nor shall edge distance be less than 3 times nominal diameter nor less than 3 inches unless specifically authorized by the Engineer.

8.2.7 If edge of concrete is chamfered, edge distance shall be measured from nearest edge of chamfer.

8.3.0 PROOF LOADING

When required by the Engineer, proof loading shall be done according to the following instructions:

8.3.1 Whenever an installation crew starts installing anchors at a job site, each of the anchors installed by that crew shall at first be proof loaded in tension to 250% of the allowable pullout load designated by the Engineer. After five successive anchor installations have been completed without failure, a random selection of 10% of the anchors of each size installed by the crew thereafter on the same project shall be tested in the above manner.

APPENDIX B

Att. 16/36

8.3.2 If proof loading is done by jacking against a surface area of concrete surrounding the anchor, the jacking pressure shall be distributed over an annular area of inner diameter at least 3 times the minimum required embedment given in Table 8.

8.3.3 Criteria for failure of an anchor during proof loading are:
(1) concrete cracks; (2) anchor breaks, or (3) anchor slip during the test is greater than 5% of the minimum required embedment.

TABLE 8

MINIMUM EMBEDMENT REQUIRED FOR STUD-TYPE

EXPANSION ANCHORS INSTALLED IN CONCRETE

Nominal Diameter (Inches)	Minimum Embedment (Inches)
1/4	1-1/8
3/8	1-3/4
1/2	2-1/4
5/8	2-7/8
3/4	3-3/8
7/8	4
1	4-1/2
1-1/4	5-5/8

CONCRETE EXPANSION ANCHORS FOR STATIC AND SEISMIC LOADING

P G & E CO.

SHEET 4 OF 4 SHEETS

DRAWING NUMBER 054162 REV. 3

MICROFILE

Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

GENERAL COMPUTATION SHEET

SHEET NO. 17 OF 56 SHEETS
JOB FILE NO. 52.7.11.5
LOCATION

SUBJECT EOI 1016
Diablo Canyon Power Plant Project

MADE BY Mike Yan DATE 6/16/82 CHECKED BY MNP APPROVED BY

II. APPENDIX

C. APPENDIX C

References of Test Data:

1. Pittsburg Testing Laboratory (PTL) Report No. 93110 (1956) and 94277 (1958)
2. PTL Report No. 96844, 96902, 97562 (1962)
3. PTL Report No. 99009 (1963)
4. PTL Report No. 100019, 100037 (1964)
5. Phillips Drill Company, Reported by T.G. Bixby (1964); see also Phillips Drill Co. Brochure (1970) citing reports from PTL and Smith-Emery Co.
6. PTL Report No. 105228 (1971).
7. Abbott A. Hanks Testing Laboratories, Report No. 8783K (1973)
8. Abbott A. Hanks Testing Laboratories, Report No. 6099 (1977).

PITTSBURGH TESTING LABORATORY

ESTABLISHED 1881

CHICAGO, ILLINOIS

Sht. 18

APPENDIX C

Ref. 1

LABORATORY No. 93110 (10-31-56)
94277 (6-30-58)

ORDER No. CH-3071, CH-4457

CLIENT'S No. PO-6903P, 821

REPORT
(Consolidated)

TESTS OF: RED HEAD SELF-DRILLING CONCRETE ANCHORS.

		PULLOUT TESTS					SHEAR TESTS				
Cat. No.	Bolt Size	Tensile Load, Lbs.	Average Load, Lbs.			Type of Failure	Shear Load, Lbs.	Average Load, Lbs.			Type of Failure
S-14	1/4"	3,728 3311 5,125 4112 3,175 2820	4,009 3561	295	13.6	Concrete Failed Concrete Failed Anchor Pulled Out*	1,000 888 1,550 1377 1,540 1368	1,363 1211	300	4.5	Bolt, Shear Bolt, Shear Bolt, Shear
S-16	5/16"	4,625 4108 5,025 4464 3,625 3220	4,425 3931			Concrete Failed Concrete Failed Concrete Failed	1,930 1714 2,240 1990 2,050 1821	2,073 1841			Bolt, Shear Bolt, Shear Bolt, Shear
S-38	3/8"	6,125 5441 6,425 5707 5,975 5308	6,175 5485	580	10.6	Concrete Failed Concrete Failed Concrete Failed	3,270 2905 3,320 2947 3,740 3321	3,443 3058	656	5.2	Bolt, Shear Bolt, Shear Bolt, Shear
S-12	1/2"	9,809 8713 9,109 8091 8,859 7869	9,259 8225	1014	9.1	Concrete Failed Concrete Failed Anchor Pulled Out*	6,660 5916 7,020 6236 6,890 6120	6,856 6090	1010	6.8	Bolt, Shear Bolt, Shear Bolt, Shear
S-58	5/8"	15,025 13347 11,075 9838 12,175 10728	12,758 11333	1740	7.3	Concrete Failed Concrete Failed Anchor Pulled Out*	12,160 10802 11,500 10215 12,800 11370	12,153 10795	1450	8.4	Bolt, Shear Bolt, Shear Bolt, Shear
S-34	3/4"	17,325 16390 17,675 15701 18,025 16011	17,675 15700	2792	6.3	Concrete Failed Concrete Failed Concrete Failed	14,600 12969 17,400 15456 17,550 15589	16,516 14671	2040	8.1	Bolt, Shear Bolt, Shear Bolt, Shear
S-78	7/8"	19,025 16900 20,725 18410 18,575 16500	19,442 17270	4030	4.8	Concrete Failed Concrete Failed Concrete Failed	18,850 16744 18,900 16789 18,700 16611	18,816 16714	2630	7.1	Bolt, Shear Bolt, Shear Bolt, Shear
T-32	Wire			WIRE BROKE							

CONCRETE USED FOR TESTS RANGED FROM 3125 TO 4280, OR AN AVERAGE OF [redacted]

*Anchor capacities where "Anchor Pulled Out" were substantially the same as in the case of concrete failures, or higher.

P_A $\quad \frac{P_u}{P_A}$ $\quad f_c' = 3.5$ ksi Reduced to 3940 psi. $\quad S_A$

Procedure for tensile tests was axial loading until ultimate failure of concrete or anchors. Procedure for shear tests was loading to a steel plate bolted to the anchors in a plane perpendicular to the axis of the anchor. Concrete blocks used for tests were of a 1:3:5 mix, having a compressive strength as indicated in each table at 28 days. Compressive strengths were checked using standard 6" x 12" test cylinders.

NOTE: Tests show ultimate total loads — not safe working loads. See manufacturer's recommended safety factors.

$P_A = P_{A3} + .802(P_{A4} - P_{A3})$

P_{A3}, P_{A4} = allowable load from Table A, Dwg 054162, at $f_c' = 3, 4$ ksi, respectively

PITTSBURGH TESTING LABORATORY

By W. H. Levelius

W. H. Levelius, District Manager

Manufacturers' recommended safe ... loads in 3500 PSI concrete — 25%

Sht 9/36

APPENDIX C

Ref. 2

PITTSBURGH TESTING LABORATORY
ESTABLISHED 1881
CHICAGO, ILLINOIS

ORDER No. CH 6677 - CH 6758 LABORATORY No. 96844, 96902 97562

CLIENT'S No. F. Werstein

REPORT

March 23, 1962

PULLOUT TESTS OF [redacted] NON-DRILLING CONCRETE ANCHORS

for

PHILLIPS DRILL COMPANY
MICHIGAN CITY, INDIANA

Anchor Size	Pullout Load, lbs.	Average lbs.	P_m/P_A 034162
1/4"	2810 2860 2680 3300	2912	10.1
3/8"	5450 4550 4600 4700	4825	8.8
1/2"	8140 7520 7320 7500	7620	7.9
5/8"	12000 11400 10600 11280 *	11570	7.0

* Block cracked diagonally. On all other tests, a conical concrete disc failed. Size of concrete spall recorded by client.

$f_c' = 3.51$

Respectfully submitted,

PITTSBURGH TESTING LABORATORY

W. H. Levelius,
District Manager

3cc: Client

WHL/rg

Average f_c'

Manufacturers recommended safe working load in 3500 PSI concrete — 25% of the average pull-out loads shown above.
NOTE: Tests were made in concrete blocks having compressive strength ranging from 2460 to 3840 PSI.
* Currently being marketed as Red Head Non-Drill Anchors.
Phillips Drill Co., Michigan City, Indiana

F309-6/64

PITTSBURGH TESTING LABORATORY

ESTABLISHED 1881

CHICAGO, ILLINOIS

APPENDIX C

Ref. 3 Sht. 2

ORDER No. CH 7899 LABORATORY No. 99009

CLIENT'S No. 9823 September 30, 1963

REPORT

PULLOUT AND SHEAR TESTS FOR "[redacted] STUD ANCHORS"*

for

PHILLIPS DRILL COMPANY, MICHIGAN CITY, INDIANA

TENSILE TESTS

Anchor Diameter	Pullout Load, Lbs.	P_A	Pullout Average	$\frac{P_u}{P_A}$	Type of Failure
1/4"	2370				Concrete Failed
	2850				Concrete Failed
	2750	300	2660	8.9	Concrete Failed
3/8"	4210				Concrete Failed
	4710				Concrete Failed
	3950	590	4290	7.3	Concrete Failed
1/2"	6220				Concrete Failed
	4850				Concrete Failed
	5780	1030	5620	5.5	Concrete Failed

SHEAR TESTS

Anchor Diameter	Shear Load, Lbs.	S_A	Shear Average	$\frac{S_u}{S_A}$	Type of Failure
1/4"	2260				Stud Sheared
	1940				Stud Sheared
	1850	300	2020	6.7	Stud Sheared
3/8"	4660				Stud Sheared
	5590				Stud Sheared
	5270	660	5170	7.8	Stud Sheared
1/2"	8500				Stud Sheared
	9180				Stud Sheared
	8440	1025	8710	8.5	Stud Sheared

Concrete used for above tests averaged 3910 psi compressive strength.

f'_c

$P_A = P_{A3} + .910 \cdot (P_{A4} - P_{A3})$

PITTSBURGH TESTING LABORATORY

W. H. Levelius

W. H. Levelius, District Manager

3cc: Client

Manufacturers recommended safe working load in 3500 PSI concrete — 25% of the average pull-out loads shown above.

* Currently being marketed as Red-Head Stud Anchors.

F344P - 8/64

Phillips Drill Co., Michigan City, Indiana

PITTSBURGH TESTING LABORATORY

ESTABLISHED 1881

CHICAGO, ILLINOIS

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APPENDIX C

Ref. 4

ORDER No. CH 8539

CLIENT'S No.

LABORATORY No. 100019, 100037

REPORT

9-30-64

Tests of: Concrete Anchors

Reported to: The Phillips Drill Co.
Michigan City, Indiana

In accordance with your instructions we have completed Pull-Out and Shear tests of anchors identified as:

1) Phillips Red Head Non Drill Anchors
2) Phillips Red Head Stud Anchors

Tests were conducted in blocks supplied by the client. Compression test cylinders and cores from actual blocks were used to establish strength's of the blocks.

Pull-Out tests were conducted by applying tension loads to the anchor through threaded rods held in the jaws of the 300,000 lb. Baldwin Testing Machine. (Calibrated September, 1964) The block was restrained on the under side of the moveable crosshead with the rod producing through the jaw opening. Shear tests were conducted by applying a load through a plate bolted to the anchor, with the load travelling perpendicular to the anchor axis.

TEST RESULTS

Concrete Compression Values:

1) Theoretical: 2000 PSI
   Actual: 1820 PSI (Average of 3 cores)
2) Theoretical: 4000 PSI — 4000 x 1.015
   Actual: 4060 PSI (Average of 3 cores)

Cylinder compression tests yielded approximately the same results.

Pull-Out Tests

1) Non-Drill Anchors (J Series)

Pull-Out Strength, lbs.

Size	2000 PSI	Failure Type	4000 PSI	Failure Ty
1/4	2580	5X7" Spall	(NOT TESTED)	
	2310	3X3" Spall		
	2540	4 X 5" Spall		
	2476	Average		

(continued)

PITTSBURGH TESTING LABORATORY
4400 WEST CHICAGO AVENUE
CHICAGO 51, ILLINOIS

(Revised to correct 10-9-64)

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Size	2000 PSI	Failure Type	4000 PSI	Failure Type
1/2	4030	Block	(NOT TESTED)	
	4020	Block		
	3950	Block		
	4000	Average		
3/4	7330	Block	17000	12 X 12" sp
	7100	Block.	17150	Block split
	7180	Block	17350	Block split
	7203	Average	17166	Average

2) Stud Anchors (JS. Series)

Pull-Out Strength, lbs.

Embedment	Size	2000 PSI	Failure Type	4000 PSI	P_m/P_A	Failure Type
Embedment : (1 5/8")	1/4	1414	5X6" Spall	(NOT TESTED)		
		1532	"			
		1340	3X6" Spall			
		1462	Average			
(2 1/4")	1/2	3280	6X9" Spall	(NOT TESTED)		
		2780	9X11" Spall			
		2930	6X9" Spall			
		2993	Average			
(2 3/4")	5/8	(NOT TESTED)		10480	5.8	Block
				8770	4.9	Block
				8470	4.7	6X10 Spall
				9240	5.1	Average
(3 1/2")	3/4	7400	9X10 Spall	13000	4.5	Block
		6670	Block	12750	4.4	Block
		6040	Block	12200	4.2	Block
		6703	Average	12650	4.4	Average

Where the failure is described "Block", this indicates the block cracked or fractured. "Anchor" describes the condition of the anchor pulling out without a spall.

$f'_c = 4\,ksi$

654162

(continued)

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PITTSBURGH TESTING LABORATORY

4400 WEST CHICAGO AVENUE
CHICAGO 51, ILLINOIS

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Shear Tests

1) Stud Anchors (JS Series)

Shear Load, lbs.

Size	2000 PSI	Failure Type	4000 PSI	S_u/S_A	Failure Type
1/4	1620	Bolt	(NOT TESTED)		
	1475	Bolt			
	1260	Bolt			
	1452	Average			
1/2	5200	Bolt	(NOT TESTED)		
	5260	Bolt			
	5510	Bolt			
	5323	Average			
5/8	(NOT TESTED)		11650	7.8	Bolt
			12000	8.0	Bolt
			11800	7.9	Bolt
			11816	7.9	Average
3/4	10500	Block	19400	9.2	Bolt
	10200	Bolt	16700	7.9	Bolt
	11200	Block	17950	8.5	Bolt
	10633	Average	17350	8.3	Average

"Bolt" type failure designates bolt shear; "Block" designates the block failed.

$f'_c = 4$ ksi

054162

Respectfully submitted,
PITTSBURGH TESTING LABORATORY

W. H. Levelius BM.

W.H. LEVELIUS, MANAGER
CHICAGO DISTRICT

PHILLIPS DRILL COMPANY

MICHIGAN CITY, INDIANA

PULLOUT AND SHEAR CAPACITY OF THE PHILLIPS REDHEAD NON-DRILL AND REDHEAD STUD ANCHORS IN SEVERAL STRENGTHS OF CONCRETE.

TABLE I

05416

LOAD	DIA.	REDHEAD STUD					REDHEAD NON-DRILL					P_u/P_r
		2000	2500	3000	3500	4000	2000	2500	3000	3500	4000	$f_c'=35$
PULLOUT CAPACITY	1/4	1560	1800	2110	2400	2830	2500	2650	2850	3000	3120	10.
	3/8	2280	2660	3100	3550	4200	3300	3650	4100	4500	4800	8.
	1/2	3360	3900	4550	5200	6180	4400	5100	5900	6800	7400	7.
	5/8	4600	5300	6150	7100	8400	5600	6600	8000	9700	10,750	5.
	3/4	7150	8300	9600	11,100	13,200	7700	9600	12,200	15,500	17,800	5.
SHEAR CAPACITY	1/4	1650	1800	1980	2110	2320						
	3/8	3350	3700	4070	4500	4950						
	1/2	5650	6350	7000	7700	8600		SEE TABLE II				
	5/8	8400	9500	10,500	11,700	13,200		nextsheet				
	3/4	11,500	13,100	14,600	16,200	18,500						

RECOMMENDED WORKING LOADS EQUAL 25 % OF THE CAPACITY VALUES GIVEN ABOVE.

Embedment:	3Ksi	P_u/P_A	4Ksi
1 5/8"	7.7	1/4"	9.4
1 7/8"	6.2	3/8"	7.0
2 1/2"	5.2	1/2"	5.9
2 3/4"	4.1	5/8"	4.7
3 1/4	4.1	3/4"	4.5

3 Ksi	S_u/S_A	4 Ksi
6.6	1/4	7.7
6.8	3/8	7.4
7.9	1/2	8.3
8.4	5/8	8.8
8.1	3/4	8.8

PHILLIPS DRILL COMPANY
MICHIGAN CITY, INDIANA

SHEAR CAPACITY OF THE REDHEAD NON-DRILL ANCHORS IN SEVERAL STRENGTHS OF CONCRETE

TABLE II

LOAD	DIA.	REDHEAD NON-DRILL ANCHOR					054162 S_u/S_A
		2000	2500	3000	3500	4000	$f'_c=3500$
SHEAR CAPACITY	1/4	2300	2300	2300	2300	—	7.7
	3/8	4000	4450	4450	4450	—	7.0
	1/2	4700	5400	6200	7000	—	7.2
	5/8	5600	6400	7300	8100	—	5.9
	3/4	8000	8900	10,000	11,300	—	5.8

TAKEN FROM A REPORT BY MORRIS DOBERNE, C.E., S.E. ENTITED: A REPORT ON SHEAR AND PULLOUT OF THE PHILLIPS REDHEAD ANCHOR AND CAST-IN-PLACE BOLTS.

RECOMMENDED WORKING LOAD EQUALS 25% OF THE CAPACITY VALUES GIVEN ABOVE.

PHILLIPS DRILL COMPANY, INC.

General Offices
Michigan City, Indiana 46360

Pullout and Shear Ultimate Capacities For The Phillips Red Head Non-Drill and Red Head Stud Anchors In Several Strengths of Concrete

PHILLIPS CONCRETE ANCHORS	CAT. NO.	BOLT SIZE	PULLOUT CAPACITY 1. CONCRETE STRENGTH, PSI					SHEAR CAPACITY 2. CONCRETE STRENGTH, PSI				
			2000	2500	3000	3500	4000	2000	2500	3000	3500	4000
RED HEAD STUD	JS-14	1/4	1560	1800	2110	2400	2830	1650	1800	1980	2110	2320
	JS-38	3/8	2280	2660	3100	3650	4200	3350	3700	4070	4500	4950
	JS-12	1/2	3360	3900	4550	5200	6180	5650	6350	7000	7700	8600
	JS-58	5/8	4600	5300	6150	7100	8400	8400	9500	10500	11700	13200
	JS-34	3/4	7150	8300	9600	11100	13200	11500	13100	14600	16200	18500
RED HEAD NON-DRILL	J-14	1/4	2500	2650	2850	3000	3120	2300	2300	2300	2300	2300
	J-38	3/8	3300	3650	4100	4500	4800	4000	4450	4450	4450	4450
	J-12	1/2	4400	5100	5900	6800	7400	4700	5400	6200	7000	7900
	J-58	5/8	5600	6600	8000	9700	10750	5600	6400	7300	8100	9100
	J-34	3/4	7700	9600	12200	15500	17800	8000	8900	10000	11300	12900

1. All Pullout Tests Resulted In The Fracturing Or Coning (Conical Spalling) Of The Concrete.
2. The Shear Tests Resulted In The Shearing Of The Bolts Or Studs Except For The Largest Sizes Where Fracturing Of The Concrete Occurred.

The Above Values Were Derived From Actual Tests Conducted By Pittsburgh Testing Laboratory, Chicago, And Smith-Emery Company Los Angeles, And Represent The Average Of Three Tests.

The Manufacturer's Recommended Working Load Equals 25% Of The Ultimate Capacity Values Given Above.

F366P (10-70)

APPENDIX C
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FORM 407

PITTSBURGH TESTING LABORATORY

ESTABLISHED 1881

CHICAGO, ILLINOIS

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Sht. 27/36

APPENDIX C

Ref. 6

ORDER No. CH-1597
CLIENT's No. 21060

LABORATORY No. 105228

March 31, 1971

REPORT

TESTS OF: Concrete Anchors

REPORTED TO: Phillips Drill Company, Inc.
P. O. Box 364
Michigan City, Indiana 46360

In accordance with your instructions we have completed pullout and shear tests of anchors identified as:

PHILLIPS RED HEAD WEDGE ANCHORS

Tests were conducted in blocks of limestone aggregate concrete from a local batching plant and poured in our facility. Compression test cylinders were used to establish strengths of the concrete.

The anchors were inserted into pre-drilled holes and expanded by tightening the nuts with a 12" adjustable wrench.

Pullout tests were conducted by applying tension loads to the anchor through a threaded rod held in the upper crosshead jaws and extending through the movable crosshead of the 300,000 lb. Baldwin Testing Machine. The block was restrained on the underside of the movable crosshead via a steel frame which placed the reaction load 5" minimum from the anchor location. Shear tests were conducted by applying a load through a plate mounted to the block by the anchor, with the load applied perpendicular to the anchor axis.

TESTS OF: RED HEAD WEDGE ANCHORS

		PULL-OUT					SHEAR				
Anchor Body Diameter	Test No.	Total Load Pull-Out Lbs.	P_A	Average Load Pull-Out Lbs.	$\frac{P_{A4}}{P_A}$	Type of Failure	Total Load Shear Lbs.	S_A	Average Load Shear Lbs.	$\frac{S_{A4}}{S_A}$	Location of Failure
1/4"	1 2 3	2303 2393 2343	290	2346	8.1	Concrete Failed Concrete Failed Concrete Failed	1940 2250 2110	300	2100	7.0	Shear Shear Shear
3/8"	1 2 3	3863 4063 3903	570	3943	6.9	Concrete Failed Concrete Failed Concrete Failed	4640 3740 3460	650	3946	6.1	Shear Shear Shear
1/2"	1 2 3	5759 4849 • 5049	990	5219	5.3	Concrete Failed Concrete Failed Concrete Failed	7500 6700 • 7000	990	7067	7.1	Shear Shear Shear
5/8"	1 2 3	7429 • 8289 7629	1710	7782	4.5	Concrete Failed Concrete Failed Concrete Failed	10,400 • 11,100 10,900	1420	10,800	7.6	Shear Shear Shear
3/4"	1 2 3	12,679 12,279 11,229 •	2730	12,069	4.4	Concrete Failed Concrete Failed Concrete Failed	18,600 17,500 21,300	2010	19,133	9.5	Block Split Block Split Anchor Shear

Tests were conducted in concrete blocks having compressive strength on an average of 3690 P.S.I. (f'_c)

PITTSBURGH TESTING LABORATORY

District Manager

Dwg. 054162

Manufacturers' recommended safe working loads in 3690 PSI concrete = 25% of the average loads shown above.

$$P_A = P_{A_3} + (f'_c - 3)(P_{A_4} - P_{A_3}) \; ; \quad S_A \text{, similarly.}$$

F765P (4-71)

10

HILTI
KWIK-BOLT

~~[illegible]~~
File No. H2189-SI
Report No. 8783R

AVERAGE ULTIMATE TENSILE & SHEAR LOADS*

APPENDIX C 1973
Ref. 7
Sht. 28/36

CONCRETE STRENGTH		2000 PSI		4000 PSI		6000 PSI	
Diameter	Embedment	Tension	Shear	Tension	Shear	Tension	Shear
1/4"	1 1/8"	3.9 975	5.5 1653	4.8 1455	8.7 2612	5.0 1755	8.0 2389
	1 1/2"	1875	1653	2225	2612	2935	2389
	1 3/4"	2275	1653	2700	2612	3300	2389
	2"	2525	1653	3125	2612	3350	2389
	2 1/4"	2680	1653	3310	2612	3350	2389
	2 1/2"	2800	1653	3350	2612	3350	2389
3/8"	1 5/8"	5.6 2245	6.9 3748	3.9 3135 2355	7.6 5107	3.5 3741 2810	7.8 6266
	2"	2725	3748	3025	5107	3650	6266
	2 1/2"	3075	3748	3900	5107	4450	6266
	3"	3300	3792	4300	5419	5000	6266
	3 1/2"	3425	3792	4600	5419	5275	6266
	4"	3520	3792	4750	5419	5375	6266
	4 1/2"	3580	3792	4800	5419	5400	6266
1/2"	2 1/4"	6.5 4545	10.0 7444	5.2 5510	8.0 8316	4.9 6845	7.0 9341
	2 3/4"	5800	7444	7200	8316	9800	9341
	3 1/2"	7000	7444	9450	8316	13200	9341
	4 1/2"	7275	8897	11225	10232	14550	11522
	5 1/2"	8250	8897	12050	10232	15150	11522
	6"	9000	8897	12300	10232	15300	11522

tual Concrete Strengths

2178 psi $= 2000 \times 1.09$ 4027 psi $= 4000 \times 1.01$ 6119 psi $= 6000 \times 1.02$

*See sheet A-3 for notes

$F.S. = \frac{P_u}{P_A}$; P_u = ultimate load shown here
P_A = allowable load from Table A, Dwg 054162-Rev 3.
No adjustments for variation of embedment or of f'_c

10

File No. H2189
Report No. 878

HILTI

KWIK-BOLT

AVERAGE ULTIMATE TENSILE & SHEAR LOADS*

APPENDIX C
Ref. 7

CONCRETE STRENGTH		2000 PSI		4000 PSI		6000 PSI	
Diameter	Embedment	Tension	Shear	Tension	Shear	Tension	Shear
5/8"	2 1/8" 2 3/4"	5913 4.5 5410	12239 11.2 11198	7214 3.7 6600	12637 7.7 11562	8416 3.2 7700	14755 6.7 13500
	3 1/2"	6250	11198	9100	11562	9560	13500
	4 1/2"	7000	11198	12000	11562	14500	13500
	5 1/2"	7550	13378	14300	15437	20300	15437
	6 1/2"	8025	13378	16000	15437	21000	15437
	7 1/2"	9000	13378	17000	15437	21000	15437
3/4"	3 3/8" 3 1/4"	8794 4.5 8155	14496 3.8 13257	10946 3.5 10150	18476 8.2 17133	17111 2.7 10860	19521 6.7 18102
	4"	9700	13257	13400	17133	13700	18102
	5"	11700	13257	16500	17133	17600	18102
	6"	13800	15195	18000	18466	22500	21009
	7"	15800	15195	21000	18466	23600	21009
	8"	16000	15195	23000	18466	23600	21009
	9"	16000	15195	23500	18466	23600	21009
1"	4 1/2"	4.2 14000	10.9 27355	8.9 16000	8.1 26879	2.7 20500	7.8 32112
	5"	15500	27355	18900	26879	24400	32112
	6"	17600	27355	24650	26879	32200	32112
	7"	18200	27355	27500	26879	35000	32112
	8"	18200	27355	27500	34491	35000	36394
	9"	18200	27355	27500	34491	35000	36394
	10"	18200	27355	27500	34491	35000	36394

Actual Concrete Strengths

2178 psi 4027 psi 6119 psi

*See sheet A-3 for notes

File No. H218
Report No. 87

HILTI
KWIK-BOLT

Sht. 30/136

AVERAGE ULTIMATE TENSILE & SHEAR LOADS* APPENDIX C

Ref. 7

CONCRETE STRENGTH		2000 PSI		4000 PSI		6000 PSI	
Diameter	Embedment	Tension	Shear	Tension	Shear	Tension	Shear
1 1/4"	5 1/2"	3.6 19000	10.8 36750	2.9 23000 *	7.9 35680	2.9 31200 *	7.9 4519
	6 1/2"	21600	36750	27100	35680	36500	4519
	7 1/2"	23600	36750	31100	35680	42000	4519
	8 1/2"	25100	39843	34600	35680	44400	4709
	9 1/2"	26200	39843	37800	35680	44400	4709
	10 1/2"	26800	39843	40900	35680	44400	4959

Actual Concrete Strengths

2178 psi 4027 psi 6119 psi

*Tension values obtained from best fit curve through mean values of tes data. Curves and test data contained in A. A. Hanks Report No. 8784 (HILTI No. TR-111A).

Shear values are minimum mean values at each embedment based on failure across threaded section of the anchor.

APPENDIX C   Sht. 31/3(

Ref. 8

ABBOT A. HANKS, INC.
TESTING LABORATORIES
Established 1866

1115 INDIANA STREET, P.O. BOX 77265
SAN FRANCISCO, CA 94107
(415) 282-8600

Laboratory Report

File No's. H22148-S01
H221100-02

Report No's. 6099
6100, 6101,
6102, 1513,
1514

March 24, 1977

HILTI FASTENING SYSTEMS
1 Cummings Point Road
Stamford, Connecticut 06904

SUBJECT: SUMMARY REPORT - HILTI HDI CONCRETE FLUSH ANCHORS TEST PROGR

Tension (pullout) and shear tests were conducted in three 8" thick non-reinforced slabs utilizing limestone aggregate designed for 28 day compressive strengths of 2000 psi, 4000 psi and 6000 psi. Standard 6 x 12 inch cylinders were cast and tested in accordance with ASTM C31 and C39 respectively to determine the actual average concrete strengths during testing.

The test program substantially meets the static test critera for tests in concrete described in ASTM E488-76, "Standard Test Methods for Strengths of Anchors in Concrete and Masonry Elements".

Loads shown are average ultimate loads in pounds.

We certify that the test values reported are indicative of the performance of HDI anchors when used in concrete strengths and under conditions as noted in the applicable reports.

Concrete Strength*	2000 PSI		3850 ~~4000~~ PSI		6200 ~~6000~~ PSI ⊛	
Anchor Size	Tension	Shear	Tension	Shear	Tension	Shear
~~HDI - 1/4~~	~~1904~~	~~1738~~	~~2251~~	~~1781~~	~~3075~~	~~3050~~
HDI - 3/8	3174	3970	4942	4225	5650	5900
HDI - 1/2	3997	5873	6751	6224	10200	9350
HDI - 5/8	5549	8683	9696	12205	10400	13600
HDI - 3/4	8857	15195	16034	17609	16400	21200

* Actual Average Concrete Strengths: 2000 psi, 3850 psi, 6200 psi

7.9	7.3	8.4	6.4	6.9	7.3
5.7	7.9	6.6	6.1	7.1	6.8
4.6	8.9	5.5	8.3	4.2	6.6
4.9	10.1	5.7	8.6	4.0	7.7

PG&E FACTOR OF SAFETY
(HILTI TEST) ÷ (STD #054162-3)

ABBOT A. HANKS, INC.
TESTING LABORATORIES

Lee W. Mattis

Lee W. Mattis
Vice President/Engineering

TR - 110

⊛ F/S for 6200 psi, as shown, are for allowables extrapolated to 6.2 Ksi in Ta[...] If based on 6.0 Ksi value [...] Sec. A.2.2) these F/S

OAKLAND LABORATORY: 2898 GLASCOCK STREET, OAKLAND 94601

Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

GENERAL COMPUTATION SHEET

SHEET NO. 32 OF 36 SHEET
JOB FILE NO. 52.7.11.5.8
LOCATION

2.

SUBJECT EOI 1016
Diablo Canyon Power Plant Project
MADE BY Mike Yu DATE 6/16/82 CHECKED BY MNP APPROVED BY

II. APPENDIX

d. APPENDIX D

Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

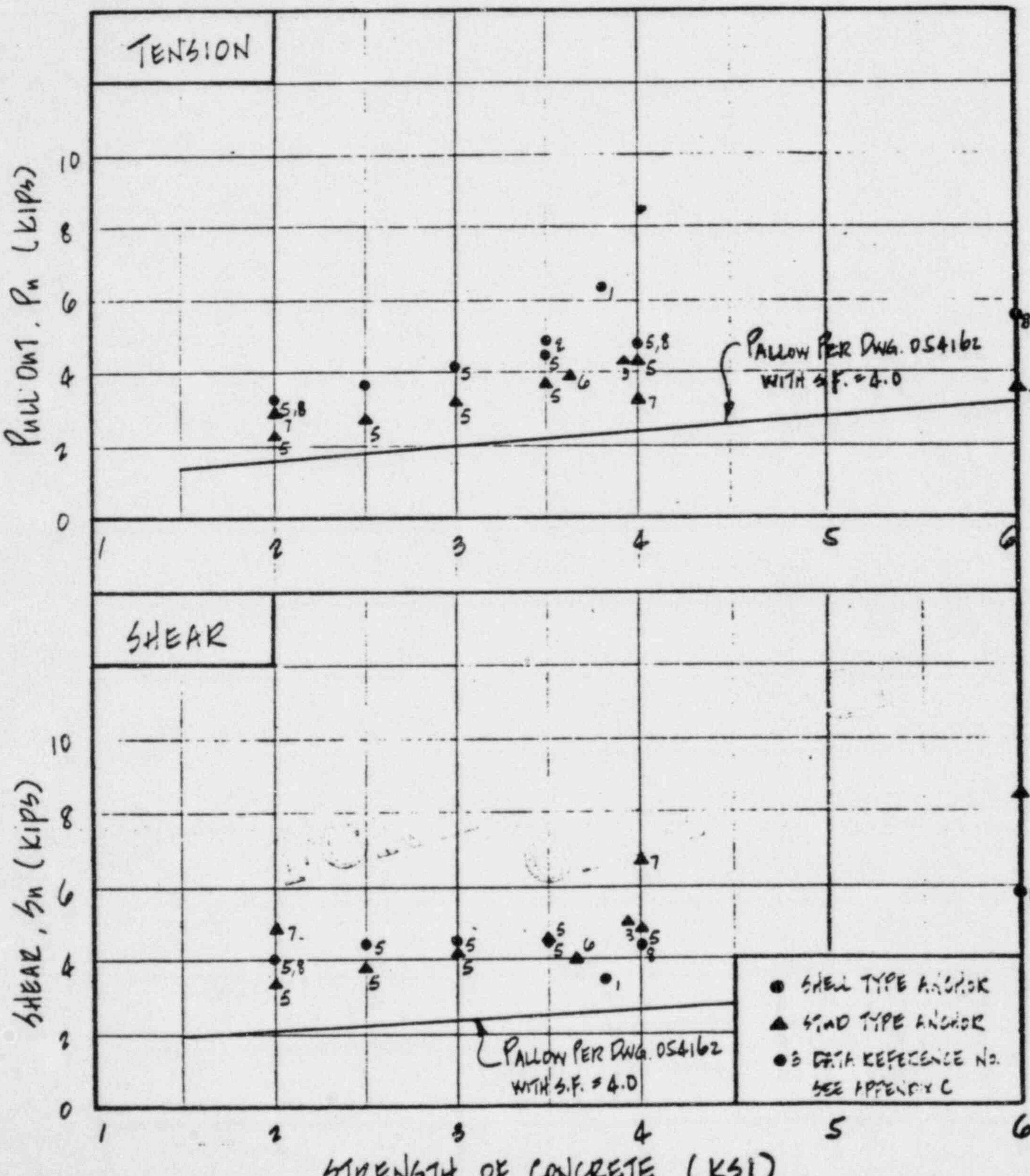
GENERAL COMPUTATION SHEET

SHEET NO. 33 OF 36 SHEET
JOB / FILE NO. 52.7.11.5.8
LOCATION

SUBJECT EOI 1016
Diablo Canyon Power Plant Project · APPENDIX D

MADE BY Mike Jun DATE 6/16/82 CHECKED BY MMP APPROVED BY

ANCHOR DIAMETER = $\boxed{3/8"}$ EMBEDMENT LENGTH = $\boxed{1\frac{3}{4}"}$



Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

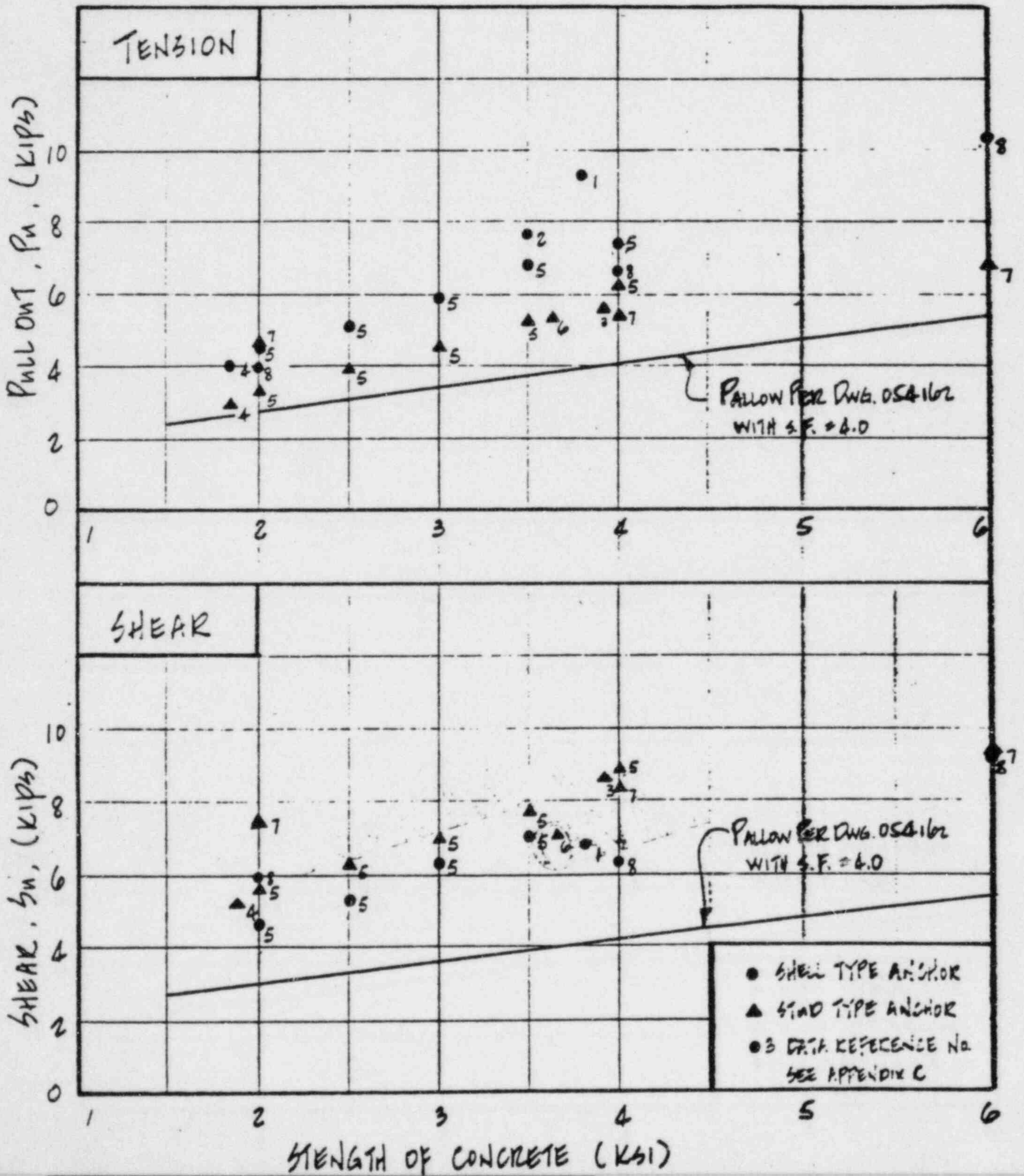
GENERAL COMPUTATION SHEET

JOB FILE NO. 52.7.11.5.8
LOCATION

SUBJECT EOI 1016
Diablo Canyon Power Plant Project · APPENDIX D

MADE BY Mike Ijam DATE 6/16/82 CHECKED BY MNP APPROVED BY

ANCHOR DIAMETER = $\boxed{1/2"}$ EMBEDMENT LENGTH = $\boxed{2 1/4"}$



Design Drafting
62-3690

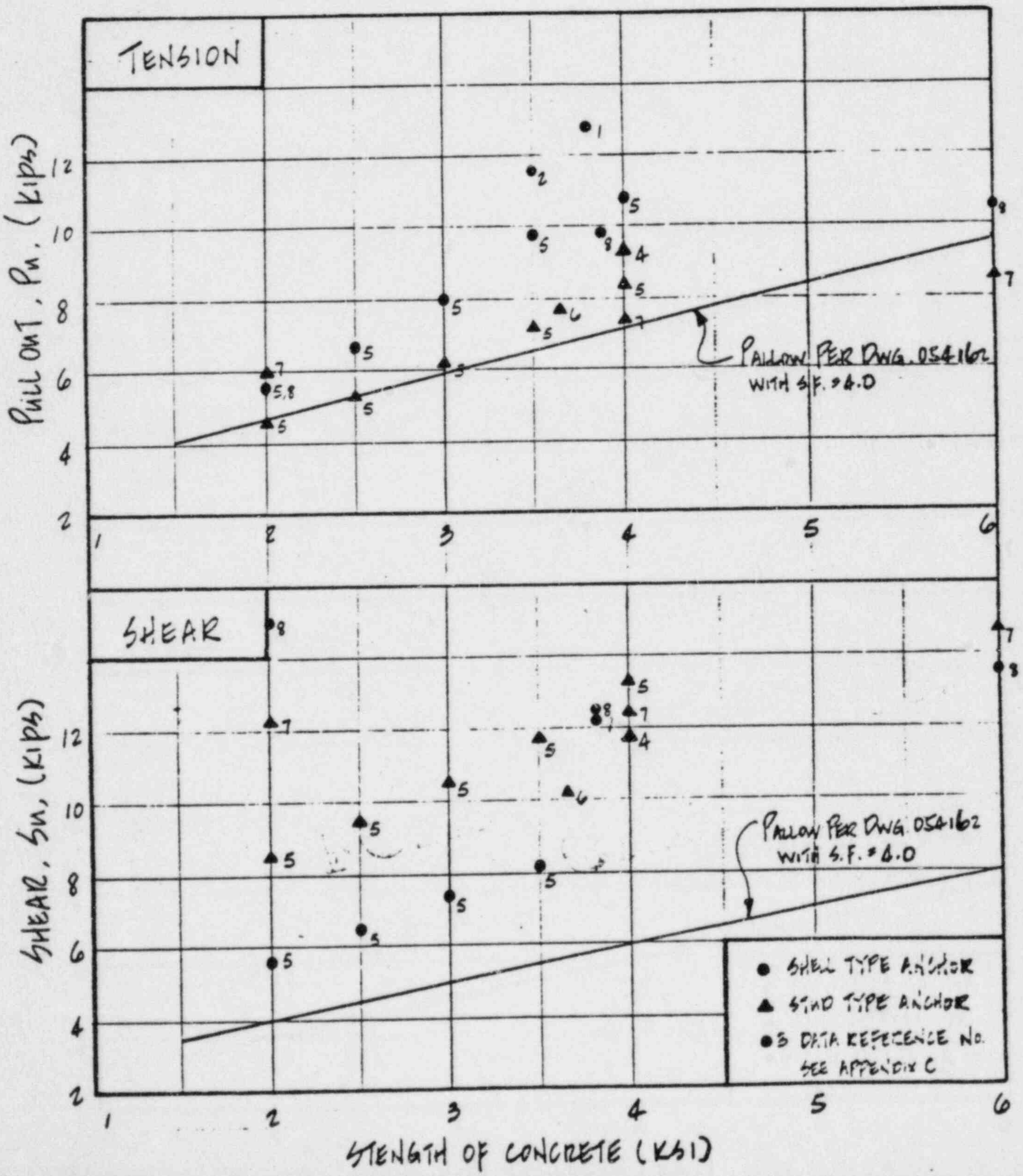
PACIFIC GAS AND ELECTRIC COMPANY

GENERAL COMPUTATION SHEET

SHEET NO. 35 OF 36 SHEETS
JOB FILE NO. 52.7.11.5.8
LOCATION

SUBJECT DCP 1016
Diablo Canyon Power Plant Project - APPENDIX D
MADE BY Mike Yun DATE 6/16/82 CHECKED BY MNP APPROVED BY

ANCHOR DIAMETER = $\boxed{5/8"}$ EMBEDMENT LENGTH = $\boxed{2\tfrac{7}{8}"}$



Design Drafting
62-3690

PACIFIC GAS AND ELECTRIC COMPANY

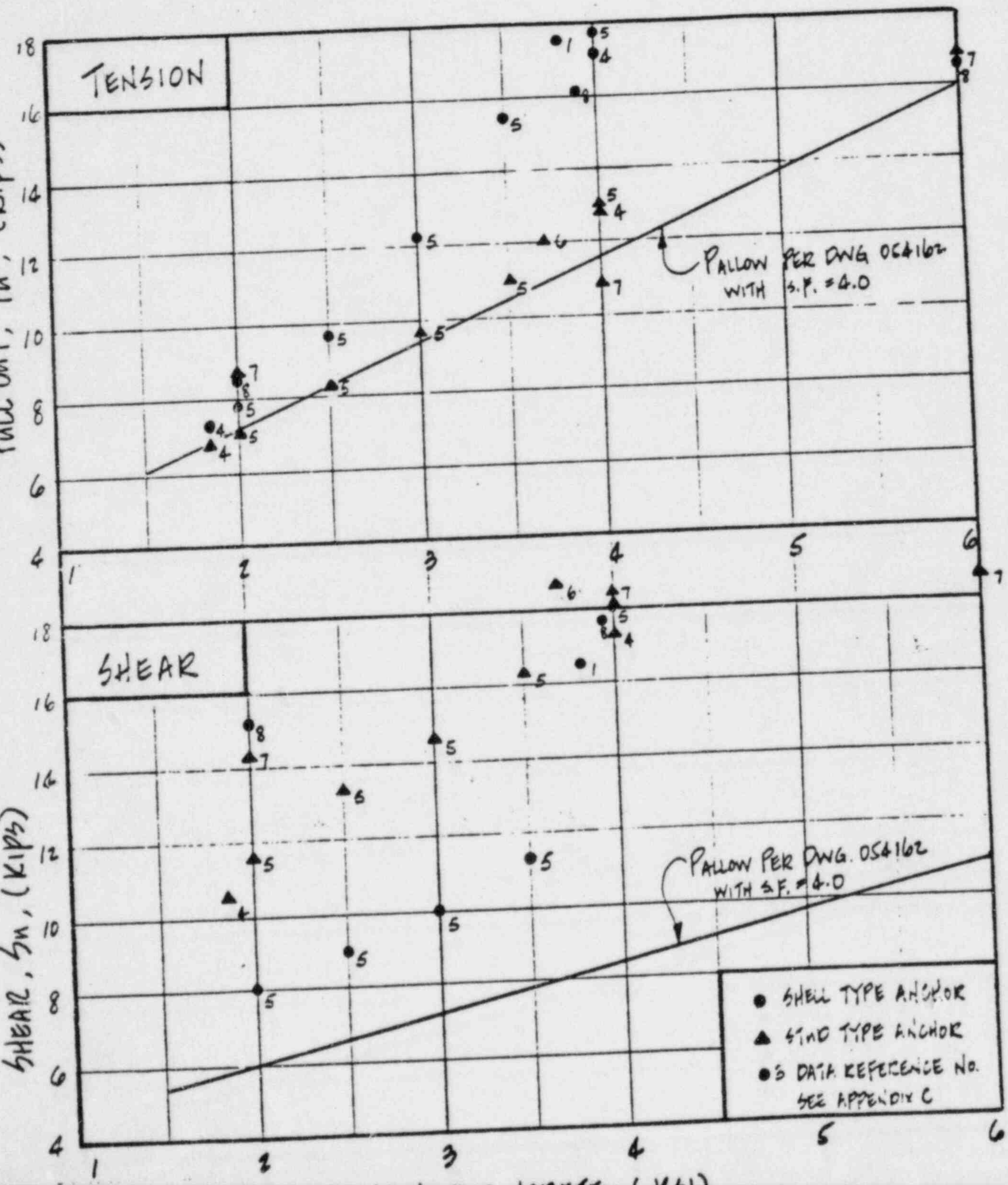
GENERAL COMPUTATION SHEET

SHEET NO. 36 OF 36 SHEETS
JOB/FILE NO. 52.7.11.5.8
LOCATION

SUBJECT EOI 1016
Diablo Canyon Power Plant Project - APPENDIX D

MADE BY Mike Yum DATE 6/16/82 CHECKED BY MNP APPROVED BY

ANCHOR DIAMETER = $\boxed{3/4"}$ EMBEDMENT LENGTH = $\boxed{3\frac{3}{8}"}$



Cont./Supp. Scott   Cont./Supp. I.D. No. 7   PG&E No. 283   3.

INSPECTION SECTION

Discrepant Item: Units I & II. Concrete flush shell anchors installed by Scott Co. for the air conditioning seismic supports.

Explanation of Discrepancy: Possible existence of incorrectly installed concrete anchors. (Continued on Page 2).

D.E. Nein   3-2-77
Field Engr./Inspector   Date

CLASSIFICATION & DISPOSITION   Minor Variation ☐   Deviation ☒

Disposition: Accept all Scott Company installed air conditioning seismic support anchors as is. Data contained in the "Procedure for Establishing Acceptance Criteria for Concrete Anchor Installations - Diablo Canyon" on file in the QA vault on site and gathered during an inspection performed by PG&E show that Phillips anchors increase their strength as they are displaced from their embedment. Displacement of the ductwork up

The following members of the Material Review Board concur with the above Disposition: (For Minor Variations, only Resident Engineer's signature required.)

to one inch is acceptable to the responsible Engineer. The duct work can easily tolerate the small movements that anchors might be displaced when subjected to design loads.

		R. D. Etzler Resident Engineer	3-2-77 Date
Don Day Name	3/23/77 Date	[signature] Name	3/23/77 Date
J Saucedo [signature] Name	APR - 8 1977 Date	Name	Date
[signature] Responsible Engineer	5-2-77 Date	E. P. Wollak Supervising Engineer	5/2/77 Date

DISPOSITION ACCOMPLISHED

Remarks: N/A

Field Engineer/Inspector   Date

STEPS TO PREVENT RECURRENCE (Deviations Only)

Scott Company has discontinued using Phillips anchors and will only use anchors manufactured by The Hilti Corp. Scott Co. has initialed an installation procedure for installing Hilti anchors, I-41-2 to assure they are installed correctly.

R.D. Etzler   6-13-77
Resident Engineer   Date

Copies		Attachments	
Coor.Q.C. Engr.	Dir.-Q.A.	1. Data Sheets	3. Scott Co. Procedure for Anchor Installati
Proj. Super.	Resp. Engr.	2. Telecon dtd 3-2-77	
Resident Engr.	Proj. Engr.		
Q.A.-Site	Supv.Insp.Engr.(G.O.)		

Report Completed

Don Day   6/28/77
Coordinating QC Engineer   Date

9003731739

DISCREPANCY REPORT

Cont./Supp. Scott Cont./Supp.I.D. No. PG&E No. 283

EXPLANATION OF DISCREPANCY:

Of seventy-seven anchor installations inspected, Thirty-three did not have their expansion plugs driven far enough to meet minimum acceptance limits established for Pullman Kellogg.

An attempt was made to drive the expansion plugs further during the inspection. Typically, they could not be driven more than 3/32" and then only with great effort.

Masonary bits were used to drill the holes. Bit wear caused slightly undersized holes and the drill point formed a conical shaped bottom. Both of these conditions prevent the expansion plugs from being fully driven.

Inplace pull out tests were performed on eleven of the thirty-three anchors, in accordance with the "Procedure for Establishing Acceptance Criteria for Concrete Anchor Installations - Diablo Canyon Power Plant". Eight of the anchors exceeded the values in Table A of Drawing No. 054162 for 5 kip concrete without being displaced more than 0.010". All eleven anchors significantly exceeded the Table A values without being displaced more than 5% of their minimum embedment (0.120" and 0.160" for 5/8" and 3/4" anchors, respectively). These eleven anchors were typical of the worst case conditions encountered during the inspection.

With the exception of the underdriven expansion plugs, the anchors were installed satisfactorily in all other respects. Also reference PG&E Deviation #282.

SUMMARY OF IN-PLACE TEST RESULTS
ON ANCHORS EXHIBITING WORST CASE CONDITIONS

Size of Phillips Anchor	Distance Plug was Driven	% of Allowable Distance	Force Developed by Test	Factor of Safety	Anchor Displaced by Test	% of Allowable Displacement
5/8"	15/32"	94%	4320lb.	2.05	0.034"	28%
5/8"	13/32"	81%	4330lb.	2.06	0.015"	13%
5/8"	1/2 "	100%	4320lb.	2.05	0.026"	22%
5/8"	17/32"	106%	4320lb.	2.05	≈0.125"	104%
5/8"	3/8 "	75%	4320lb.	2.05	0.010"	8%
3/4"	1/4 "	50%	3770lb.	1.09	0.010"	6%
3/4"	9/32"	56%	5800lb.	1.68	0.16 "	100%
*3/4"	~~9/32"~~	~~56%~~	7160lb.	2.08	0.235"	147%
3/4"	3/8 "	75%	4700lb.	1.36	0.010"	6%
3/4"	17/32"	106%	4350lb.	1.26	0.010"	6%
3/4"	15/32"	94%	4120lb.	1.19	0.007"	4%
3/4"	9/16"	56%	6960lb.	2.02	0.008"	5%

*Continuation of test on preceeding anchor.

0 0 3 7 4 3 - 1 7 4 0

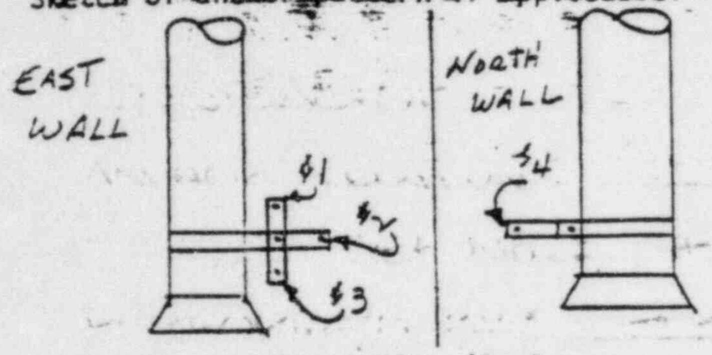
ANCHOR INSPECTION CHECK LIST

anchors)

CONTRACTOR Scott AREA H ELEVATION 60'

SYSTEM n/a GAS DECAY TANK 1-3

Sketch of anchor pattern if applicable.



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P	5/8 P	5/8 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	No
AS FOUND PLUG DEPTH	1 19/32	1 15/32	1 19/32	1 14/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 18/32	1 14/32	1 17/32	1 13/32
DISTANCE PLUG DRIVEN BY RESETTING	1/32	1/32	2/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	No	No	No	No

REMARKS BRACKETS DO NOT FIT TOGETHER WELL.

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walker 2-11-77

REVIEWED BY/DATE: JEN 2/18/77
(If required)

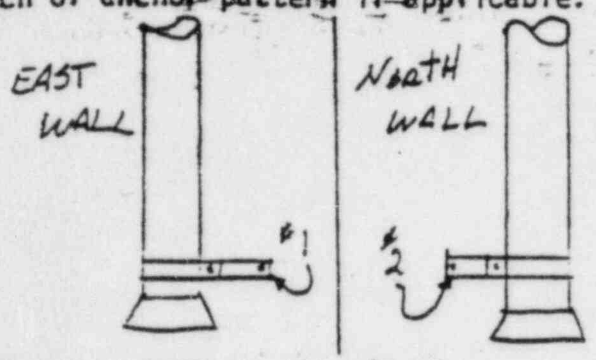
00373-1741

0037 3-1742

CONTRACTOR Scott AREA H ELEVATION + 60'

SYSTEM A/C

Sketch of anchor pattern if applicable. GAS DECAY TANK 1-2



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2		
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P		
*OBVIOUS IRREGULARITIES (yes/no)	No	No		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No		
AS FOUND PLUG DEPTH	1 15/32	1 16/32		
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 14/32	1 15/32		
DISTANCE PLUG DRIVEN BY RESETTING	1/32.	1/32		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: C Walker 2-11-77

REVIEWED BY/DATE: DSE 2/18/77
(If required)

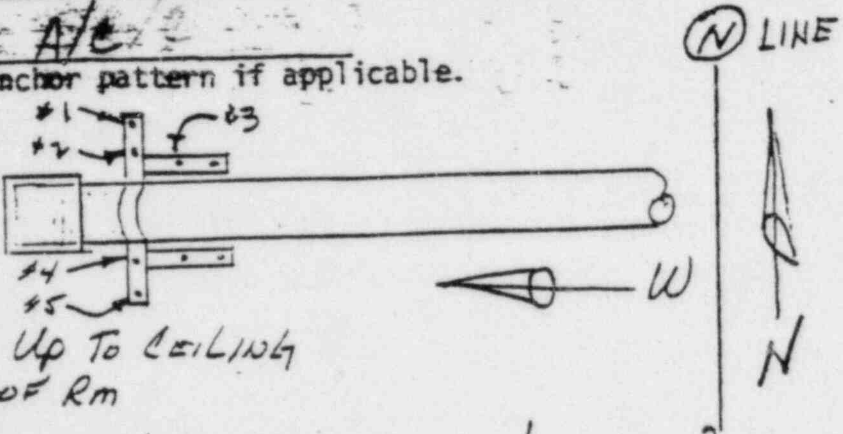
ANCHOR INSPECTION CHECK LIST

anchors) SHEET 5

CONTRACTOR Scott AREA GE ELEVATION 73'

SYSTEM A/C

Sketch of anchor pattern if applicable.



Room Above Boron Injection Tank 1-1 @ 73' Elev.

Looking Up To Ceiling Center of Rm

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1.	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P	5/8P	5/8P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	-4/32 OK BEN	No	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	No
AS FOUND PLUG DEPTH	1 18/32	1 14/32	1 18/32	1 13/32
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 13/32	1 12/32	1 18/32	1 12/32
DISTANCE PLUG DRIVEN BY RESETTING	0	2/32	0	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO	NO	NO

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walker / 2-11-77

REVIEWED BY/DATE: LEN 2/14/77
(If required)

0037 3-1751

[illegible]

4 anchors)

CONTRACTOR Scott AREA GE ELEVATION 73'

SYSTEM A/C

Sketch of anchor pattern if applicable.

SEE SHEET #1

0037 3-1752

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5			
ANCHOR TYPE AND SIZE INSTALLED	5/8 P			
*OBVIOUS IRREGULARITIES (yes/no)	No			
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No			
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No			
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No			
AS FOUND PLUG DEPTH	1 8/32			
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 8/32			
DISTANCE PLUG DRIVEN BY RESETTING	0.			
POSSIBLE EXP. END CUT OFF (yes/no)	Yes (5/32)			

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [signature] 2-11-77

REVIEWED BY/DATE: SEN 2/14/77
(If required)

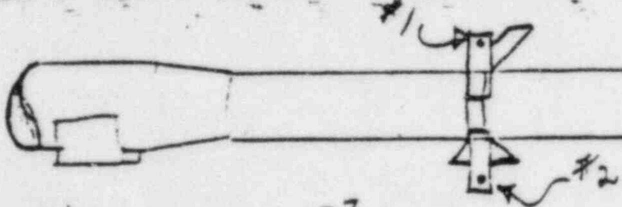
ANCHOR INSPECTION CHECKLIST

4 anchors]

CONTRACTOR Scott AREA H ELEVATION 73'

SYSTEM A/C

Sketch of anchor pattern if applicable. CONTAINMENT SPRAY Pump 1-1



North WALL ON 15-7 LINE

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2		
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P		
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	CONCRETE TO SHOULDER -8/32 9/32	NO		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO		
AS FOUND PLUG DEPTH	SHOULDER TO PLATE 1 24/32	4/32" low 1 12/32		
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 22/32	1 11/32 2/32" low		
DISTANCE PLUG DRIVEN BY RESETTING	2/32	1/32		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS #1 Pull tested: 0.010" @ 4150 lbs, 0.013" @ 434

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walden/2-11-77

REVIEWED BY/DATE: KEN 2/18/-
(If required)

0037.3.1753

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: CONT. SPRAY PUMP 1-1 RM, EL 73

ANCHOR REF. NO.: #1 DATE: 2/17/77

PERFORMED BY: J.E. Niemi

GAUGE PRESS.	APPLIED FORCE	MOVEMENT	GAUGE PRESS.	APPLIED FORCE	MOVEMENT
650 psig	2350 lb	0.001"			
810	2970	.002"			
870	3210	.003			
950	3530	.004			
1000	3730	.005			
1020	3810	.006			
1060	3960	.007			
1090	4040	.008			
1090	4070	.009			
1110	4150	0.010			
1130	4240	0.011			
1150	4320	0.012			
1160	4340	0.013"			

5/8 PHILLIPS

PLUG DRIVEN 3/8"

0037-1754

ANCHOR INSPECTION CHECK LIST

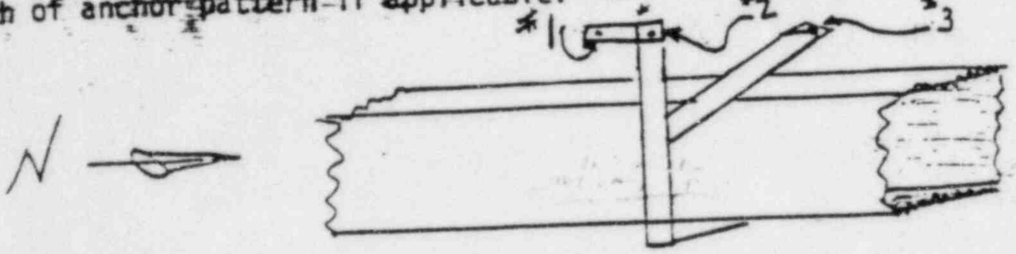
[illegible]

(Where there are [illegible] anchors)

CONTRACTOR Scott AREA H ELEVATION 73'

SYSTEM A/C CONTAINMENT SPRAY PUMP 1-2

Sketch of anchor pattern if applicable.



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	CAN not GET Socket on BOLT HEAD. BOLT HEAD COULD BE WELDED TO HANGER.	3/4 P	
*OBVIOUS IRREGULARITIES (yes/no)	No		No	
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO		NO	
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No		NO	
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO		NO	
AS FOUND PLUG DEPTH	1 29/32		1 23/32	
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 29/32		1 23/32	
DISTANCE PLUG DRIVEN BY RESETTING	0		0	
POSSIBLE EXP. END CUT OFF (yes/no)	NO		NO	

REMARKS

DATA TAKEN BY/DATE: C Walden / 2-11-77

*If yes, describe in "Remarks" and check "Review Required" box.

REVIEWED BY/DATE: DEN 2/18/77
(If required)

0037J-1755

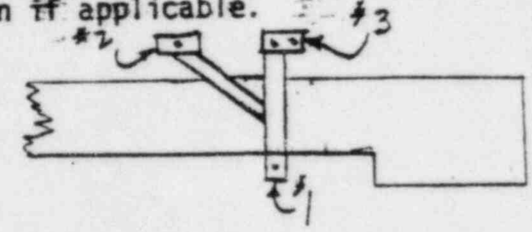
anchors)

CONTRACTOR Scott AREA R ELEVATION 85 ±

SYSTEM A/2 LetDown Heat Exch. 1-1 Room

Sketch of anchor pattern if applicable.

16.8



15.7

LOOKING EAST

00373-1756

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1.	2	3	
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P	3/4 P	
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	
AS FOUND PLUG DEPTH	2 3/32 (4/32" long)	1 23/32	2 4/32 (5/32" long)	
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	2 3/32 (4/32" long)	1 23/32	2 4/32 (5/32" long)	
DISTANCE PLUG DRIVEN BY RESETTING	0	0	0	
POSSIBLE EXP. END CUT OFF (yes/no)	no	no	no	

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: CWallm / 2-15-77

REVIEWED BY/DATE: DEN 2/18
(If required)

ANCHOR INSPECTION CHECK LIST

(Use ... if there are more than 4 anchors)

☐ ...
☐ Review Required

00373-1757

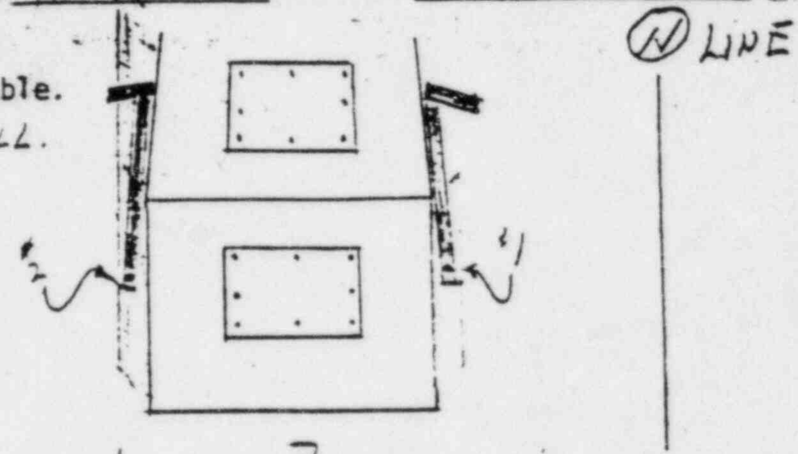
CONTRACTOR Scott AREA K ELEVATION 85'

SYSTEM A/2

Sketch of anchor pattern if applicable.

unit on 17th Line Wall.

Looking South



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1.	2		
ANCHOR TYPE AND SIZE INSTALLED	1/2 H.	1/2 H		
*OBVIOUS IRREGULARITIES (yes/no)	No	No		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	-8/32	-7/32		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No		
AS FOUND PLUG DEPTH (min: 31/32)	30/32	1 2/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 1/32	1 8/32		
DISTANCE PLUG DRIVEN BY RESETTING	+3/32.	+6/32		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: EWalker 2-15-7

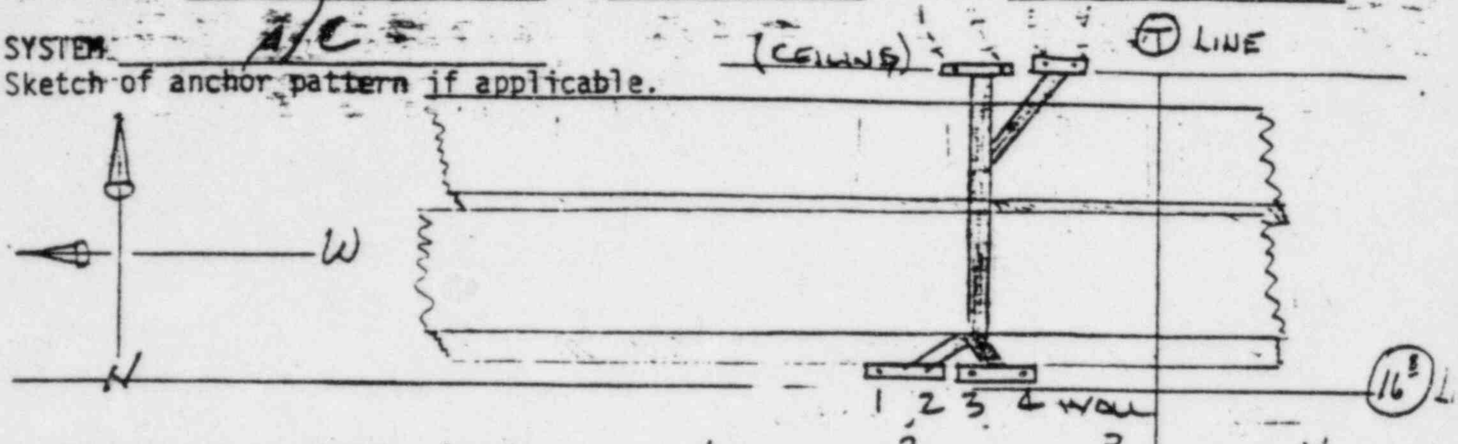
REVIEWED BY/DATE: DEN 2/18
(If required)

ANCHOR INSPECTION CHECKLIST

CONTRACTOR Scott AREA K ELEVATION 100' +

SYSTEM A/C

Sketch of anchor pattern if applicable.



0037 3-1758

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P	3/4 P	3/4 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	No
AS FOUND PLUG DEPTH	8/32 low 2 7/32	7/32 2 6/32	7/32 2 6/32	7/32 2 6/32
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	2 4/32 5/32	2 4/32 5/32	2 4/32 5/32	2 5/32 6/32
DISTANCE PLUG DRIVEN BY RESETTING	3/32	2/32	2/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	no	no	no	no

REMARKS * Pull test ON #1 : 3770 lb, ANCHOR Displaced 0.010

#3: 0.010" @ 980 lbs, 0.235" at 7160 lb

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: CWeller/2-14-77

REVIEWED BY/DATE: JEN 2/18/77
(If required)

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: EL 100', AREA K, NEAR Ⓓ LINE

ANCHOR REF. NO.: #3 DATE: 2/16/77

PERFORMED BY: DE Niemi

GAUGE PRESS.	APPLIED FORCE	MOVEMENT
280 psig	920 psi	.010"
350	1180	.020
440	1540	.030
500	1770	.040
570	2045	.050
630	2270	.060
720	2620	.070
850	3130	.080
980	3650	.090
1080	4040	.100
1180	4420	.110
1290	4860	.120
1380	5220	.125
1390	5280	.140
1460	5560	.150
1520	5800	.160
1590	6090	.170
1660	6380	.190"
1700	6540	.200"
1850	7160	.235

3/4 PHILLIPS

Plug driven 9/32"

00373-1759

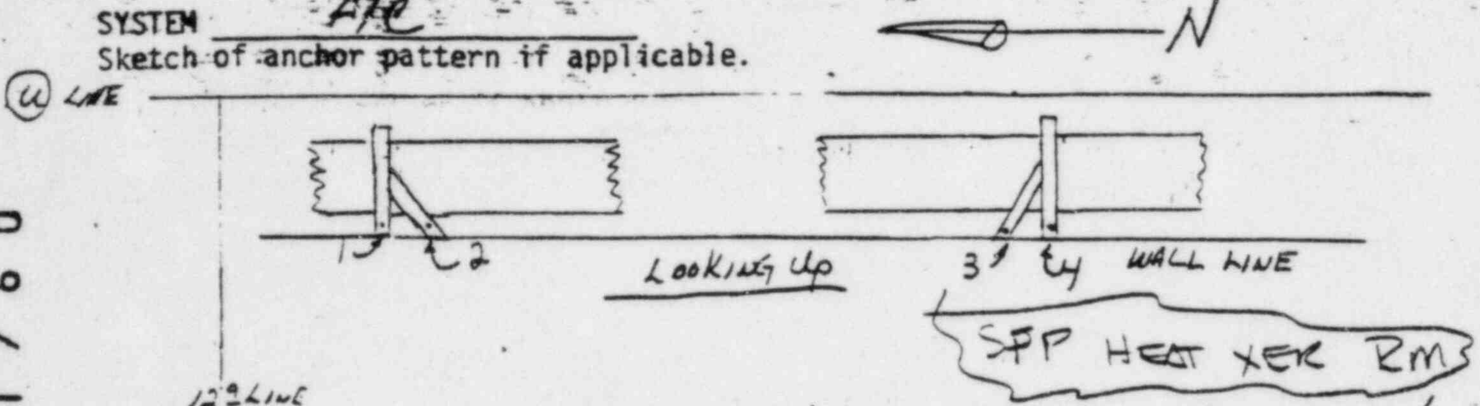
ANCHOR INSPECTION CHECK LIST

4 anchors)

CONTRACTOR Scott AREA J ELEVATION 100'+

SYSTEM AFC

Sketch of anchor pattern if applicable.



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P	3/4 P	3/4 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	- 7/32	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	No
AS FOUND PLUG DEPTH	5/32" long 2 4/32	8/32 2 7/32	2/32+ 2 1/32	8/32 2 7/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	2 4/32 5/32	2 4/32 5/32	2 1/32 2/32	2 4/32 5/32
DISTANCE PLUG DRIVEN BY RESETTING	0	3/32	0	3/32
POSSIBLE EXP. END CUT OFF (yes/no)	no	no	no	no

REMARKS #3 PULL TESTED TO 4700 lb, Anchor displaced 0.010

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: C Walden 2-14-77

REVIEWED BY/DATE: [signature] 2/18/77
(If required)

00373-1760

ANCHOR INSPECTION CHECK LIST

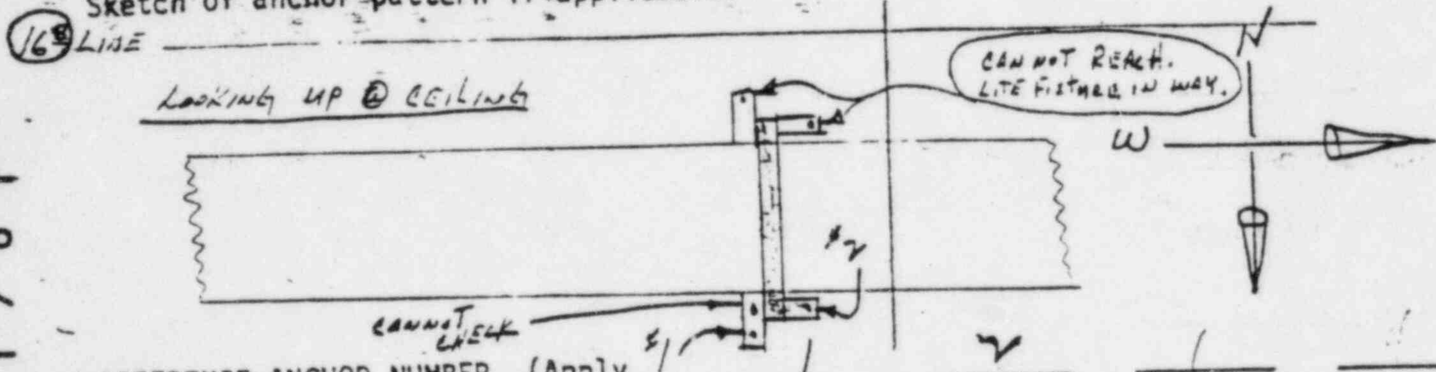
☐ Anchor Installation Okay

Anchors)

CONTRACTOR Scott AREA K ELEVATION 100' +

SYSTEM A/C

Sketch of anchor pattern if applicable.



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2		
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P		
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	NO		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO		
AS FOUND PLUG DEPTH	3/32" long 2 2/32	5/32" long 2 4/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	2 7/32 3/32"	2 4/32 5/32"		
DISTANCE PLUG DRIVEN BY RESETTING	0.	0		
POSSIBLE EXP. END CUT OFF (yes/no)	no	no		

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walden 2-14-7

REVIEWED BY/DATE: (If required) JEN 2/18/

0037-3-1761

0 0 3 7 3 - 1 7 6 2

ANCHOR INSPECTION CHECK LIST

Page _ of _
(use additional pages
if there are more than
4 anchors)

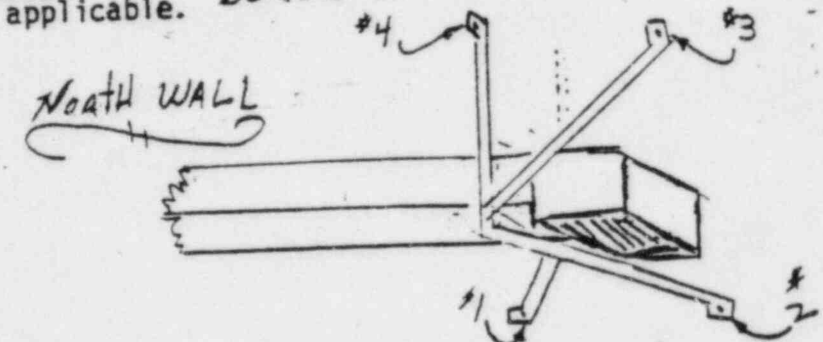
☑ Anchor Installation Satisfactory

☐ Review Required

CONTRACTOR Scott AREA K ELEVATION 100'+

SYSTEM AC BORON CONCENTRATION SYS. TANK AREA

Sketch of anchor pattern if applicable.



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P	3/4 P	3/4 P
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO	NO	NO
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO	NO	NO
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	① -10/32 ② -11/32	NO	NO	NO
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO	NO	NO
AS FOUND PLUG DEPTH	1 26/32	4/32 long 2 5/32	4/32 2 6/32	2/32 2 4/32
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 25/32	2 5/32 4/32	2 2/32 3/32	2 1/32 2/32
DISTANCE PLUG DRIVEN BY RESETTING	1/32	0	1/32	0
POSSIBLE EXP. END CUT OFF (yes/no)	NO	no	no	no

REMARKS ______________________________

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walker 2-14-77

REVIEWED BY/DATE: DEN 2/18/77
(If required)

ANCHOR INSPECTION CHECK LIST

Page 1 of 2
(Use additional pages if there are more than 4 anchors)

SHEET 5

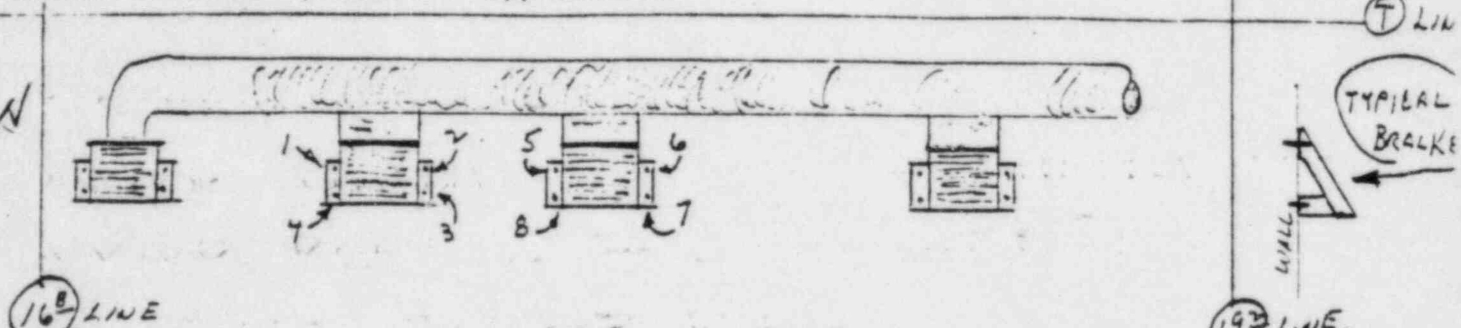
☐ Anchor Installation Okay

☐ Review Required

CONTRACTOR Scott AREA K ELEVATION 102' +

SYSTEM A/C

Sketch of anchor pattern if applicable.



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	1/2 P	1/2 P	1/2 P	1/2 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	No
AS FOUND PLUG DEPTH	1 8/32	1 8/32 only; 1 11/32	1 10/32	1 6/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 8/32	1 4/32	1 7/32	1 5/32
DISTANCE PLUG DRIVEN BY RESETTING	0	3/32	3/32	3/32
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO	NO	NO

REMARKS MAX = 1 8/32"

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walden / 2-14-77

REVIEWED BY/DATE: DEN 2/18/77
(If required)

0037-31763

ANCHOR INSPECTION CHECKLIST

(Check if additional ... if there are ... anchors)

CONTRACTOR Scott AREA K ELEVATION 102 +

SYSTEM A/C

Sketch of anchor pattern if applicable.

SEE SHEET # 1

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5	6	7	8
ANCHOR TYPE AND SIZE INSTALLED	1/2 P	1/2 P	1/2 P	1/2 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	No
AS FOUND PLUG DEPTH	1 5/32	1 7/32	1 6/32	1 7/32
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 5/32	1 5/32	1 6/32	1 7/32
DISTANCE PLUG DRIVEN BY RESETTING	0	2/32	0	0
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO	NO	NO

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: CWalker/2-24-77

REVIEWED BY/DATE: JEN 2/28/7

(If required)

00373-1764

ANCHOR INSPECTION CHECK LIST

☐ Anchor Installation [illegible]

☐ Review Required

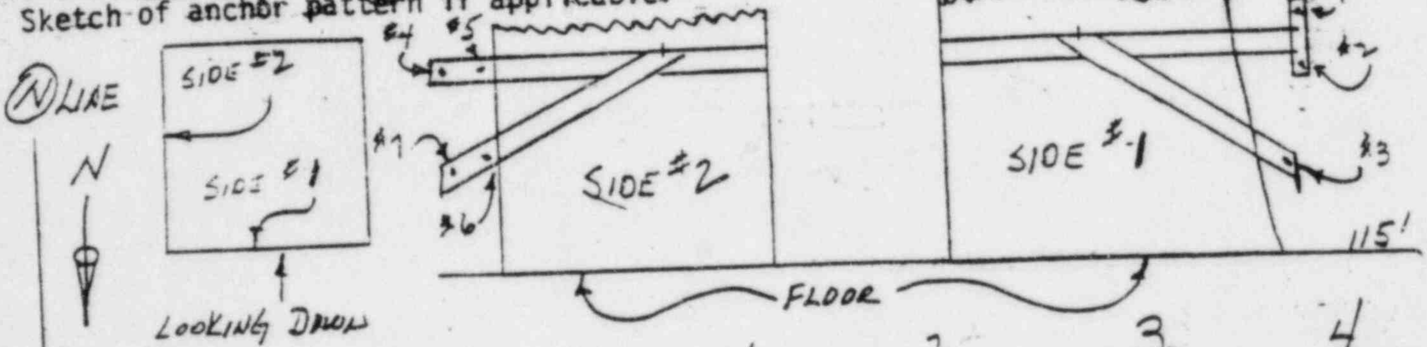
(Additional [illegible] if there are [illegible] 4 anchors)

SHEET [illegible]

CONTRACTOR Scott AREA H ELEVATION 115'

SYSTEM A/C

Sketch of anchor pattern if applicable.



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P	3/4 P	3/4 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	No	NO	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	No	No	No
AS FOUND PLUG DEPTH	1 31/32	1 26/32	2 1/32 (2/32")	1 26/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 29/32	1 26/32	1 28/32	1 25/32
DISTANCE PLUG DRIVEN BY RESETTING	2/32	0	5/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	no	no	no	no

REMARKS #3 Pulled tested: 0.010" at 4350 lb.

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: C Wallen 2-11-77

REVIEWED BY/DATE: (If required) DEN 2/18

0037-1/65

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: EL 115', AREA K, NEAR ELEV.

ANCHOR REF. No.: # 3 DATE: 2/17/77

PERFORMED BY:

GAUGE PRESS.	APPLIED FORCE	MOVEMENT	GAUGE PRESS.	APPLIED FORCE	MOVEMENT
470 PSI	1650 lb	.001"			
900	3340	.002			
1000	3730	.003			
1040	3895	.004			
1070	4000	.005"			
1090	4080	.006			
1120	4200	.007"			
1120	4200	.008			
1160	4350	.009"			
1160	4350	.010"			

3/4" PHILLIPS

PLUG DRIVEN 17/32"

ANCHOR INSPECTION CHECK LIST

☐ Anchor Installation Only

Page [illegible] of [illegible]
(use additional pages if there are more than 4 anchors)

CONTRACTOR Scott AREA H ELEVATION 115

SYSTEM A/C

Sketch of anchor pattern if applicable.

SEE SHEET #1

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5	6	7	
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P	3/4 P	
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	CONCRETE TO SHOULDER -9/32 2nd -12/32	No	No	
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	
AS FOUND PLUG DEPTH	1/32 long 2"	1/32 long * 2"	1 27/32 *	
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 29/32	1 30/32	1 27/32	
DISTANCE PLUG DRIVEN BY RESETTING	3/32	2/32	0	
POSSIBLE EXP. END CUT OFF (yes/no)	no	no	no	

REMARKS #6 Pull tstd: 0.007" @ 4120 lbs

#7 Pull tstd: 0.008" @ 6960 lbs

DATA TAKEN BY/DATE: Walden / 2-11-77

REVIEWED BY/DATE: DSN 2/18/81
(If required)

*If yes, describe in "Remarks" and check "Review Required" box.

0037-3-1767

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: EL 115', NEXT TO ELEV. AREA K

ANCHOR REF. NO.: # 6 DATE: 2/17/77

PERFORMED BY: A.E. Nieni

GAUGE PRESS.	APPLIED FORCE	MOVEMENT	GAUGE PRESS.	APPLIED FORCE	MOVEMENT
200 psig	600lb	.003"			
300	980	.005			
360	1230	.006			
470	1660	.007			
1100	4120	.007			

3/4 PHILLIPS

PLUG DRIVEN 15/32"

00373-1768

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: EL' 115, NEAR ELEV. AREA K

ANCHOR REF. NO.: #7 DATE: 2/17/77

PERFORMED BY: D E Niemi

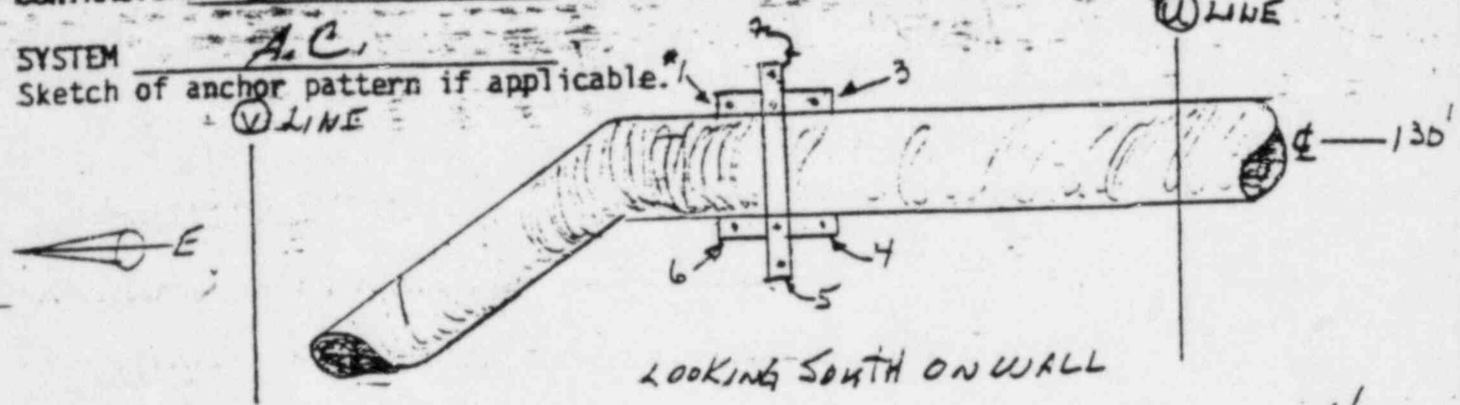
GAUGE PRESS.	APPLIED FORCE	MOVEMENT	GAUGE PRESS.	APPLIED FORCE	MOVEMENT
600 PSI	2160 lb	.001"			
740	2700	.002			
900	3340	.003			
1100	4120	.003			
1300	4910	.004			
1800	6960	.008			

3/4 PHILLIPS
PLUG DRIVEN 13/32"

CONTRACTOR Scott AREA L ELEVATION 115'+

SYSTEM A.C.

Sketch of anchor pattern if applicable.



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P	5/8 P	5/8 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	NO
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	NO
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	NO
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	NO
AS FOUND PLUG DEPTH	~~good~~ 1 20/32	good KN 1 18/32	~~good~~ 1 20/32	~~good~~ 1 19/32
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 16/32	1 17/32	1 19/32	1 17/32
DISTANCE PLUG DRIVEN BY RESETTING	4/32	1/32	1/32	2/32
POSSIBLE EXP. END CUT OFF (yes/no)	No	NO	NO	NO

~~Plug accept~~ KN

6/4 SEA

REMARKS MAX ALLOWABLE = 1 18/32"

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walden / 2-15-7

REVIEWED BY/DATE: DEN 2/18/

(If required)

00373-1770

anchors)

CONTRACTOR Scott AREA 2 ELEVATION 115' 7

SYSTEM A/C

Sketch of anchor pattern if applicable.

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5	6		
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P		
*OBVIOUS IRREGULARITIES (yes/no)	No	No		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	~~None~~ acceptable	
AS FOUND PLUG DEPTH	1 20/32	1 20/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 17/32	1 16/32		
DISTANCE PLUG DRIVEN BY RESETTING	3/32	4/32		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

MAX ALLOWABLE = 1 18/32"

REMARKS

DATA TAKEN BY/DATE: CWalker 2-15-7?

REVIEWED BY/DATE: (If required) DEN 2/19

*If yes, describe in "Remarks" and check "Review Required" box.

0037 3-1771

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: FIRE PUMP ROOM, EL. 115'

ANCHOR REF. NO.: ~~#~~5 DATE: 2/17/77

PERFORMED BY: J E Niemi

GAUGE PRESS.	APPLIED FORCE	MOVEMENT
650 psi	2350 lb	0.001"
700	2550	0.002
725	2640	0.003
750	2740	0.004
800	2930	0.005
825	3040	0.006
835	3070	0.007
850	3140	0.008
875	3230	0.009
900	3340	0.010
910	3380	0.011
920	3410	0.012
930	3450	0.013
940	3500	0.014
950	3530	0.015
975	3630	0.016
[illegible]	[illegible]	[illegible]

GAUGE PRESS.	APPLIED FORCE	MOVEMENT
1020	3810	0.019
1050	3840	0.020
1080	4040	0.022
1100	4110	0.023
1110	4160	0.024
1125	4210	0.02[illegible]
1150	4320	0.026

5/8 PHILLIPS

PLUG DRIVEN 16/32"

00373-1776

CHECK
Call
Drawing Change

Copy is to be returned to Engr'g. Dept. for their information

Call requires a Contractor DVR

PACIFIC GAS AND ELECTRIC COMPANY
STATION CONSTRUCTION DEPARTMENT
Diablo Canyon Project

SAN FRANCISCO TELEPHONE CALLS

INCOMING
OUTGOING X

PERSON CALLED: ELLIOTT NICHOLS

DATE CALLED: MARCH 2, 1977 TIME: 0810

SUBJECT: ACCEPTABLE LIMITS FOR MOVEMENTS OF THE CLASS I A/C DUCTWORK

DRAWING NO. — CHG: — SPEC. NO.: 8737 4R NO.: —

REASON FOR CALL: TO VERIFY WITH THE RESPONSIBLE ENGINEER THAT THE A/C DUCTS CAN TOLERATE THE SMALL MOVEMENTS THAT COULD OCCUR WHEN THE CONCRETE ANCHORS SUPPORTING THE DUCTS ARE SUBJECTED TO DESIGN LOADS.

DATE OF REPLY: SAME TIME: SAME

REPLY RECEIVED: NICHOLS SAID THAT SLIGHT DEFORMATIONS OF THE SHEET METAL CAUSED BY DUCT MOVEMENTS UP TO ONE INCH ARE ACCEPTABLE. HE STATED THAT THE SMALL ANCHOR MOVEMENTS (0.120" TO 0.160") CAN BE EASILY TOLERATED BY THE DUCTWORK.

NOTE: (1) FOLLOW THRU ON EACH CALL, VENDOR PROBLEMS, ENGINEERING CHANGES, ETC. KEEP CLOSE CHECK FOR TIME LAPSE BETWEEN DATE CALLED AND ANSWER TO CALL OR PROBLEM.

(2) IF THIS CONVERSATION CONSTITUTES A DWG. CHANGE, THE RESPECTIVE CONTRACTOR AND DESIGN ENGINEER WILL RECEIVE A COPY.

SIGNED: J. E. [illegible]

00373-1778

INSTALLATION OF HILTI ANCHORS
(DROP INS)

(1) Obtain proper drill and setting tool for size anchor being installed using Figure 1 for reference.

(2) Drill hole indicated in Figure 1 (hole depth indicated does not include conical section caused by drill point) keeping drill perpendicular to concrete surface. Finished hole must be perpendicular to concrete surface with a maximum deviation of 5°.

(3) Insert anchor and assure that expander is in anchor. (NOTE) Top of anchor must be flush or slightly recessed (not to exceed 1/8") from concrete surface.

(4) Using proper setting tool expand anchor by driving expander plug until shoulder on the tool is flush with top of anchor.

(5) Using your assigned I.D. Symbol stamp the head of bolt in each anchor you have installed.

(6) Center to center spacing of anchors shall not be less than 12 nominal diameters and distance to edge of concrete shall not be less than 3" or less than 6 diameters, whichever is greater, except when design or lack of space dictates otherwise. (Refer to Figure 2)

(7) When, due to encounter with steel a new hole is drilled, a minimum of 1" solid concrete must be left between holes. If new hole is within 4½ diameters of the original hole the blank hole must be grouted.

(8) If completed installation appeares discrepant in any manner the employee shall notify Scott Co. Q.C. Inspector immediately.

APPROVAL (AS NOTED)

- ☐ Approved as to Substance
- ☐ Subject to Notations Shown
- ☐ Not Approved
- ☐ Revised Drawings Required
- ☐ Furnish Reproducibles
- ☒ Approved for Constr.

Resident Engineer R. D. Etzler

By R.S.B. Date 4/4/77

PACIFIC GAS & ELECTRIC CO.
Diablo Canyon

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: EL 115', FIRE PUMP ROOM

ANCHOR REF. NO.: #3 DATE: 2/17/77

PERFORMED BY: J.E. Niemi

GAUGE PRESS.	APPLIED FORCE	MOVEMENT
110 psig	310 lb	.002"
150	430	.003
170	500	.004
210	620	.005
240	760	.006
280	910	.007
320	1070	.008
360	1230	.009
420	1450	.010
450	1590	.011
530	1880	.012
630	2180	.013
650	2350	.015
670	2430	.016
680	2470	.017
700	2550	.018
721	2621	0.020
750	2740	.022
800	2930	.023
840	3100	.024
880	3260	.025
900	3340	.026
950	3540	.027
990	3700	.028
1020	3800	.029
1050	3920	.030
1070	4000	.031
1100	4120	.032
1120	4200	.033
1140	4280	.034
1150	4320	.03[illegible]

5/8 PHILLIPS

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: EL 115', FIRE PUMP ROOM

ANCHOR REF. NO.: #4 DATE: 2/17/77

PERFORMED BY: DE Niemi

GAUGE PRESS.	APPLIED FORCE	MOVEMENT	GAUGE PRESS.	APPLIED FORCE	MOVEMENT
300 psig	980	0.002"			
325	1080	0.003			
825	3040	0.004			
875	3240	0.005			
900	3340	0.006			
925	3430	0.007			
950	3530	0.008			
1000	3720	0.010			
1050	3930	0.011			
1075	4020	0.012			
1100	4120	0.013			
1125	4210	0.014			
1150	4330	0.015			

5/8 PHILLIPS

PLUG DRIVEN 13/32

ANCHOR INSPECTION CHECK LIST

[ ] Anchor Installation Only

[ ] Review Required

CONTRACTOR Scott AREA J ELEVATION 115' +

SYSTEM A/C

Sketch of anchor pattern if applicable.

SEE SHEET #1

00373-1175

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5			
ANCHOR TYPE AND SIZE INSTALLED	5/8 P			
*OBVIOUS IRREGULARITIES (yes/no)	no			
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	no			
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	no			
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	no			
AS FOUND PLUG DEPTH	1 2/32			
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 8/32			
DISTANCE PLUG DRIVEN BY RESETTING	7/32			
POSSIBLE EXP. END CUT OFF (yes/no)	no			

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [signature] 2-15-7

REVIEWED BY/DATE: [signature] 2/18

(If required)

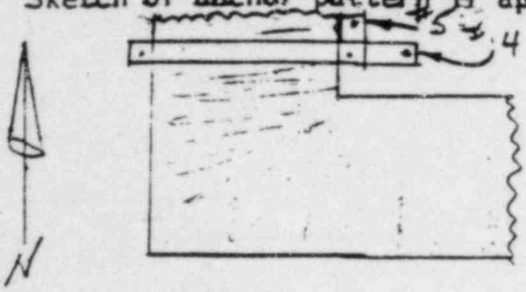
ANCHOR INSPECTION CHECK LIST

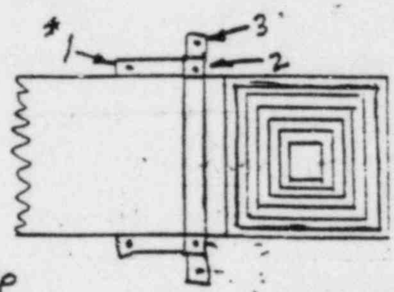
4 anchors)

CONTRACTOR Scott AREA J ELEVATION 115' +

SYSTEM A/C Aux. FW. HYDRAZINE & Ammonia PPS. Rm.

Sketch of anchor pattern if applicable.





LOOKING UP

0 0 3 7 3 - 7 7 2

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P	5/8 P	5/8 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	No 2/32 long +
AS FOUND PLUG DEPTH	1 21/32	1 19/32	1 20/32	1 22/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 20/32 DSN	1 19/32 OK DSN	1 19/32 OK DSN	1 21/32 1/32 low
DISTANCE PLUG DRIVEN BY RESETTING	1/32	0	1/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	no	no	no	no

REMARKS #3 Pull tested: 1150 lb, 0.010" @ 4320#, 0.034".
#4 Pull tested: 0.010" @ 3725#, 0.015" @ 4320#
#5 Pull tested: 0.010" @ 3240#, 0.026" @ 4320#

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [signature] 2-15-77

REVIEWED BY/DATE: DSN 2/28/77
(If required)

ANCHOR INSPECTION CHECK LIST

Page [illegible] of [illegible]
(Use additional pages if there are more than 4 anchors)

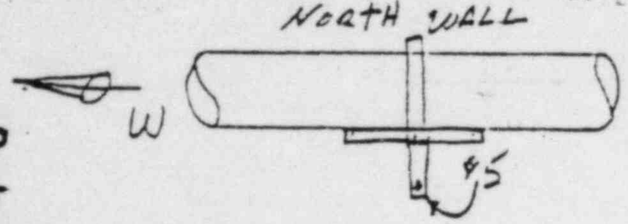
☐ Anchor Installation Okay
☐ Review Required

CONTRACTOR Scott AREA K ELEVATION 60'

SYSTEM A/C

Sketch of anchor pattern if applicable. MONITOR TANK 1-1 AREA

SEE SHEET #1



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5			
ANCHOR TYPE AND SIZE INSTALLED	5/8 P			
*OBVIOUS IRREGULARITIES (yes/no)	NO			
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO			
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO			
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO			
AS FOUND PLUG DEPTH	1 16/32			
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 15/32			
DISTANCE PLUG DRIVEN BY RESETTING	1/32			
POSSIBLE EXP. END CUT OFF (yes/no)	NO			

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walden 2-11-77

REVIEWED BY/DATE: DEN 2/18/77
(If required)

0 0 3 7 3 - 1 7 4 3

0 0 3 7 3 - 1 7 4 4

ANCHOR INSPECTION CHECKLIST

Page 1 of 2 (Use additional sheets if there are more than 4 anchors)

☐ Anchor installation okay

☐ Review Required

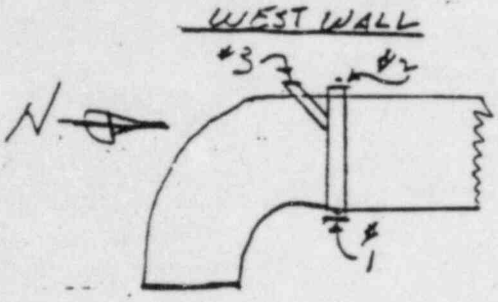
SHEET 1

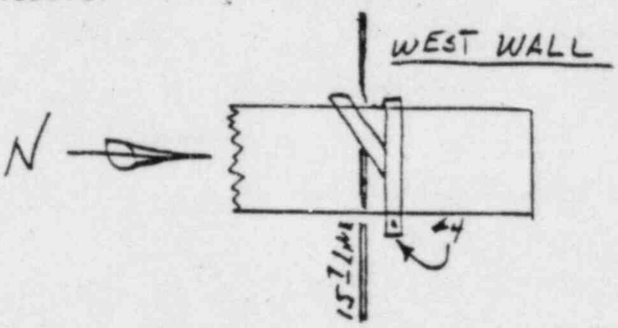
CONTRACTOR Scott AREA K ELEVATION 60'

SYSTEM A/C

Sketch of anchor pattern if applicable.

MONITOR TANK #1-1





REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1.	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P	3/4 P	3/4 P
*OBVIOUS IRREGULARITIES (yes/no)	No			No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO			NO
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No			No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No			No
AS FOUND PLUG DEPTH	1 29/32			1 28/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 28/32			1 28/32
DISTANCE PLUG DRIVEN BY RESETTING	1/32.			0
POSSIBLE EXP. END CUT OFF (yes/no)	NO			NO

Anchor 2: CANNOT GET READINGS BECAUSE OF SHAPE OF HANGER.

Anchor 3: CANNOT GET READINGS BECAUSE, CANNOT GET WRENCH OR SOCKET ON BOLT HEAD, AS STEEL & CONDUIT ARE TO CLOSE TO BOLT,

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walden 2-11-77

REVIEWED BY/DATE: DEN 2/18/77
(If required)

ANCHOR INSPECTION CHECK LIST

Page 1 of 1
(Use additional pages if there are more than 4 anchors)

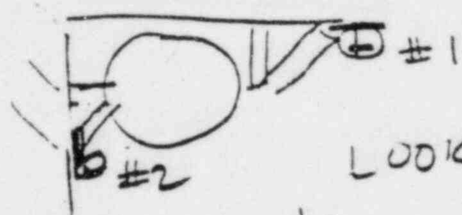
☒ Anchor Installation Okay
☐ Review Required

CONTRACTOR SCOTT AREA K ELEVATION 61

SYSTEM A/C

Sketch of anchor pattern if applicable.

VALVE ROOM BETWEEN RHR PUMPS,
NORTH EAST CORNER OF ROOM, 2' ABOVE FLO. GRATING



LOOKING DOWN

00373-1/45

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2		
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P		
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	NO		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO		
AS FOUND PLUG DEPTH Plug to Shoulder	1 16/32	1 15/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 15/32	1 14/32		
DISTANCE PLUG DRIVEN BY RESETTING	1/32	1/32		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS -

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [illegible] 2/

REVIEWED BY/DATE: [illegible] 2/18/[illegible]

ANCHOR INSPECTION CHECK LIST

Page 1 of 1
(Use additional pages if there are more than 4 anchors)

☒ Anchor Installation Only

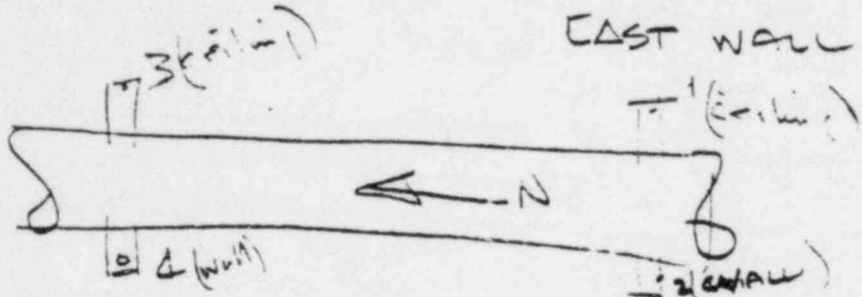
☐ Review Required

CONTRACTOR SCOTT AREA K ELEVATION 64

SYSTEM AIR CONDIT.

Sketch of anchor pattern if applicable.

WATER CHAMBER ROOM #1-1
EAST WALL 8' ABOVE FLOOR



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P	5/8P	5/8P
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO	NO	NO
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO	NO	NO
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	NO	NO	NO
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO ★	NO	NO
AS FOUND PLUG DEPTH	1 13/32	1 17/32	1 17/32	1 16/32
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 11/32	1 17/32	1 16/32	1 15/32
DISTANCE PLUG DRIVEN BY RESETTING	2/32	0	1/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO	NO	NO

REMARKS ★ Pull tested #2: 0.010" @ 2010 lbs, 0.045 @ 2780
approx 1/8" @ 4340 lbs.

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: JEN 2/10/77

REVIEWED BY/DATE: JEN 2/18/77
(If required)

0037.3-1746

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: EL 64' WATER CHAMBER 1-1 RM

ANCHOR REF. No.: #2 DATE: 2/17/77

PERFORMED BY: J E Niemi

GAUGE PRESS	APPLIED FORCE	MOVEMENT
510 psig	1810 lb.	0.003"
530	1850	.004
540	1930	.006
550	1960	.008
560	2010	.010
570	2040	.015
580	2080	.019
610	2200	.025
630	2280	.030
660	2390	.035
710	2580	.040
760	2780	.045

DIAL INDICATOR WAS BUMPED, READINGS BEYOND .045" WERE NOT TAKEN

GAUGE PRESS.	APPLIED FORCE	MOVEMENT

TOTAL ANCHOR DISPLACEM WAS ≈ 1/8" AT 1150 psig, 4320 lb.

5/8 PHILLIPS PLUG DRIVEN 17/32"

DESIGN LOAD in 5 KIP CONCRETE: 2100 lbs

0037-1747

ANCHOR INSPECTION CHECKLIST

Page 1 of 1
(Use additional pages if there are more than 4 anchors)

☐ Anchor Satisfactory
☐ Review Required

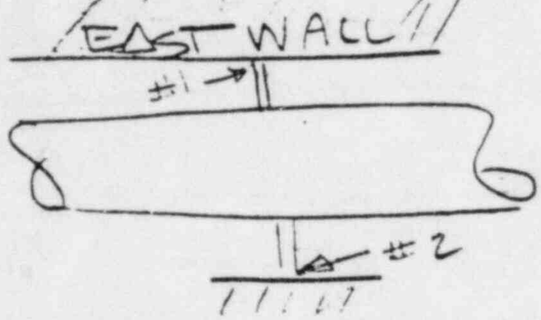
0037317748

CONTRACTOR SCOTT AREA K ELEVATION 64

SYSTEM A/C

Boron injection tank room

Sketch of anchor pattern if applicable.



6' ABOVE floor

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2		
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P		
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	NO		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO		
AS FOUND PLUG DEPTH	1 17/32	1 17/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 14/32	1 17/32		
DISTANCE PLUG DRIVEN BY RESETTING	3/32	0		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: JENiemi 2/10

REVIEWED BY/DATE: JEN 2/18/ (If required)

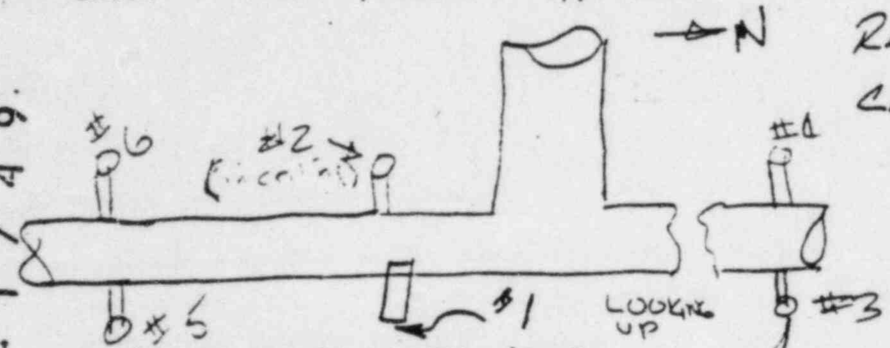
ANCHOR INSPECTION CHECKLIST

Page 1 of 2
(Use additional pages if there are more than 4 anchors)

☒ Anchor Installation Okay
☐ Review Required

CONTRACTOR Scott AREA K ELEVATION 64'

SYSTEM Air Conditioning
Sketch of anchor pattern if applicable.



RECIRCULATING WATER CHAMBER Rm 1-2
WEST WALL 6'6" ABOV FLOOR

00373-1/49

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P	5/8	5/8 P.
*OBVIOUS IRREGULARITIES (yes/no)	No	NO	NO	NO
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO	NO	NO
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	NO	NO	NO
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO	NO	NO
AS FOUND PLUG DEPTH Should be flush	1 17/32	1 15/32	1 15/32	1 16/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 15/32	1 15/32	1 16/32	1 15/32
DISTANCE PLUG DRIVEN BY RESETTING	2/32	2/32	2/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO	NO	NO

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: D E Niemi 2/10/7

REVIEWED BY/DATE: DEN 2/18
(If required)

ANCHOR INSPECTION CHECK LIST

Page 2 of 2
(Use additional pages if there are more than 4 anchors)

☒ Anchor Installation Okay
☐ Review Required

CONTRACTOR Scott AREA K ELEVATION 621

SYSTEM A/C

Sketch of anchor pattern if applicable.

See page 1

0037 3-1750

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5	6		
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P		
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	1/8		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	OK per 5°		
AS FOUND PLUG DEPTH	1 13/32	1 14/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 12/32	1 12/32		
DISTANCE PLUG DRIVEN BY RESETTING	1/32	2/32		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS ______

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [signature] 2/10/7

REVIEWED BY/DATE: DEN 2/18/7
(If required)

ANCHOR INSPECTION CHECKLIST

Page 2 of 2

(Use additional sheet if there are more than 4 anchors)

Review Required

CONTRACTOR Scott AREA K ELEVATION 124

SYSTEM A/C

Sketch of anchor pattern if applicable.

See page 1

0 0 3 7 3 - 1 7 5 0

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5	6		
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P		
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	1/8		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	5°		
AS FOUND PLUG DEPTH	1 13/32	1 14/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 12/32	1 12/32		
DISTANCE PLUG DRIVEN BY RESETTING	1/32	2/32		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [signature] 2/10

REVIEWED BY/DATE: DEN 2/18/-

(If required)

ANCHOR INSPECTION CHECK LIST

Page 1 of 2
(Use additional pages if there are more than 4 anchors)

[X] Anchor Installation Okay

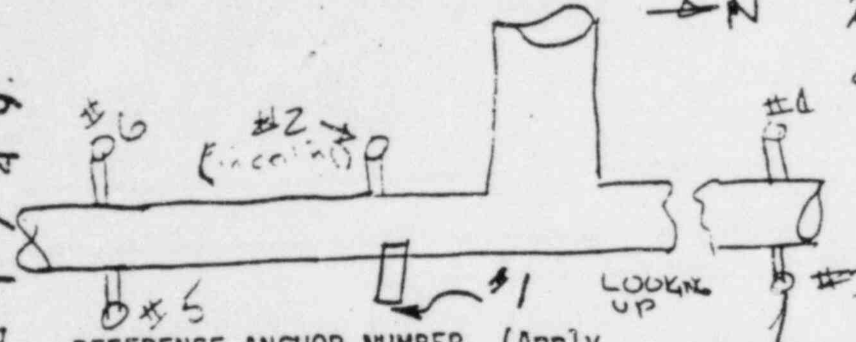
[ ] Review Required

00373-1/149

CONTRACTOR Scott AREA K ELEVATION 64'

SYSTEM Air Conditioning

Sketch of anchor pattern if applicable.



RECIRCULATING WATER CHAMBER Rm 1-2
WEST WALL 6'6" ABOV FLOOR

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P	5/8	5/8 P
*OBVIOUS IRREGULARITIES (yes/no)	No	NO	NO	NO
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	NO	NO	NO
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	NO	NO	NO
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO	NO	NO
AS FOUND PLUG DEPTH Shoulder to plug	1 17/32	1 15/32	1 15/32	1 16/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 15/32	1 15/32	1 16/32	1 15/32
DISTANCE PLUG DRIVEN BY RESETTING	2/32	2/32	2/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO	NO	NO

REMARKS ______________________

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: D E Niemi 2/16

REVIEWED BY/DATE: DEN 2/18
(If required)

ANCHOR INSPECTION CHECKLIST

(Use additional sheets if there are more than 4 anchors)

☐ Review Required

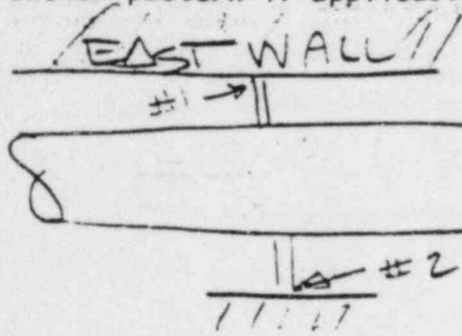
CONTRACTOR SCOTT AREA K ELEVATION 64

SYSTEM A/C

Sketch of anchor pattern if applicable.

Boron injection tank room

6' ABove floor



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2		
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P		
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	NO		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO		
AS FOUND PLUG DEPTH	1 17/32	1 17/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 16/32	1 17/32		
DISTANCE PLUG DRIVEN BY RESETTING	3/32	0		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: DENiemi 2/10/7

REVIEWED BY/DATE: DEN 2/18/77
(If required)

0037317748

00373-1747

ANCHOR PULL TEST

CONTRACTOR: SCOTT

ANCHOR LOCATION: EL 64' WATER CHAMBER 1-1 RM

ANCHOR REF. NO.: #2 DATE: 2/17/77

PERFORMED BY: J E Niemi

GAUGE PRESS.	APPLIED FORCE	MOVEMENT
510 psig	1810 lb.	0.003"
520	1850	.004
540	1930	.006
550	1960	.008
560	2010	.010
570	2040	.015
580	2080	.019
610	2200	.025
630	2280	.030
660	2390	.035
710	2580	.040
760	2780	.045

DIAL INDICATOR WAS BUMPED, READINGS BEYOND .045" WERE NOT TAKEN

GAUGE PRESS.	APPLIED FORCE	MOVEMENT

TOTAL ANCHOR DISPLACEM
WAS ≈ 1/8" AT
1150 psig, 4320 lb.

5/8 PHILLIPS
PLUG DRIVEN 17/32"

DESIGN LOAD in 5 KIP
CONCRETE:
2100 lbs

ANCHOR INSPECTION CHECKLIST

(Use ... if there are ... 4 anchors)

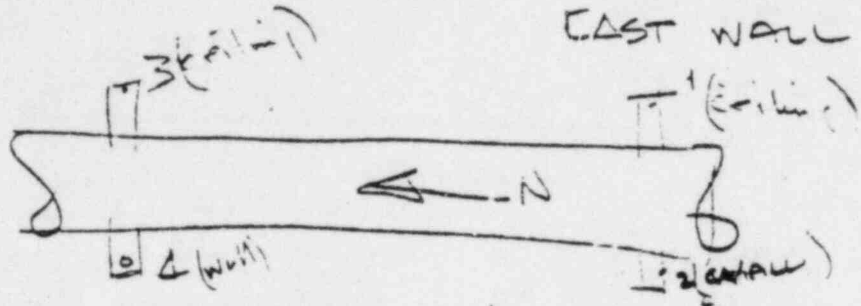
☒ Anchor Installation ...

☐ Review Required

CONTRACTOR SCOTT AREA K ELEVATION 64

SYSTEM AIR CONDUIT.

Sketch of anchor pattern if applicable. WATER CHAMBER ROOM #1-1 EAST WALL 8' ABOVE FLOO



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P	5/8P	5/8P
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO	NO	NO
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO	NO	NO
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	NO	NO	NO
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO *	NO	NO
AS FOUND PLUG DEPTH	1 13/32	1 17/32	1 17/32	1 16/32
AS LEFT PLUG DEPTH (If not within +1/16" of fully driven acceptance criteria*.)	1 11/32	1 17/32	1 16/32	1 15/32
DISTANCE PLUG DRIVEN BY RESETTING	2/32	0	1/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO	NO	NO

REMARKS * Pull tstd #2: 0.010" @ 2010 lbs, 0.045 @ 2...
approx 1/8" @ 4340 lbs.

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: JEN 2/10/7-

REVIEWED BY/DATE: JEN 2/18/
(If required)

0037317

ANCHOR INSPECTION CHECK LIST

Page __ of __
(Use additional pages if there are more than 4 anchors)

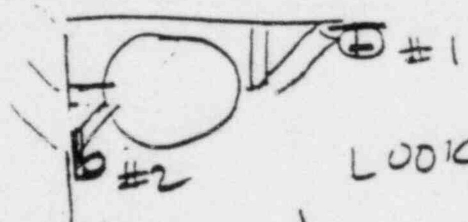
☒ Anchor Installation Diary
☐ Review Required

CONTRACTOR SCOTT AREA K ELEVATION 61

SYSTEM A/C

Sketch of anchor pattern if applicable.

VALVE ROOM BETWEEN RHR PUMPS, NORTH EAST CORNER OF ROOM, 2' ABOVE FLOOR GRATING



LOOKING DOWN

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2		
ANCHOR TYPE AND SIZE INSTALLED	5/8P	5/8P		
*OBVIOUS IRREGULARITIES (yes/no)	NO	NO		
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO	NO		
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO	NO		
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO	NO		
AS FOUND PLUG DEPTH Plug to Shoulder	1 16/32	1 15/32		
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 15/32	1 14/32		
DISTANCE PLUG DRIVEN BY RESETTING	1/32	1/32		
POSSIBLE EXP. END CUT OFF (yes/no)	NO	NO		

REMARKS -

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [illegible] 2/

REVIEWED BY/DATE: [illegible] 2/18/82

00373-1/45

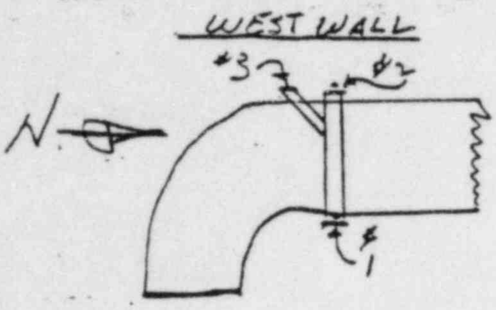
[illegible] one additional [illegible] if there are more than 4 anchors)

SHEET [illegible]

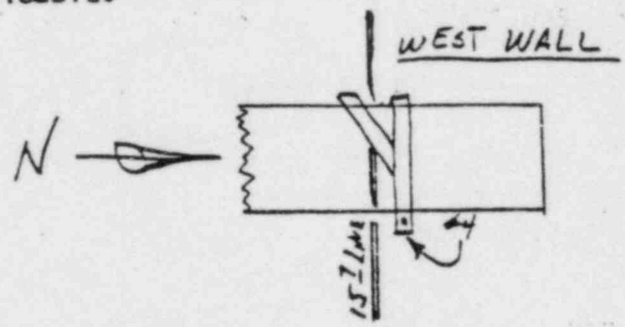
CONTRACTOR Scott AREA K ELEVATION 60'-

SYSTEM A/C

Sketch of anchor pattern if applicable.



MONITOR TANK #1-1



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	3/4 P	3/4 P	3/4 P	3/4 P
*OBVIOUS IRREGULARITIES (yes/no)	No			No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO			NO
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	CANNOT GET READINGS BECAUSE OF SPRING HANGER.	CANNOT GET READINGS BECAUSE, CANNOT GET WRENCH OR SOCKET ON BOLT HEAD, AS STEEL & CONDUIT ARE TO CLOSE TO BOLT,	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No			No
AS FOUND PLUG DEPTH	1 29/32			1 28/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 28/32			1 28/32
DISTANCE PLUG DRIVEN BY RESETTING	1/32.			0
POSSIBLE EXP. END CUT OFF (yes/no)	NO			NO

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walden 2-11-7[illegible]

REVIEWED BY/DATE: DEN 2/18/[illegible]
(If required)

00373-1744

ANCHOR INSPECTION CHECK LIST

Page 1 of 1
(Use additional pages if there are more than 4 anchors)

☒ Anchor Installation Okay

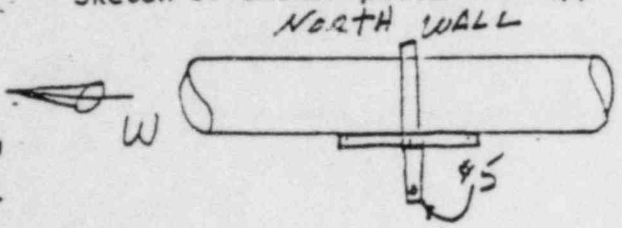
☐ Review Required

CONTRACTOR Scott AREA K ELEVATION 60'

SYSTEM A/C

Sketch of anchor pattern if applicable MONITOR TANK 1-1 AREA

SEE SHEET #1



REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5			
ANCHOR TYPE AND SIZE INSTALLED	5/8 P			
*OBVIOUS IRREGULARITIES (yes/no)	NO			
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	NO			
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	NO			
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	NO			
AS FOUND PLUG DEPTH	1 16/32			
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 15/32			
DISTANCE PLUG DRIVEN BY RESETTING	1/32			
POSSIBLE EXP. END CUT OFF (yes/no)	NO			

REMARKS

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: Walder 12-11-77

REVIEWED BY/DATE: DEN 2/18/77
(If required)

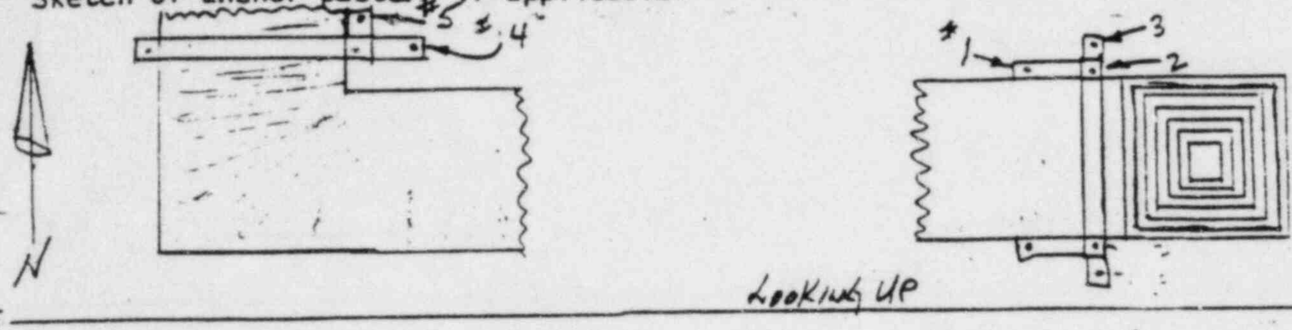
00373-1743

(See additional ...
If there are more than ...
4 anchors)

CONTRACTOR Scott AREA J ELEVATION 115' +

SYSTEM AFW Aux. FW. Hydrazine & Ammonia PPS. Rm.

Sketch of anchor pattern if applicable.



00373-1772

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	1	2	3	4
ANCHOR TYPE AND SIZE INSTALLED	5/8 P	5/8 P	5/8 P	5/8 P
*OBVIOUS IRREGULARITIES (yes/no)	No	No	No	No
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	No	No	No	No
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	No	No	No	No
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	No	No	No	No 2/32" low +
AS FOUND PLUG DEPTH	1 21/32	1 19/32	1 20/32	1 22/32
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 20/32 OK DSN	1 19/32 OK DSN	1 19/32 OK DSN	1 21/32 1/32 low
DISTANCE PLUG DRIVEN BY RESETTING	1/32	0	1/32	1/32
POSSIBLE EXP. END CUT OFF (yes/no)	no	no	no	no

REMARKS #3 Pull tested: 1600 lb; 0.010" @ 4320#, 0.034".
#4 Pull tested: 0.010" @ 3725#, 0.015" @ 4320#
#5 Pull tested: 0.010" @ 3240#, 0.026" @ 4320#

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [signature] 2-15-77

REVIEWED BY/DATE: DSN 2/28
(If required)

ANCHOR INSPECTION CHECK LIST

Page __ of __
(Use additional pages if there are more than 4 anchors)

☐ Anchor Installation Only

☐ Review Required

CONTRACTOR Scott AREA J ELEVATION 115'+

SYSTEM A/C

Sketch of anchor pattern if applicable.

SEE SHEET #1

REFERENCE ANCHOR NUMBER (Apply reference numbers to sketch)	5			
ANCHOR TYPE AND SIZE INSTALLED	5/8 P			
*OBVIOUS IRREGULARITIES (yes/no)	no			
THREADED END CUT OFF (yes/no) (If yes, record number of threads remaining in entry. If less than 4 full threads*.)	no			
ANCHOR DEPTH GREATER THAN 1/8" BELOW SURFACE (yes/no) (If yes, record in entry. If greater than 1/2"*.)	no			
MORE THAN 5 DEGREES FROM PERPENDICULAR (yes/no) (If yes, record in entry. If greater than 15°*.)	no			
AS FOUND PLUG DEPTH	1 7/32			
AS LEFT PLUG DEPTH (If not within ±1/16" of fully driven acceptance criteria*.)	1 5/32			
DISTANCE PLUG DRIVEN BY RESETTING	[illegible]			
POSSIBLE EXP. END CUT OFF (yes/no)	no			

REMARKS ______________________

*If yes, describe in "Remarks" and check "Review Required" box.

DATA TAKEN BY/DATE: [signature] 2-15-7

REVIEWED BY/DATE: [signature] 2/18/
(If required)

00373-1115

4

PROCEDURE FOR ESTABLISHING ACCEPTANCE

CRITERIA FOR CONCRETE ANCHOR INSTALLATIONS

DIABLO CANYON POWER PLANT

Prepared By: Thomas E Niemi

Approved By: MR Tresler

Revision: 2 Date: 12/10/76

PURPOSE

This procedure will develop inspection criteria that can be used to evaluate concrete anchor installations in the field.

SCOPE

This procedure will determine minimum acceptance criteria for misinstalled concrete anchors for the following conditions in nominal 3,000 psi design concrete: (1) wedge plugs not driven fully, (2) field modified anchors, (3) angular misalignment, and (4) effects of overembedment on shear strength.

This procedure will test 1/2", 5/8", 3/4" and 7/8" concrete anchors (flush shell type) manufactured by both the Phillips Drill Company, Inc. and the Hilti Corporation.

TEST PROCEDURE

A. TEST FIXTURE

The test fixture consists of a base, support structure, hydraulic cylinder with a hollow ram, pressure gauge, hand operated hydraulic pump, hydraulic hose and threaded rods of required sizes to fit anchors. (See Figure 1)

Also, a dial indicator with a magnetic base and various accessories to measure anchor movement will be used.

B. CALIBRATION OF TEST FIXTURE

1. Assemble the hydraulic cylinder, hand pump, pressure hose and calibrated pressure gauge.

2. Using the concrete compression tester in the concrete testing lab, determine the load applied by the cylinder at various pressure readings as read on the pressure gauge. Record data on Data Sheet No. 1, "Hydraulic Cylinder Force."

NOTE: Make ten calibration runs. At each pressure plateau, record the hydraulic pressure and applied force. Average the ten readings at each pressure plateau and plot the average value on Figure 2.

3. Using the data from Data Sheet 1, develop a curve for Figure 2, "Cylinder Force vs. Hydraulic Pressure."

C. <u>GENERAL TEST INSTRUCTIONS</u>

1. Install anchor of type and size required for testing.

2. Position test fixture over embedded anchor and connect to anchor with threaded rod of required size.

3. Position dial indicator to detect anchor movement. The dial indicator should contact the shoulder of the anchor if possible. Use the dial indicator accessories, (i.e. magnetic base and extension rods) as required to assure that equipment deflection and rod stretch is not affecting the dial indicator.

4. Increase hydraulic pressure until the dial indicator detects movement of the anchor. Record hydraulic pressure on applicable data sheet at which movement is detected.

5. Continue increasing hydraulic pressure until one of the following conditions exist:

   a. the anchor has slipped five percent of the minimum embedment depth,

   b. the concrete cracks, or

   c. the anchor breaks.

   Record on applicable data sheet.

6. Vent hydraulic pressure and remove test apparatus.

7. Using Figure 2, "Cylinder Force vs. Hydraulic Pressure," determine load applied to anchor at which anchor movement is detected. Record the force on the applicable data sheet.

D. TESTING TO DETERMINE ACCEPTANCE CRITERIA

1.0 Unmodified Hilti Anchors

1.1 Plug Depth Before Driving

a. For each size of Hilti anchors, select ten at random.

b. Insert the expansion plug (by hand) as far as possible. Tap the plug lightly to assure it is seated on it's taper.

c. Measure and record the distance from the threaded end shoulder to the top of the plug on Data Sheet No. 2 for ten anchors.

d. From the data obtained, determine the average dimension that the plug can be inserted for each size of Hilti anchors and record on Data Sheet No. 2.

1.2 Minimum Depth of Expansion Plug to Meet Design Load

a. Drill holes in 3,000 psi concrete of the required diameter for each size of Hilti anchors to depths at which the anchors will be flush with the surface of the concrete.

b. Install anchor and drive the expansion plug 1/8". Record on Data Sheet No. 3.

NOTE: The depth of the expansion plug is determined by subtracting the average dimension for each size of Hilti anchor (obtained in Section 1.1) from the distance of the plug to the anchor threaded end shoulder after driving.

c. Perform pull test on anchor and record data at which anchor movement (or failure) is detected on Data Sheet 3. Record the pressure for both initial movement of the anchor and when the anchor has been displaced five percent of minimum embedment.

NOTE: The following are minimum acceptable values for anchor strengths, both for PHILLIPS and HILTI anchors. They are 10% greater than Table A values for 3,000 psi concrete in PG&E Engineering Standard No. 054162, Revision 2.

Anchor Size	Min. Acceptable Force
1/2"	965 lbs.
5/8"	1,650 lbs.
3/4"	2,585 lbs.
7/8"	3,685 lbs.

d. Compare pull-out force at initial anchor movement with the minimum acceptable values. If the minimum acceptable force is not met, rerun the test with the anchor expansion plug driven deeper. Increase plug depths in 1/8" increments. Use a new anchor, expansion plug and hole for each test.

e. If the minimum pull-out force is exceeded, run four more anchor pull tests with the plug driven the same minimum amount. Record data on Data Sheet No. 3.

NOTE: Five consecutive pull tests at a selected expansion plug depth must pass the minimum acceptable pull-out force before this plug depth can be established as a minimum field inspection criterion. If, during testing, any anchor fails at the selected plug depth, this depth is not satisfactory and the next deeper increment must be tested.

f. Determine the minimum expansion plug depth for 1/2", 5/8" and 3/4" HILTI Anchors and record findings on Data Sheet No. 3.

g. After once having determined the minimum plug depth to meet design load for each size of anchor, drive the expansion plug deeper in 1/8" increments and perform a pull test at each deeper increment until 300% design load is reached. Record information on Data Sheet No. 3.

h. For each anchor size, drive the expansion plug fully one time and test per above. Record findings on Data Sheet No. 3.

2.0 Unmodified Phillips Anchors

2.1 Plug Depth Before Driving

NOTE: Use Phillips test gauge as shown in Figure 3 for each size of Phillips anchors for measurements.

a. Select ten Phillips anchors. Insert the expansion plugs (by hand) as far as possible. Tap the plug lightly to assure that it is seated on it's taper.

b. Insert test gauge in each selected anchor and measure from the top of the expansion plug to the shoulder of the test gauge. Record the information on Data Sheet No. 2.

NOTE: It is extremely important that the test gauge be inserted as far as possible when obtaining measurements to assure that the test gauge is at the end of the threaded section.

c. From the data obtained above, determine the average dimension that the plug can be inse~ted for each size of Phillips anchors and record on Data Sheet No. 2.

2.2 Minimum Depth of Expansion Plug to Meet Design Load

a. Test Phillips anchors as outlined in Section 2.1 except for the following.

(1) The depth of the expansion plug is the difference from the top of the plug to the shoulder of the test gauge (after driving plug) and the distance determined in 2.1.

(2) Record pull-out data on Data Sheet No. 4 and develop minimum field acceptance criteria for Phillips anchors.

(3) Perform Step 1.2.g for Phillips anchors and record on Data Sheet 4.

(4) Perform Step 1.2.h for each size of Phillips anchors and record on Data Sheet 4.

3.0 Modified Anchors

3.1 HILTI ANCHORS - Establishing a Reference Point for a Modified Anchor

a. Select ten Hilti anchors at random for 1/2", 5/8" and 3/4".

b. Record the distance from the face of the threaded end to the end of the threaded section for each anchor. Record measurements on Data Sheet No. 5.

c. Drill holes of required diameters to the depths noted below.

Anchor Size	Hole Depth
1/2"	1 3/8"
5/8"	1 3/4"
3/4"	2 1/16"

d. Install anchor in the holes and drive the plug until the end of the threaded section is just visible.

e. Perform one pull test on each size anchor with the plugs driven to this depth and record the required information on Data Sheet No. 5.

NOTE: If the anchor fails to meet minimum acceptance criteria at the plug depths in Step 3, reperform this test with the plugs driven deep enough to pass minimum acceptance criteria.

3.2 PHILLIPS ANCHORS - Establishing a Reference Point for a Modified Anchor

NOTE: The distance that the expansion plug is driven can be determined by measuring from the plug to the end of the threaded section. Since this measurement has previously been obtained in Section 2.0, this test on Phillips anchors is not required.

3.3 HILTI ANCHORS - Expansion End Cut Off (Perform this test for each size of anchor)

a. For each size of anchor, determine the minimum depth that the plug must be driven to meet minimum acceptable design load. Record on Data Sheet No. 15. (See Section 1.2 and Data Sheet No. 3 for minimum plug depth)

b. Insert the expansion plug by hand, as far as possible. Tap the plug lightly to assure that it is seated on it's taper.

c. Measure overall length of unmodified anchor and record on Data Sheet No. 15.

d. Measure the distance from the shoulder of the expansion end to the plug. Record on Data Sheet 15.

e. Subtract the minimum distance that the plug must be driven to meet design load (obtained from Data Sheet No. 3) from the distance obtained in Step d. Cut off this amount from the anchor expansion end. Record information on Data Sheet No. 15.

f. Drill a hole in concrete to the required depth so that the modified anchor will be flush or slightly above the surface of the concrete. Record hole depth on Data Sheet No. 15.

g. Insert the anchor and drive the expansion plug fully. Record the distance that the plug was driven.

h. Perform a pull test on the modified anchor and record information on Data Sheet No. 15.

i. Repeat Steps e through h for the same size anchor, except decrease the amount cut off in 1/4" increments until 300% design load is reached.

j. Perform this test for each size of Hilti anchor.

3.4 PHILLIPS ANCHORS — Expansion End Cut Off
(Perform this test for each anchor size)

a. Remove 3/4" from the expansion end of the anchor.

b. Measure the overall length of the modified anchor and record on Data Sheet No. 16.

c. Drill hole depth as required to allow the anchor to be flush with the top surface after fully driving expansion plug. Record hole depth on Data Sheet No. 16.

d. Insert anchor in hole and drive plug fully.

e. Measure the distance that the plug has been driven using the appropriate test gauge. Record on Data Sheet No. 16.

f. Perform a pull test on the anchor and record information on Data Sheet No. 16.

g. Repeat this test, increasing the amount removed from the expansion end in 1/4" increments, until the anchor no longer meets minimum design load.

3.5 HILTI and PHILLIPS ANCHORS - Threaded End Cut Off

a. Obtain one anchor for each size and type.

b. Cut off the threaded end until four full threads remain on each anchor.

c. Perform a pull test on each anchor. The hole depth should be deep enough so that the anchors are flush with the top surface of the concrete after driving their expansion plugs. The plugs should be driven fully for each anchor. Record information on Data Sheet No. 6.
NOTE: The pull test need not be performed to failure. Terminate the test at 300% of the design load.

4.0 <u>Angular Misalignment</u>

4.1 15° Misalignment - Plugs at Minimum Depth to Meet Design Load.

a. Perform one pull test for each size and type of anchor. The plugs are to be inserted to the minimum depths that have been determined to meet design load (Sections 1.0 and 2.0). The holes are to be drilled as close to 15° from vertical as possible. The hole depths are to be flush with the surface of the concrete after driving the expansion plugs. Record information on Data Sheet No. 8.

4.2 15° Misalignment - Plugs Fully Inserted.

a. Perform one pull test for each size and type of anchor with their holes as close to 15° from vertical as possible. The expansion plugs are to be driven fully and the hole depths are to be deep enough for the tops of the anchors to be flush with the surface of the concrete. Record on Data Sheet No. 7.

5.0 Shear Loading Over Embedded Anchors

5.1 HILTI ANCHORS - Perform Once for Each Size of Anchor.

a. Drill holes of required size in a vertical concrete surface. Hole depths should be sufficiently deep to embed the anchors 1/2" below the surface of the concrete.

NOTE: Drill the holes at the required height above the floor so that the hydraulic cylinder may be placed on the floor and apply a shear force to the anchor bolt.

b. Drive the expansion plugs fully on each anchor to be tested.

c. Insert a bolt of the proper size through the shear load test fixture shown in Figure 4. Tighten the bolt.

d. Position the hydraulic cylinder under the test fixture.

e. Increase the hydraulic pressure until the anchor or the bolt fails, or 300% design load is reached. Record information on Data Sheet No. 9.

6.0 Discussion and Conclusions

6.1 Anchor Uniformity

Data Sheets 2 and 5 indicate that anchors are manufactured with sufficient uniformity to use various reference points on the anchors to measure distances that expansion plugs are driven. Measurements were repeatable within 1/16" and in most cases, 1/32".

6.2 Expansion Plugs - Minimum and Fully Driven Distances

The following table summarizes test results for both (1) fully driven expansion plugs and (2) expansion plugs driven to minimum depths and still meet acceptance criteria. The results are from Data Sheets 3 and 4, including the remarks for each entry. An anchor was considered to have failed when it's total displacement exceeded 0.010".

Anchor Size and Type	1/2" HILTI	.5/8" HILTI	3/4" HILTI	1/2" PHILLIPS	5/8" PHILLIPS	3/4" PHILLIPS	7/8" PHILLIPS
Minimum Acceptable Force Required	965 lbs.	1650 lbs.	2585 lbs.	965 lbs.	1650 lbs.	2585 lbs.	3685 lbs.
Min. Acceptable Plug Driven Distance / % of Fully Driven Plug Distance	3/8" / 63%	3/8" / 55%	1/4" / 29%	3/16" / 50%	1/2" / 76%	1/2" / 84%	1/2" / 73%
Ave. Force Dev. at Min. Plug Driven Dis. / % of Min. Acceptable Force	4010 lb. / 416%	3039 lb. / 184%	3475 lb. / 134%	1606 lb. / 166%	3312 lb. / 201%	6576 lb. / 254%	5692 lb. / 154%
Fully Driven Plug Distance	19/32"	11/16"	7/8"	3/8"	21/32"	19/32"	11/16"
Force Developed For Fully Driven Plug / % of Min. Acceptable Force	4910 lb. / 508%	6140 lb. / 372%	11,000 lb. / 426%	3740 lb. / 388%	2380 lb. / 144%	6750 lb. / 261%	5890 lb. / 160%

Testing was performed in the northwest corner of the Diablo Canyon auxiliary building, elevation 64. Concrete in that area is typical of 3000 psi concrete used throughout the plant.

Anchor slippage was the predominate mode of failure, even for fully driven expansion plugs. Hilti anchors generally held until the applied force was sufficient to cause them to move. Once movement began, it continued quickly to failure. Generally, the force required to maintain a steady displacement was less than the force that initially caused slippage.

Phillips anchors also failed by slipping, however, their mode of slippage was different than Hilti anchors. Once slipping began, and if the applied force was then held constant, the anchors would eventually stop slipping. Increasing the force would reinitiate anchor slipping. Holding

the force constant at a larger value would allow the anchor to stabilize again. Further force application would cause the same effect until the point at which the anchor no longer stabilized; it would either slip to failure (especially true for small expansion plug driven distances) or the concrete failed because it's shear cone became too small (especially true for anchors with their expansion plugs driven farther or fully driven).

Some Phillips anchors were tested into the slip range and ultimately to failure. Several tests were performed in which the load was held constant after slipping had begun. After a short time, the anchor displacement stabilized. The load was released and then, slowly reapplied. The anchor was able to withstand the load at which slipping had originally begun without further displacement. The force required to reinitiate slipping was approximately the same as that at which the anchor had previously stabilized. Larger forces would then cause correspondingly larger anchor displacements until the ultimate force was reached causing total failure.

Conclusion - Anchors with their expansion plugs driven at least the distances shown in the above table will develop sufficient strengths to meet minimum acceptable loads.

6.3 Modified Anchors - Threaded End Cut Off

Results obtained from Data Sheet 5 indicate that if Hilti expansion plugs are driven to the point at which the end of the threaded section is just visible, only the 3/4" Hilti anchor will develop sufficient force to meet the acceptance criterion. The expansion plugs for 1/2" and 5/8" Hilti anchors must be driven 3/16" and 3/32" beyond the end of the threaded section, respectively, to meet acceptance criteria. These additional plug depths were required to meet the minimum plug driven distances previously established.

Data Sheet No. 6 contains results of anchors modified by cutting off the threaded end until four full threads remained. Generally, concrete failure, either cracking or shear cone pull-out, occurred during Hilti anchor testing. This can be attributed to the anchors being closer to the surface of the concrete. Phillips anchors exhibited their typical slipping phenomonon during this testing phase; their failure occured with no apparent concrete damage. The effective grip area of Phillips anchors is farther below the concrete surface than that for Hilti anchors, hence the differences in failure modes. The following summarizes results of Data Sheet No. 6:

Forces Developed With Threaded End Cut Off

Anchor Size and Type	Max. Amount Cut Off	Force Dev. at Failure	% of Min. Acceptable Force
1/2" Hilti	1/2"	2860 lb.	296%
5/8" Hilti	25/32"	4710 lb.	285%
3/4" Hilti	1 1/8"	7350 lb.	284%
1/2" Phillips	5/8"	3340 lb.	346%
5/8" Phillips	1/2"	5310 lb.	322%
3/4" Phillips	1 1/8"	7770 lb.	301%
7/8" Phillips	15/16"	11,200 lb.	304%

Conclusion - Anchors with their threaded end cut off to the extent shown above, will meet minimum acceptable loads. However, their expansion plugs must be fully driven and hole depths must be sufficient to allow the anchors to be flush with the concrete surface.

6.4 Modified Anchors - Expansion End Cut Off

Cutting off the expansion end reduced the anchor's ability to withstand loads. The forces required to cause initial movements of Hilti anchors decreased as more of the expansion ends were removed. However, the reverse is true for Phillips anchors. In all cases, the modified anchors were able to exceed the minimum acceptable test loads. The following summarizes test results contained in Data Sheets 15 and 16:

Expansion End Cut Off

Anchor Size and Type	Max. Amount Cut Off	Force Dev. at Failure	% of Min. Acceptable Force
1/2" Hilti	9/32"	3210 lb.	333%
5/8" Hilti	3/8"	3175 lb.	192%
3/4" Hilti	11/16"	3500 lb.	135%
1/2" Phillips	7/8"	2080 lb.	216%
5/8" Phillips	1"	2980 lb.	181%
3/4" Phillips	1 1/16"	3730 lb.	144%
7/8" Phillips	1 1/2"	9570 lb.	260%

Conclusion - The expansion end of anchors can be cut off to the extent shown above and still maintain sufficient strengths to meet acceptance criteria. However, the expansion plugs must be driven fully and hole depth must be sufficient to allow the anchor to be flush with the concrete surface.

6.5 Angular Misalignment

Anchors installed approximately 15° from vertical were still able to meet minimum acceptance criteria. The following summarizes test results contained in Data Sheet 7 and 8:

	Plugs Fully Driven		Plugs Driven Min. Distance	
Anchor Size and Type	Applied Force	% of Min. Acceptable Load	Applied Force	% of Min. Acceptable Load
1/2" Hilti	3130 lb.	324%	3100 lb.	322%
5/8" Hilti	5725 lb.	347%	1740 lb.	105%
3/4" Hilti	8820 lb.	341%	2670 lb.	103%
1/2" Phillip	2900 lb.	300%	2170 lb.	225%
5/8" Phillip	5725 lb.	347%	2940 lb.	178%
3/4" Phillip	7770 lb.	300%	4120 lb.	135%
7/8" Phillip	11,420 lb.	310%	10,000 lb.	271%

Phillips anchors did not exhibit the previously experienced slip phenomenon when angularily misinstalled. They generally were able to sustain larger loads than equivalent properly installed anchors.

Conclusion - Anchors with expansion plugs driven at least the minimum distances previously established can be misinstalled up to 15° from vertical and still meet minimum acceptance criteria.

6.6 Over Embedment Effects on Shear Strengths

All Hilti anchors easily exceeded 300% minimum acceptable shear strength values. There was no evidence of concrete failure after testing, however, threads on the bolts were slightly flattened. Several bolts were bent approximately two to five degrees.

Minimum acceptable shear strength values are 10% greater than Table A shear values for 3000 psi concrete in PG&E Engineering Standard 054162, Revision 2.

Phillips anchors were not tested because their self drilling feature prevents overembedment. However, the same test results would have been obtained had Phillips anchors been tested.

Conclusion - Over embedding anchors up to 1/2" below the surface of the concrete will not affect the shear strength of the bolted connection.

6.7 Testing in 5000 psi Concrete

Testing was not performed in 5000 psi concrete because design did not take credit for the extra strength developed by

5000 psi concrete. Also, the failure mode predominately encountered was anchor slippage, not concrete failure. In the few cases where concrete failed, stronger concrete should produce more favorable results.

Since testing in 5000 psi concrete was not performed, Data Sheets 10 through 14 have been deleted from the procedure.

APPENDIX

CONTENTS:

19. Data Sheet 15 - Hilti Anchor-Expansion End Cut Off

20. Data Sheet 16 - Phillips Anchor-Expansion End Cut Off

21. Data Sheet 17 - Instruments Used During Testing

22. References:

a. "Concrete Expansion Anchors for Static and Seismic Loading", Engineering Design Standard 054162, Change 2, 4/17/73.

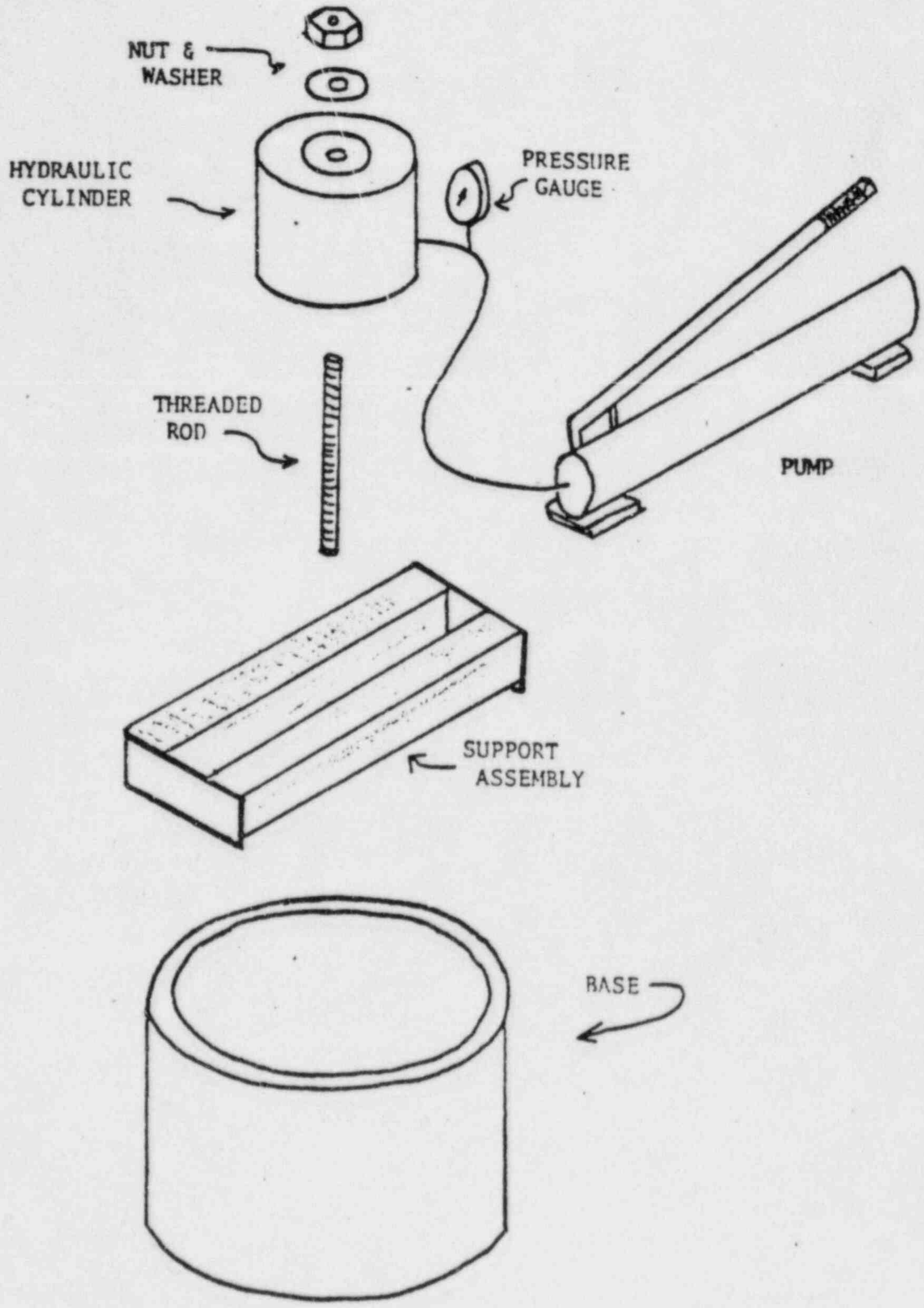


FIGURE 1 - PULL TEST FIXTURE

CIVIL ENGINEERING

Acceptance Criteria For Concrete Expansion Anchors
Diablo Canyon Project

6.

October 2, 1978

MR. C. K. MAXFIELD:

1. This letter supersedes the following documents:

   a. May 4, 1976 letter, E. P. Wollak to G. S. Bates on Diablo Canyon project - Spacing Between Concrete Expansion Anchors.

   b. January 7, 1977 letter, E. P. Wollak to G. S. Bates on Concrete Anchors - Diablo Canyon.

   c. February 25, 1977 letter, E. P. Wollak to G. S. Bates on Concrete Anchors.

   d. June 22, 1978 letter, E. P. Wollak to M. R. Tresler on drawing No. 054162 - Design Criteria Clarification for Concrete Expansion Anchors and Raceway Supports.

   e. April 14, 1978, DCPP telephone conversation between D. Wright and I. Sokoloff on Concrete Anchors.

   The acceptance and/or repair criteria contained in the following documents are also superseded:

   f. June 30, 1978, Civil Engineering memorandum to the file by E. P. Wollak on Concrete Expansion Anchor Testing and Acceptance Criteria - Diablo Canyon.

   g. March 14, 1977. Deviation Report No. 282, Revision 1.

   h. March 2, 1977. Deviation Report No. 283.

2. General

   All new concrete expansion anchors shall be installed to meet the criteria set forth on Engineering Standard Drawing No. 054162.

3. Spacing

   a. If 12-diameter spacing cannot be met and allowable reduction cannot be determined according to the rules on drawing No. 054162, or if the utilization of tolerances allowed by other rules are not possible, the installation shall be marked for the Responsible Civil Engineer's inspection.

The Responsible Civil Engineer will visually inspect the marked locations and designate what corrective action, if any, is required.

For those only where an immediate decision cannot be made, a Construction Problem Control Sheet (DP) shall be submitted for further investigation by the Engineering Department.

b. Anchor spacing embedded to Unistrut:

1) An embedded unistrut is considered loaded only at that point where the raceway support, pipe support, etc. is attached.

2) Anchors may be installed ½" clear from any embedded unistrut, provided there is no loading of the unistrut within 12 nominal diameters of that anchor. (Exception: Unistrut saddle brackets, see item c.1 below).

c. Minimum spacing of anchors for saddle-brackets:

1) Where two unistrut saddle brackets are installed the two outer anchors shall be used to determine spacing.

d. Method of attachment trays to supports:

1) Mounting strap supplied with tray hardware must be installed on the inside of the support construction, not on the outer edge where it may slip off the support. (Also, strap must be attached to bottom of tray). See cable tray note 2, drawing No. 050029.

2) Square-headed bolts may be used with the above strap, provided they are set flush with the raised ribs of the tray bottoms and do not cause damage to wire in trays.

e. No raceway supports are to be mounted to any electrical equipment except where specifically authorized by the Engineering Department on the design drawing.

f. Anchors may be installed within ½" clear of sleeve passing through concrete walls, provided the sleeve thickness is at least ¼".

4. Improper Installation

a. Expander plugs not fully driven:

Unmodified anchors may be rated at full value if the expander plug has been driven at least the amount shown below:

Size	Hilti	Phillips
1/2	3/8	5/16
5/8	3/8	1/2
3/4	7/16	1/2
7/8	—	9/16

b. Axis of anchor not normal to concrete surface:

Unmodified anchors which deviate from the normal shall be rated as follows:

Deviation Angle	Driven Distance of Expander Plug	Allowable Load (% of Allowable From Dwg. 054162)
0° - 15°	Full Distance	100%
> 15° - 45°	Full Distance	Interpolate between 60% at 15° and zero at 45°
0° - 5°	As in Par. 4a	100%
> 5° - 15°	As in Par. 4a	Interpolate between 90% at 5° and 60% at 15°

c. Anchor overembedded:

Unmodified anchors which have not more than ½" overembedment may be rated at full value for shear only and for combinations of shear and tension. Anchors which will be loaded in tension only may be overembedded to any depth without penalty.

5. Unauthorized Modifications (Shell Anchors)

a. Part of threaded end removed:

If at least 4 threads remain in a cut-off anchor, if the anchor does not deviate more than 5° from normal, and if the expander plug has been driven at least the amount required in Par. 4.a., the anchor may be rated at full value.

b. Part of expansion end removed:

Shell anchors, which have been modified by cutting off part of the expansion end, may be rated at full value if the anchor does not deviate more than 5° from normal, if the expander plug has been driven as far as possible (flush with the cut-off end), and if the inferred length of cut-off does not exceed 60% of nominal diameter for shell anchors (100% of nominal diameter for Phillips shell anchors).

6. Nonconforming anchors:

a. If possible, the defective anchor should be properly driven to meet the criteria for a fully acceptable anchor.

b. If a. is not possible, the Responsible Engineer should be consulted to determine whether the anchor, either for full or reduced capacity (Par. 4 and 5 above), was necessary to resist the design loads, or whether the other anchors in the same group are sufficient to resist the design loads; or

c. Replace defective anchor by installing an additional anchor.

d. If an anchor has been properly installed to replace a nonconforming one, the latter may be left in place and considered equivalent to one which has been removed and the hole filled with grout.

e. Whenever an anchor is installed that is of a smaller size than that shown on the design drawing, the Responsible Engineer must be consulted to determine the adequacy of the installation.

E. P. WOLLAK

EPW(3536):ml

cc RDEtzler
VJGhio
JBHoch/DLPolley
GVRichards
CWSteinhardt
RFWischow
JWWoodward/LGRasmussen

DISCREPANCY REPORT

Spec. No. ~~8727~~ 8827 Ad

Page 1 of 2

Cont./Supp. Scott Cont./Supp.I.D. No. ______ PG&E No. 283

INSPECTION SECTION

Discrepant Item: Unit I & II. Concrete flush shell anchors installed by Scott Co. for the air conditioning seismic supports.

Explanation of Discrepancy: Possible existence of incorrectly installed concrete anchors. (Continued on Page 2).

D E Nevin — Field Engr./Inspector — 3-2-77 Date

CLASSIFICATION & DISPOSITION Minor Variation [ ] Deviation [X]

Disposition: Accept all Scott Company installed air conditioning seismic support anchors as is. Data contained in the "Procedure for Establishing Acceptance Criteria for Concrete Anchor Installations - Diablo Canyon" on file in the QA vault on site and gathered during an inspection performed by PG&E show that Phillips anchors increase their strength as they are displaced from their embedment. Displacement of the ductwork up

The following members of the Material Review Board concur with the above Disposition: (For Minor Variations, only Resident Engineer's signature required.)

to one inch is acceptable to the responsible Engineer. The duct work can easily tolerate the small movements that anchors might be displaced when subjected to design loads.

		R. D. Etzler — Resident Engineer	3-2-77 — Date
Don Day — Name	3/23/77 — Date	[signature] — Name	3/23/77 — Date
J Soucolof — Name	APR - 8 1977 — Date	Name	Date
[signature] — Responsible Engineer	5-2-77 — Date	E P Wollak — Supervising Engineer	5/2/77 — Date

DISPOSITION ACCOMPLISHED

Remarks: N/A

Field Engineer/Inspector — Date

STEPS TO PREVENT RECURRENCE (Deviations Only)

Scott Company has discontinued using Phillips anchors and will only use anchors manufactured by The Hilti Corp. Scott Co. has initialed an installation procedure for installing Hilti anchors, I-41-2 to assure they are installed correctly.

R. D. Etzler — Resident Engineer — 6-13-77 Date

Copies		Attachments
Coor.Q.C. Engr.	Dir.-Q.A.	1. Data Sheets 3. Scott Co. Procedure for Anchor Installatic
Proj. Super.	Resp. Engr.	2. Telecon dtd 3-2-77
Resident Engr.	Proj. Engr.	
Q.A.-Site	Supv.Insp.Engr.(G.O.)	

Report Completed

Don Day — Coordinating QC Engineer — 6/28/77 Date

0 0 3 7 3 - 1 7 3 9

7

Spec. No. 8827 ~~8727~~

DISCREPANCY REPORT

Cont./Supp. Scott Cont./Supp.I.D. No. ______ PG&E No. 283

EXPLANATION OF DISCREPANCY:

Of seventy-seven anchor installations inspected, Thirty-three did not have their expansion plugs driven far enough to meet minimum acceptance limits established for Pullman Kellogg.

An attempt was made to drive the expansion plugs further during the inspection. Typically, they could not be driven more than 3/32" and then only with great effort.

Masonary bits were used to drill the holes. Bit wear caused slightly undersized holes and the drill point formed a conical shaped bottom. Both of these conditions prevent the expansion plugs from being fully driven.

Inplace pull out tests were performed on eleven of the thirty-three anchors, in accordance with the "Procedure for Establishing Acceptance Criteria for Concrete Anchor Installations - Diablo Canyon Power Plant". Eight of the anchors exceeded the values in Table A of Drawing No. 054162 for 5 kip concrete without being displaced more than 0.010". All eleven anchors significantly exceeded the Table A values without being displaced more than 5% of their minimum embedment (0.120" and 0.160" for 5/8" and 3/4" anchors, respectively). These eleven anchors were typical of the worst case conditions encountered during the inspection.

With the exception of the underdriven expansion plugs, the anchors were installed satisfactorily in all other respects. Also reference PG&E Deviation #282.

SUMMARY OF IN-PLACE TEST RESULTS ON ANCHORS EXHIBITING WORST CASE CONDITIONS

Size of Phillips Anchor	Distance Plug was Driven	% of Allowable Distance	Force Developed by Test	Factor of Safety	Anchor Displaced by Test	% of Allowable Displacement
5/8"	15/32"	94%	4320lb.	2.05	0.034"	28%
5/8"	13/32"	81%	4330lb.	2.06	0.015"	13%
5/8"	1/2 "	100%	4320lb.	2.05	0.026"	22%
5/8"	17/32"	106%	4320lb.	2.05	≈0.125"	104%
5/8"	3/8 "	75%	4320lb.	2.05	0.010"	8%
3/4"	1/4 "	50%	3770lb.	1.09	0.010"	6%
3/4"	9/32"	56%	5800lb.	1.68	0.16 "	100%
*3/4"	~~9/32"~~	~~56%~~	7160lb.	2.08	0.235"	147%
3/4"	3/8 "	75%	4700lb.	1.36	0.010"	6%
3/4"	17/32"	106%	4350lb.	1.26	0.010"	6%
3/4"	15/32"	94%	4120lb.	1.19	0.007"	4%
3/4"	9/16"	56%	6960lb.	2.02	0.008"	5%

*Continuation of test on preceeding anchor.

00373-1740

A. DESIGN

A.1.0 APPLICATIONS

A.1.1 Concrete expansion anchors should not be used indiscriminately. For important work, bolts should preferably be cast-in-place, welded, or grouted in drilled holes or in cast-in-place sleeves. Where these types of installation are for good reason impractical, expansion anchors may be used.

A.1.2 Provisions of this standard shall apply to the shell or stud type expansion anchors designated in Part 8.

A.1.3 Anchors must be at least 1/2" diameter when used for structural connections or for anchorage of pipes, conduits or ducts greater than 2" diameter.

A.1.4 Anchors shall not be installed in prestressed concrete elements nor used to connect concrete elements which must have a specified value of fire resistance.

A.1.5 Embedded length of anchor shall be exclusive of thickness of grout pad or other overlay.

A.2.0 ALLOWABLE LOADS

A.2.1 Allowable loads shown in Table A, as modified by the provisions of this standard, shall apply to anchors installed in ordinary concrete.

A.2.2 For concrete strength between 2 ksi and 6 ksi, linear interpolation in Table A may be used. For concrete strength greater than 6 ksi, use 6 ksi allowable values. For sound concrete of unknown strength, use 2 ksi values.

A.2.3 Allowable load values given in this standard shall not be increased because of short duration of loading (e.g., for wind or seismic loads).

A.2.4 For anchors subjected to continuous or frequent (more than 500 times per year) reversal of loading, allowable loads shall be 1/3 of the allowable values given in this standard.

A.2.5 Allowable loads given in this standard are intended for use at "working load" levels. For "ultimate" or "limit" load design purposes, twice these values may be used.

A.2.6 Anchors installed in lightweight aggregate concrete shall have allowable loads equal to those provided for anchors in ordinary concrete with $f'_c = 2$ ksi.

A.2.7 Allowable loads of anchors of 1/2" or larger diameter may be increased by 50% if proof loading is done according to the instructions given in Part 8.

A.2.8 If center to center spacing of anchors is less than 12 diameters and/or if distance from edges of concrete to center of anchor is less than 6 diameters, the allowable loads shall be reduced in accordance with the following formulae:

$$P_D = 2.25\, P_A \frac{N}{N+6} \frac{E}{E+3} \qquad S_D = 1.5\, S_A \frac{E}{E+3}$$

Where: P_D = allowable pullout load reduced for edge distance and/or spacing.
P_A = allowable pullout load from Table A
S_D = allowable shear load reduced for edge distance
S_A = allowable shear load from Table A
N = no. of diameters of anchor spacing ($6 \le N \le 12$): if $N>12$, use $N=12$
E = no. of diameters of edge distance ($3 \le E \le 6$): if $E>6$, use $E=6$

Anchor spacing shall be not less than 6 times nominal diameter of anchor. Edge distance shall be not less than 3 times nominal diameter nor less than 3 inches. If edge of concrete is chamfered, edge distance shall be measured from nearest edge of chamfer.

FOR INFORMATION ONLY

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APPROVED BY	REV	DATE	DESCRIPTION	DWN.	CHKD.	APVD.
	3	11-K-78	GENERAL REVISION REDRAWN SHEETS 3 & 4 ADDED	JF	BC	DWS

GM 5407		
SUPV. MC	ENGINEERING STANDARD	SUPERSEDES
DSGN. SA, AA	CONCRETE EXPANSION ANCHORS FOR STATIC AND SEISMIC LOADING	SUPERSEDED BY
DWN. JF	DEPARTMENT OF ENGINEERING	SHEET NO. 1 OF 4 SHEETS
CHKD. BC	PACIFIC GAS AND ELECTRIC COMPANY	DRAWING NUMBER 054162 REV. 3
O.K. MC	SAN FRANCISCO, CALIFORNIA	MICROFILM
DATE 4-17-73 SCALE NONE		

A.2.9 For anchors which will be subjected simultaneously to pullout and shear forces, the allowable load values used must satisfy the following formula (Figure 1):

$$\left(\frac{P_C}{P_D}\right)^{5/3} + \left(\frac{S_C}{S_D}\right)^{5/3} \leq 1$$

Where P_D, S_D = allowable loads (pullout, shear), reduced for spacing or edge distance if appropriate

P_C, S_C = allowable loads to be used in cases where pullout and shear loads may occur simultaneously

Note: For convenience in calculation, exponents in the above formula may, conservatively, be reduced to 1.0.

TABLE A
ALLOWABLE LOAD (KIPS) ON EXPANSION ANCHORS

NOMINAL DIAMETER (INCH)	CONCRETE STRENGTH, fc'									
	2 ksi		3 ksi		4 ksi		5 ksi		6 ksi	
	P	S	P	S	P	S	P	S	P	S
1/4	.25	.30	.275	.30	.30	.30	.325	.30	.35	.30
3/8	.40	.54	.50	.60	.60	.67	.70	.73	.80	.80
1/2	.70	.74	.87	.89	1.05	1.04	1.23	1.19	1.40	1.34
5/8	1.20	1.00	1.50	1.25	1.80	1.50	2.10	1.75	2.40	2.00
3/4	1.60	1.50	2.35	1.80	2.90	2.10	3.45	2.40	4.00	2.70
7/8	2.50	2.00	3.35	2.35	4.20	2.70	5.05	3.05	5.90	3.40
1	3.30	2.50	4.30	2.90	5.50	3.30	6.60	3.70	7.70	4.10
1 1/4	5.30	3.40	6.65	3.95	8.00	4.50	9.35	5.10	10.70	5.70

NOTE: P, PULLOUT; S, SHEAR
For expansion anchors installed in lightweight aggregate concrete, assume f'c = 2 ksi. See par. A.2.6.

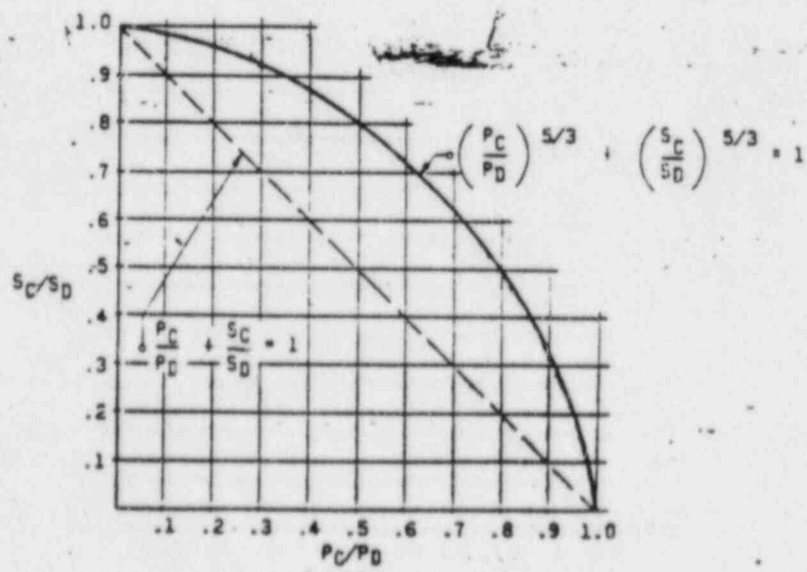


FIGURE 1
REDUCTION FACTORS FOR COMBINED PULLOUT AND SHEAR

CONCRETE EXPANSION ANCHORS FOR STATIC AND SEISMIC LOADING	PG&E CO.	DRAWING NUMBER	REV.
	SHEET 2 OF 4 SHEETS	054162	3
		MICROFILM	

8. INSTALLATION

8.1.0 APPLICATIONS

8.1.1 Provisions of this standard shall apply to the following concrete expansion anchors. Other expansion anchors shall not be used without specific authorization of the Engineer.

SHELL ANCHORS: • PHILLIPS SELF-DRILLING, PHILLIPS NONDRILLING, DIAMOND, HILTI HDI, RAWL SABER-TOOTH.

STUD ANCHORS: • KWIK-BOLT, PARABOLT, PHILLIPS WEDGE, PHILLIPS SLEEVE, WEJ-IT ANKR-TITE.

• PHILLIPS STUD ANCHOR may be used in sizes up to 3/4" diameter.

• WEJ-IT (original style, with spade-shape wedges) may be used, provided embedment is 125% of that shown in Table B, with 50% of the allowable load values shown in Table A.

8.1.2 Anchors must be at least 1/2" diameter when used for structural connections or for anchorage of pipes, conduits or ducts greater than 2" diameter.

8.1.3 Anchors shall not be installed in prestressed concrete elements nor used to connect concrete elements which must have a specific value of fire resistance.

8.2.0 INSTALLATION

8.2.1 Installation of anchors shall be according to manufacturer's instructions as to tools, torque and tightening procedure.

8.2.2 If a hole cannot be drilled to the correct depth (e.g., if reinforcing steel is encountered while drilling), a new hole shall be drilled. There shall be at least 1/2" of sound concrete between abandoned hole and new hole. If an unused hole is within 4.5 nominal diameters of an expansion anchor, center to center, the unused hole shall be filled with grout or with an expanded anchor.

8.2.3 If axis of a drilled hole deviates from normal to concrete surface by more than 5° the hole shall not be used unless specifically authorized by the Engineer.

8.2.4 Minimum required embedment, for shell type anchors, is equal to the length of shell. For most shell anchors the shell may be recessed not more than 1/4 of the nominal diameter. Installed shells recessed to greater depths shall not be used unless specifically authorized by the Engineer.

Minimum required embedment for stud type anchors is given in Table B.

Embedment length is exclusive of thickness of any grout pad or other overlay.

8.2.5 Anchors shall be installed according to manufacturer's instructions. If, after starting from finger-tightened position, anchor slips more than 10% of minimum required embedment while being tightened, one of the following remedial actions shall be taken:

a. Remove bolt or nut, reset anchor, repeat tightening;

b. Remove anchor, substitute larger diameter or longer anchor;

c. Drill new hole and install additional anchor which satisfies the requirements of this standard.

8.2.6 Anchor spacing, center to center, shall be not less than 6 times nominal diameter of anchor nor shall edge distance be less than 3 times nominal diameter nor less than 3 inches unless specifically authorized by the Engineer.

8.2.7 If edge of concrete is chamfered, edge distance shall be measured from nearest edge of chamfer.

8.3.0 PROOF LOADING

When required by the Engineer, proof loading shall be done according to the following instructions:

8.3.1 Whenever an installation crew starts installing anchors at a job site, each of the anchors installed by that crew shall at first be proof loaded in tension to 250% of the allowable pullout load designated by the Engineer. After five successive anchor installations have been completed without failure, a random selection of 10% of the anchors of each size installed by the crew thereafter on the same project shall be tested in the above manner.

8.3.2 If proof loading is done by jacking against a surface area of concrete surrounding the anchor, the jacking pressure shall be distributed over an annular area of inner diameter at least 3 times the minimum required embedment given in Table 8.

8.3.3 Criteria for failure of an anchor during proof loading are:
(1) concrete cracks, (2) anchor breaks, or (3) anchor slip during the test is greater than 5% of the minimum required embedment.

TABLE 8

MINIMUM EMBEDMENT REQUIRED FOR STUD-TYPE

EXPANSION ANCHORS INSTALLED IN CONCRETE

Nominal Diameter (Inches)	Minimum Embedment (Inches)
1/4	1-1/8
3/8	1-3/4
1/2	2-1/4
5/8	2-7/8
3/4	3-3/8
7/8	4
1	4-1/2
1-1/4	5-5/8

DISCREPANCY REPORT

9.

[illegible] No. 8802

Cont./Supp. H.P. Foley Cont./Supp.I.D. No. ________ PG&E No. 288 R1

INSPECTION SECTION

Discrepant Item: Unit I & II
H.P. Foley installed concrete wedge stud anchor bolts.

Explanation of Discrepancy: H.P. Foley Company ordered and installed some concrete anchor bolts which were too short to meet minimum embedment criteria of the installation drawings.

Robert J Thompson Jr — Field Engr./Inspector — 4-19-77 Date

CLASSIFICATION & DISPOSITION Minor Variation [ ] Deviation [X]

Disposition: see attached.

The following members of the Material Review Board concur with the above Disposition: (For Minor Variations, only Resident Engineer's signature required.)

INDEXED RMS

Robert J Thompson Jr — Resident Engineer — 4-20-77 Date

Don Day — Name — 4/21/77 Date | [signature] — Name — 4/21/77 Date

[signature] — Name — JUN 14 1977 Date | E.W. Vollak — Name — 6/27/77 Date

E.W. Lynch — Responsible Engineer — 6/16/77 Date | [signature] — Supervising Engineer — 6/16/76 Date

DISPOSITION ACCOMPLISHED

Remarks: N.A.

________ Field Engineer/Inspector ________ Date

STEPS TO PREVENT RECURRENCE (Deviations Only)

The majority of the improperly installed anchor bolts were installed prior to implementation of installation procedures by the H.P. Foley Company. This procedure is now in effect.

R.J. Thompson / DOR — Resident Engineer — 6-22-77 Date

Copies		Attachments
Coor.Q.C. Engr.	Dir.-Q.A.	WA-1
Proj. Super.	Resp. Engr.	E-72 -1/2"
Resident Engr.	Proj. Engr.	E-72 -3/8"
Q.A.-Site	Supv.Insp.Engr.(G.O.)	

Report Completed

Don Day — Coordinating QC Engineer — 7/6/77 Date

Discrepancy Report
DR-288

Explanation of Discrepancy: A test was performed (Electrical Department Test Procedure WA-1) to determine the minimum embedment required to meet design loading by H.P. Foley Company installed electrical raceway and equipment supports. The maximum design loadings for various sized anchors was determined by multiplying the Table A values in 054162 by 1.66 by the direction E.P. Wollak, Supervising Civil Engineer. As a result of test WA-1 it was determined that embedments of 1 1/8" for 3/8" anchors and 1 1/2" for 1/2" anchors would give adequate pull out strengths.

A field inspection was made of 508 1/2" anchors and 514 3/8" anchors to determine embedment. As part of the inspection the nuts were removed from the studs and the exposed studs were measured. During this inspection no stud anchors were found to have embedments less than the values determined in WA-1. Upon reinstalling the nuts on the studs and torquing the nuts, five 1/2" and two 3/8" stud anchors were discovered not to be set in the concrete. In further torquing two of the 1/2" and both of the 3/8" studs set with adequate embedment after some slippage. Three of the 1/2" anchors were pulled out of the wall and later replaced by H.P. Foley in accordance with their installation procedures.

1/2" and 3/8" stud anchors were inspected because these sizes represent well over 99% of the stud anchors used for raceway support.

Disposition: Accept as is.
An inspection of a representative sample of installed stud anchors shows that less than 1% are improperly installed. A vast majority of the stud anchors installed by H.P. Foley are installed with embedments exceeding those required in 054162. This and the conservation of the raceway support design means that it is unlikely that the failure of one anchor in a support would cause the support to fail. It is extremely unlikely that the small number of improperly installed stud anchors would lead to failure of mutually redundant circuits.

INSPECTION REPORT

Date 4-12-77 | Discrepancy Report No. DR-288

Description of Work to be performed:

Inspect embedment of 3/8 inch wedge stud anchors.

Inspection Hold Points:

Determine stud length using ultrasonic transducer. Measure stud length exposed from concrete. Calculate stud enbedment. Accept enbedments of 1 1/8 inch or more. Reject enbedments less than 1 1/8 inch.
NOTE: Any 3/8" stud anchor with less than 1 inch exposed will be acceptable and it is not necessary to measure stud length ultrasonicly. Mark acceptable studs with green paint. Mark rejected studs with red paint.
Inspect 500 anchors.

Inspector assigned B. Whited Inspection plan approval R J Thompson Jr.
Resident Engineer

Summary of Inspection Results:

See attached

Inspected by: [signature] Date 4/15/77

Repair work completed by: N/A Date

Approved by: R J Thompson Date 4/18/77

E-72 (Rev. 3-25-77)

Summary of Inspection Results (Continued)

Results of Inspection of 3/8 inch wedge stud anchors

514 bolts were inspected per DR 288 and the following listing of amounts and location were found to be acceptable by visual measurement criteria:

Amount	Area	Elevation
69	D	85
42	C	85
42	B	85
24	B	82
6	A	below 85
44	FE-FW	85
10	K	100
26	K	73
65	H	128
60	H	115
60	H	100
448		

The following list shows amounts and location of studs that were inspected with an ultrasonic measuring device and were acceptable:

Amount	Area	Elevation
3	D	85
2	C	85
2	B	82
5	FE-FW	85
2	GW	115
4	K	100
9	K	73
3	K	64
13	K	below 64
15	H	128
5	H	115
1	H	100
64		

2 suspect studs on K6679, when nuts were torqued to specs. (25 pounds), pulled out of concrete two inches. When checked ultrasonically it was noted that they were 3 1/2 inch studs and the enbed was acceptable. However, with that much stud out of the concrete, it required two washers for spacers between clamp and threads in order to tighten nuts.

Additionally; visual inspection of acceptable anchor bolts, by measuring thread length, indicated that the enbed of these bolts exceeded 1 1/2". The ultrasonic tests showed that, in all but the two above mentioned bolts, the enbed was two inches or more.

INSPECTION REPORT

Discrepancy Report No. DR-288

ate April 8, 1977

escription of Work to be performed:

Inspect inbedment of 1/2 inch wedge stud anchors. Check 500 anchors at random in various locations in the plant.

nspection Hold Points:

Measure exposed length. If exposed length is less than or equal to 1¼" then accept. If greater than 1¼ then measure thread length. If thread length 1 1/8 then reject. If thread length 1¼" and exposed length is 2¼" accept. If exposed length is between 2¼ and 2 3/4 reject. Between 2 3/4 and 4" accept. Reject 4".

(see attached)

Inspector assigned C. Holmes Inspection plan approval Robert J. Thompson
Resident Engineer

Summary of Inspection Results:

See attached.

Inspected by: C. R. Holmes Date 4/11/77

Repair work completed by: N/A Date

Approved by: R. J. Thompson Date 4/16/77

(Rev. 3-25-77)

INSPECTION REPORT DR-288
(Continued)

Exposed length	Thread Length	Accept/Reject
≤1¼"	-	Accept
>1¼"	1 1/8	Reject
≤2¼"	1 1/4	Accept
2 3/4>EL>2¼	1 1/4	Reject
4 ≥ El≥2 3/4	1 1/4	Accept
>4	1 1/4	Reject

Paint end of acceptable studs green, rejected red. Note the location of all rejected studs.

SUMMARY OF INSPECTION RESULTS (Continued)

508 wedge stud anchors were inspected, at random, in the following amounts by area and elevation:

Amount	Area	Elevation
9	H	128
41	A	85
1	B	85
80	K	115
43	K	100
41	K	85
41	K	73
43	F&G	117
124	GW	115
70	GE	115
15	GE	100
508		

DISCREPANCIES:

2 - 2 3/4" x 1/2" wedge stud anchors were found in area GW, Elev. 117' on J wall between 15 15^7 lines that pulled out to 1 3/4" before setting up.

1 - 2 3/4" x 1/2" wedge stud anchor was found in Diesel Gen 1-3 room at approx. 88', over s. compressor, that pulled out same as above.

1 - 2 3/4" x 1/2" wedge stud anchor was found in Diesel Gen. 1-3 room at approx. 88' over n. compressor, that would only spin in hole. The threads were damaged on this stud and a thread chaser was used to clean up threads, when nut was replaced and tightened the stud set up to torque spec's with acceptable enbed.

1 - 2 3/4" x 1/2" wedge stud anchor on right upper support for LPH65C (n. wall dsl. gen. 1-3 rm) pulled out of wall as nut was tightened. This happened to be the first suspect stud we came across and nut was not tightened to see how far stud would move before setting tight. After experiencing some similar situations we returned to this stud, tightened it to torque set and found it to have an acceptable enbed.

TEST PROCEDURE WA-1

CONCRETE WEDGE ANCHORS

PURPOSE:

Determine the minimum embedment required to meet design loading required by H.P. Foley Company installed electrical raceway and equipment supports.

SCOPE:

This procedure will provide data to develop acceptance criteria for concrete anchors for the following conditions in nominal 3,000 PSI and 5,000 PSI design concrete: (1.) effects at various stages of less than minimum embedment and (2.) angular misalignment.

MATERIAL SPECIFICATION:

Anchors, drills and drill bits, of proper size and type, from regular construction supplies normally used for installation. During this test Hilti Kwik Bolts and Phillips Red Head Wedge Anchors will be tested.

Concrete test slab to be selected from an area on the construction site of the concrete strength noted in Table 1A:

TABLE OF CHANGES

No.	DATE	DESCRIPTION	BY	APPD.
0	3-4-77	Original Typing	cwn	RJ
1	3-29-77	General Revision	RJ	RJ

INSTALLATION PROCEDURE:

1. Anchors are to be installed in predrilled holes of the depth and diameter for each anchor as listed in Table 1A. After the hole is drilled, it must be cleared of all loose material. Minimum anchor spacing to be no less than 12X normal hole diameter.

2. Insert anchor to a sufficient depth that the expanded anchor, by tightening to the torque value shown on Table 1A, is within 1/16" of the depth specified in Table 1A.

3. Measure the exposed anchor length. Record in exposed length column in Table 1A.

TEST PROCEDURE:

1. Position test fixture over embedded anchor and connect to anchor with threaded rod of required size. (Reference Figure 1) Anchors will be pulled perpendicular to the concrete unless otherwise noted in the remarks column.

2. Position dial indicator to detect anchor movement. The dial indicator extension rods shall be attached on the threaded part of the anchor.

3. Increase hydraulic pressure until the dial indicator detects movement of the anchor. Record hydraulic pressure in applicable column on Table 1B.

4. Continue increasing hydraulic pressure until one of the following conditions exist:

   a. the anchor has slipped greater than 5% of minimum embedment

   b. the concrete cracks

   c. the hydraulic pressure reaches the equivalent of 1.66 times (or greater) the force specified in P G & E drawing 054162 for the appropriate concrete strength.

   d. the anchor breaks.

CAUTION: Particular care should be taken when using the dial indicator on shallow set anchors so that a quick release will not damage the dial indicator.

5. Vent hydraulic pressure and remove test apparatus.

6. Using Figure 2, "Cylinder Force vs. Hydraulic Pressure," determine load applied to anchor at which anchor failure is detected. Record the force in the applicable column on Table 1B. (Figure 2 was developed using Hydraulic Jack listed below and a calibrated gauge. See Procedure for Establishing Acceptance Criteria For Concrete Anchor Installations. Prepared by Thomas E. Niemi, 12-10-76.)

TEST EQUIPMENT

The test fixture consists of a base, support structure, hydraulic cylinder with a hollow ram, pressure gauge, hand operated hydraulic pump, hydraulic hose, threaded rods and long nuts of required size to fit anchors. (See Figure 1.)

Also a dial indicator with a magnetic base and various accessories to measure anchor movement.

Hydraulic Jack - Enerpac 20 Ton, Model RCH-202, OGI.

Pressure Gauge - Ashcroft 2,000 PSIG Duragauge.

TEST NO.	ALLOW. MOVEMENT	GAUGE PRESS. AT INITIAL MOVEMENT	GAUGE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	GAUGE PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
1	.113	450	450	.001	P				
			500	.002					
			550	.002					
			600	.005					
			650	.008					TEST DISCONTINUED
2	.113	530	550	.002	P				
			600	.006					
			650	.010					TEST DISCONTINUED
3	.113	420	650	.025	P				
			700	.034					
			750	.039					
			800	.050		810	2990	concrete	
4									NO SET
5	.113	440				460	1600	concrete	
6									NOT TESTED
7	.113	200	250	.002					
			300	.003					
			350	.004					
			400	.005					
			425	.012	✓				
			450	.025	F	450	1575	concrete	

T.P.# 1!/-1 REV. 1

TESTED BY C Needham DATE 2-20-77

[illegible]	[illegible]	AT INITIAL [illegible]	AT ANCHOR SET	AT SET (INCHES)	[illegible] OR FAIL	AT FAILURE (PSI)	FAIL FORCE (LBS.)	[illegible]	REMARKS
8	.113	200	250	.003					
			300	.005					
			350	.008					
			400	.014					
			425	.050	F	425	1500	concrete	
9									NO TEST
10									NO TEST
11									NO TEST
12									NO TEST
13	.113	400	425	.003	✓				
			450	.004	P				
			500	.005					
			550	.008					
			600	.020					
				NO SET		650	2350	concrete	
14	.113	360	400	.005	✓				
			450	.010	P				
				NO SET		500	1775	concrete	
15	.113	400		.030 NO SET	F	590	2155	concrete	

TESTED BY C Needham DATE 3-29-77

T.P. [illegible] REV. 1
PAGE 4b/ OF 6

NO.	[illegible] MOVEMENT	[illegible] AT INITIAL MOVEMENT	[illegible] AT ANCHOR SET	[illegible] AT SET (INCHES)	[illegible] OR FAIL	[illegible] AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
16	.113	500	500	.001	P				
			550	.002					
			600	.006					
			650	.010					
			700	.020					TEST DISCONTINUED
17	.113	300	425	.007	✓				
			450	.009	P				
			500	.010					
			550	.013					
			600	.017		650	2350	concrete	
18	.113	250	425	.020	✓				
			450	.020	P				
			500	.030					
				.060 NO SET		550	1975	concrete	
19	.113	350	425	.009	✓				
			450	.010	P				
			500	.011					
			550	.015					
			600	.018					
CONT.									

TESTED BY C Needham DATE 3-29-77

T.P. 1E 1/-1 REV. 1

PAGE 4 of 6

No.	RIVET DIA.	AT INITIAL INSERT	AT ANCHOR SET	AT SET (INCHES)	PASS OR FAIL	AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
19			650	.024					
			700	.030@3min					TEST DISCONTINUED
20	.113	300	425	.008	✓				
			450	.009	P				
			500	.010					
			550	.016					
			600	.025					
			650	.040					
			700	.060@5min					TEST DISCONTINUED
21	.113	290	300	.002	✓				
			350	.003	✓				
			400	.004	✓				
			450	.005	P				
			500	.008					
			550	.010					
			600	.014					
			650	.020@3min					TEST DISCONTINUED
22	.113	425	425	.001	✓				
			450	.001	P				
			500	.002					
Cont									

TESTED BY C Needham DATE 3-29-77

T.P. 1[st] W-1 REV. 1
PAGE 4d [illegible]

NO.	ALLOWABLE MOVEMENT	AT INITIAL MOVEMENT	AT ANCHOR SET	AT SET (INCHES)	PASS OR FAIL	AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
22	.113		550	.002					
			600	.004					
			650	.008@2min					
23	.113	450	625	.028	P				Axis@19°
			650	.031@3min					
24	.113	350	625	.027	P				Axis@21°
			650	.033@3min					
25	.113	.480	625	.027	P				Axis@20°
			650	.027@3min					
26	.113	330	600	.020	P				Axis@20°
			625	.025					
			650	.030@3min					
27	.113	475	500	.004	P				
			550	.005					
			600	.006					
			650	.012					
			700	.021					
			750	.030					
			800	.040					
			850	.046					
Cont.									

TESTED BY C Needham DATE 3·30-77

T.P. 1E IV-1 REV. 1
PAGE 4e1 OF 6

NO.	MOVE	AT INITIAL MOVEMENT	AT ANCHOR SET	AT SET (INCHES)	OR FAIL	AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
27			900	.059					
			950	.064					
			1000	.071					DISCONTINUED TEST
28									NO TEST
29									NO TEST
30									NO TEST
31									NO TEST
32									NO TEST
33	.113	425	425	.003	✓				
			450	.005	P				
			500	.007					
			550	.010					
			600	.020					
			650	.028					
			700	.038					
			750	.050					
			800	.060					
			850	.070					
			900	.085					
			950	.099					
			1000	.102					DISCONTINUED TEST

TESTED BY C Needham DATE 3-30-77

T.P. 1E 17-1 REV. 1
PAGE 461 OF 6

...O.	ALLOWABLE MOVEMENT	... AT INITIAL MOVEMENT	... AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	... AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
...4									NO TEST
...5	.113	360	425	.002	✓				
			450	.002	P				
			500	.004					
			550	.009		600	2175	concrete	
...6	.113	250	425	.008	✓				
			450	.008	P				
			500	.009		550	1975	concrete	
...7	.113	360	425	.008	✓				
			450	.009	P				
			500	.012					
			550	.018					
			600	.027					
			650	.035					
			700	.048					DISCONTINUED TEST
...8	.113	280	425	.002	✓				
			450	.002	P				
			500	.003					
			550	.004					
			600	.007					
			650	.014		700	2550	concrete	

TESTED BY C Needham   DATE 3-31-77

O.	ALLOWABLE MOVEMENT	AT INITIAL MOVEMENT	AT ANCHOR SET	AT SET (INCHES)	OR FAIL	AT FAILURE (PSI)	FAIL FORCE (LBS.)		REMARKS
9									NO TEST
0	-.113	450	450	.001	✓				
			500	.003	P				
			550	.005					
			600	.008					
			650	.010					
			700	.014					
			750	.019					DISCONTINUED TEST
1									NO SET
2	.088	270	300	.001	✓				
			325	.001	✓				
			350	.002	P				
			375	.002					
			400	.002					
			425	.003					
			450	.004					
			475	.005					
			500	.010					
			525	.010					DISCONTINUED TEST AFTER 3 MIN OF SET
			550	.015					

TESTED BY C Needham DATE 3-31-77

T.P. # 11-1 REV. 1
PAGE 4 b1 OF 6

	ALLOWABLE MOVEMENT	CABLE PRESS. AT INITIAL MOVEMENT	CABLE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
3									NO TEST
4	.088	500	500	.001	P				
			525	.002					
			550	.002					DISCONTINUED TEST
5									NO TEST
6.									NO TEST
7	.088	110	270	.015	✓				
			300	.016	P				
			325	.020					
			350	.024					
			375	.035					
			400	.052		400	1400	concrete	FAILED AFTER 5 MIN
8	.088	120	270	.022	✓				
			300	.023	P				
			325	.028					
			350	.045		350	1200	concrete	FAILED AFTER 5 MIN
9	.088	240	270	.006	✓				
			300	.007	P				
			325	.008					
			350	.009					

TESTED BY C Needham DATE 3-31-77

T.P. 1st [illegible]-1 REV. 1

[illegible]	ALLOWABLE MOVEMENT	CABLE PRESS. AT INITIAL MOVEMENT	CABLE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	[illegible] PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
9			375	.012					
			400	.019					
			425	.032					
			450	.050		450	1575	concrete	
0	.088	240	270	.001	✓				
			300	.001	P				
			325	.002					
			350	.003					
			375	.003					
			400	.006					
			425	.020		425	1500	concrete	
51	.088	190	270	.003	✓				
			300	.003	P				
			325	.003					
			350	.004					
			375	.006					
			400	.007					
			425	.0209		425	1500	concrete	

TESTED BY C Needham DATE 4-1-77

T.P.# IW-1 REV. 1
PAGE 4 [illegible] OF 6

	TOVER	AT INITIAL INSERTION	AT ANCHOR SET	AT SET (INCHES)	OR FAIL	AT FAILURE (PSI)	FAIL FORCE (LBS.)		REMARKS
52	.088	325	325	.001	P				
			350	.002					
			375	.004					
			400	.005					
			425	.007					
			450	.025		450	1575	concrete	
53	.088	140	270	.019	✓				
			300	.021	P				
			325	.025					
			350	.027					
			375	.030					
			400	.035					
			425	.038					
			450	.042					
54	.088	160	270	.001	✓				
			300	.001	P				
			325	.002					
			350	.003					
			375	.005					
			400	.007					
CONT									

TESTED BY C Needham DATE 4-1-77

T.P. IV-1 REV. 1
PAGE 4K1 OF 6

[illegible]	ALLOWABLE MOVEMENT	GAGE PRESS. AT INITIAL MOVEMENT	GAGE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	[illegible] PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
4			425	.010					
			450	.013					DISCONTINUED TEST
5	.088	160			F	270	830	concrete	INSPECTION OF CONCRETE SHOWED CRACK
6	.056	200	200	.003	P	225	700	concrete	
7	.056	200	200	.001	P				
			225	.002					
			250	.005					
			275	.014		275	900	concrete	
8	.056	200	200	.002	P				
			225	.003		250	800	concrete	
9	.056	200	200	.003	P				
			225	.004					
			250	.017		275	900	concrete	
0									NO TEST
1	.144	190	685	.062	✓				
			700	.067	P				
			750	.085					
			800	.105		850	3125	concrete	
2	.144	160	685	.040@5min	✓				
			700	.048@3min	P				
			750	.060@3min					

TESTED BY C Needham DATE 4-8-77

T.P. # VA-1 REV. 1

NO.	MOVEMENT	AT INITIAL MOVEMENT	AT ANCHOR SET	AT SET (INCHES)	OR FAIL	AT FAILURE (PSI)	FAIL FORCE (LBS.)		REMARKS
62			800	.092@4min		820	3020	concrete	
63	.088	170			F	170	520	concrete	
64	.088	110	270	.027@1min	✓				
			300	.029@2min	P				
			325	.032@1min					
			350	.047@4min		375	1300	concrete	
65									NO TEST
66									NO TEST
67	.088	180	270	.004	✓				
			300	.006@1min	P				
			325	.006@1min					
			350	.011@2min					
			375	.017@1min					
			400	.027@2min					
			425	.040@1min		450	1575	concrete	
68									NO TEST
70	.088	100			F	240	790	concrete	
71	.088	140	270	.012@1min	✓				
			300	.013@2min	P				
			325	.014@2min					
CONT			350	.015@1min					

TESTED BY C Needham DATE 4-8-77

T.P.# W-1 REV. 1
PAGE 4ml OF 6

T NO.	ALLOWABLE MOVEMENT	PRESS. AT INITIAL MOVEMENT	AT ANCHOR SET	AT SET (INCHES)	OR FAIL	AT FAILURE (PSI)	FAIL FORCE (LBS.)		REMARKS
1			375	.016 @ 1 min					
			400	.017 @ 2 min					
			425	.019 @ 2 min					
			450	.021		450	1575	concrete	
9	.088	400	400	.004 @ 2 min	P				
			425	.010 @ 3 min					
			450	.017 @ 2 min					

TESTED BY C Neel Fram DATE 4-8-77

T.P.# W-1 REV. 1

ANCHOR DIAMETER, LENGTH & MFG.	TEST NO.	TEST EMBEDMENT	EXPOSED LENGTH	ACTUAL EMBEDMENT	MAXIMUM TEST PRESS. (PSI)	CONCRETE STRENGTH (KSI)	INSTALLATION SET TORQUE (FT. LBS.)	AXIS OF ANCHOR TO SLAB	HOLE DEPTH	REPAIR
1/2" x 3 3/4" Hilti	1		2 1/4"	1 1/2"	425	3	45	<5°	1 11/16	
	2		2 7/16"	1 5/16"					1 9/16	
	3		2 3/8"	1 3/8"					1 5/8	
	4		NO SET	✓					1 1/4	
	5		2 11/16"	1 1/16"					1 5/16	
	6		2 3/4"	1"					1 1/4	
	7		2 11/16"	1 1/16"					1 3/8	
	8		2 5/8"	1 1/8"					1 3/8	
	9		2 11/16"	1 1/16"					1 3/8	
	10		2 3/8"	1 3/8"					1 9/16	
	11		2 5/8"	1 1/8"					1 1/2	
	12		2 3/8"	1 3/8"					1 1/2	
	13		2 1/2"	1 1/4"					1 7/16	
	14		2 1/2"	1 1/4"					1 1/2	
	15		2 1/2"	1 1/4"					1 7/16	
	16		2 1/4"	1 1/2"					1 3/4	
	17		2 5/16"	1 7/16"					1 11/16	
	18		2 5/16"	1 7/16"					1 11/16	
	19		2 1/16"	1 11/16"					1 15/16	
	20		2 5/16"	1 7/16"					1 15/16	
1/2" x 3 3/4" Hilti	21		2 1/16"	1 11/16"	425	3	45	<5°	1 7/8	

T.P.# 1A-1 REV. 1

TESTED BY C Needham DATE 3-29-77

ANCHOR DIAMETER, LENGTH & MFG.	TEST NO.	TEST EMBEDMENT	EXPOSED LENGTH	ACTUAL EMBEDMENT	MAXIMUM TEST PRESS. (PSI)	CONCRETE STRENGTH (KSI)	INSTALLATION SET TORQUE (FT. LBS.)	AXIS OF ANCHOR TO SLAB	HOLE DEPTH	REMARK
" x 3 3/4" Hilti	22		2 1/16	1 11/16"	425	3	45	<5°	1 15/16"	
	23		2 1/4"	1 1/2"				19°	1 11/16"	
	24		2 3/16"	1 9/16"				21°	1 3/4"	
	25		2 1/16"	1 11/16"				20°.	1 15/16"	
	26		1 15/16"	1 13/16"				20°	2"	
	27		1 15/32"	2 9/32"				<5°	2 7/16"	
	28		1 5/8"	2 1/8"					2 13/32"	
	29		1 5/16"	2 7/16"					2 21/32"	
	30		1 3/8"	2 3/8"					2 11/16"	
	31		1"	2 3/4"					2 15/16"	
	32		1"	2 3/4"					2 15/16"	
	33		1 7/16"	2 5/16"					2 1/2"	
1/2" x 3 3/4" Hilti	34		1 7/32"	2 17/32"					2 11/16"	
1/2" x 4 1/4" Red-head	35		3 1/16"	1 3/16"					1 7/16"	
	36		3 1/8"	1 1/8"					1 7/16"	
	37		2 13/16"	1 7/16"					1 21/32"	
	38		2 13/16"	1 7/16"					1 21/32"	
	39		2 1/2"	1 3/4"					1 15/16"	
1/2" x 4 1/4" Red-head	40		2 5/8"	1 5/8"	425	3	45	<5°	1 29/32"	

T.P. # PA-1 REV. 1

TESTED BY [illegible signature] DATE 2-20-77

ANCHOR ...METER, LENGTH & MFG.	TEST NO.	TEST EMBEDMENT	EXPOSED LENGTH	ACTUAL EMBEDMENT	... TEST PRESS. (PSI)	... STRENGTH (KSI)	... SET TORQUE (FT. LBS.)	... ANCHOR TO SLAB	... DEPTH	
3/8" x 3 1/2" Hilti	41		NO SET	✓	270	3	25	<5°	1 3/8"	
	42		2 1/4"	1 1/4"					1 5/8"	
	43		2 1/8"	1 3/8"					1 11/16"	
	44		2 3/16"	1 5/16"					1 11/16"	
	45		2 9/16"	15/16"					1 1/4"	
	46		2 1/8"	1 3/8"					1 3/4"	
	47		2 5/16"	1 3/16"					1 3/8"	
	48		2 5/16"	1 3/16"					1 7/16"	
	49		2 3/8"	1 1/8"					1 11/32"	
3/8" x 3 1/2" Hilti	50		2 3/8"	1 1/8"					1 3/8"	
3/8" x 5" Red-head	51		4"	1"					1 5/16"	
	52		4"	1"					1 5/16"	
	53		3 7/8"	1 1/8"					1 7/16"	
	54		3 13/16"	1 3/16"					1 1/2"	
3/8" x 5" Red-head	55		3 7/8"	1 1/8"	270		25		1 7/16"	
1/4" x 2 1/4" Hilti	56		1 7/16"	13/16"	160		10		1 1/16"	
	57		1 1/2"	3/4"					1"	
	58		1 1/2"	3/4"					1 1/8"	
	59		1 3/8"	7/8"					1 1/8"	
1/4" x 2 1/4" Hilti	60		1 1/4"	1"	160	3	10	<5°	1 3/16"	

TESTED BY C Needham DATE 4-1-77

T.P.# 1'A-1 REV. 1

ANCHOR DIAMETER, LENGTH & MFG.	TEST NO.	TEST EMBEDMENT	EXPOSED LENGTH	ACTUAL EMBEDMENT	MAXIMUM TEST PRESS. (PSI)	CONCRETE STRENGTH (KSI)	INSTALLATION SET TORQUE (FT. LBS.)	AXIS OF ANCHOR TO SLAB	HOLE DEPTH	REPAIR
1/8" x 4 1/2" Hilti	61		2 7/8"	1 5/8"	685	3	60	<5°	1 15/16"	
1/8" x 4 1/2" Hilti	62		2 7/8"	1 5/8"	685		60		1 7/8"	
1/8" x 3 1/2" Hilti	63		2 9/16"	15/16"	270		45		1 1/4"	
	64		2 7/16"	1 1/16"					1 5/16"	
	65		2 5/16"	1 3/16"					1 3/8"	
	66		2 5/16"	1 3/16"					1 7/16"	
	67		2 3/8"	1 1/8"					1 5/16"	
	68		2 1/4"	1 1/4"					1 3/8"	
	69		2 3/8"	1 1/8"					1 5/16"	
	70		2 1/2"	1"					1 1/4"	
3/8" x 3 1/2" Hilti	71		2 13/32"	1 3/32"	270	3	45	<5°	1 3/8"	

T.P.# MA-1 REV. 1

TESTED BY C. Needham DATE 4-8-77

NO.	MOVEMENT (INCHES)	AT INITIAL MOVEMENT	AT ANCHOR SET	AT SET (INCHES)	OR FAIL	AT FAILURE (PSI)	FAIL FORCE (LBS.)		REMARKS
1	.113	200		.065 @ 7min	F	575	2075	concrete	
2	.113	330	575	.007@5min	✓				
			600	.011@4min	P				
			650	.019@5min					
			700	.045 @8min		700	2550	concrete	
3	.113	500	575	.015@2min	✓				
			600	.022@3min	P				
			650	.055@12min					
			650	.060@15min					
			700	.069@3min					
			700	.075@6min					
			700	.080@9min					
			700	.095		700	2550	concrete	
4	.113	260		.035 @5min	F	575	2075	concrete	
5	.113	350	575	.025@2min	✓				
			600	.027@2min	P				
			650	.039@4min					
			700	.115@6min		700	2550	concrete	

TESTED BY C Meedham DATE 4-4-77

T.P. 1E VI-1 REV. 1

TEST NO.	ALLOWABLE MOVEMENT (INCHES)	GAGE PRESS. AT INITIAL MOVEMENT	GAGE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	JET PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
6	.113	410	575	.048@10min	✓				
			600	.054@3min	P				
			650	.072@5min					
			700	.099@8min					
			750	.125@7min			2750	Maximum Slip	
7	.113	555	575	.001@2min	✓				
			600	.001@1min	P				
			650	.002@2min					
			700	.004@2min					
			750	.006@2min					
			800	.009@4min					
8	.113	340	575	.004@1min	✓				
			600	.005@2min	P				
			650	.008@2min					
			700	.014@2min					
			750	.024@3min					
			800	.032@3min		800	2950	concrete	

TESTED BY C. Needham DATE 4-4-77

T.P. [illegible] REV. 1

	ALLOWABLE MOVEMENT	AT INITIAL MOVEMENT	AT ANCHOR SET	AT SET (INCHES)	OR FAIL	AT FAILURE (PSI)	FAIL FORCE (LBS.)		REMARKS
[illegible]	.088	345	345	.002@1min	✓				
			375	.007@ 3min	P				
			400	.010@ 2min					
			425	.020 @ 3min					
			450	.032@ 5min					
			475	.033↑@1min		475	1700	concrete	
0	.088	275		.45↑	F	275	900	concrete	
1	.088	120	345	.020↑@5min	F	345	1162	concrete	
2	.088	280	345	.010@5min	✓				
			375	.014@5min	P				
			400	.016					
			425	.025					
			450	.030					
			475	.042↑@1min		475	1700	concrete	
13	.088	320		contineous	F	345	1162	concrete	
14	.088	60	345	.010	P				
			375	.023		400	1400	concrete	

TESTED BY C. Needham DATE 4-4-77

T.P. 1E IV-1 REV. 1

TEST NO.	ALLOWABLE MOVEMENT	AT INITIAL MOVEMENT	AT ANCHOR SET	AT SET (INCHES)	PASS OR FAIL	AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
15	.088	110	345	.007	✓				
			375	.015@6min	P				
			400	.019					
			425	.030@5min					
			450	.041					
			475	.051					
			500	.055 (set)					
16	.088	70	345	.006@4min	✓				
			375	.010@3min	P				
			400	.014@3min					
			425	.035@3min					
			450	.061@10min					
			475	.065		475	1700	concrete	
17	.088	80	345	.050	✓				
			375	.065@3min	P				
			400	.071@5min					
			425	.093@5min					
			450	.100@1min		450	1575	maximum movement	

TESTED BY C Needham DATE 4-5-77

T.P. IV-1 REV. 1

TEST NO.	ALLOWABLE MOVEMENT	GAUGE PRESS. AT INITIAL MOVEMENT	GAUGE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	GAUGE PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
18	.088	110	345	.054@10min	✓				
			375	.062@6min	P				
			400	.069@5min					
			425	.082@8min					
			450	.098@3min		450	1575	maximum movement	
19									NO TEST
20									NO TEST
21									NO TEST
22	.056	80	185	.001	✓				
			200	.001	P				
			225	.003					
			250	.007					
			275	.014		300	100	concrete	
23	.056	120	185	.002	✓				
			200	.002	P				
			225	.008					
			250	.017					
			275	.023					
			300	.030		325	1100	concrete	

TESTED BY C Needham DATE 4-8-77

T.P.# W-1 REV. 1

TEST NO.	ALLOWABLE MOVEMENT	CABLE PRESS. AT INITIAL MOVEMENT	CABLE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	CABLE PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
4	.056	175	185	.002	✓				
			200	.002	P				
			225	.004					
			250	.009@2min					
			275	.015@1min					
			300	.020@2min		325	1100	concrete	
5	.144	500			F	945	3486	concrete	
6	.144	630			F	700	2550	concrete	
7	.144	650	945	.090@3min	✓				
			1000	.110@5min	P				
			1050	.118@2min					
			1100	.130@2min		1150	4325	concrete	
28	.144	300			F	945	3486	concrete	
29	.144	400	945	.110@3min	✓				
			1000	.130	P				
			1050	.140		1100	4125	concrete	
30	.144	440	945	.139@1min	✓				
			1000	.144@1min	P				
			1050	.155@1min					
			1100	.165@1min					
CONT			1150	.175@1min					

T.P.# W-1 REV. 1

TESTED BY C Needham DATE 4-8-77

TEST NO.	ALLOWABLE MOVEMENT	CABLE PRESS. AT INITIAL MOVEMENT	CABLE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	CABLE PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
30			1200	.190@1min					
			1250	.250@1min				maximum movement	
31	.088	120	345	.007@1min	F	375	1300	concrete	
32	.088	135	345	.020@3min	✓				
			375	.021@1min	P				
			400	.022					
			425	.023					
			450	.026					
			475	.040@2min		500	1775	concrete	
33	.088	180	345	.037@4min	F	370	1280	concrete	
34									NO TEST
35									NO TEST
36	.088	220	345	.021@1min	✓				
			375	.022	P				
			400	.024					
			425	.027					
			450	.030					
			475	.034		500	1775	concrete	
37									NO TEST

TESTED BY C Needham DATE 4-8-77

T.P. 1[1] 1!-1 REV. 1

TEST NO.	ALLOWABLE MOVEMENT	GAGE PRESS. AT INITIAL MOVEMENT	GAGE PRESS. AT ANCHOR SET	DISPLACEMENT AT SET (INCHES)	PASS OR FAIL	GAGE PRESS. AT FAILURE (PSI)	TENSILE FAIL FORCE (LBS.)	TYPE FAILURE	REMARKS
8	.088	120	345	.012@1min	✓				
			375	.013	P				
			400	.014					
			425	.015					
			450	.016					
			475	.018					
			500	.020					
			525	.024@2min					
			550	.031@2min					
			575	.041@2min					DISCONTINUED TEST

TESTED BY C Needham DATE 4-8-77

T.P. 1E WA-1 REV. 1

ANCHOR DIAMETER, LENGTH & TYPE	TEST NO.	TEST EMBEDMENT	EXPOSED LENGTH	ACTUAL EMBEDMENT	MAXIMUM TEST PRESS. (PSI)	CONCRETE STRENGTH (KSI)	INSTALLATION SET TORQUE (FT. LBS.)	AXIS OF ANCHOR TO SLAB	HOLE DEPTH	REMARKS
1/2 x 3 3/4" Hilti	1		2 3/8"	1 3/8"	575	5	45	< 5°	1 19/32"	
	2		2 5/16"	1 7/16"					1 19/32"	
	3		2 3/16"	1 9/16"					1 11/16"	
	4		2 7/16"	1 5/16"					1 11/16"	
	5		2 3/16"	1 9/16"					1 11/16"	
1/2" x 3 3/4" Hilti	6		2 1/16"	1 11/16"					1 7/8"	
1/2" x 5 1/2" Red-head	7		4 1/8"	1 3/8"					1 11/16"	
1/2" x 5 1/2" Red-head	8		4 1/8"	1 3/8"	575		45		1 11/16"	
3/8" x 3 1/2" Hilti	9		2 3/8"	1 1/8"	345		25		1 1/4"	
" "	10		2 5/8"	7/8"					1 1/4"	
3/8" x 3 1/2" Hilti	11		2 3/8"	1 1/8"					1 1/4"	
3/8" x 5" Red-head	12		3 7/8"	1 1/8"					1 1/4"	
3/8" x 3 1/2" Hilti	13		2 7/16"	1 1/16"					1 1/4"	
	14		2 5/16"	1 3/16"					1 1/4"	
	15		2 5/16"	1 3/16"					1 1/4"	
	16		2 1/4"	1 1/4"					1 3/8"	
	17		2 3/16"	1 5/16"					1 3/8"	
	18		2 7/32"	1 9/32"					1 3/8"	
3/8" x 3 1/2" Hilti	19		2 1/16"	1 7/16"	345		25		1 5/8"	
1/2" x 3 3/4" Hilti	20		1 5/8"	2 1/8"	575	5	45	< 5°	2 3/16"	

TESTED BY C Needham DATE 4-4-77

T.P.# HA-1 REV. 1

ANCHOR DIAMETER, LENGTH & TYPE	TEST NO.	TEST EMBEDMENT	EXPOSED LENGTH	ACTUAL EMBEDMENT	MAXIMUM TEST PRESS. (PSI)	CONCRETE STRENGTH (KSI)	INSTALLATION SET TORQUE (FT. LBS.)	AXIS OF ANCHOR TO SLAB	HOLE DEPTH	REPAIR
1/4" x 2 1/4" Hilti	21		1 1/4"	1"	185	5	10	<5°	1 1/8"	
" "	22		1 1/2"	3/4"					1"	
1/4" x 2 1/4" Hilti	23		1 7/16"	13/16"					1"	
1/4" x 3" Hilti	24		2 3/16"	13/16"	185		10		7/8"	
5/8" x 4 1/2" Hilti	25		2 3/4"	1 3/4"	945		60		1 7/8"	
	26		2 15/16"	1 9/16"					1 3/4"	
	27		2 1/2"	2"					2 1/8"	
	28		2 1/2"	2"					2 1/8"	
	29		2 1/2"	2"					2 1/8"	
5/8" x 4 1/2" Hilti	30		2 1/4"	2 1/4"	945		60		2 3/8"	
3/8" x 3 1/2" Hilti	31		2 1/2"	1"	345		45		1 5/16"	
	32		2 3/8"	1 1/8"					1 3/8"	
	33		2 13/32"	1 3/32"					1 11/32"	
	34		2 1/4"	1 1/4"					1 13/32"	
	35		2 3/16"	1 5/16"					1 7/16"	
	36		2 3/8"	1 1/8"					1 3/8"	
	37		2 5/16"	1 3/16"					1 11/32"	
3/8" x 3 1/2" Hilti	38		2 3/8"	1 1/8"	345	5	45	<5°	1 3/8"	

TESTED BY C. Needham DATE 4-8-77

T.P. HA-1 REV. 1

PERFORMED BY: C Needham DATE: 4-20-77

APPROVED BY: Robert J Fleming Jr. DATE: 4-20-77

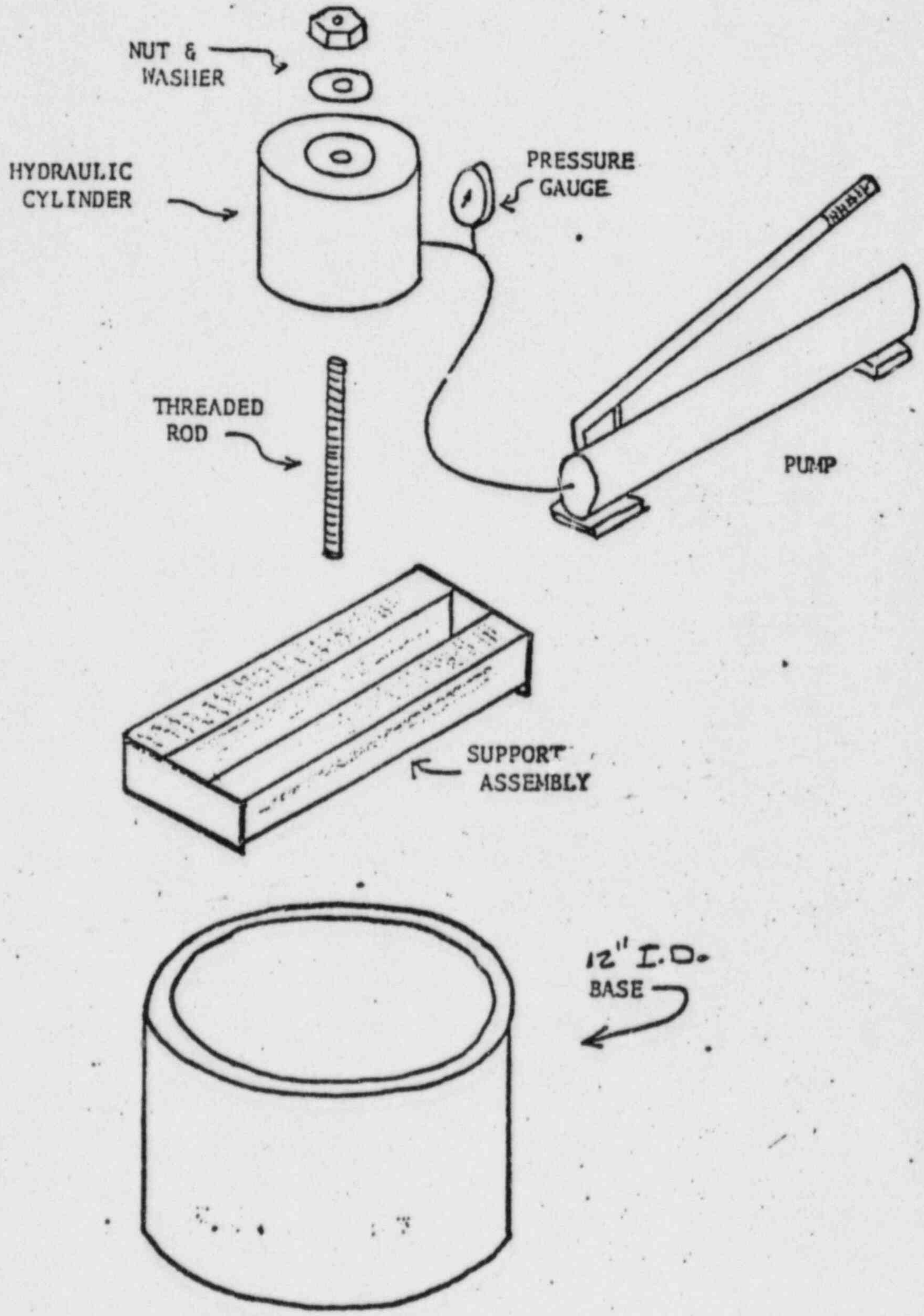
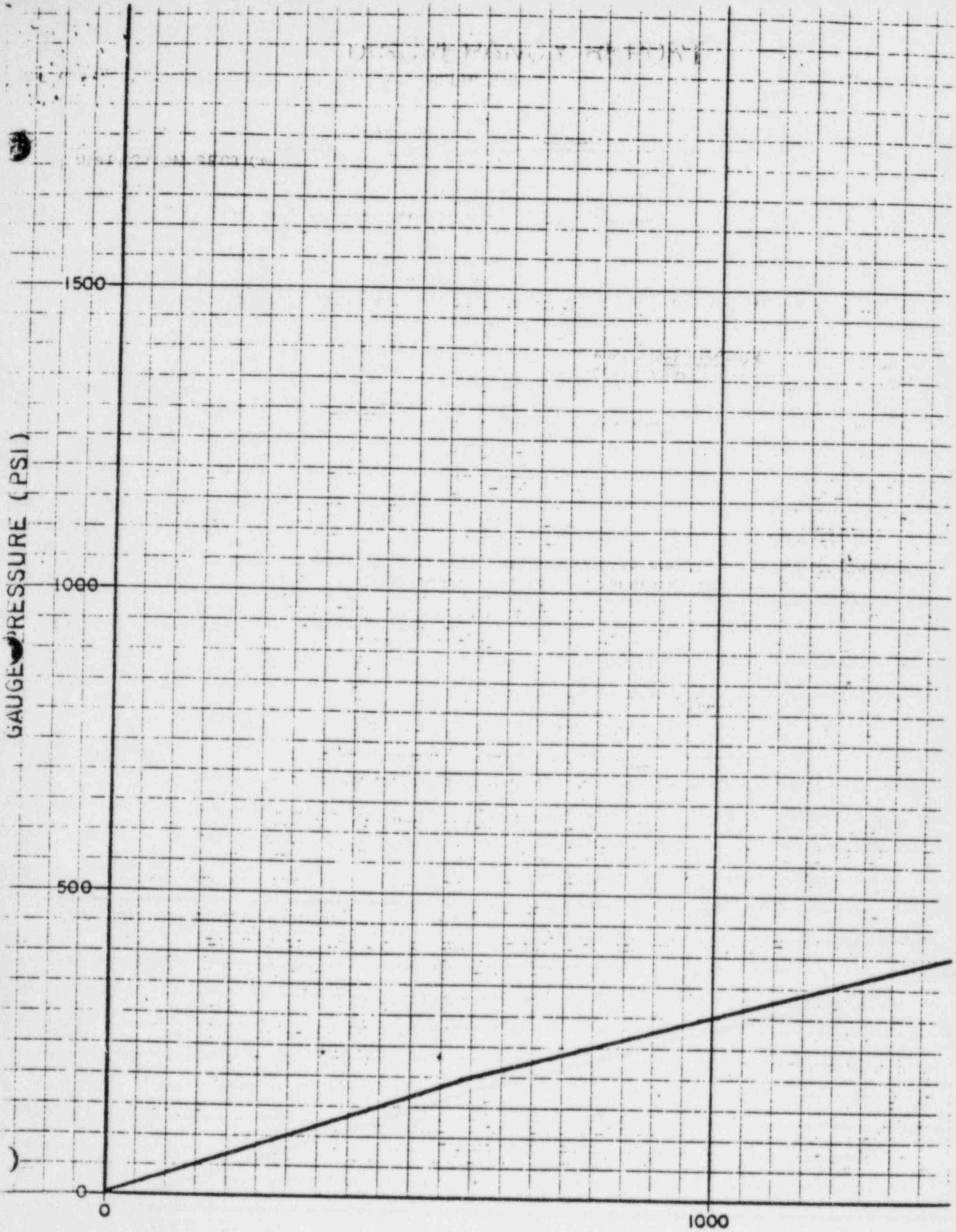
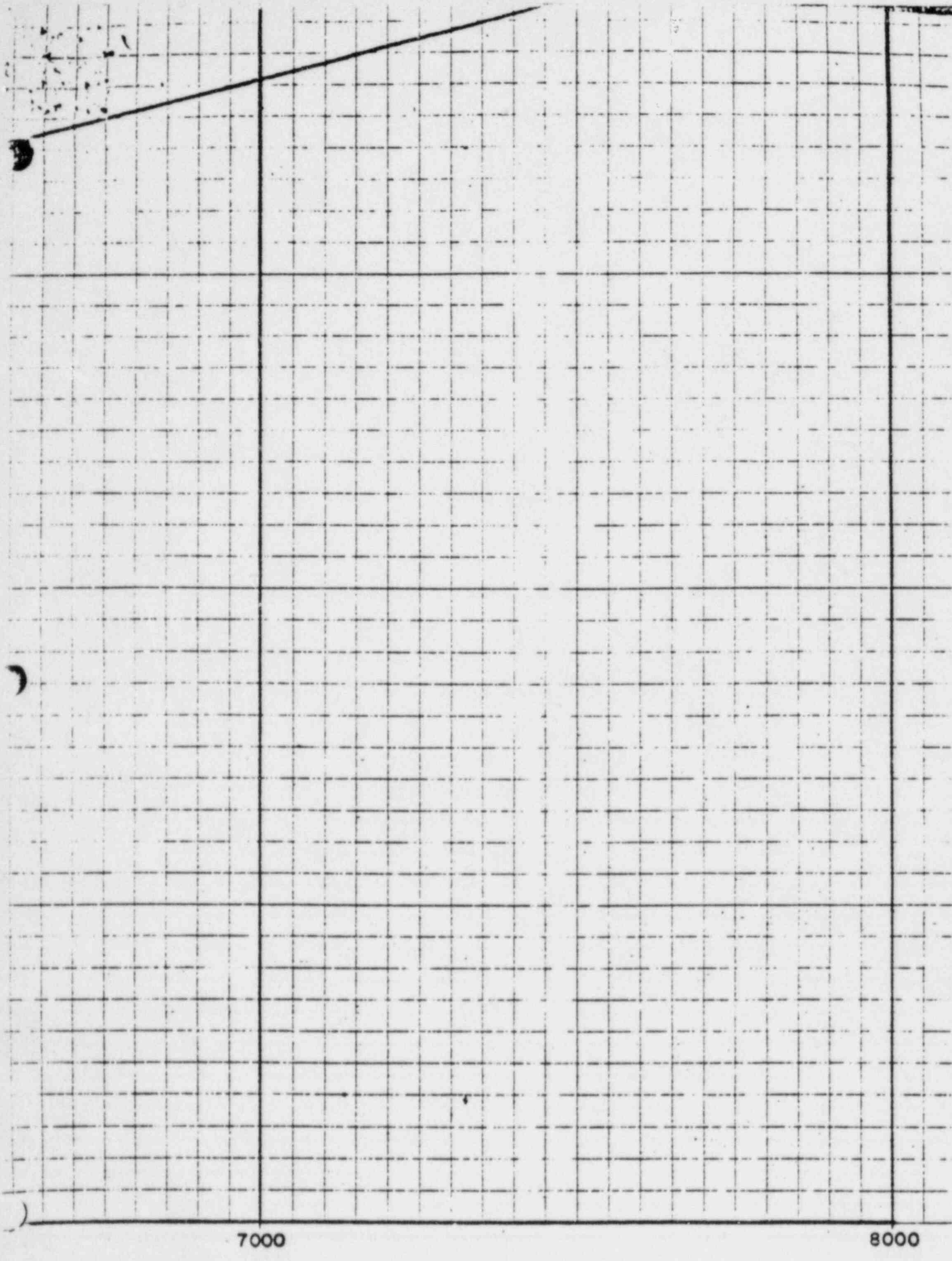
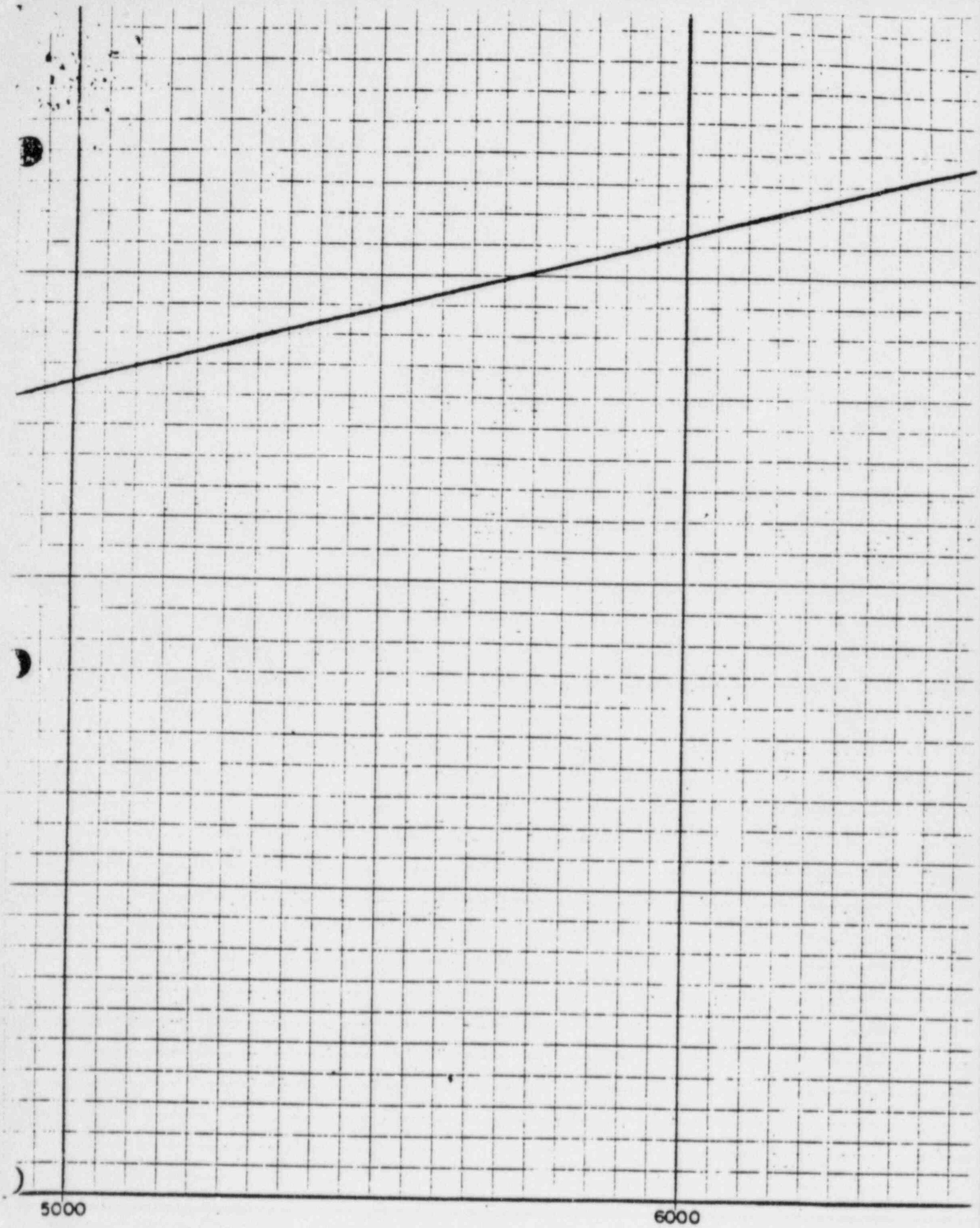


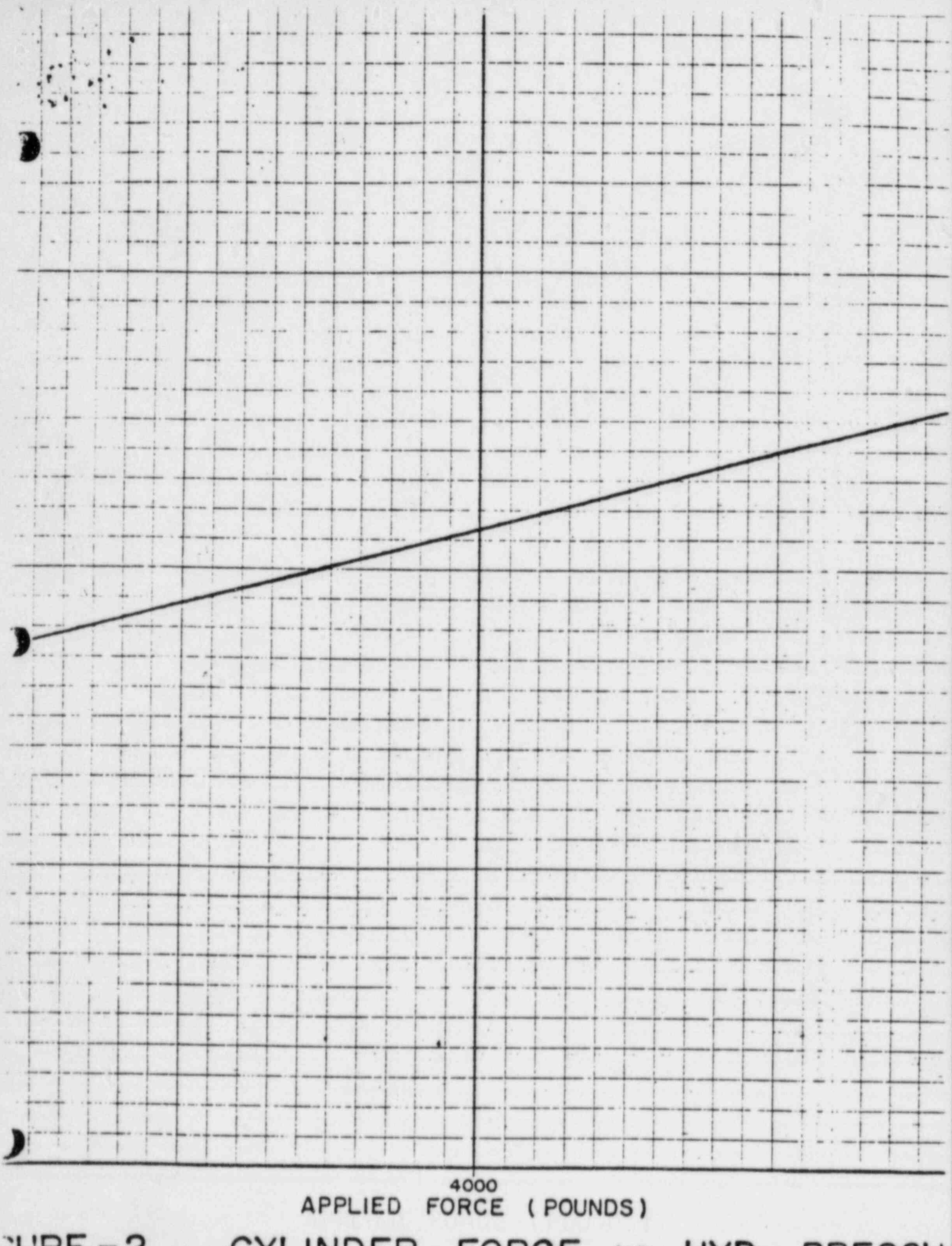
FIGURE 1 - PULL TEST FIXTURE



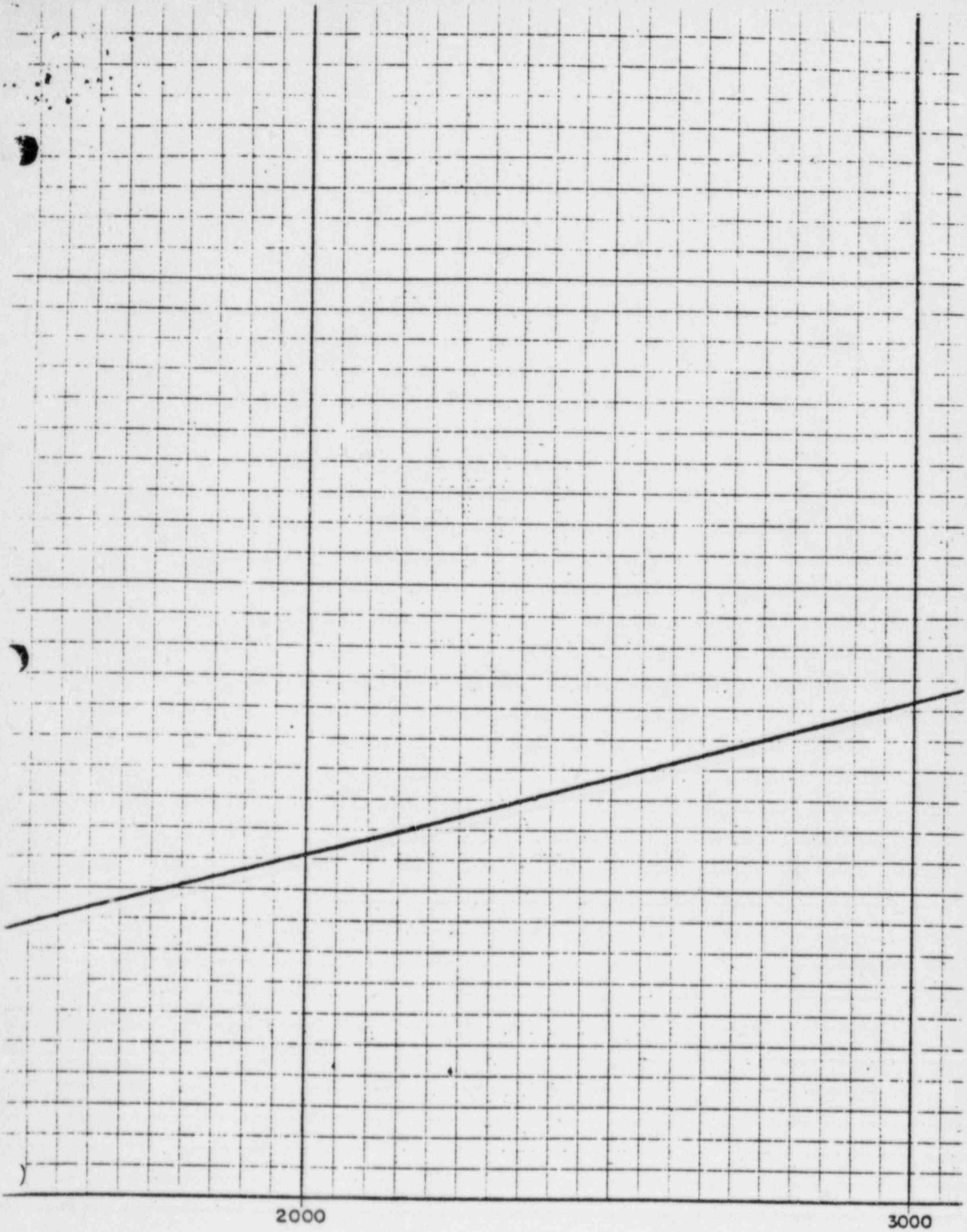
1500
1000
500
0
0
1000
GAUGE PRESSURE (PSI)


7000
8000


5000
6000



ɜURE - 2 CYLINDER FORCE vs HYD. PRESSU


2000
3000

DISCREPANCY REPORT

PRELIMINARY

Spec. No. ________ Page__of__

Cont./Supp.________ Cont./Supp.I.D. No.________ PG&E No. 288

INSPECTION SECTION

SUPERSEDED BY REV. 1

Discrepant Item: Units I and II Various anchor bolts of 1/4", 3/8", 1/2" diameter purchased by H. P. Foley Company.

Explanation of Discrepancy: Anchor bolts which are too short to be properly embedded per Dwg. 054162-2 have been on the job and may have been installed.

Douglas S. Wright — Field Engr./Inspector — 3-30-77 Date

CLASSIFICATION & DISPOSITION Minor Variation [ ] Deviation [X]

Disposition:

The following members of the Material Review Board concur with the above Disposition: (For Minor Variations, only Resident Engineer's signature required.)

R. J. Thompson — Resident Engineer — 3-31-77 Date

Name ____ Date ____ Name ____ Date ____

Name ____ Date ____ Name ____ Date ____

Responsible Engineer ____ Date ____ Supervising Engineer ____ Date ____

DISPOSITION ACCOMPLISHED

Remarks:

Field Engineer/Inspector ____ Date ____

STEPS TO PREVENT RECURRENCE (Deviations Only)

Resident Engineer ____ Date ____

Copies	Attachments
Coor.Q.C. Engr.	Dir.-Q.A.
Proj. Super.	Resp. Engr.
Resident Engr.	Proj. Engr.
Q.A.-Site	Supv.Insp.Engr.(G.O.)

Report Completed

Coordinating QC Engineer ____ Date ____

QA-2 (Rev. 12-16-76)

10.

INTEROFFICE MEMORANDUM

Diablo Canyon Project

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

To Mike Yan

Subject Anchor Bolt Verification

Re Letter Of

Copies To G. H. Moore wo/a
G. L. Parkinson wo/a
J. K. McCall wo/a
File wa

File No

Date September 10, 1982

From R. D. Etzler

Of General Construction

At Diablo Canyon Site

As per your verbal request we have completed the investigation of all supports that our documents (S.I.W.S.) indicated as as having less than 2¼" anchor bolt embedment.

Anchor bolt types and length were ascertained with the aid of an ultrasonic tester.

Seven (7) supports were inaccessible because of pyrocrete or equipment.

Seven (7) supports could not be located, one of which, GE/GW-140-3-6 can be assumed to be an inspector error.

Seven (7) supports are noted abandoned based on material evidence in the field.

Anchor bolts in seven (7) supports will be modified in the field to meet the criteria of Dwg. 050030.

Forty-four (44) supports have bolts with less than 2¼" embedment. The enclosed "As Builts" indicate type of bolt (H = Hilti, P. R. H. = Philipps Red Head) and their respective projection from face of concrete.

The remaining supports meet existing criteria per Dwg. 050030. (73)

R. D. Etzler /mun
R. D. Etzler
Project Superintendent

PG&E
62 3408 (4/77)

		NO ACCESS (1) / NOT FOUND (2)	AS BUILT REQUIRED NO	AS BUILT REQUIRED YES	REMARKS
S-20	A-107-4-70			X	
S-20	104			X	
S-40	-7-95		X		
S-20	9-21			X	
S-7	9-20		X		
S-7	9-12			X	
S-20	8-47	1	X		COVERED WITH PYROCRETE
S-41	8-5				
S-258	9-73		X		
S-102	-119-2-33			X	
S-4B	3-43			X	
S-18	C-104-3-20		X		
S-4B	D-140-5-57		X		
S-4B	-12		X		
S-20	E-123-5-8		X		NO LONGER IN EXISTENCE ABANDONED
S-243	-10		X		ABANDONED
S-20 FE FW	-117-1-148		X		
S-20	150		X		
S-20	2-79	2			
S-20	F-117-2-		X		SEE "WALK DOWN" NOTE
S-4B	F-140-1-66			X	
S-20	2-178			X	
S-20	2-			X	
S-4B	2-		X		A COMPLETE WALKDOWN CONFIRMED ALL OF THE SUPPORT TYPES TO HAVE EMBEDMENTS (OF ANCH. OF 2 1/4" OR MORE
S-20	2-		X		
S-4B	2-		X		
S-289	2-		X		
S-4B	2-		X		
S-202	5-		X		
S-243	5-35		X		

PG&E
62 3408 (9/77)

	NO ACCESS (1)	NOT FOUND (2)	AS BUILT REQUIRED NO	AS BUILT REQUIRED YES	REMARKS
S-19A G-117-2-			x		SEE "WALKDOWN" NOTE
20 -6-			x		ON SHEET 1 OF 6
1B 140-1-			x		
315 1-			x		SEE PAGE 6 OF 6 FOR
20 4-			x		S-4B/G-140-8-1023B
202 4-			x		S-102/ -1-
41 4-5			x		S-332/ -1-
41 7-			x		
4B 7-243				x	
4B 7-243B				x	
19A GE/GW -100-2-152					
20 -115-2-101				x	
20 -115 2-118				x	
18 140-1-142			x		
18 140-1-90			x		
20 140-1-62				x	
20 140-1-3			x		
18 115-4-79			x		
41 115-4-216				x	
18 115-4-206					REPLACE
20 115-4-198				x	
20 115-4-239	1				COVERED WITH PYROCRETE
20 140-3-6		2			NO DISCREPANT EMBEDMENT ENTIRE CONDUIT RUN
242 140-4-109				x	
18 4-131		2			
20 4-142			x		
20 4-143				x	
20 4-151				x	
20 4-155			x		
20 4-161				x	
20 4-152			x		
40 4-170			x		
20 4-185					

PG&E
62-3408 (4/77)

		NO ACCESS (1)	NOT FOUND (2)	AS BUILT REQUIRED NO	YES	REMARKS
S-4B GE GW	140-4-207			x		
4B	4-216			x		
288	4-300				x	
288	4-550			x		
102	6-303			x		
102	6-301			x		
102	6-177			x		
98	6-1			x		
19A	7-137			x		
18	7-22			x		
18	7-23			—	—	REPLACE
19A	7-253			x		
18	H-85-2-39			x		ABANDONED
289	3-11				x	
60B	100-1-111	1				
87	109	1				
87	108	1				
19A	115-1-1			x		ABANDONED
242	2-11				x	
114	3-95			x		
19A	3-17			x		ABANDONED
299	128-12-6				x	
19A	1-62			x		
233	1-59				x	
87	1-58				x	
93	1-54			x		
20	1-45			x		ALL CAP SCREWS INTO EMB. UNISTRUT
20	1-6			x		
98	1-4			x		
289	3-76			—	—	W.R. INSTALL NEW BRACE
98	5-40			x		
98	5-23			x		

PG&E
62-3408 (4/77)

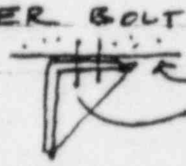
		(1) NO ACCESS	(2) NOT FOUND	AS BUILT REQUIRED NO	YES	REMARKS
S-88 CSR	-127-3-77				x	
417	-3-327				x	
181	-453				x	
85	480				x	
101	422					
98	4-106			x		ABANDONED
98	4-104			x		
98	4-107			x		
136	4-121				x	
88	4-152				x	
88	4-180			x		
18	5-254	1				
19A	5-251			x		
88	5-261				x	
88	6-166				x	
88	6-417			x		
102	7-135			x		
183	7-171			x		ALL CAP SCREWS INTO EMB. UNISTRUT
145	7-213			x		

PG-E
62 3408 (4/77)

	NO ACCESS (1)	NOT FOUND (2)	AS BUILT REQUIRED NO	AS BUILT REQUIRED YES	REMARKS
S-477 J-115- 3-49			x		
20 5-7			x		
383 10-63				x	
64 10-43				x	
477 11-59				x	
18 J-140- 4-50					REPLACE
20 3-11					
20 3-10					
18 K-73- 1-162		2			
18 1-161		2			
18 K-85- 2-96			x		
18 2-95			x		
18 2-69					REPLACE
18 2-68					REPLACE
202 2-25				x	
85 4-24			x		
19A K-100- 3-40				x	
116 6-34				x	
18 7-176	1				
215 7-29			x		ABANDONED
243 11-40				x	
18 K-115- 4-69			x		
202 1-21			x		
18 K-140- 9-2				x	
87 9-37			x		
19A K-154- 1-218			x		
19A 1-19	1				
20 L-140- 7-123			x		
20 2-3			x		
40 G-17.5- 4-7			x		

D.R. 288 "CUT BOLT"

THE FOLLOWING SUPPORTS WITH "CUT-BOLT" INDICATION ON THEIR RESPECTIVE S.I.W.S (H.P. FOLEY) ARE DEEMED ACCEPTABLE :

	DETAIL #	SUPPORT I.D. #	BASIS FOR ACCEPTANCE	
1	S-88	A-85-9-7	NO CUT BOLTS.	O.K
	S-40	A-107-9-77	DET. REQUIRES 4 BOLTS, THIS SUPPORT HAS 8 A.B., ONE OF WHICH IS CUT.	O.K
	S-20	D-104-5-117	NO CUT BOLTS.	O.K
	S-243	G-140-1-◯	NO CUT BOLTS WERE FOUND ON ANY OF THE S-243^S FOR CONDUIT KX 887 IN THIS GRID.	O.K
5	S-243	GE/W-115-1-126	THESE SUPPORTS W ABANDONED WHEN THE CONDUIT WAS REROUTED.	O.K
	S-20	-1-101		O.K
	S-20	2-91	NO CUT BOLTS.	
	S-183	2-129	4 BOLTS CUT. EACH CUT BOLT IS THE INNER BOLT IN A P1331 BRACKET:  U.S OF SLAB / CUT BOLT	O.K.
	S-19A	H-85-4-22	ONE BOLT WAS CUT. THE NEXT SUPPORT S-19A H-85-4-23 TAKES OVER THE FUNCTION FOR H-85-4-22 WITH ALL SPAN REQUIREMENTS.	O.K
10	S-576	H-115-3-66	NO CUT BOLTS.	O.K
	S-19A	H-128-2-125	NO CUT BOLTS.	O.K
	S-18	-2-112	NO CUT BOLT.	O.K
	S-243	-2-94	ONE BOLT CUT. 2'-0" TO NEXT SUPPORT. NO OVERSPANS IF S-243 WAS ELIMINATED.	O.K
	S-264	-5-44	ONE BOLT CUT, INSIDE BOLT OF P 1331 BRACKET.	O.K

CONTINUED ON NEXT PAGE

G.C. EL./D.C.P.P.
KARL ISSEL
NOV - 20 - 1982

D.R. 288 "CUT BOLT"

	DETAIL Nº	SUPPORT I.D. Nº	BASIS FOR ACCEPTANCE	
15	S-18	H-128-5-41	NO CUT BOLT.	O.K.
	S-18	-5-28		O.K.
	S-18	-5-27		O.K.
	S-18	-5-25		O.K.
	S-101	CSR-127-7-80	ONE BOLT CUT. OUTSIDE BOLT IN P 1331 BRACKET.	O.K.
20	S-20	K-73-6-11 (K5886)	THIS SUPPORT WAS REMOVED (SOMETIME IN THE PAST) AND REPLACED BY AN S-235.	O.K.
	S-19A	K-100-7-121	ONE BOLT CUT. THIS BOLT IS INSIDE AN S-19A WHICH IS ONLY 9" DISTANCED FROM THE NEXT S-19A. BOTH S-19AS ARE HOLDING AN CONDULET TO THE WALL. THIS CONDULET IS THE TERMINAL POINT FOR K 9156, A 3/4"⌀ R.I. THE FIRST SUPPORT, 13" AWAY FROM THE TERMINATION, IS AN S-19A.	O.K
22	S-87	K-140-9-33	NO CUT BOLTS.	O.K
23	S-243	K-85-1-56	NO CUT BOLTS.	O.K

PG&E
62-3408 (5/77)

	AS BUILT REQUIRED NO	AS BUILT REQUIRED YES	REMARKS
S-4B G-140-8-1023B		X	
S-102 G-140-1-		X	
S-332 G-140-1-			W.R. ADD ONE SADDLE NEXT TO UNDEREMB. BOLT

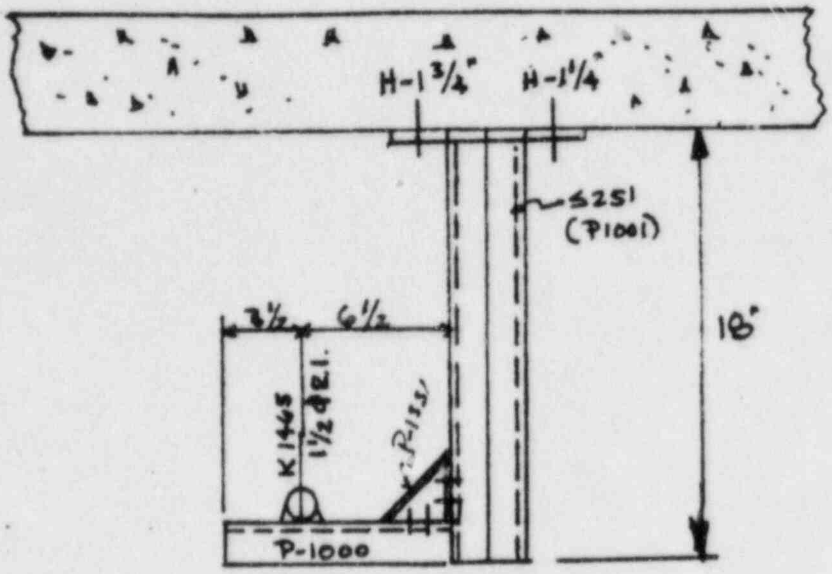
ALSO NOT FOUND OR INACCESSIBLE

S-18 GE/GW-140-4-465

S-18 5-72

S-19A K -100-6-64 INACCESSIBLE

NOTE: ALL BOLTS 1/2"Φ x 3 3/4" HILTI



LOOKING TOWARDS COL. 10
BETWEEN Cols 9 & 10

SPANS

36" South to S-196	K1465-1 1/2"Φ R.I. - 40" North to tray

R.V. Montezole
G.C. STA. Elec.
DCPP 9-10-82

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD

GM SUPV. DSGN. DWN. CHKD. O.K. DATE SCALE	"AS BUILT" G-140-1- notes S-102 Mounted From Ceiling PACIFIC GAS AND ELECTRIC COMPANY SAN FRANCISCO, CALIFORNIA	B/M DWG. LIST SUPSDS SUPSD BY SHEET NO. SHEETS DRAWING NUMBER REV. MICROFILM

PG&E

	NO ACCESS (1)	NOT FOUND (2)	AS BUILT REQUIRED NO	AS BUILT REQUIRED YES	REMARKS
S-20 A-107-4-70				X	
S-20 104				X	
S-40 -7-95			X		
S-20 9-21				X	
S-7 9-20			X		
S-7 9-12				X	
S-20 8-47	1		X		COVERED WITH PYROCRETE
S-41 8-5					
S-258 9-73			X		
S-102 -119-2-33				X	
S-4B 3-43				X	
S-18 C-104-3-20			X		
S-4B D-140-5-57			X		
S-4B -12			X		
S-20 E-123-5-8			X		NO LONGER IN EXISTENCE ABANDONED
S-243 -10			X		ABANDONED
S-20 FE FW -117-1-148			X		
S-20 150			X		
S-20 2-79		2			SEE "WALK DOWN" NOTE
S-20 F-117-2-			X		
S-4B F-140-1-66				X	
S-20 2-178				X	
S-20 2-				X	
S-4B 2-			X		A COMPLETE WALKDOWN CONFIRMED ALL OF THESE SUPPORT TYPES TO HAVE EMBEDMENTS (OF ANCH. B OF 2 1/4" OR MORE
S-20 2-			X		
S-4B 2-			X		
S-289 2-			X		
S-4B 2-			X		
S-202 5-			X		
S-243 5-35			X		

FO-E
e(3ACE 4/77)

	NO ACCESS (circled dash)	NOT FOUND (N)	AS BUILT REQUIRED NO	AS BUILT REQUIRED YES	REMARKS
S-19A G-117-2-			X		SEE "WALKDOWN" NOTE
20 -6-			X		ON SHEET 1 OF 6
1B 140-1-			X		
315 1-			X		SEE PAGE 6 OF 6 FOR
20 4-			X		S-4B/G-140-8-1023 B
202 4-			X		S-102/ -1-
41 4-5			X		S-332/ -1-
41 7-			X		
4B 7-243				X	
4B 7-243B				X	
19A GE/GW -100-2-152					
20 -115-2-101				X	
20 -115 2-118				X	
18 140-1-142			X		
18 140-1-90			X		
20 140-1-62				X	
20 140-1-3			X		
18 115-4-79			X		
41 115-4-216				X	REPLACE
18 115-4-206					
20 115-4-198				X	COVERED WITH PYROCRETE
20 115-4-239	1				NO DISCREPANT EMBEDMENT
20 140-3-6	2				ENTIRE CONDUIT RUN
242 140-4-109				X	
18 4-131	2				
20 4-142			X		
20 4-143				X	
20 4-151				X	
20 4-155			X		
20 4-161				X	
20 4-152			X		
40 4-170			X		

PG&E
62 3408 (1/77)

		NO ACCESS (1)	NOT FOUND (2)	AS BUILT REQUIRED NO	AS BUILT REQUIRED YES	REMARKS
S-4B GE GW	·140-4-207			X		
4B	4-216			X		
288	4-300				X	
288	4-550			X		
102	6-303			X		
102	6-301			X		
102	6-177			X		
98	6-1			X		
19A	7-137			X		
18	7-22			X		
18	7-23			—	—	REPLACE
19A	7-253			X		
18	H-85-2-39			X		ABANDONED
289	3-11				X	
60B	100-1-111	1				
87	109	1				
87	108	1				
19A	115-1-1			X		ABANDONED
242	2-11				X	
114	3-95			X		
19A	3-17			X		ABANDONED
299	128-12-6				X	
19A	1-62			X		
233	1-59				X	
87	1-58				X	
93	1-54			X		
20	1-45			X		ALL CAP SCREWS INTO EMB. UNISTRUT
20	1-6			X		
98	1-4			X		
289	3-76			—	—	W.R. INSTALL NEW BRACE E-1202
98	5-40			X		
98	5-23			X		

PG&E
62 3408

		① NO ACCESS	② NOT FOUND	AS BUILT REQUIRED NO	AS BUILT REQUIRED YES	REMARKS
S-88	CSR-127-3-77				x	
417	-3-327				x	
181	-453				x	
85	480				x	
101	422					
98	4-106			x		ABANDONED
98	4-104			x		
98	4-107			x		
136	4-121				x	
88	4-152				x	
88	4-180			x		
18	5-254	1				
19A	5-251			x		
88	5-261				x	
88	6-166				x	
88	6-417			x		
102	7-135			x		ALL CAP SCREWS INTO EMB. UNISTRUT
183	7-171			x		
145	7-213			x		

PG&E
62 3408 (5/77)

AS BUILT

	No Access (1)	Not Found (2)	As Built Required: No	As Built Required: Yes	Remarks
S-477 J-115- 3-49			x		
20 5-7			x		
383 10-63				x	
64 10-43				x	
477 11-59				x	
18 J-140- 4-50					REPLACE
20 3-11					
20 3-10					
18 K-73-1-162		2			
18 1-161		2			
18 K-85-2-96			x		
18 2-95			x		
18 2-69					REPLACE
18 2-68					REPLACE
202 2-25				x	
85 4-24			x		
19A K-100- 3-40				x	
116 6-34				x	
18 7-176	1				ABANDONED
215 7-29			x		
243 11-40				x	
18 K-115- 4-69			x		
202 1-21			x		
18 K-140- 9-2				x	
87 9-37			x		
19A K-154- 1-218			x		
19A 1-19	1				
20 L-140- 7-123			x		
20 2-3			x		
40 G-17.5-4-7			x		

	AS BUILT REQUIRED NO	YES	REMARKS
S-4B G-140-8-1023B		×	
S-102 G-140-1-		×	
S-332 G-140-1-			W.R. ADD ONE SADDLE NEXT TO UNDEREMB. BOLT

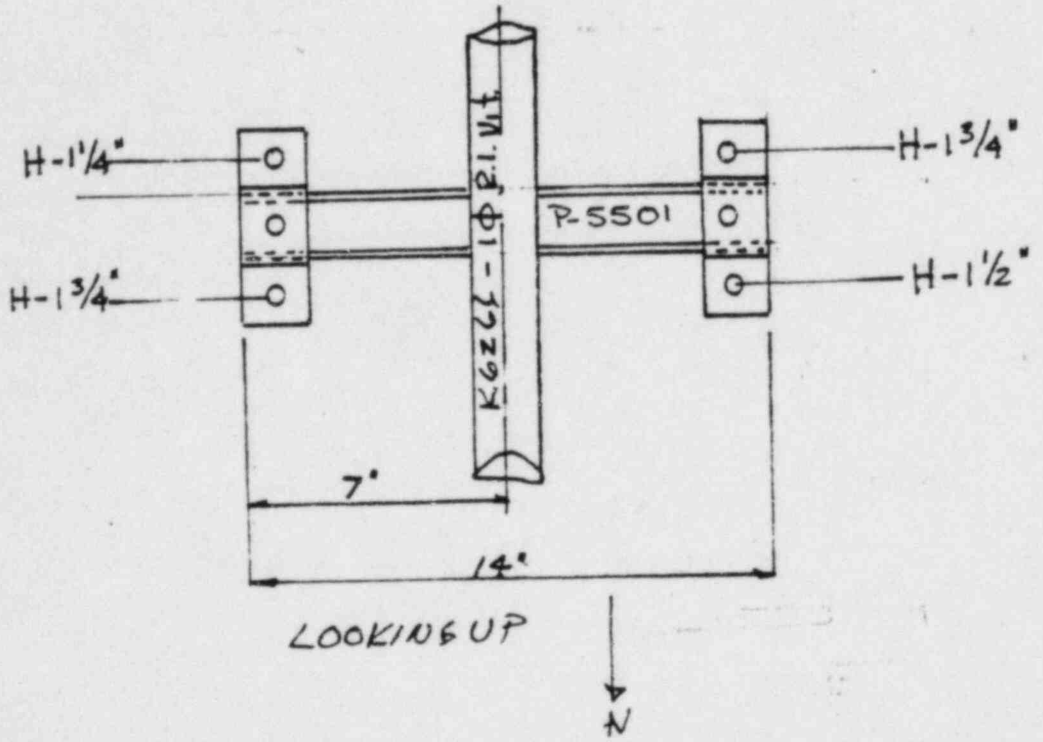
ALSO NOT FOUND OR INACCESSIBLE

S-18 GE/GW-140-4-465

S-18 5-72

S-19A K -100-6-64 INACCESSIBLE

NOTE: ALL BOLTS $\frac{1}{2}$" ϕ × 3 3/4" ϕ Hiltis



SPAN

60" SOUTH | K6266-1ϕR.I(Vit) 56" North

R.V. Monterok
G.C. STA. ELEC
DCPP
9-3-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

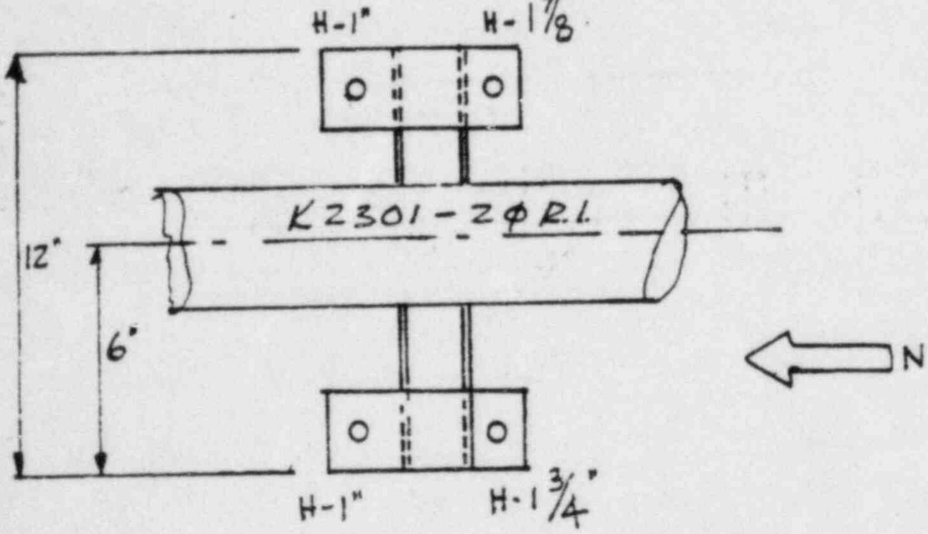
GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE | SCALE

"AS BUILT"
GE/GW-115-4-198
S-20
Ceiling Mounted

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. | SHEETS
DRAWING NUMBER | REV.
MICROFILM

NOTE: ALL BOLTS 1/2"Ø x 3 3/4" Hilti's



SPANS

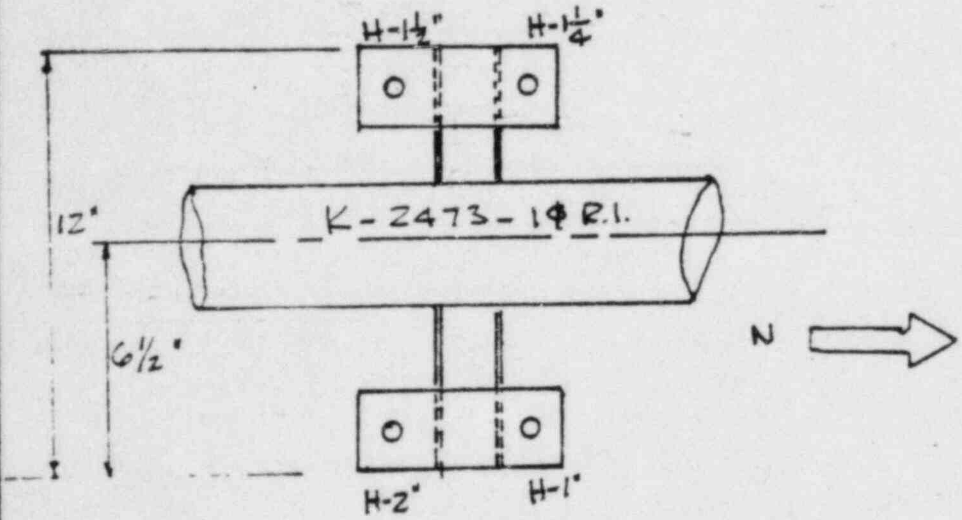
53" North to S-20	K-2301-2Ø-R.I. 65" South To S-20

R.V. Monterola
G.C. STA. Elec
DCPP 9-7-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM	"AS BUILT"	B/M
SUPV.	A-107-4-70	DWG. LIST
DSGN.	S-20	SUPSDS
DWN.	WALL Mounted	SUPSD BY
CHKD.		SHEET NO. SHEETS
O.K.		DRAWING NUMBER REV.
DATE SCALE	PACIFIC GAS AND ELECTRIC COMPANY SAN FRANCISCO, CALIFORNIA	

NOTE: ALL BOLTS 1/2"ϕ x 3 3/4" Hiltis



SPANS

44" NORTH TO S-20	K-2473-1ϕ R.I. -42" South To S-20

R.V. Monterola
G.C. STA. Elec
DCPP 9-7-82

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM SUPV. DSGN. DWN. CHKD. O.K. DATE SCALE	"As BUILT" A-107-4-104 S-20 WALL Mounted **PACIFIC GAS AND ELECTRIC COMPANY** SAN FRANCISCO, CALIFORNIA	B/M DWG. LIST SUPSDS SUPSD BY SHEET NO. SHEETS DRAWING NUMBER REV.

ORIGINAL

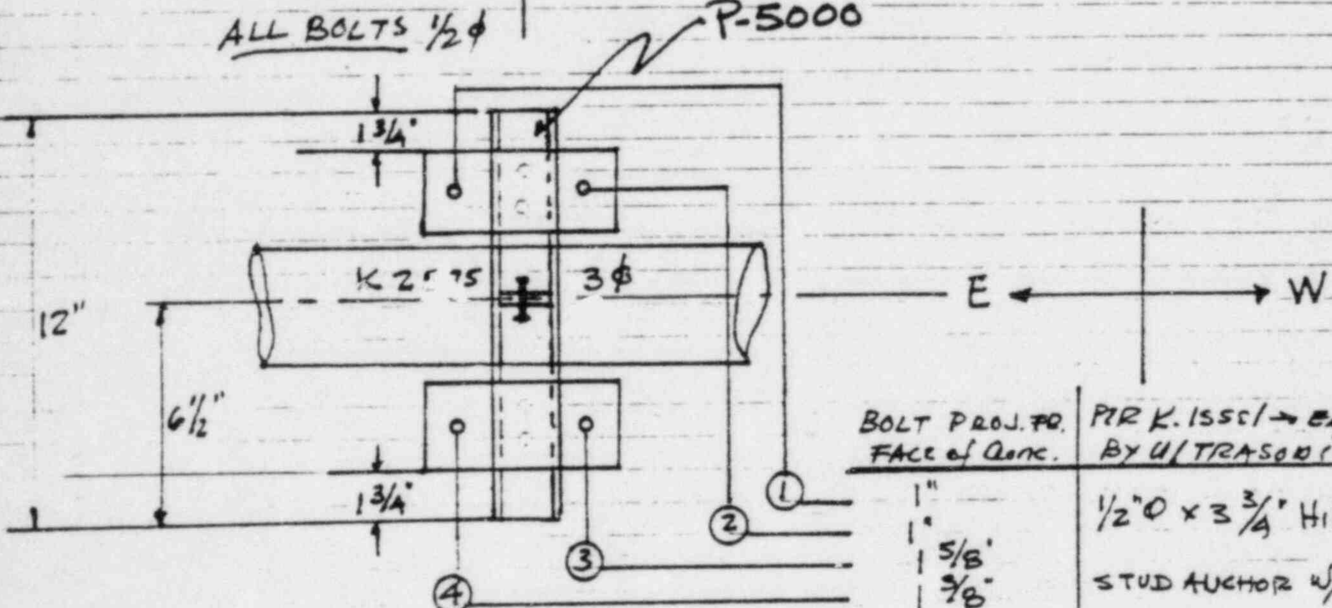
"AS BUILT" Support No. A-107-9-21

DETAIL No. S-20

WALL Mounted

SPANS

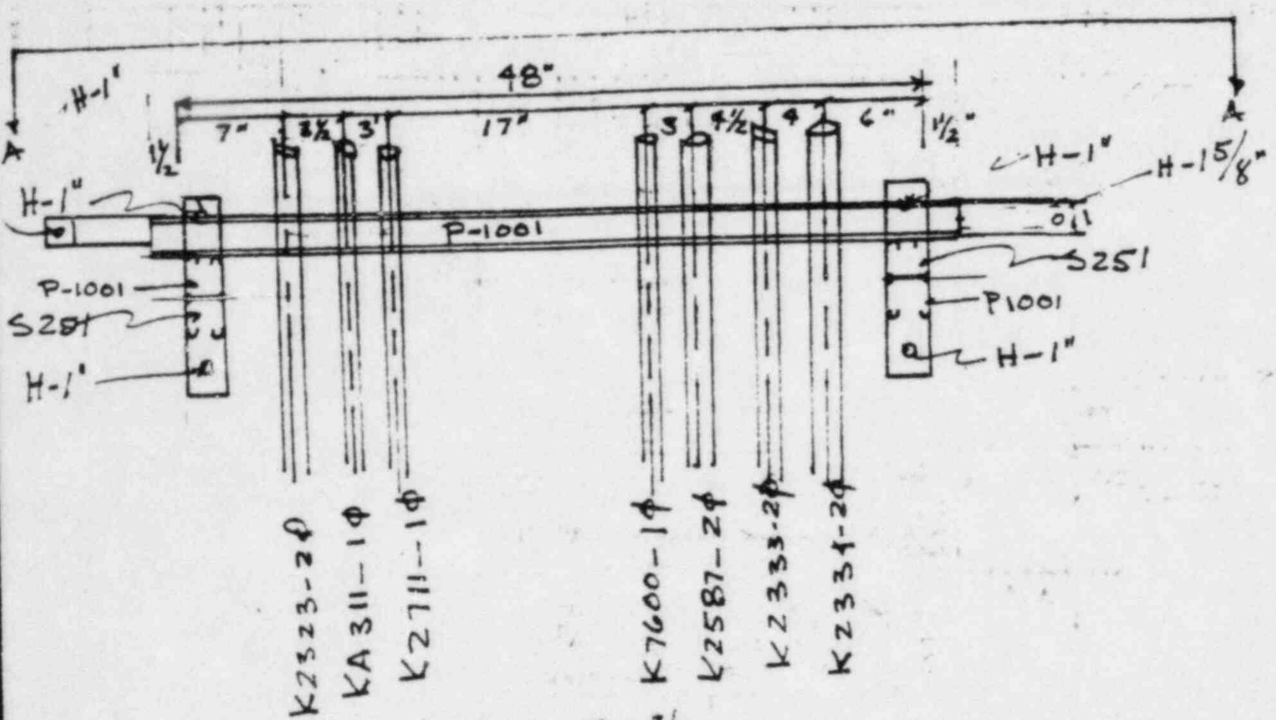
32" EAST TO BJA253 ← K2575-3Ø - 32" WEST TO BJA255



	BOLT PROJ. FR. FACE of Conc.	PER K.1555/ → EMBEDMENT BY ULTRASONIC Transducer
1	1"	1/2"Ø x 3 3/4" HILTI
2	1"	STUD ANCHOR w/split ring
3	5/8"	
4	3/8"	

R.V. Monterole
G.C. STA. Elec.
9-1-82

NOTE: ALL BOLTS 1/2 Ø x 3 x 3/4" Hiltis



Looking South.

Sect. A-A

SPANS

Down 12" TO PANEL

- K2334-2Ø, K2333-2Ø, K2587-2Ø: UP 70" TO S-7
- K2711-1Ø UP 56' TO S-20
- K-7600-1Ø UP 48' TO S243
- K-2323-2Ø, KA311-1Ø: UP 54" To S-7

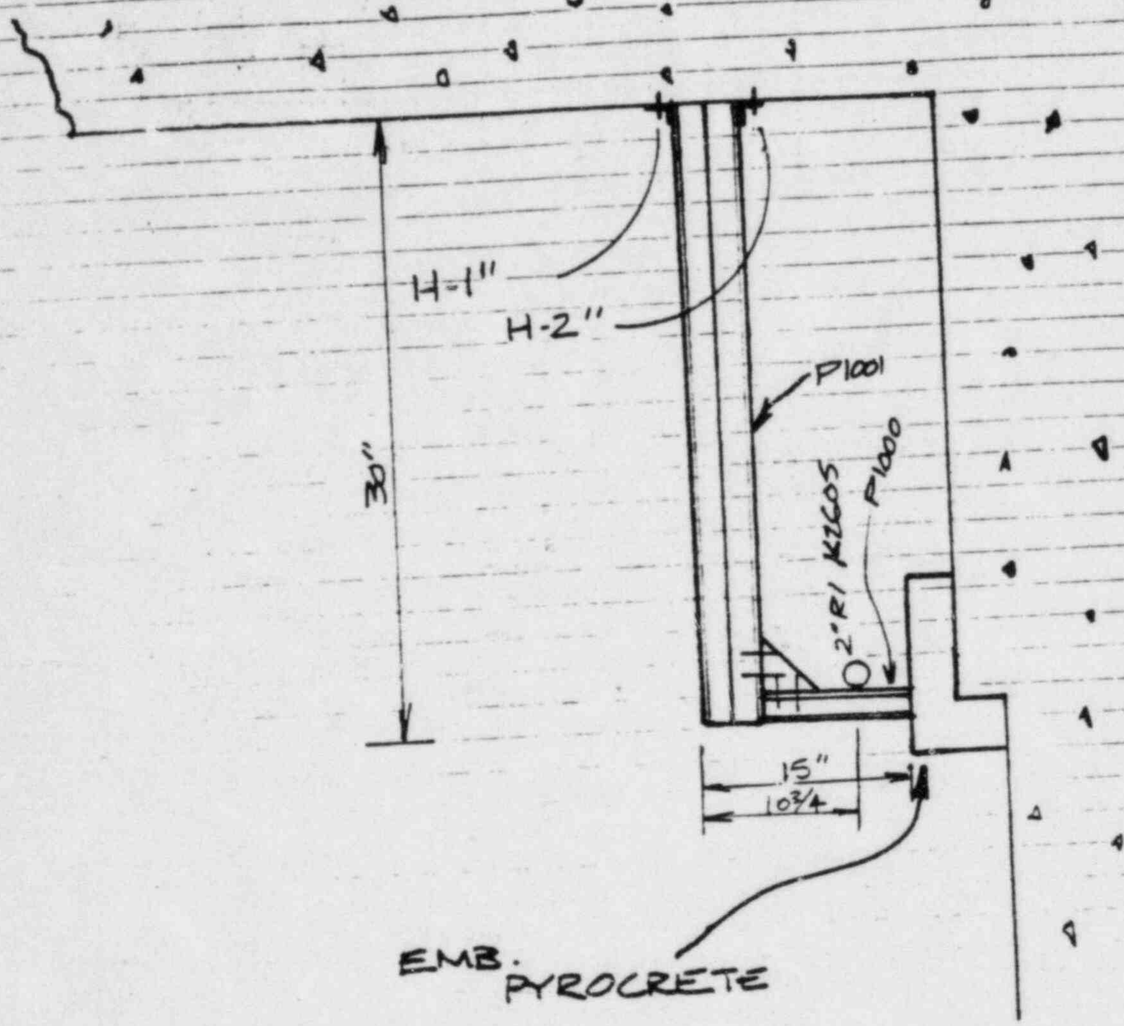
R.V. Monterola
G.C. STA. Elec
DCPP
9-7-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM SUPV. DSGN. DWN. CHKD. O.K. DATE / SCALE	"AS BUILT" A-107-9-12 S-7 WALL Mounted PACIFIC GAS AND ELECTRIC COMPANY SAN FRANCISCO, CALIFORNIA	B/M DWG. LIST SUPSDS SUPSD BY SHEET NO. / SHEETS DRAWING NUMBER / REV.

DATE: 9·8·82

S-102 A-119-2-33



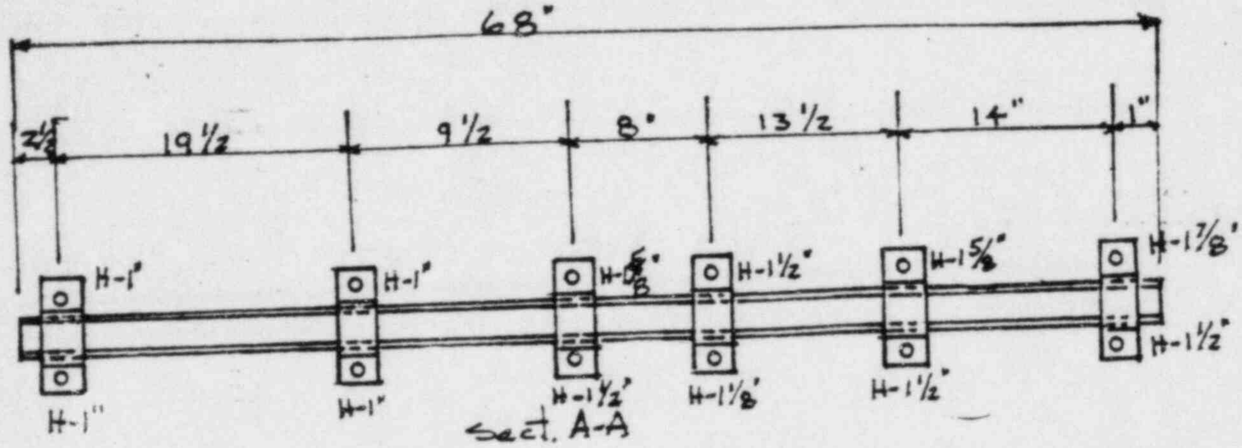
Spans

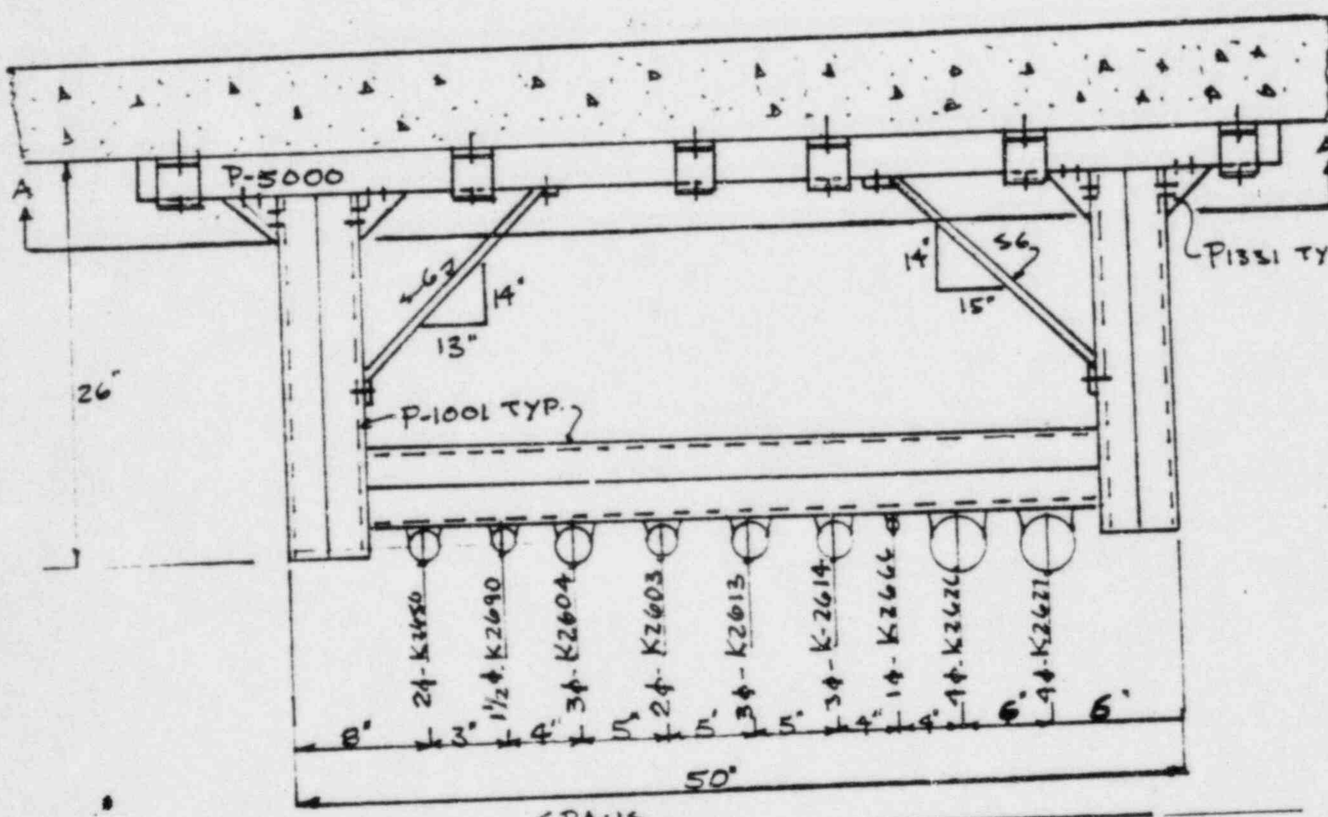
By M. CAMPBELL

South — Wall — 45"

North — Pyrocrete — 30"

NOTE: ALL BOLTS 1/2 ϕ





SPANS

45" EAST TO WALL

K2650-2ϕ-
K2604-3ϕ-
K2603-2ϕ-
K2613-3ϕ-
K2614-3ϕ-
K-2626-4ϕ-
K-2666-1ϕ-
K-2627-4ϕ-

96" West to S4B

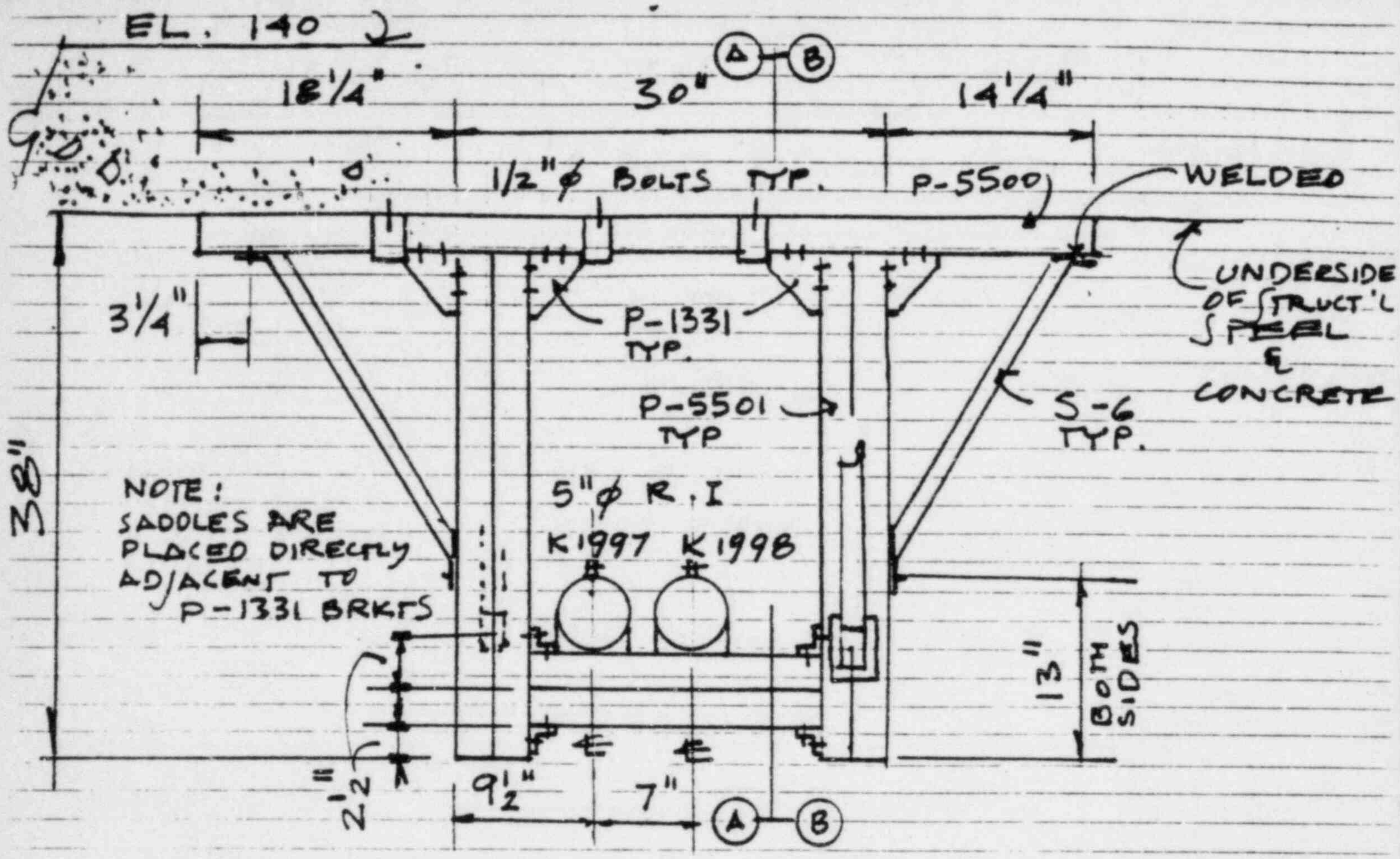
K-2690-1 1/2ϕ-95' West to S-1B

Z.V. Monteric
Gc. STA Elec.
DCPP
9-8-82

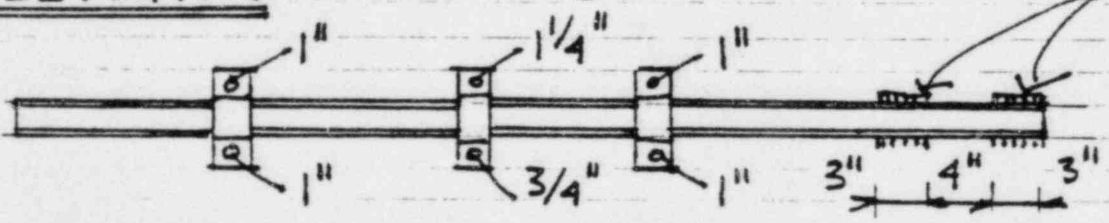
APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APV

GM		"AS BUILT"	B/M
SUPV.		A-119-3-43	DWG. LIST
DSGN.		~~S-4B~~	SUPSDS
DWN.		Mounted at ceiling	SUPSD BY
CHKD.			SHEET NO. SHEE
O.K.			DRAWING NUMBER RE
DATE	SCALE		

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA



ELEVATION LOOKING "SOUTH"

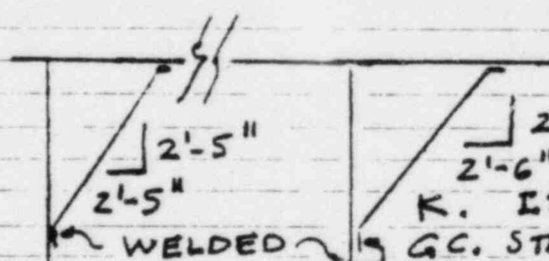


REFLECTED PLAN OF P-5500 WITH BOLT PROJECTIONS MEASURED FROM FACE OF CONCRETE.

NOTE : ALL A. BOLTS ARE ½"ϕ x 3¾" HILTIS

SPANS :

74" "SOUTH" TO S-4B F-140-1-65	66" "NORTH" TO S-4B F-140-1-68

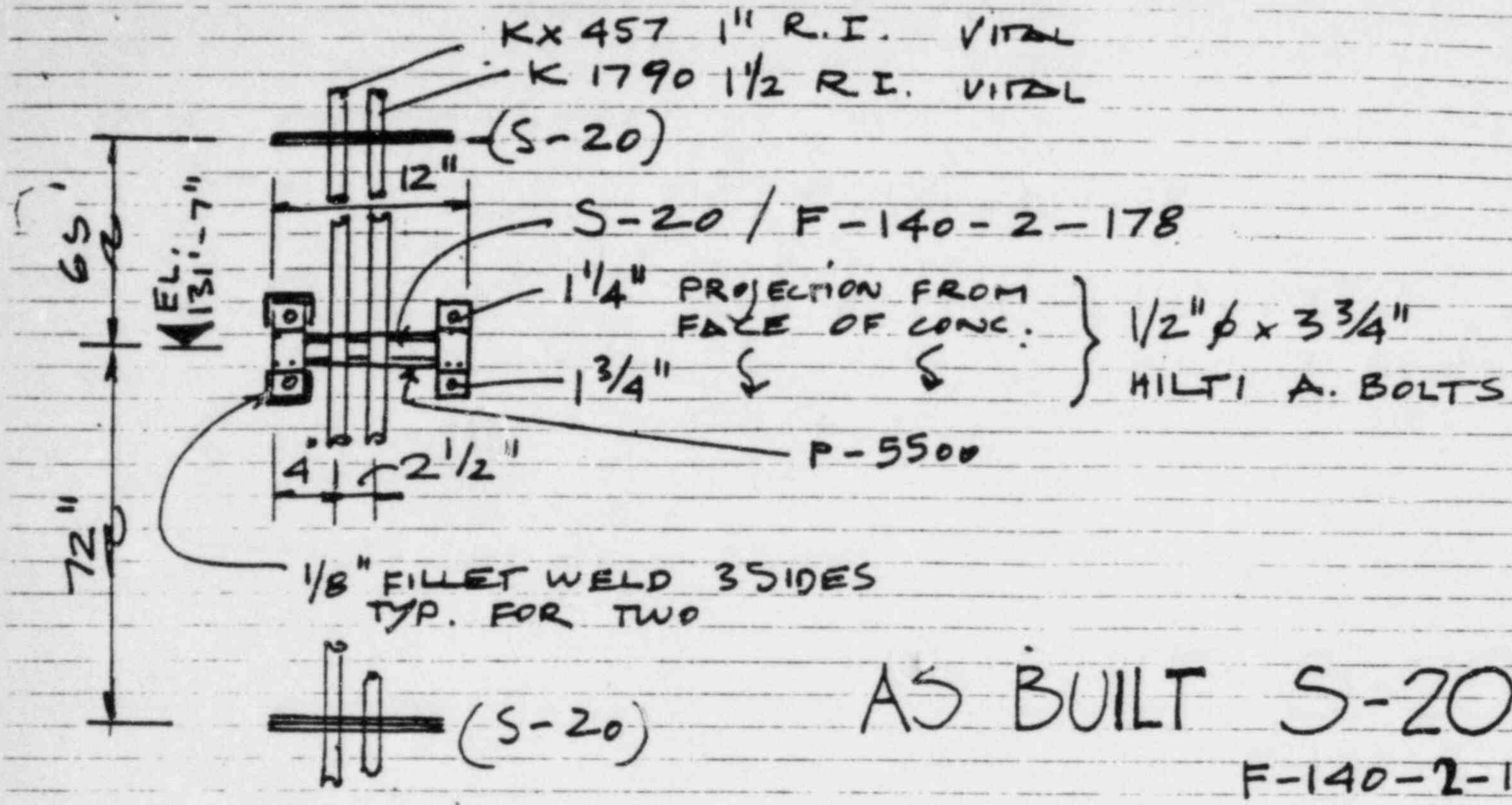


A-A

K. ISSEL
G.C. STATION/EL.
D. C. P. P.
9 - 3 - 1982

S-4B

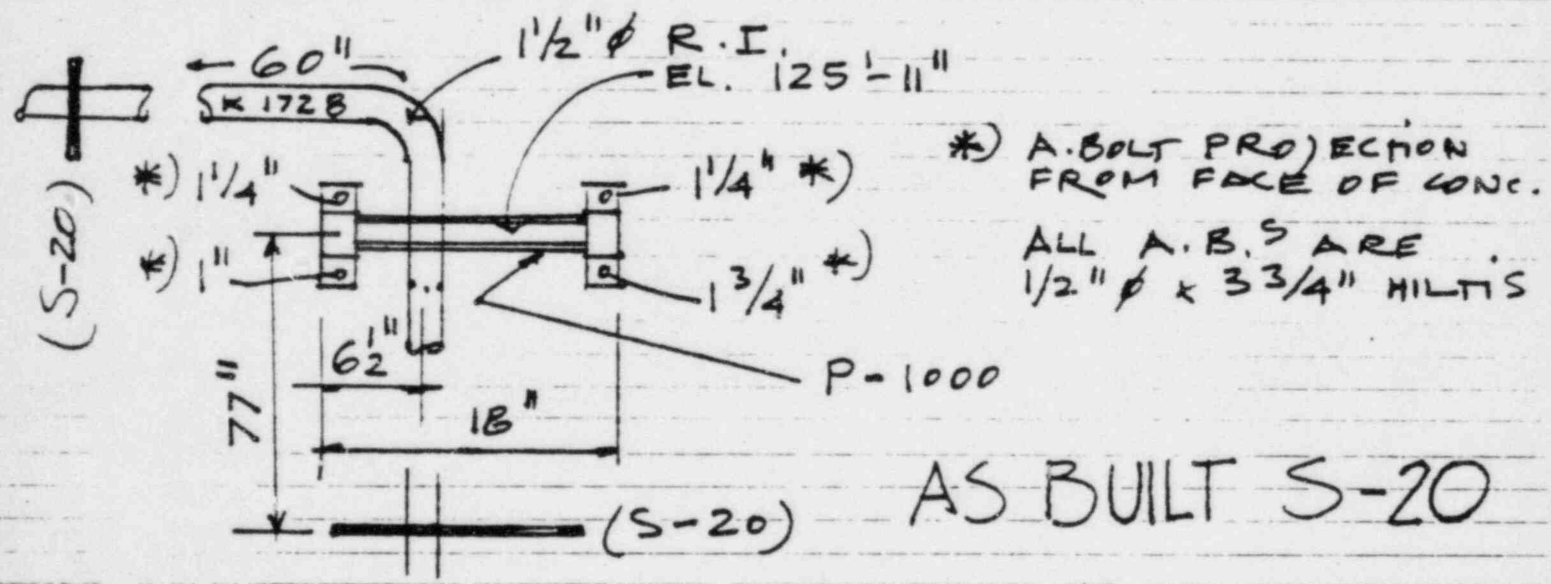
AS BUILT F-140-1-66



AS BUILT S-20

F-140-2-178

ELEVATION OF S-20 ATTACHED TO CRANE WALL



AS BUILT S-20

F-140-2 - NO TAG

ELEVATION OF S-20 ATTACHED TO CRANE WALL

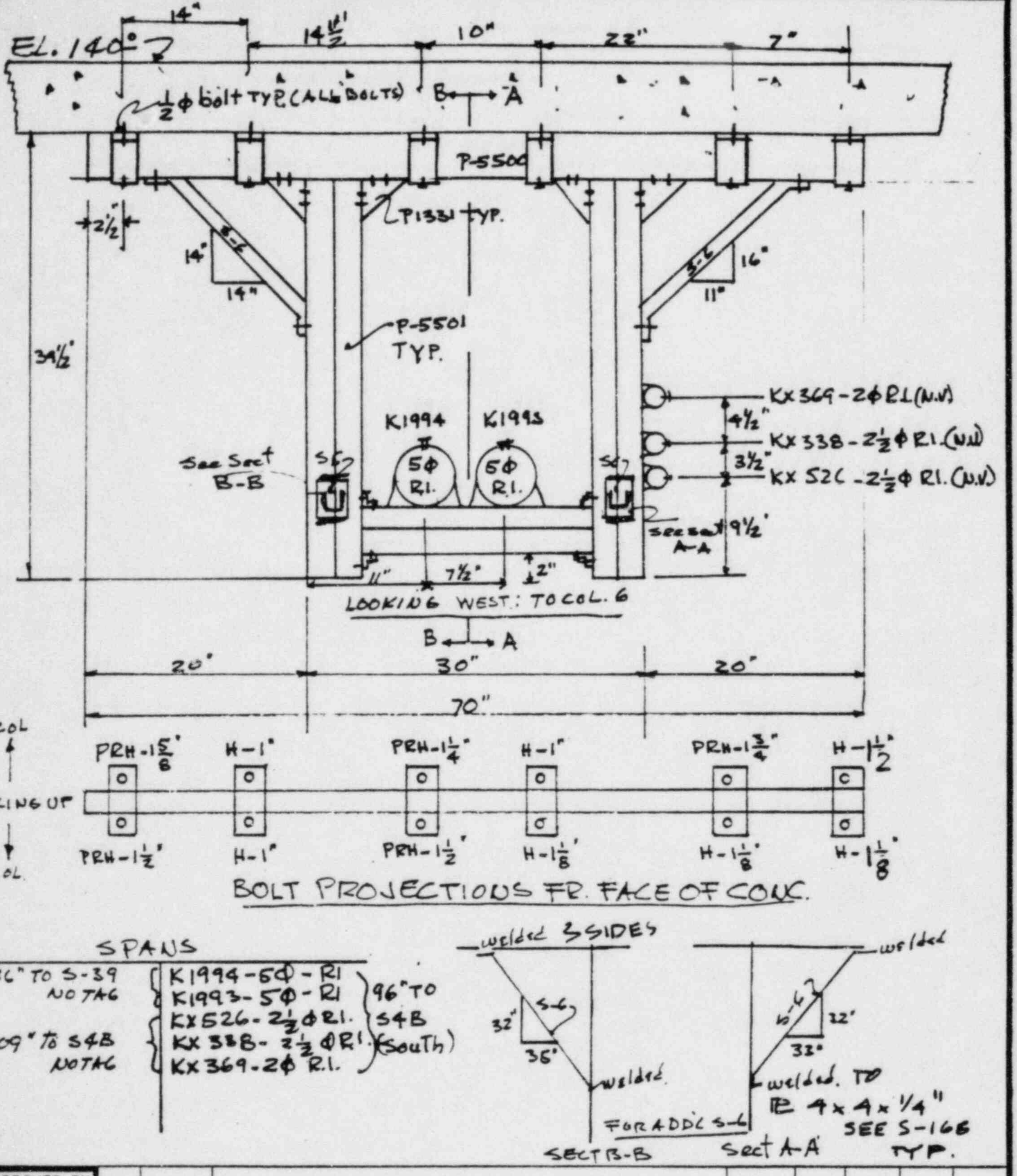
K. ISSEL

G.C. STATION / EL

D.C.P.P.

9-3-1982

ORIGINAL



APPROVED BY							
			R.V. Monterole GC STA. ELEC. DCPP				
	REV.	DATE	DESCRIPTION 9-2-82	GM	DWN.	CHKD.	SUPV. APVD.

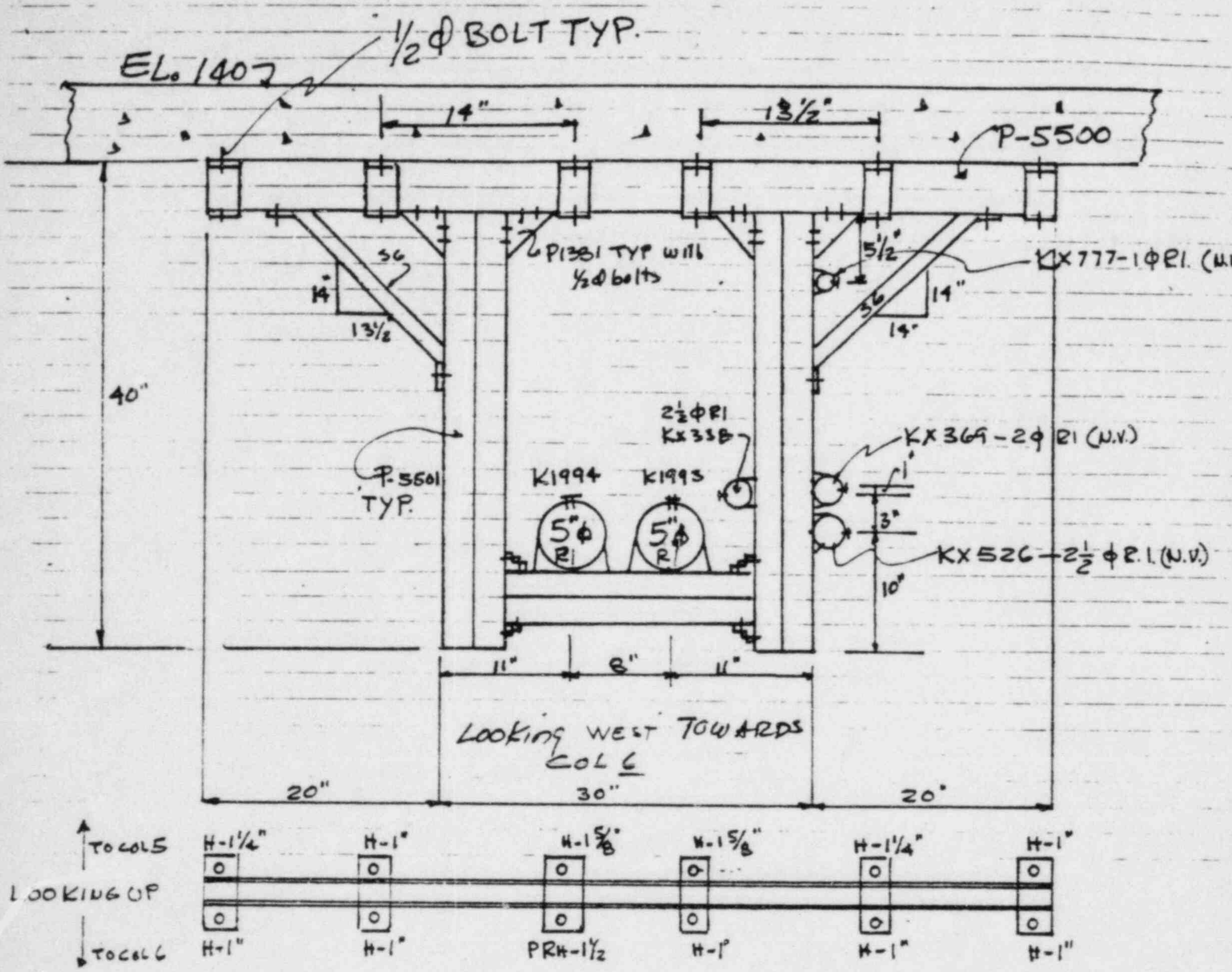
GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE | SCALE

"AS BUILT" G-140-7-243
S-4B

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. | SHEETS
DRAWING NUMBER | REV.

ORIGINAL



PROJECTIONS OF BOLTS FR. FACE of CONC.

SPANS

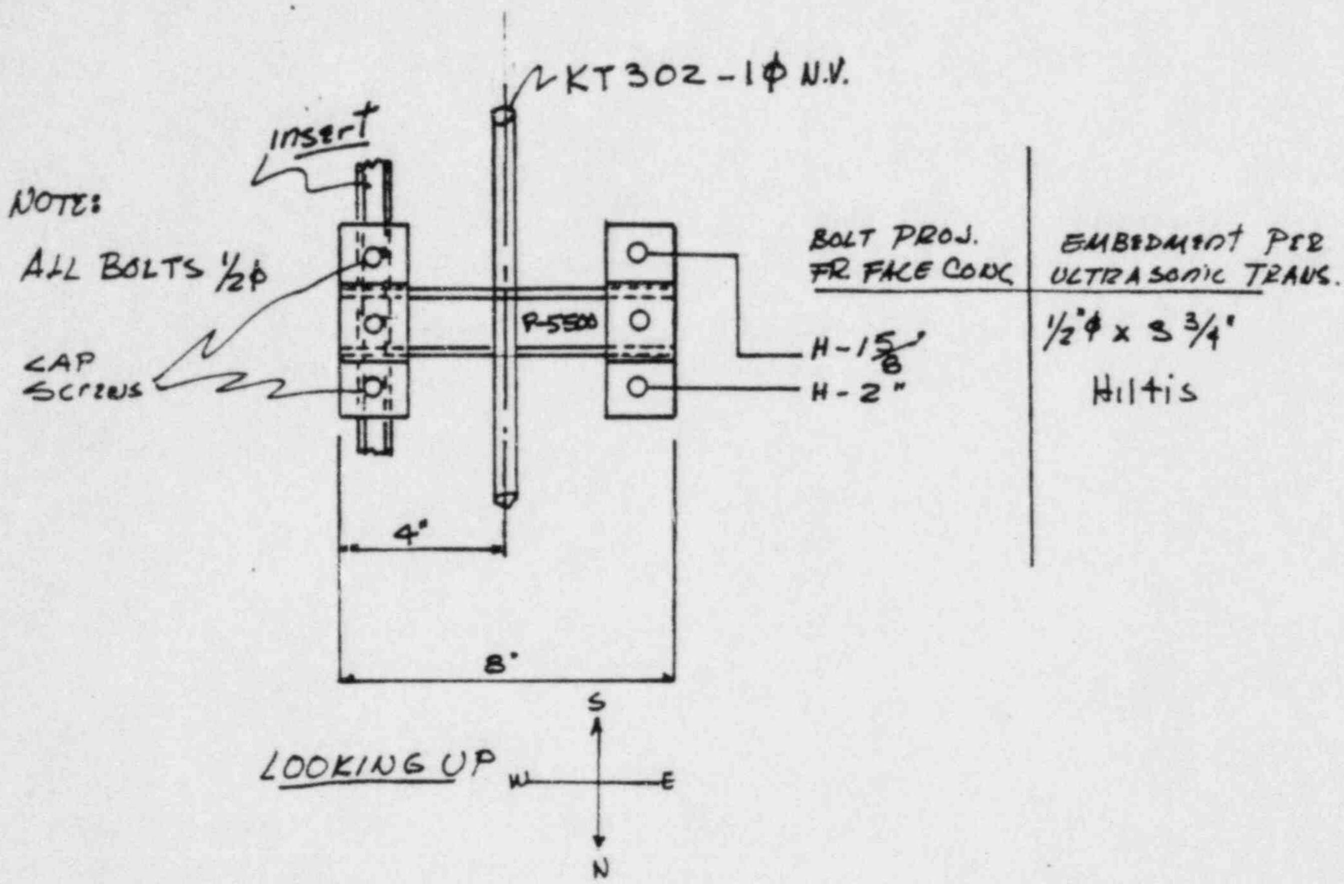
To col 5
- 6'-3" To S4B (G-140-8-1023B) — 6ϕ K1994, 6ϕ K1993
- 124" To S-19A (NOTAC) — $2\frac{1}{2}$ϕ KX 338 N.V.
- 24" To BJX138 — $2\frac{1}{2}$ϕ KX 526 N.V., 2ϕ KX 369 N.V., 1ϕ KX 777 N.V.

96" To S4B (G-140-7-143A) TOWARD col 6.

"AS BUILT" G-140-7-243B

S-4B

R.V. Monterola
G.C. STA DCPP
9-2-82



SPANS

78" EAST TO S20	KT 302-1φ - 51" NORTH TO S-20

R.V. Montreok
G.C. STA. Elec. DCPP
9-3-82

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

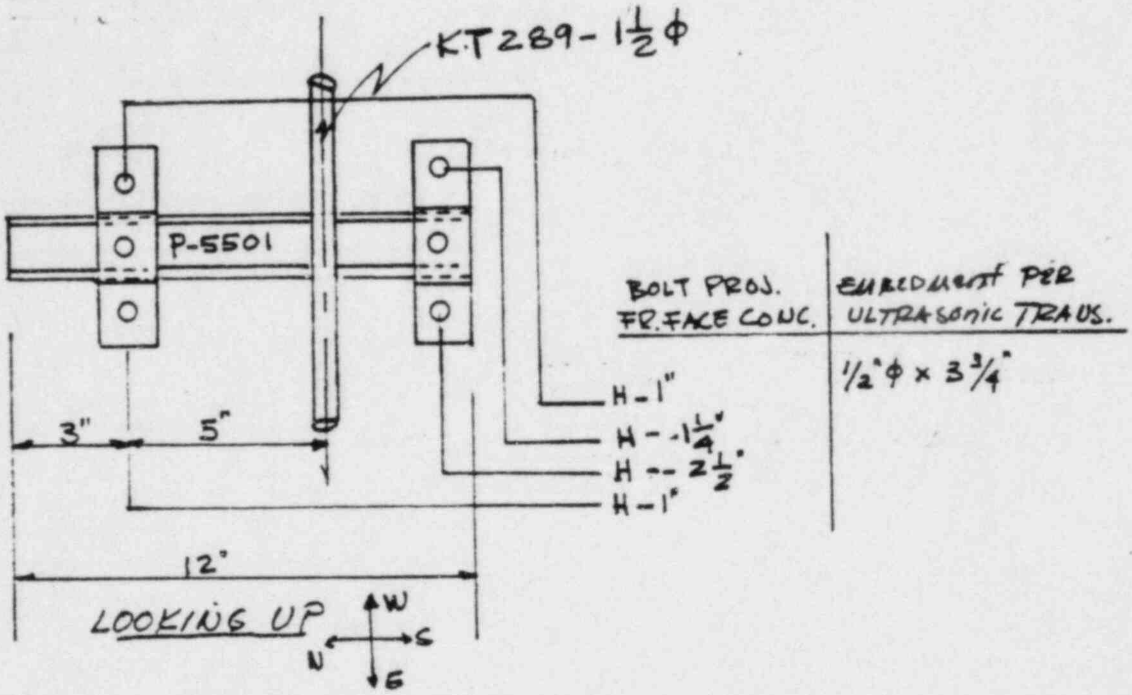
"AS BUILT"
GE/GW-115-2-101
S-20
Mounted in ceiling

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.

GE/GW-115-2-118
S-20
Mounted in ceiling

NOTE:
ALL BOLTS
1/2 Φ TYP



SPAN

78" EAST TO S20 - KT289 - 1 1/2 Φ - 78" WEST TO S19A

R.V. Monterole
G.C. STA Elec. DCPP
9-8-82

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

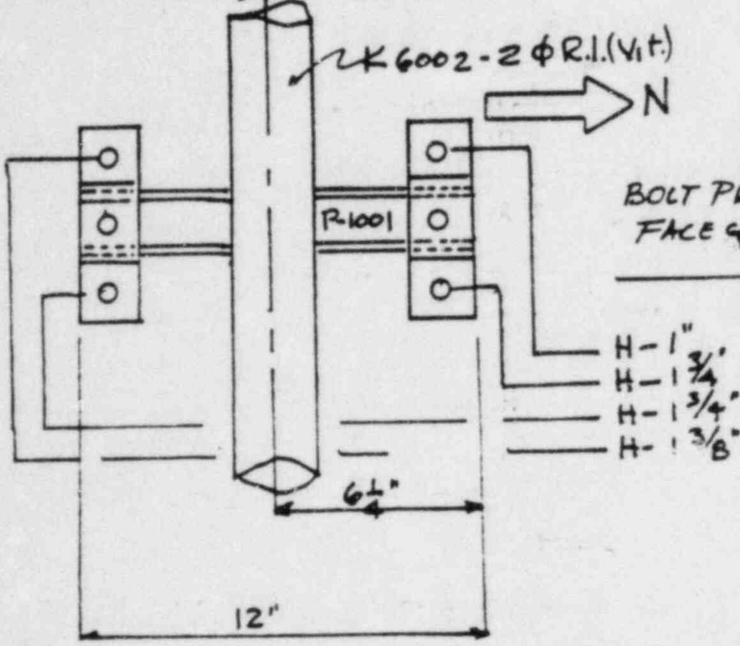
GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

GE/GW-115-2-118
S 20
MTD in ceiling

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.

NOTE:
ALL BOLTS 1/2 φ



BOLT PROJ FR. FACE of Conc.	EMBEDMENT by U.T.
	1/2"φ x 3 3/4" Hiltis

SPAN

South 46" To S-20	K6002-2φ R.I. NORTH 29" to S20

R.V. Montorola
G.C. STA. ELEC.

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.
					DCPP				
					9-3-82				

GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

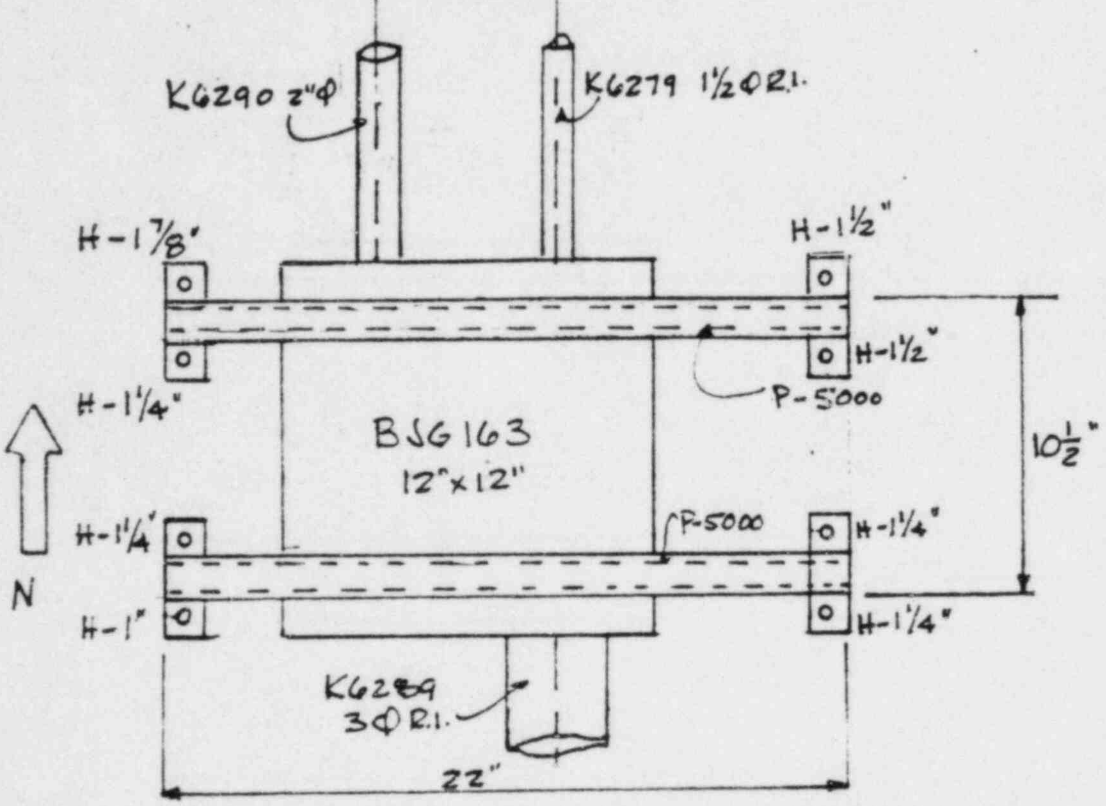
"AS BUILT"

GE/GW-140-1-62, DET. S20
WALL Mounted

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.

Notes: ALL bolts $1/2"\phi \times 3\,3/4"$ Hilti's



LOOKING DN FR Bottom of 140' S Lab.

SPANS

FROM BOX BJG 163:
- K6279 - 1½Φ R.I. } 24" NORTH TO S-20
- K-6290 - 2Φ R.I. } 24" NORTH TO S-20
- K6289 - 3Φ R.I. → 12" TO S-20 South

R.V. Monterola
G.C. STA. Elec
DCPP
9-7-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM	
SUPV.	
DSGN.	
DWN.	
CHKD.	
O.K.	
DATE	SCALE

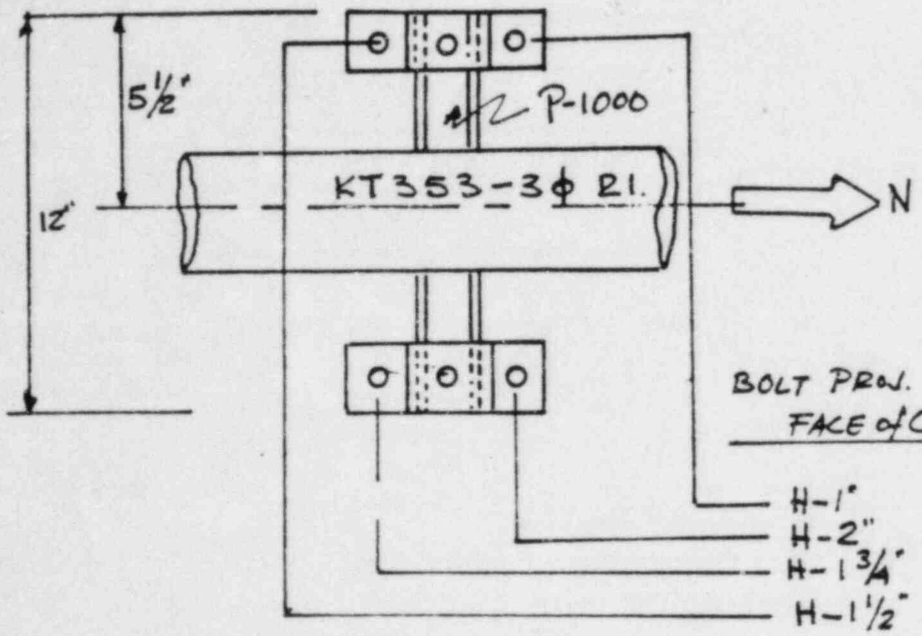
"AS BUILT"
GE/GW-115-4-216
S-41
Mounted on ceiling

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M	
DWG. LIST	
SUPSDS	
SUPSD BY	
SHEET NO.	SHEETS
DRAWING NUMBER	REV.

MICROFILM

NOTE: ALL BOLTS ½ φ



BOLT PROJ. FR. FACE of Conc.	EMBEDMENT by U.T.
	½"φ x 3¾ Hilti

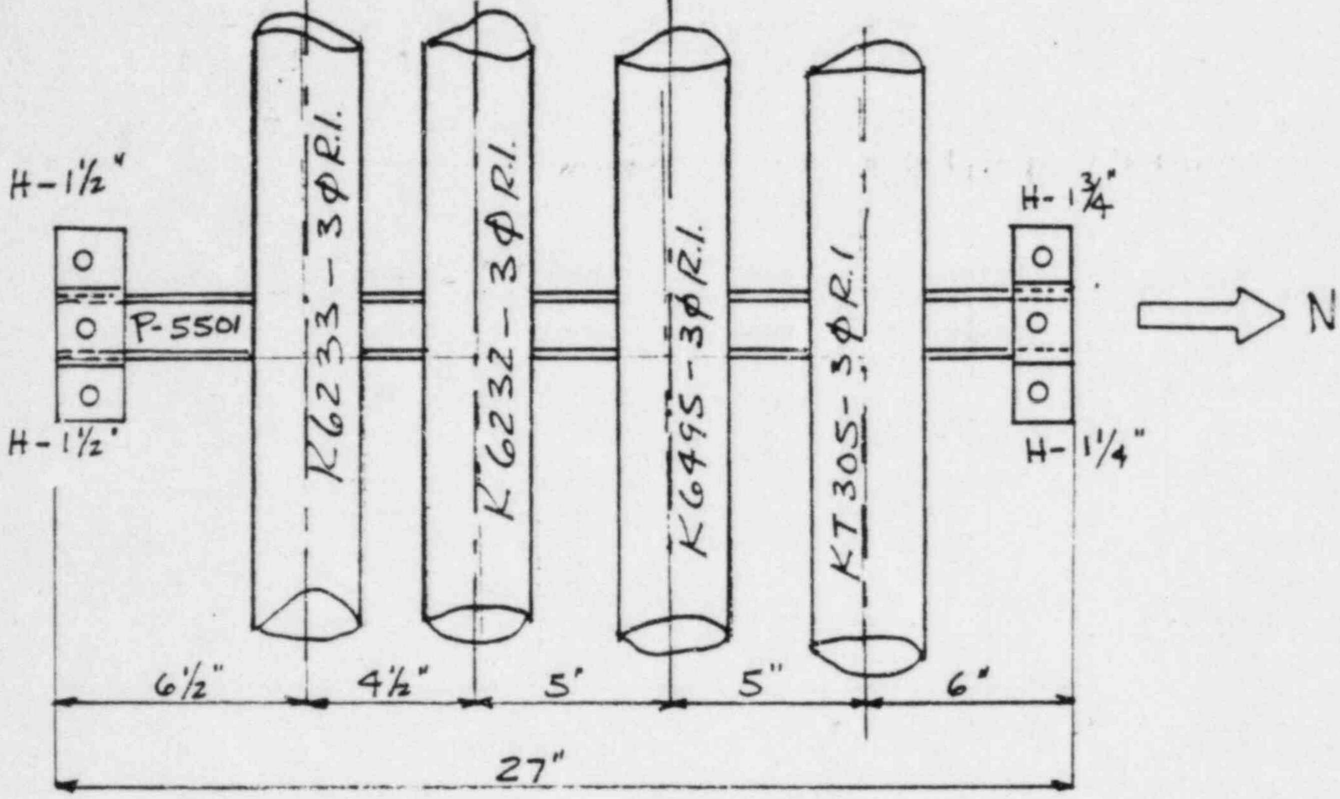
SPAN	
16" South To S-19A	KT353-3φ R.I. - 48" NORTH TO S20

R.V. Monterole
G.C. STA. Elec
DCPP 9-3-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM	"AS BUILT"	B/M
SUPV.	GE/GW-144-4-143	DWG. LIST
DSGN.	S-20	SUPSDS
DWN.	WALL Mounted	SUPSD BY
CHKD.	PACIFIC GAS AND ELECTRIC COMPANY	SHEET NO. SHEETS
C.K.	SAN FRANCISCO, CALIFORNIA	DRAWING NUMBER REV.
DATE SCALE		

NOTE: ALL BOLTS 1/2φ



SPANS

48" DN TO S-20

- KT305 - 3φ R.I.
- K6495 - 3φ R.I.
- K6232 - 3φ R.I.
- K6233 - 3φ R.I.

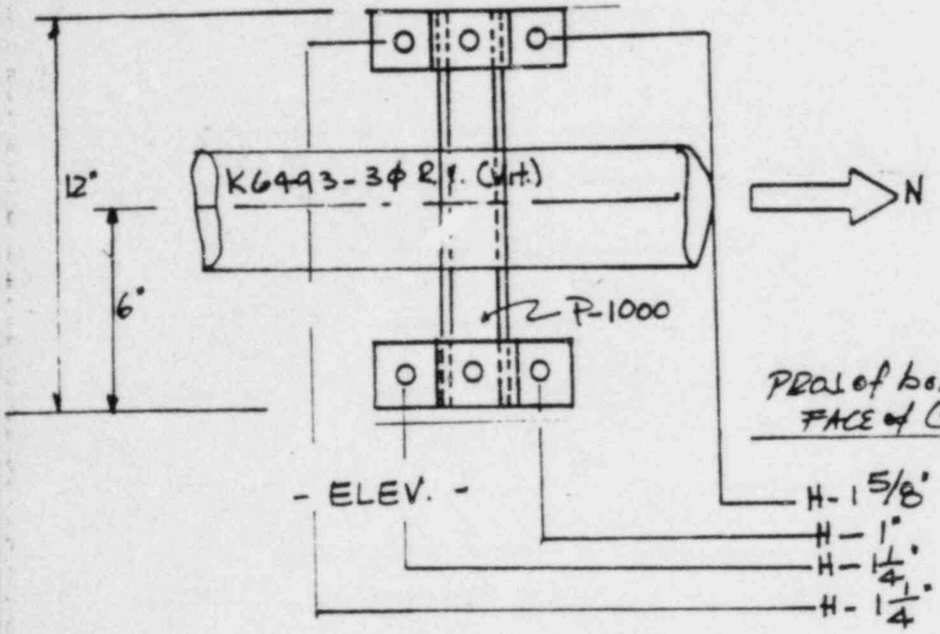
48" UP TO S20

R.V. Monterok
GC STA. ELEC
DCPP
9-3-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM SUPV. DSGN. DWN. CHKD. O.K. DATE / SCALE	"AS BUILT" GE/GW-~~140~~-4-151 S-20 WALL Mounted **PACIFIC GAS AND ELECTRIC COMPANY** SAN FRANCISCO, CALIFORNIA	B/M DWG. LIST SUPSDS SUPSD BY SHEET NO. / SHEETS DRAWING NUMBER / REV.

NOTE: ALL BOLTS $\frac{1}{2}\phi$



PROJ of bolt FR FACE of CONC	EMBEDMENT BY ULTRASONIC TRANS
	1/2" Φ x 3 3/4" Hiltis

SPANS

30" south To BJG207 — K6493-3Φ-R.1 - 48' NORTH TO S19A

R.V. Monterole
G.C. ELEC. DCPP
9-3-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

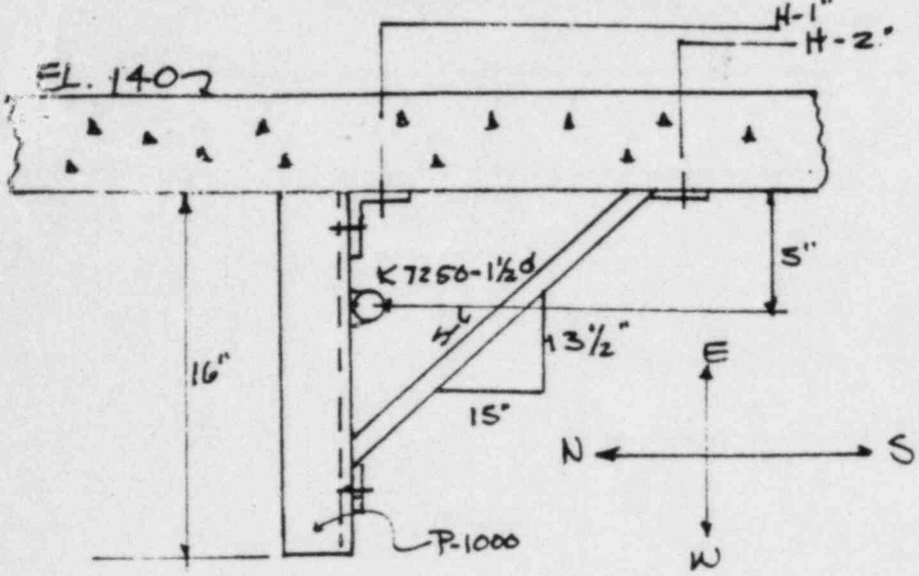
GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

"AS BUILT"
GE/GW-140-4-161
S-20
Mounted on WALL

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.

NOTE: ALL BOLTS 1/2" Φ x 3 3/4" Hiltis



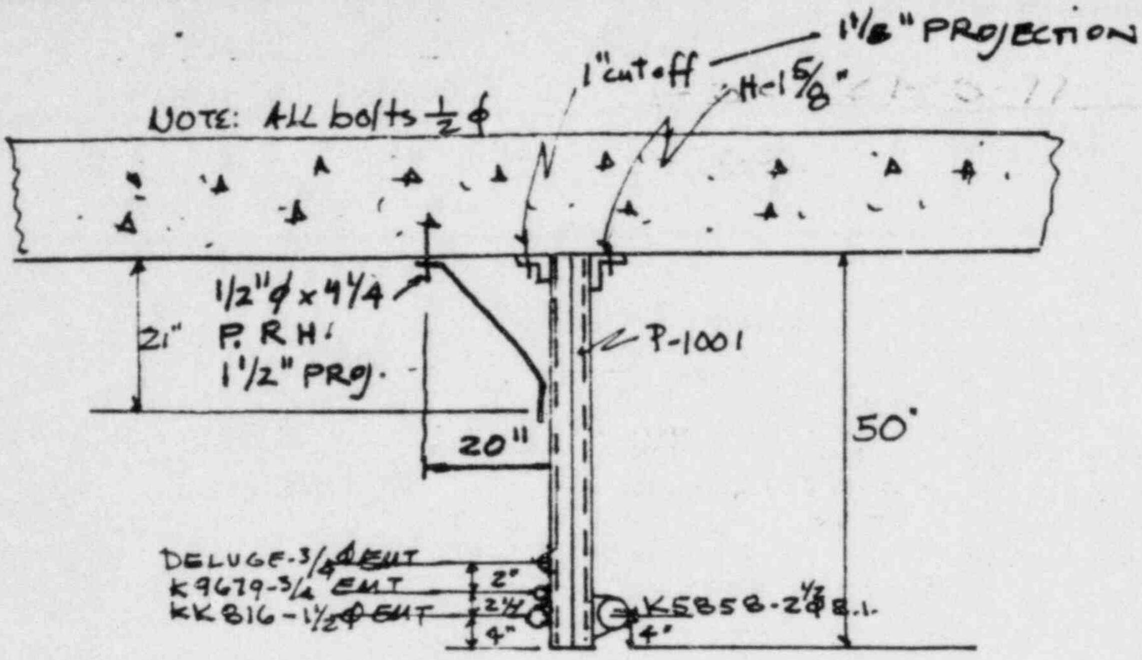
SPAN

48" EAST TO S288 | K7250-1 1/2 Φ - 14' WEST TO S-40

R.V. Monterola
G.C. STA. Elec
DCPP

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.
					9-3-82			

GM SUPV. DSGN. DWN. CHKD. O.K. DATE / SCALE	"AS BUILT" GE/GW-140-4-300 S-288 Ceiling Mtd. PACIFIC GAS AND ELECTRIC COMPANY SAN FRANCISCO, CALIFORNIA	B/M DWG. LIST SUPSDS SUPSD BY SHEET NO. / SHEETS DRAWING NUMBER / REV.



LOOKING SOUTH

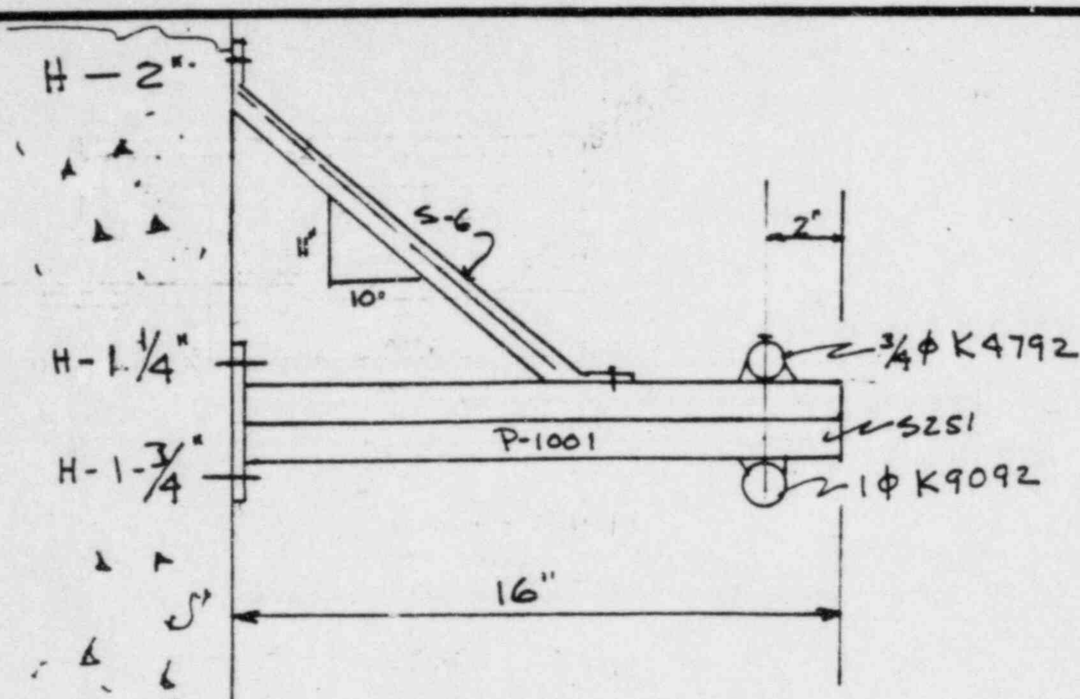
SPANS

96" North to S-202	DELUGE - 3/4 ϕ EMT - 64" South to S-18
	K9679 - 3/4 ϕ EMT - 70" S-18
	KK816 - 1 1/2 ϕ EMT - 72" S-18
	K5858 - 2 1/2 ϕ RI - 56" S-18

R.V. Montero
G.C. STA. Elec
DCPP
9-7-82

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM SUPV. DSGN. DWN. CHKD. O.K. DATE / SCALE	"AS BUILT" S-289 H-85-S-11 Mounted on Ceiling PACIFIC GAS AND ELECTRIC COMPANY SAN FRANCISCO, CALIFORNIA	B/M DWG. LIST SUPSDS SUPSD BY SHEET NO. / SHEETS DRAWING NUMBER / REV.



Looking EAST

SPANS

90" WEST TO S288 { 3/4φ-K4792 / 1φ-K9092 } 40" EAST TO WALL

R.V. Manterola
G.C. STA. Elec
DCPP
9-9-82

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

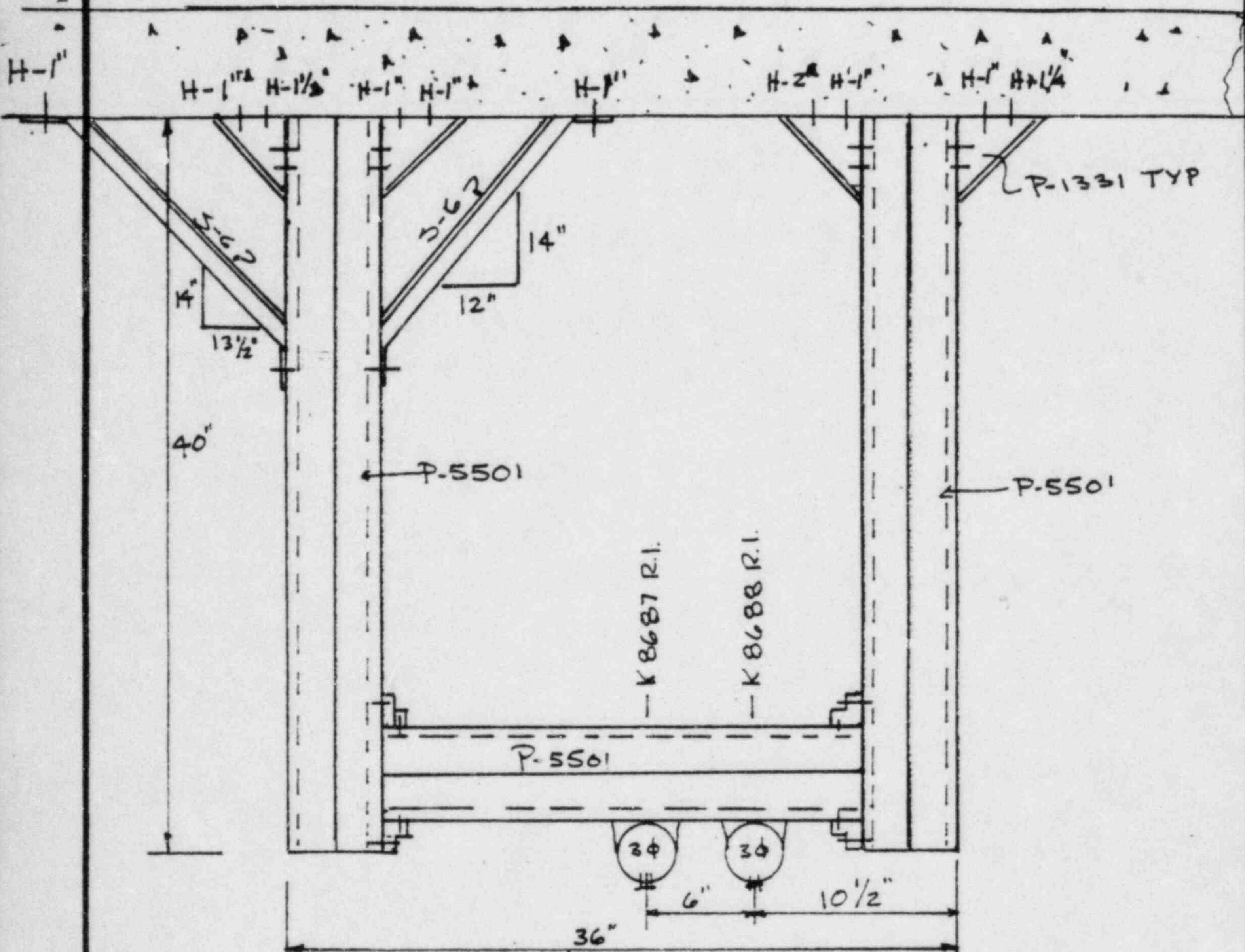
GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

"AS BUILT"
H-115-2-11
S-242
WALL Mounted

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.

NOTE: ALL BOLTS 1/2" Φ



LOOKING EAST

SPAN

90" WEST TO S271 { K8687-3Φ-R.I / K8688-3Φ-R.I } 41" EAST TO WALL

R.V. Monterole
GC. STA. ELEC
DCPP
9-10-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

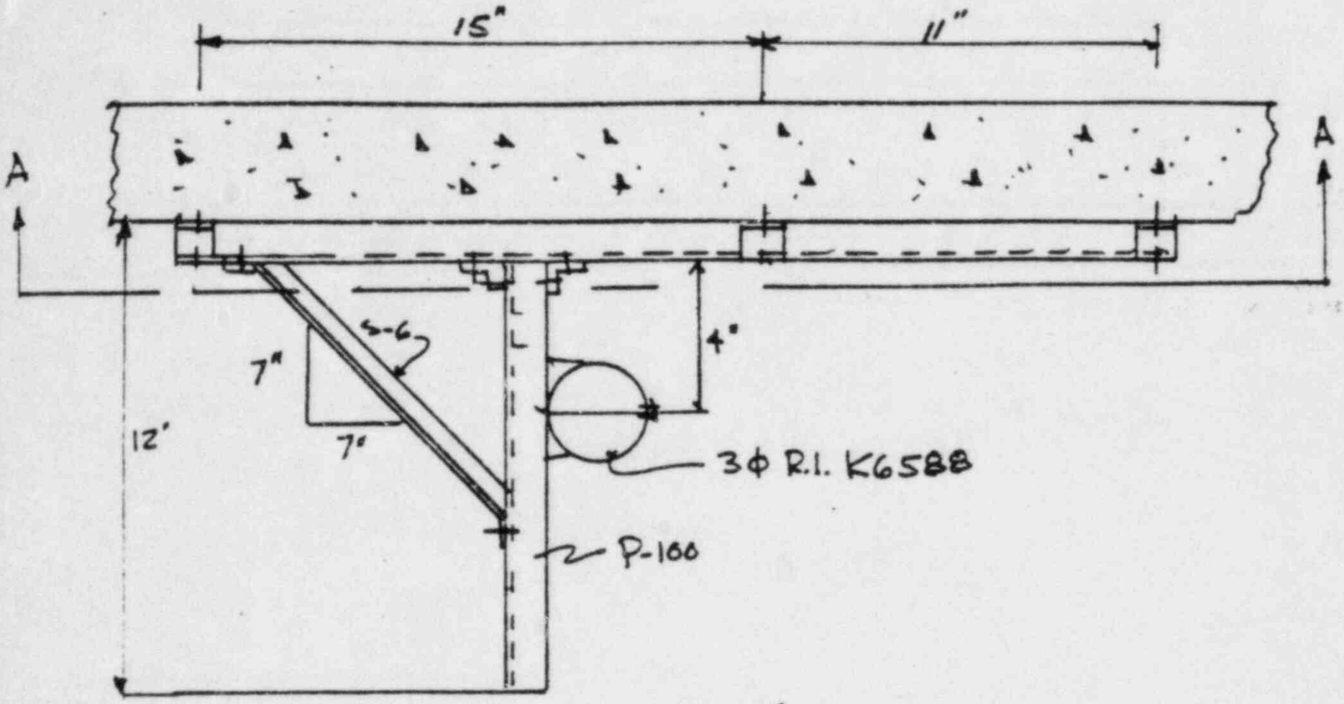
GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

"AS BUILT"
H-128-12-6
S-299
Mounted at Ceiling

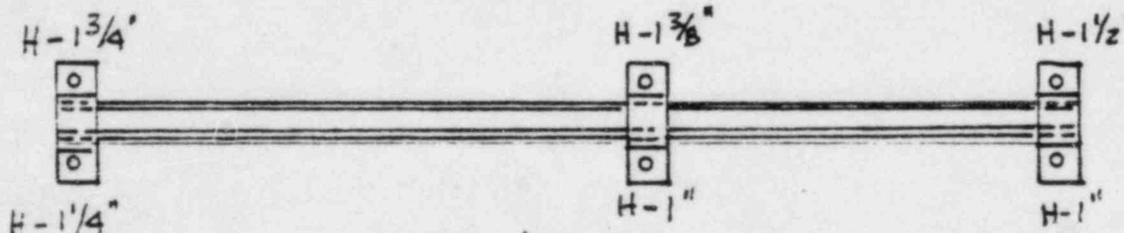
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.

Note: ALL bolts 1/2"φ



Looking North



Section A-A

SPANS

48" TO TRAY NORTH	K6588 - 3φ R.I. - 69 1/2" South to S102

R.V. Monterak
G.C. STA. Elec
DCPP
9-9-82

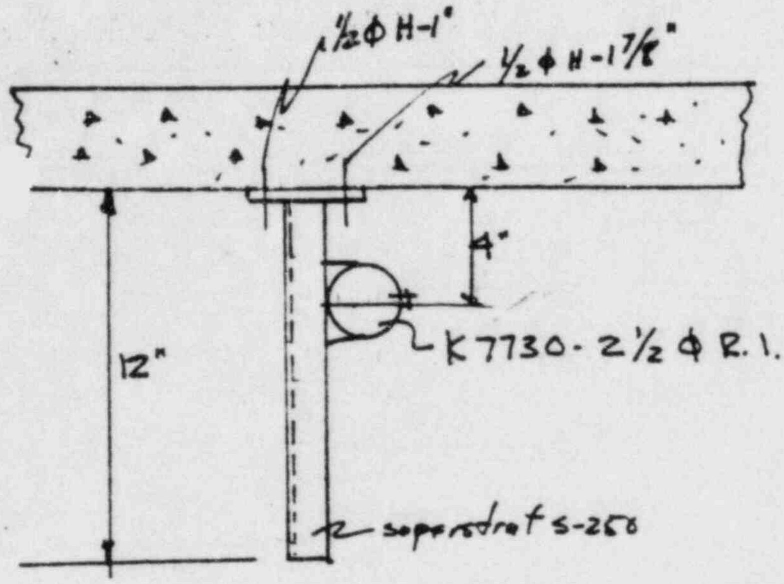
APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APPD.

GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

"AS BUILT"
H-128-1-59
S-233
Mounted From Ceiling

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.



LOOKING South

SPANS

40" North To Tray	K7730-2½ ϕ R.I. - 53' South, then EAST TO S-288

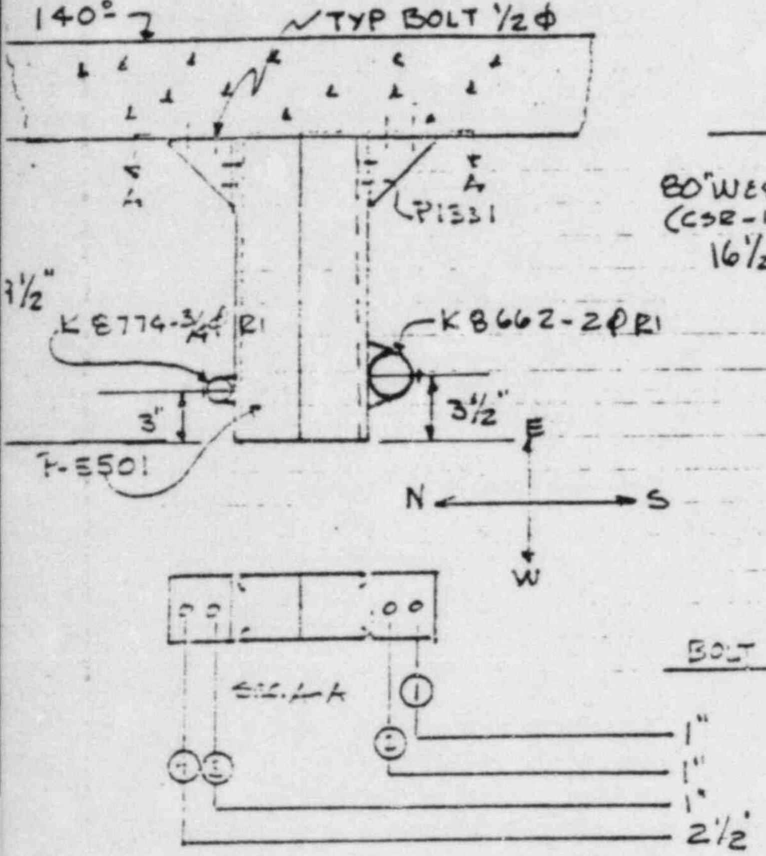
R.V. Monterola
GC. STA. Elec
DCPP 9-9-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM	"As Built"	B/M
SUPV.	H-128-1-58	DWG. LIST
DSGN.	S-87	SUPSDS
DWN.	Mounted at Ceiling	SUPSD BY
CHKD.		SHEET NO. SHEETS
O.K.	PACIFIC GAS AND ELECTRIC COMPANY	DRAWING NUMBER REV.
DATE SCALE	SAN FRANCISCO, CALIFORNIA	

"AS BUILT" SUPPORT NO. CSR-127-3-77

DETAIL NO. S-88



Conduit Spans

80" WEST TO SBB (CSR-127-3-78) 16 1/2" West To No det.	K8774 - (3/4Φ RI) K8662 - (2Φ RI) } 6" EAST TO BOX BJH225

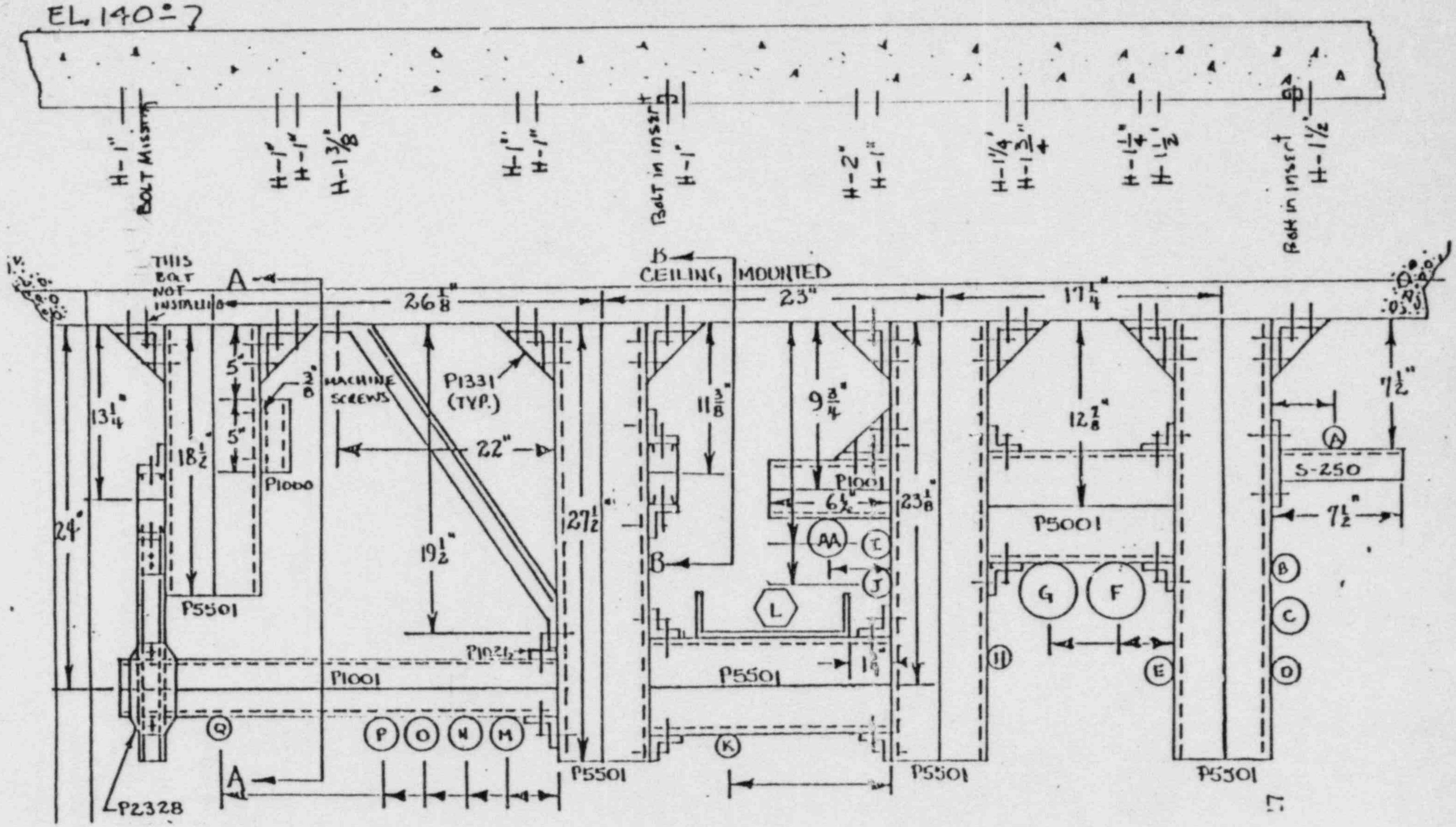
BOLT PROJ. FR. FACE of CONC.	FROM R. ISSEL EX... PER ULTRASONIC TRANSDUCER
	1/2"Φ x 3x3/4" HILTI'S

R.V. Monterde
G.S. STA.
SEPT. 1982

BOLT PROJECTION FROM FACE OF concrete

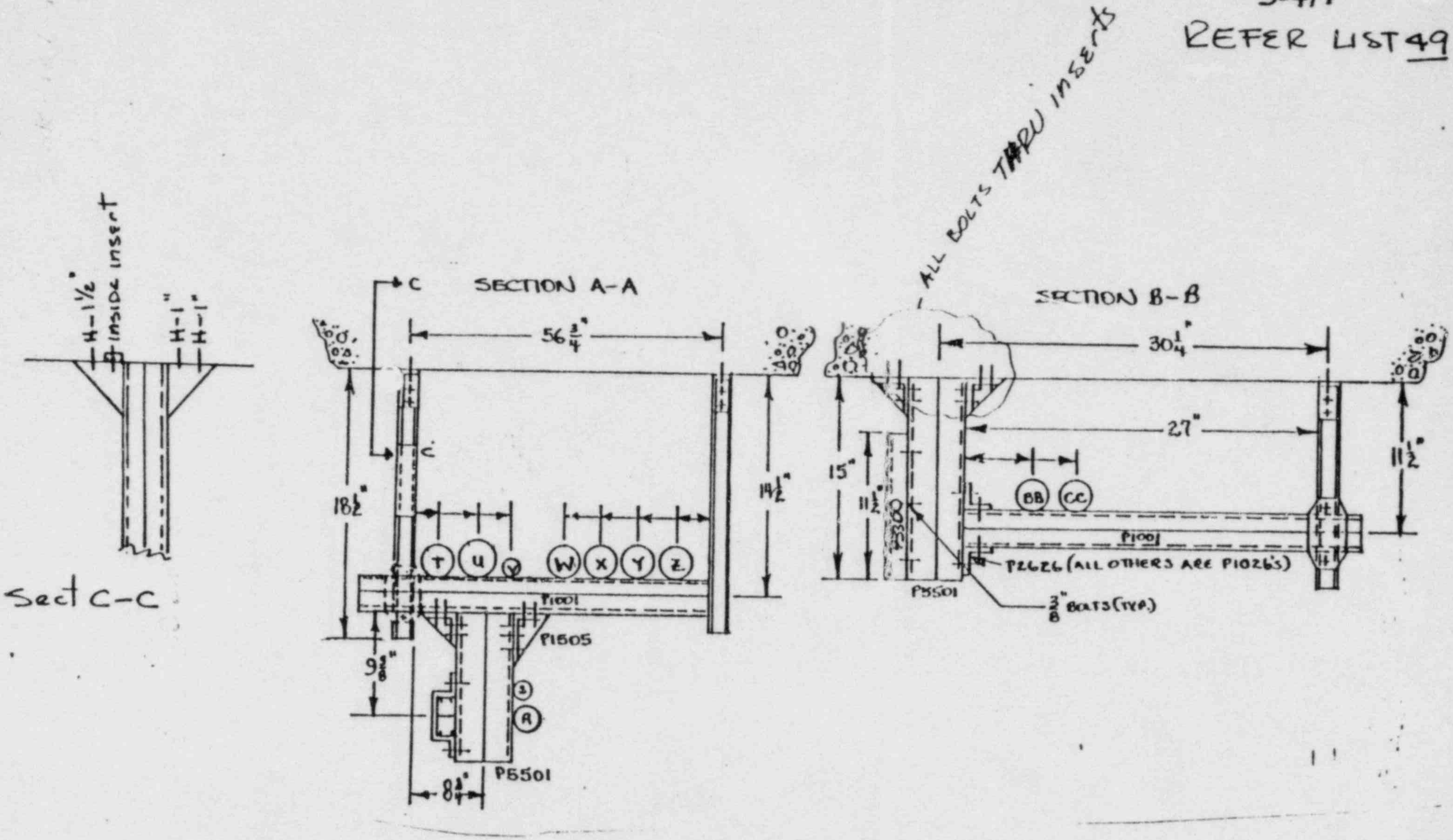
CSR-127-S-327
S-417

As BUILT PER LIST 49
REFER: List 49

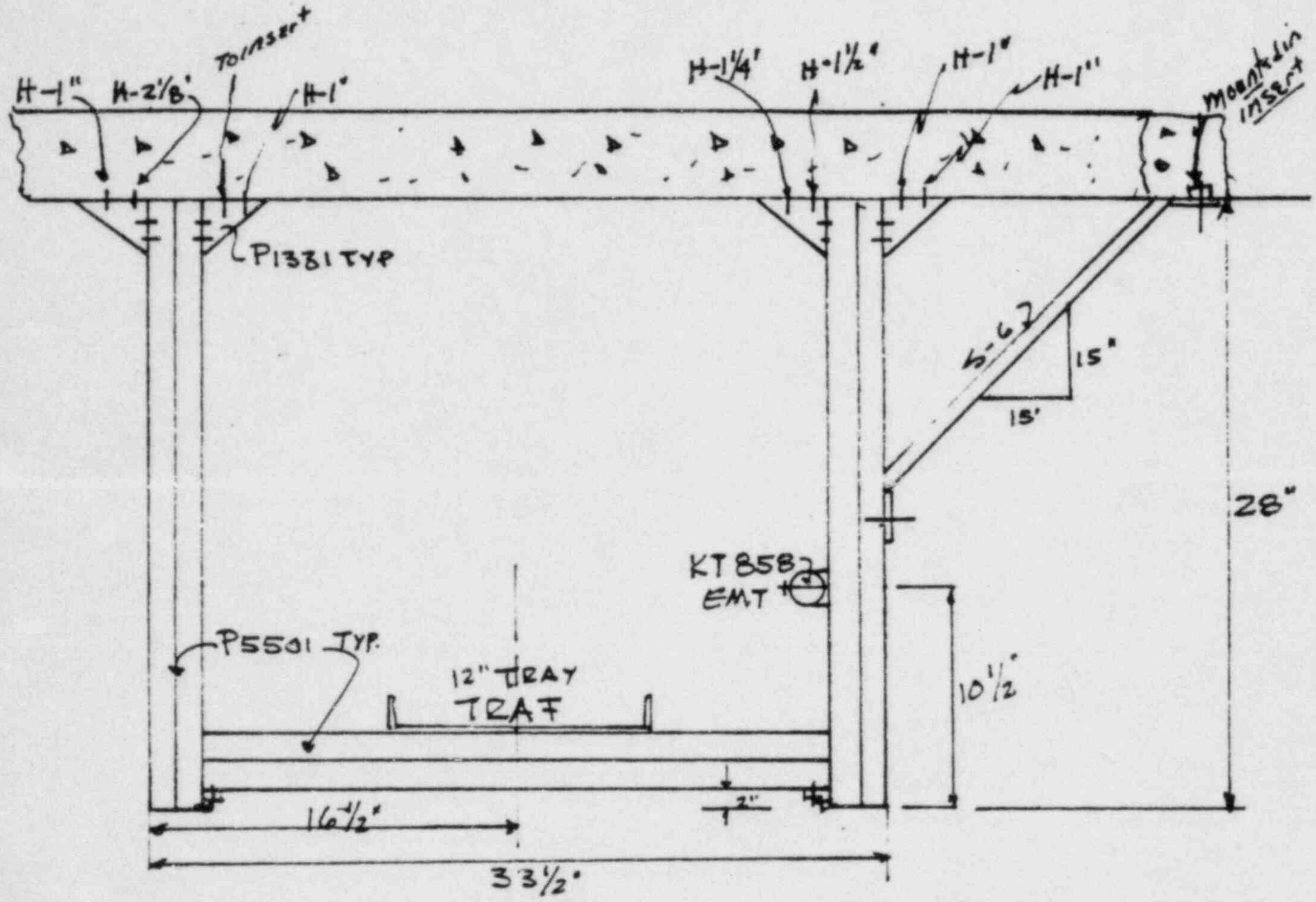


PAGE 2 of 2

CSR-127-S-327
S-417
REFER LIST 49



NOTE: ALL BOLTS 1/2"Φ x 3 3/4" Hilti's



SPANS

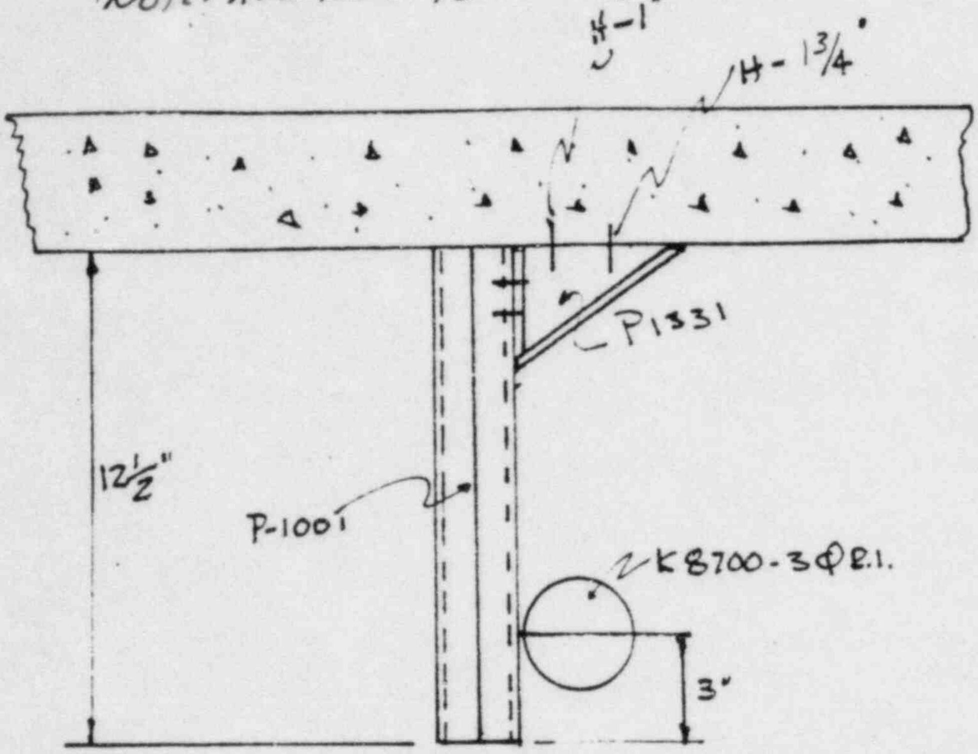
44" S.W TO TRAY TRHL	12" TRAY TRAF - } 46" N.E TO S417
12" S.W. TO TRAY TRBE	KT858 -

R.V. Monteroli
G.C. STA. Elec
DCPP 9-7-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM	"AS BUILT"	B/M
SUPV.	CSR-127-3-453	DWG. LIST
DSGN.	S-181	SUPSDS
DWN.	FROM CEILING	SUPSD BY
CHKD.	PACIFIC GAS AND ELECTRIC COMPANY	SHEET NO. SHEETS
O.K.	SAN FRANCISCO, CALIFORNIA	DRAWING NUMBER REV.
DATE SCALE		

Note: ALL BOLTS 1/2" Φ x 3 3/4" Hilti's



LOOKING NORTH

SPANS

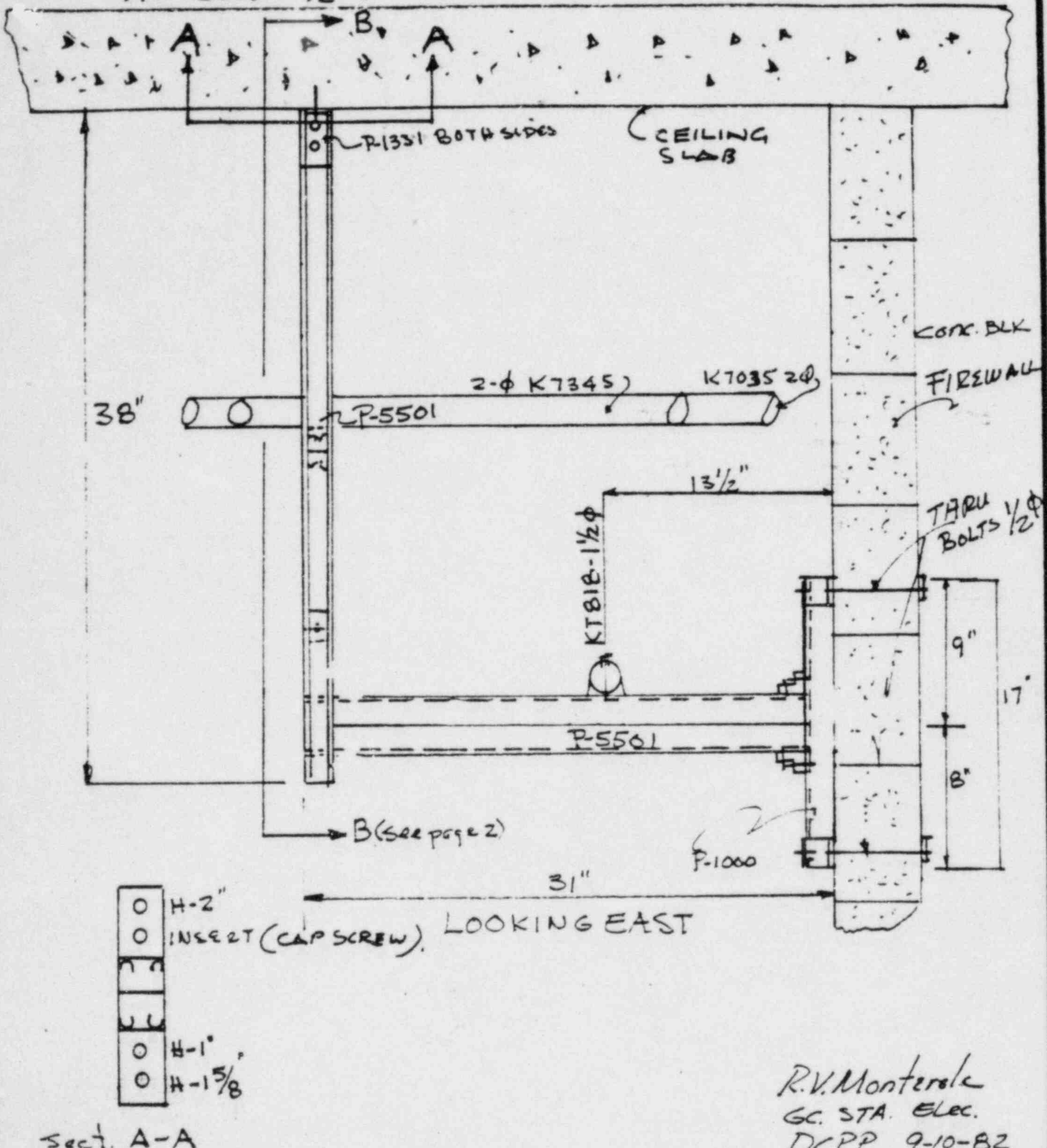
66' South To S243	K8700-3Φ R.I. - 42" NORTH TO S-129

R.V. Monterola
G.C. STA. Elec
DCPP 9-7-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM	"AS BUILT"	B/M
SUPV.	CSR-127-3-480	DWG. LIST
DSGN.	S-85	SUPSDS
DWN.	ceiling Mounted	SUPSD BY
CHKD.	PACIFIC GAS AND ELECTRIC COMPANY	SHEET NO. SHEETS
O.K.	SAN FRANCISCO, CALIFORNIA	DRAWING NUMBER REV.
DATE SCALE		

ALL BOLTS 1/2" Φ



R.V. Monterola
GC. STA. Elec.
DCPP 9-10-82

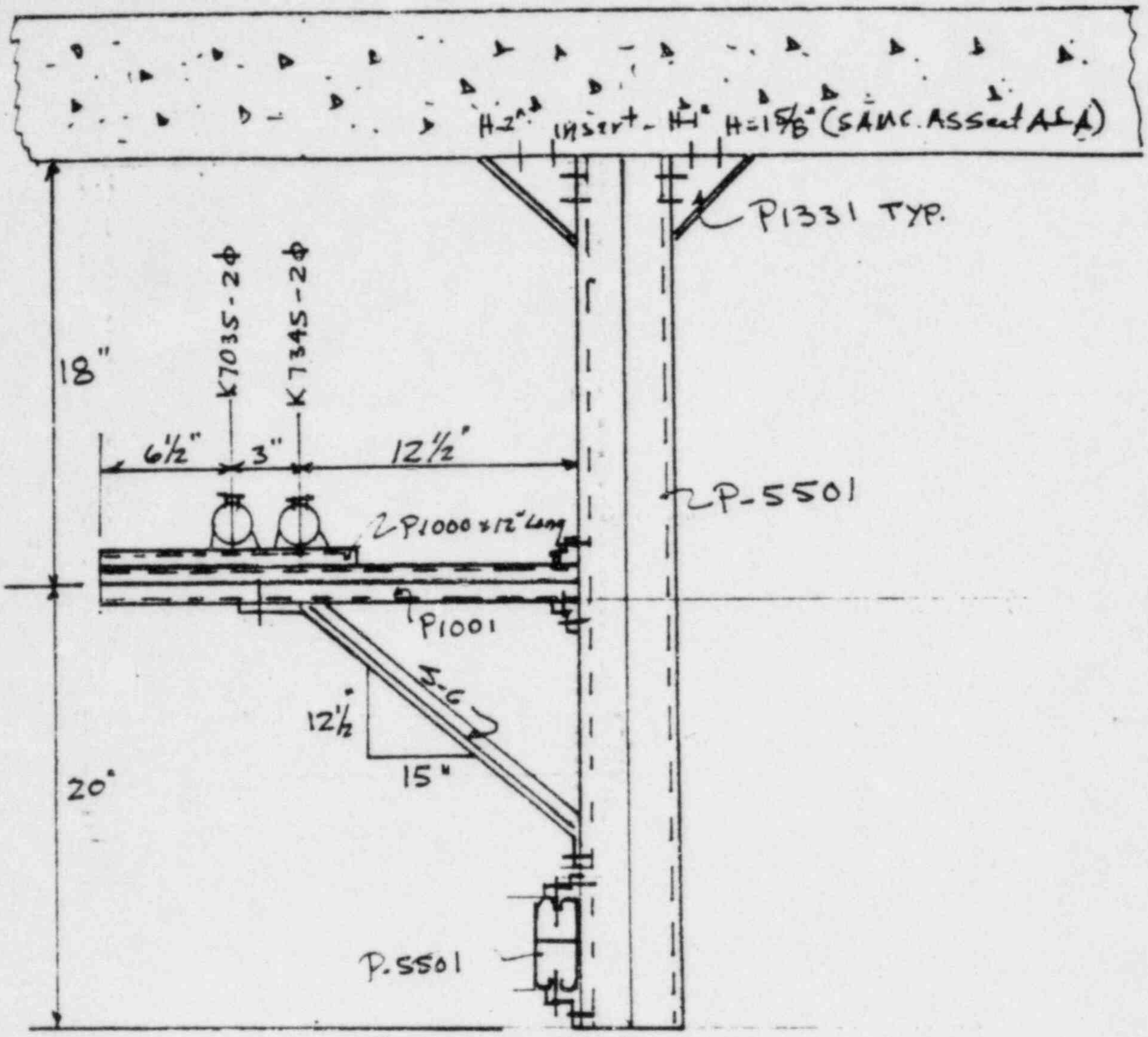
APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE | SCALE

"AS BUILT"
CSR-127-4-121
S-136
Ceiling & WALL Mounted

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. | SHEETS
DRAWING NUMBER | REV.



SECTION B-B

SPANS

50" WEST TO S135	KT818 - 1½ϕ - 100" EAST TO S135
96" NORTH TO S121 -	K7035 - 2ϕ - } 31" south to blockwall.
12" NORTH TO TRAY	K7345 - 2ϕ - }

R.V. Monterde
G.C. STA. Elec.
DCPP 9-10-82

APPROVED BY									
	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.	

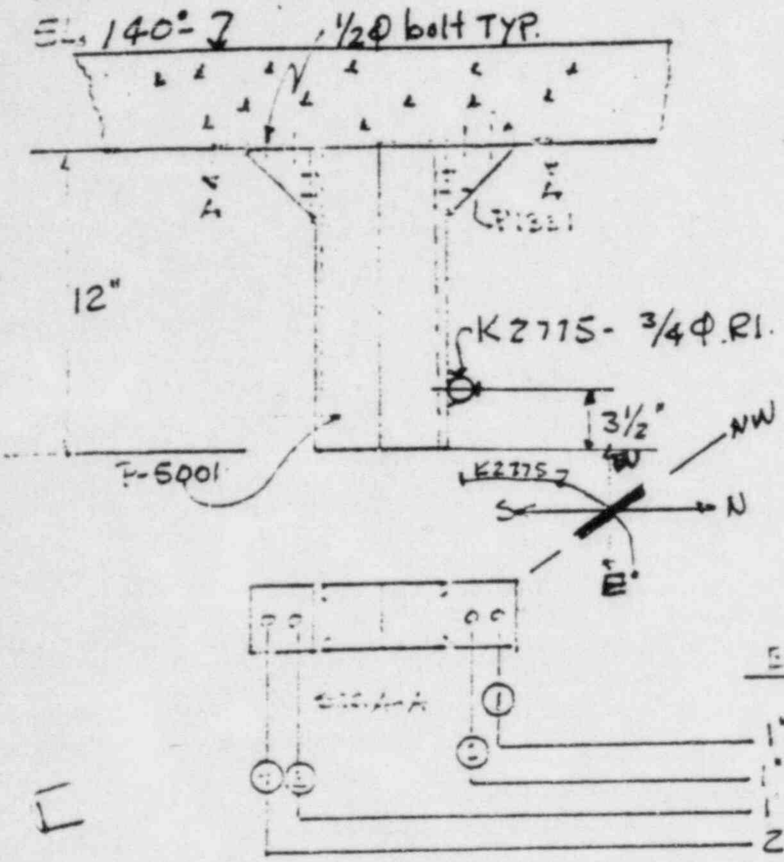
GM	"AS BUILT"	B/M
SUPV.	CSR-127-4-121	DWG. LIST
DSGN.	S-136	SUPSDS
DWN.	Ceiling & WALL Mounted	SUPSD BY
CHKD.		SHEET NO. SHEETS
O.K.	PACIFIC GAS AND ELECTRIC COMPANY	DRAWING NUMBER REV.
DATE SCALE	SAN FRANCISCO, CALIFORNIA	

K-1(

"AS BUILT" SUPPORT NO. CSR-127-4-152

DETAIL NO. S-88

E-10(



Conduit SPANS	
97" south to S88	K-2775- 3/4Φ RL 44' L Cell.

BOLT FROM FR. FACE of Conc.	FROM R.I. EMBEDMENT ULTRASONIC TR
	1/2"Φ x 3 3/4"

E-100

E-106

E-10C

E-100

E-115

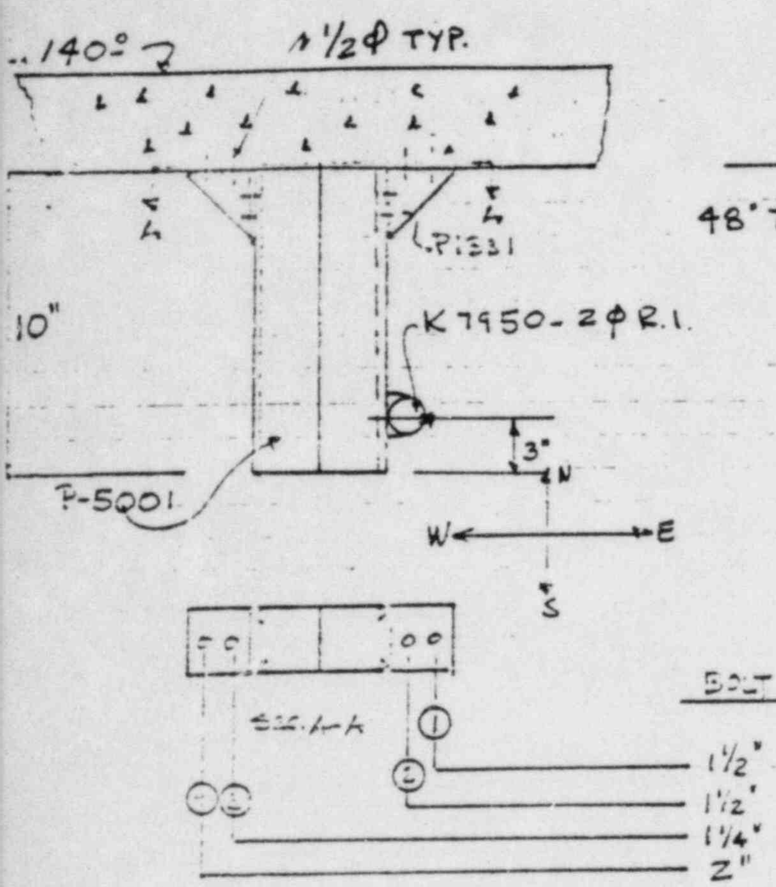
E-115

1F

R.J. Menter
G.E. STI.
SEPT. 19

"AS BUILT" SUPPORT NO. CSR-127-5-261

DETAIL NO. S-88



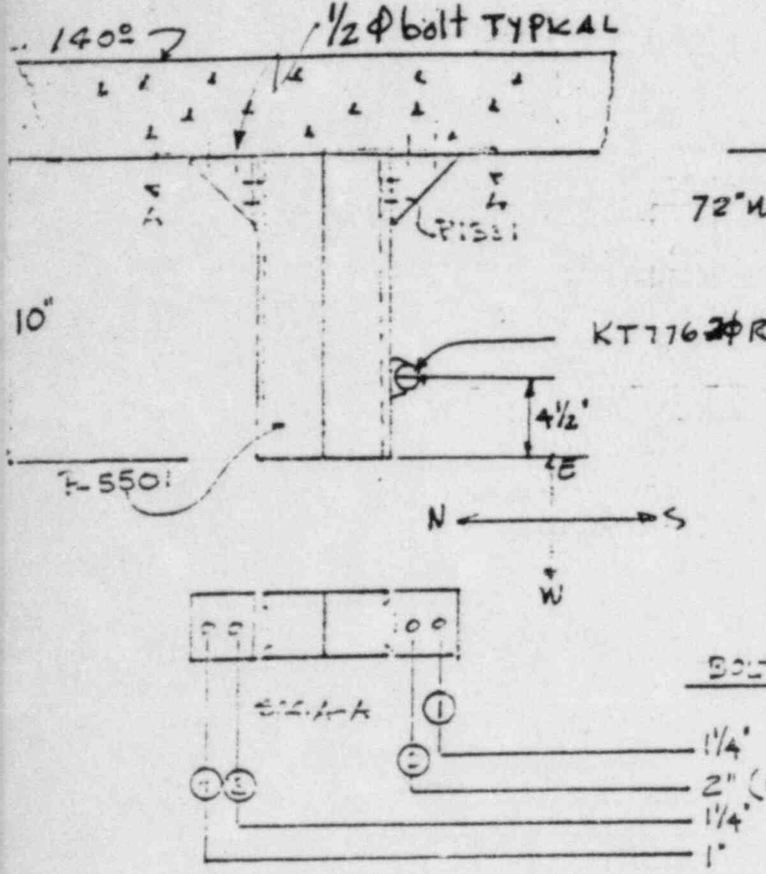
Conduit SPANS	
48" To WALL (NORTH)	K7950 - 97" South to rack No. 17 Control Box

BOLT PROJ. FR. FACE of Conc.	FROM R. ISSEL EMBEDMENT PER ULTRASONIC TRANSDUCER
	1/2" x 3 3/4" HILTI

R.V. Mentrele
G.G. STA.
SEPT. 1982

"AS BUILT" SUPPORT NO. CSR-127-6-166

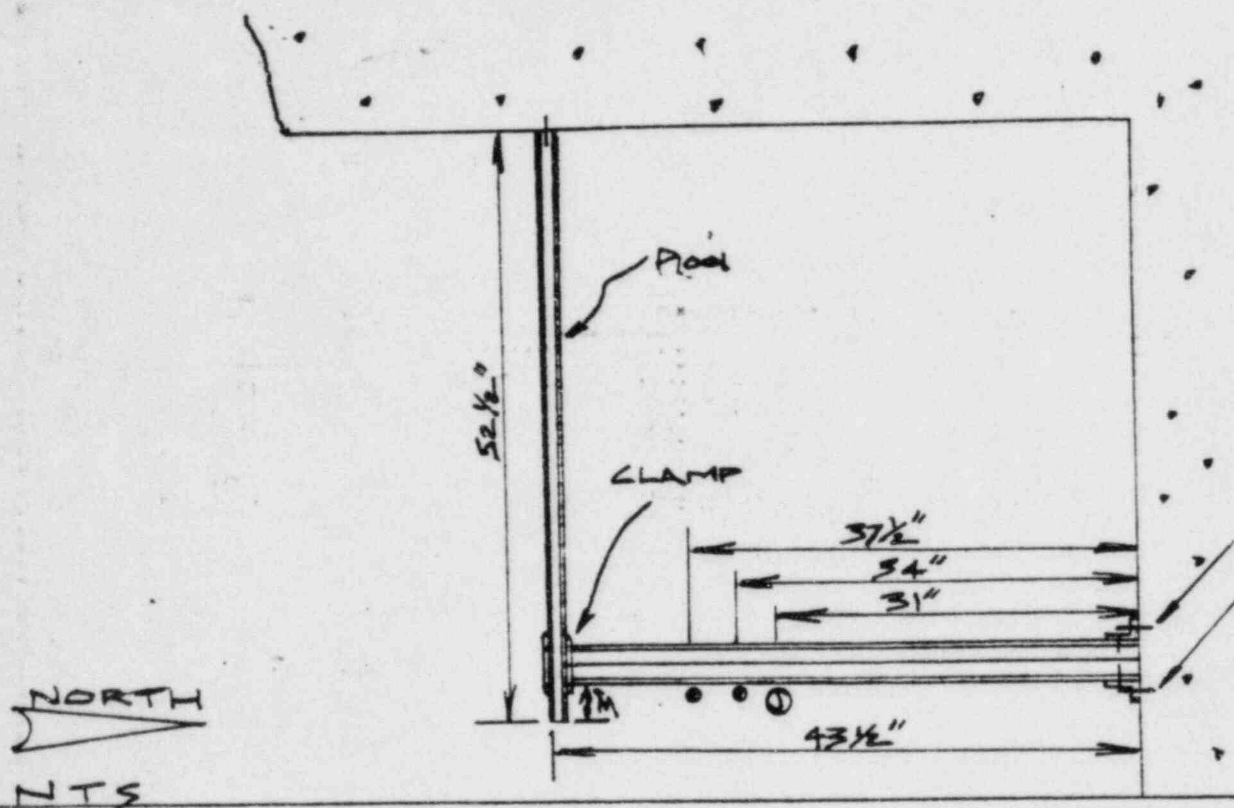
DETAIL NO. S-88

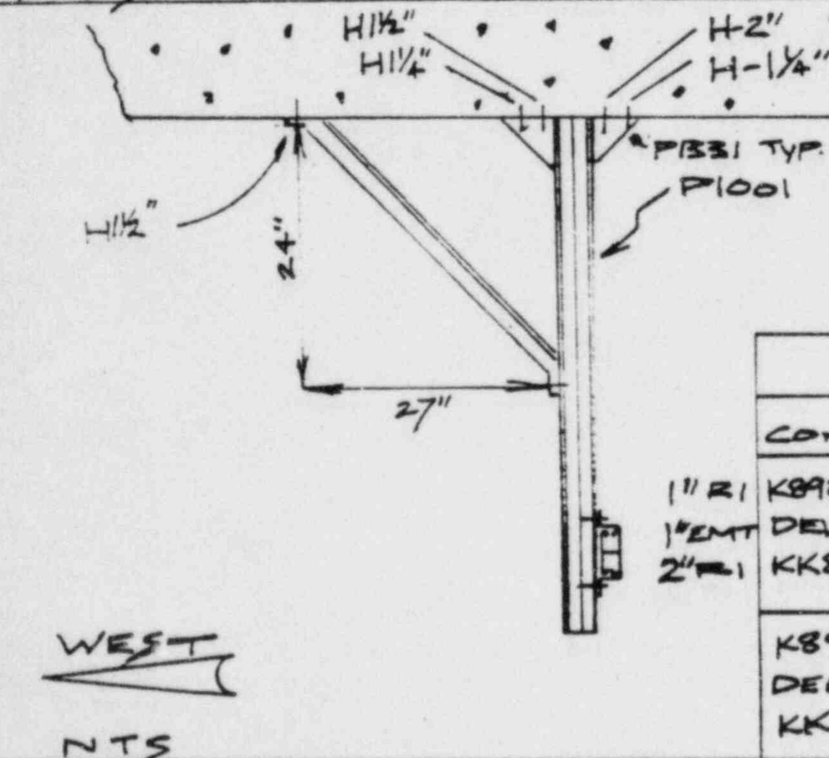


Conduit spans		
72" WEST TO S-143	KT776-1φR1	69" EAST TO S-70

BOLT PROJ. FR. FACE of CONC	FROM RISSEL EMBEDMENT PER ULTRASONIC TRANSDUCER
	1/2" φ × 3 3/4" HILTI

R.J. [signature]
G.E. STA.
SEPT. 1982





SPANS

	CONDUIT	DETAIL		
1" RI 1" EMT 2" RI	K8923 DELUGE KK807	S-383	WEST	76"
	K8923 DELUGE KK807	S-202	EAST	100"

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE | SCALE

J-115-10-63 S-383

AS-BUILT

BY M. CAMPBELL

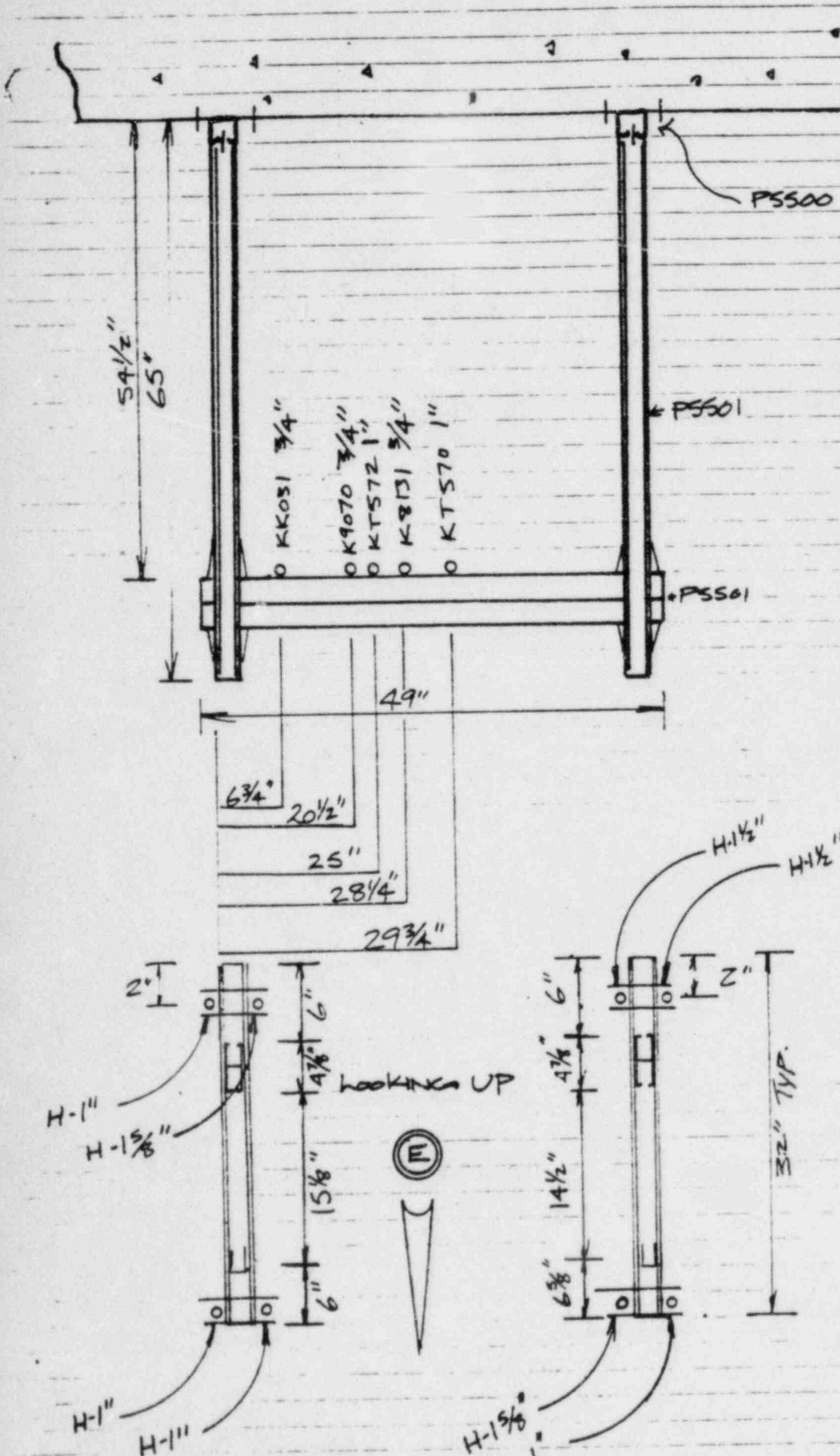
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA DATE 9.7.82

B/M
DWG. LIST
SUP'DS
S[illegible] BY
SHEET NO. SHEETS
DRAWING NUMBER REV.

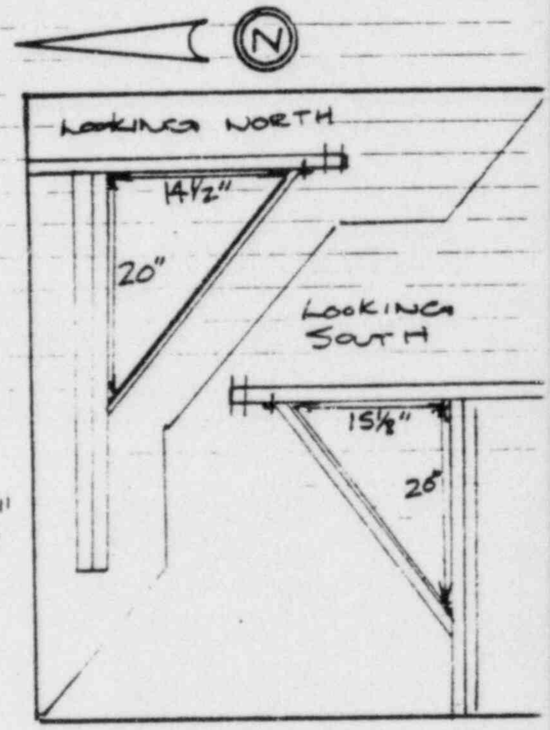
DATE: 7.8.82

S-477. J-115-11-59

PAGE 1 OF 1



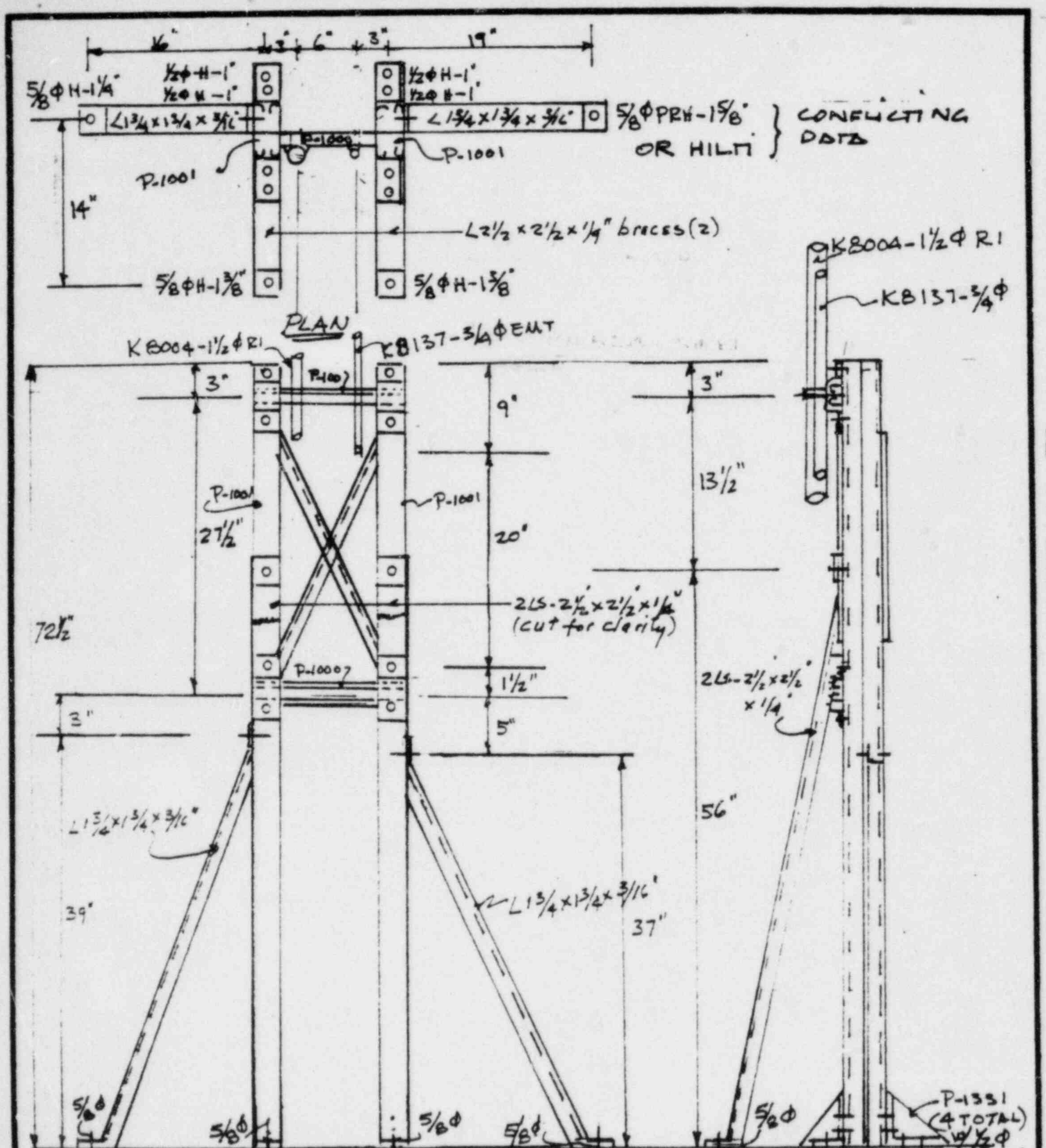
LOOKING EAST



SPANS

CONDUIT	EAST	DETAIL	WEST	DETAIL
KK031	45"	475	61"	477
K9070	45"	475	70"	289
KT572	66"	64	70"	289
K8131	45"	475	82"	64
KT570	45"	475	89"	MOTOR

BY. M. CAMPBELL



SPANS

38" Down to Valve

K8137-3/4ϕ EMT - 37" UP TO TRAY (MSAJ)

K8004-1 1/2ϕ RI, 96" TO BOX SOLB79 DWG.

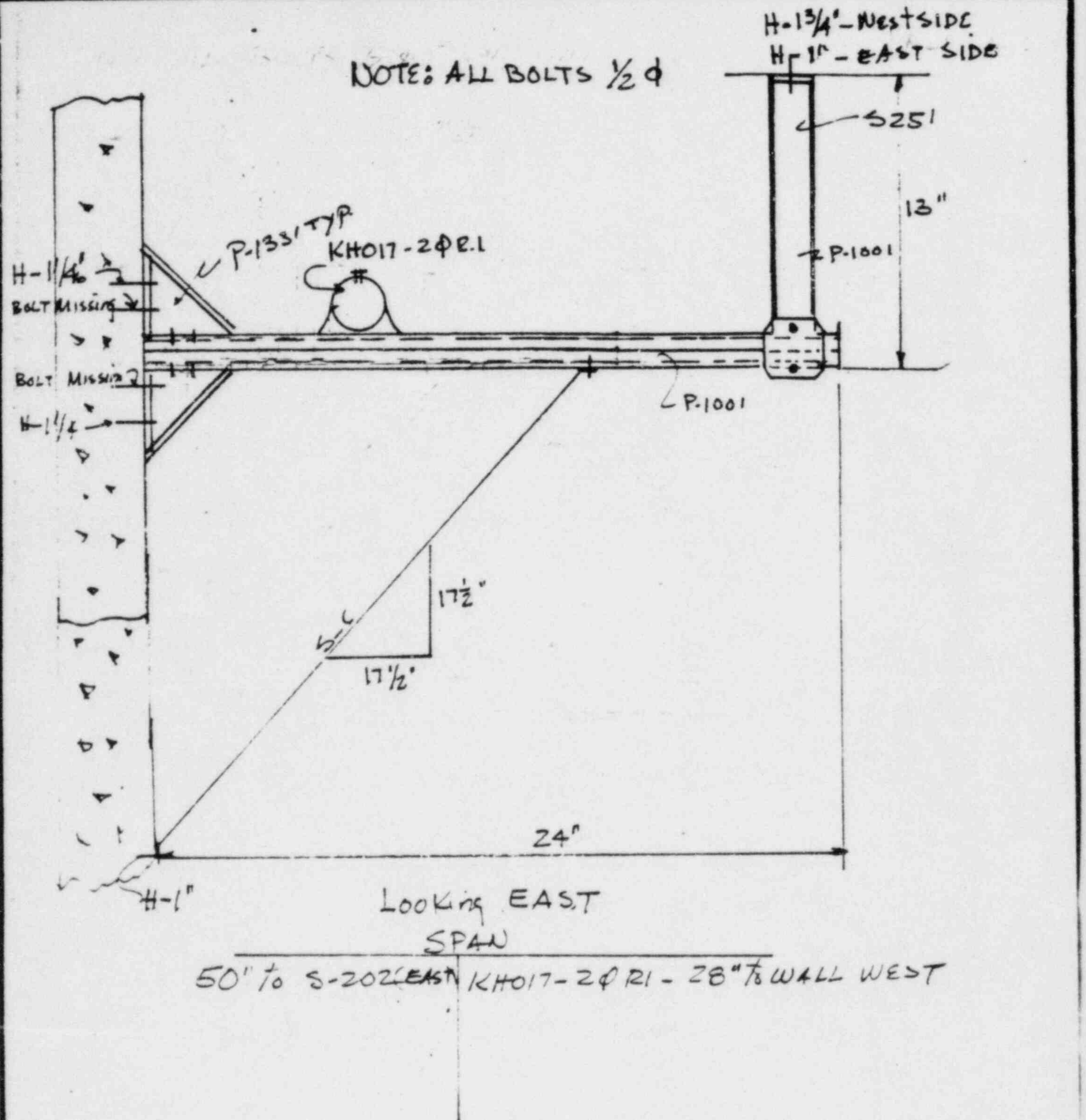
APPROVED BY		
GM		
SUPV.		
DSGN.		
DWN.		
CHKD.		
O.K.		
DATE	SCALE	

"AS BUILT"
J-115-10-43
S-67
FLOOR Mounted

R.V. Montenegro
GC STA. ELEC
DCPP 9-10-82

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M	
DWG. LIST	
SUPSDS	
SUPSD BY	
SHEET NO.	SHEETS
DRAWING NUMBER	REV.

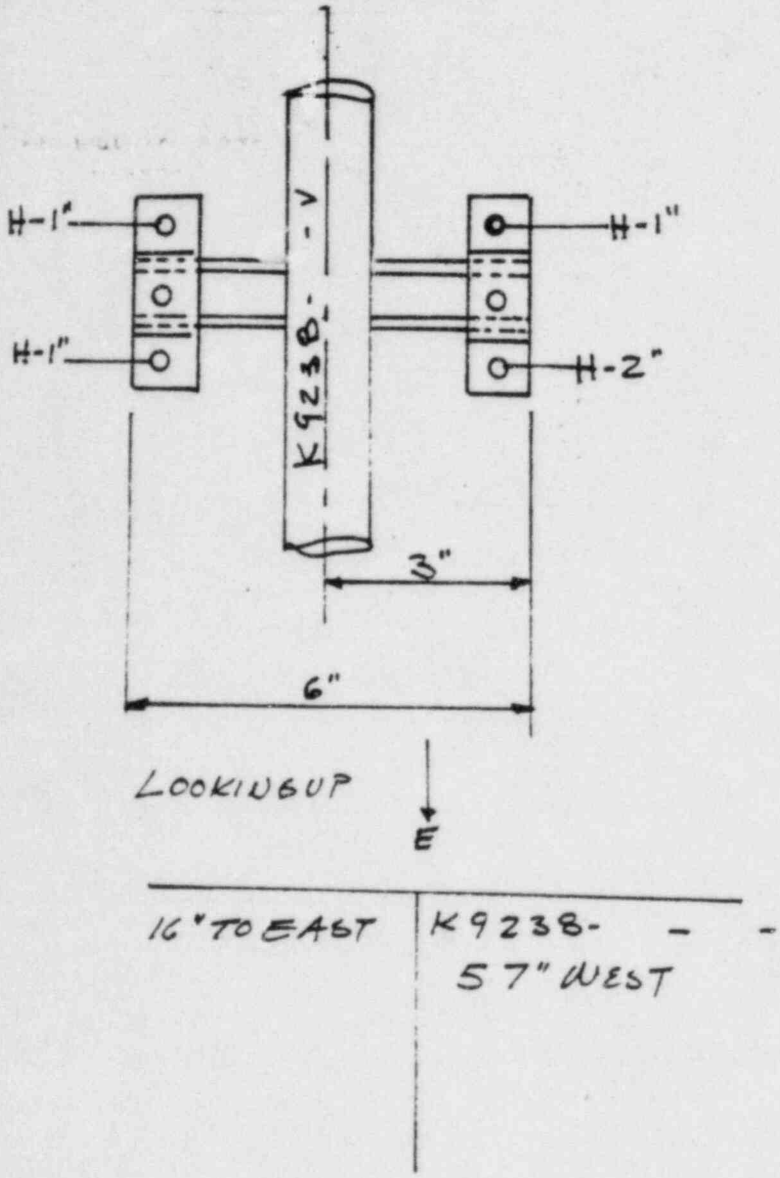


R.V. Montrof?
GC STA. DCPP
9-7-82

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

GM SUPV. DSGN. DWN. CHKD. O.K. DATE / SCALE	"AS BUILT" K-85-2.25 S-202 Mounted on WALL & CEILING **PACIFIC GAS AND ELECTRIC COMPANY** SAN FRANCISCO, CALIFORNIA	B/M DWG. LIST SUPSDS SUPSD BY SHEET NO. SHEETS DRAWING NUMBER REV.

NOTE: ALL BOLTS 1/2" ϕ x 3 3/4" Hiltis



R.V. Montorola
GC STA. ELEC.
DCPP 9-3-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

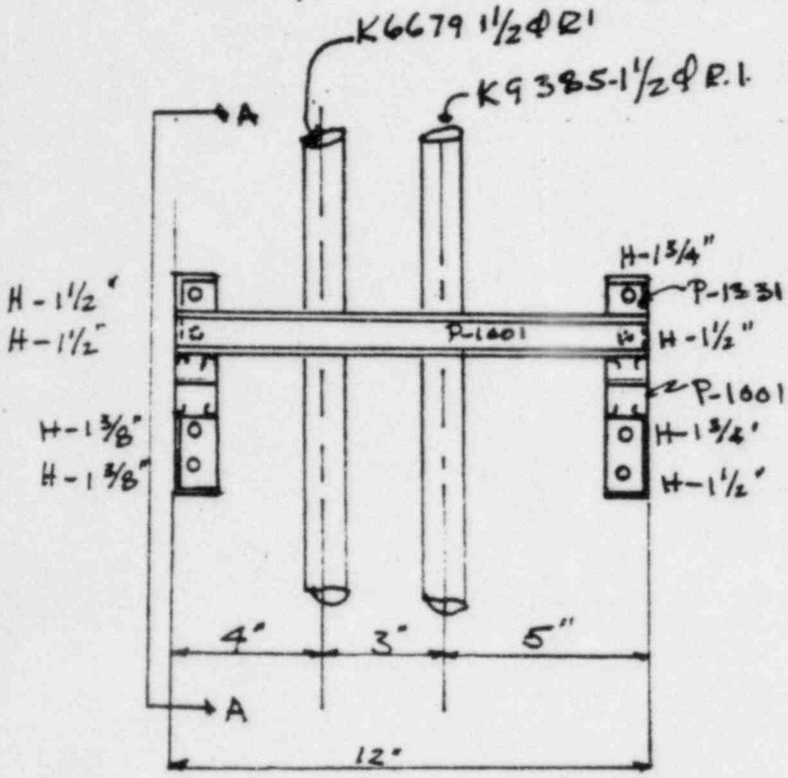
GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE | SCALE

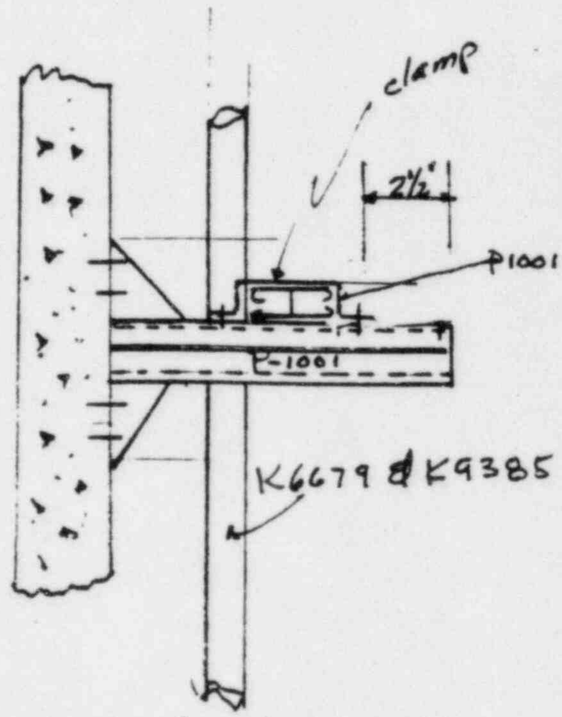
"AS BUILT"
K-100-3-40
S-19A
Ceiling Mounted

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. | SHEETS
DRAWING NUMBER | REV.

Note: ALL BOLTS 1/2" Φ × 3 3/4" Hiltis





Section A-A

	SPANS	
UP 90"-To 19B	-	K6679-1 1/2 Φ R.I.
UP 92" To S19A	-	K9385-1 1/2 Φ R.I.

Dn To Panel 31"

R.V. Manterola
G.C. STA. DCPP
9-7-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD

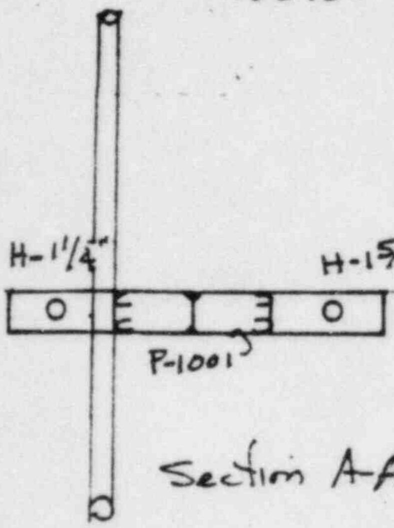
GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

"AS BUILT"
K-100-6-34
S-116
WALL Mounted

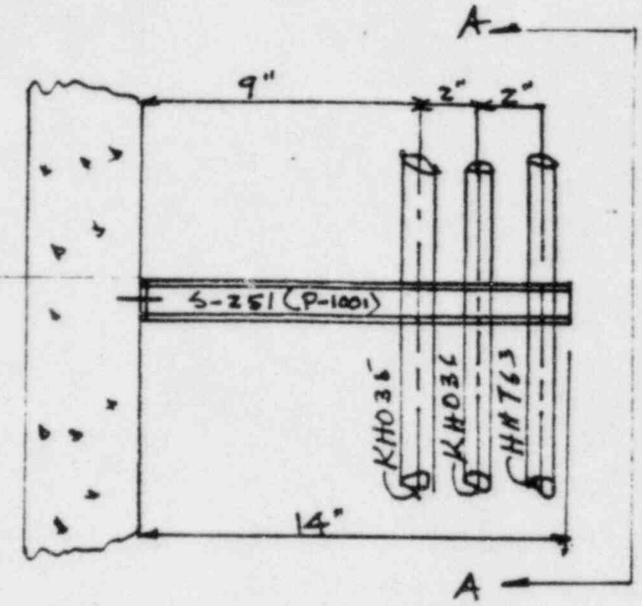
PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.
MICROFILM

NOTE: ALL BOLTS $\frac{1}{2}\phi$" x 3$\frac{3}{4}$" Hiltis



Section A-A



SPANS

73" -To S-20 UP	KH035 - 1ϕ - R.I. KH036 - 1ϕ - R.I. KHT63 - 1ϕ - R.I.	72" To S202 DN.

R.V. Monterola
GC. STA. ELEC
DCPP
9-7-82

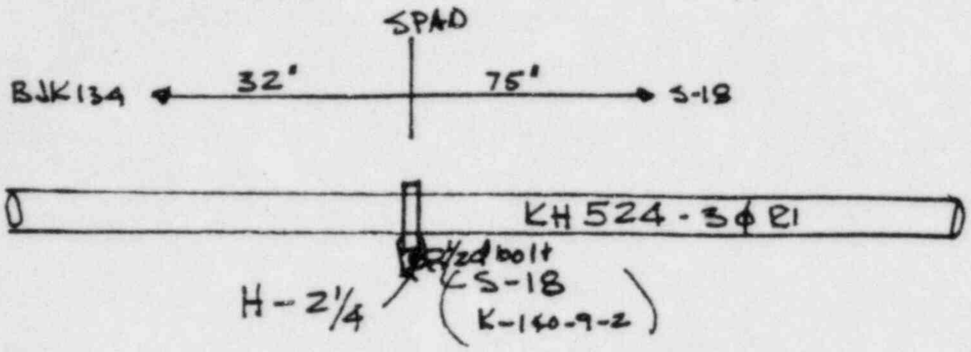
APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD

GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

"As BUILT"
K-100-11-40
S-243
WALL Mounted

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.



R.V. Monterok
Gc. STA. Elec
DCPP
9-7-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.

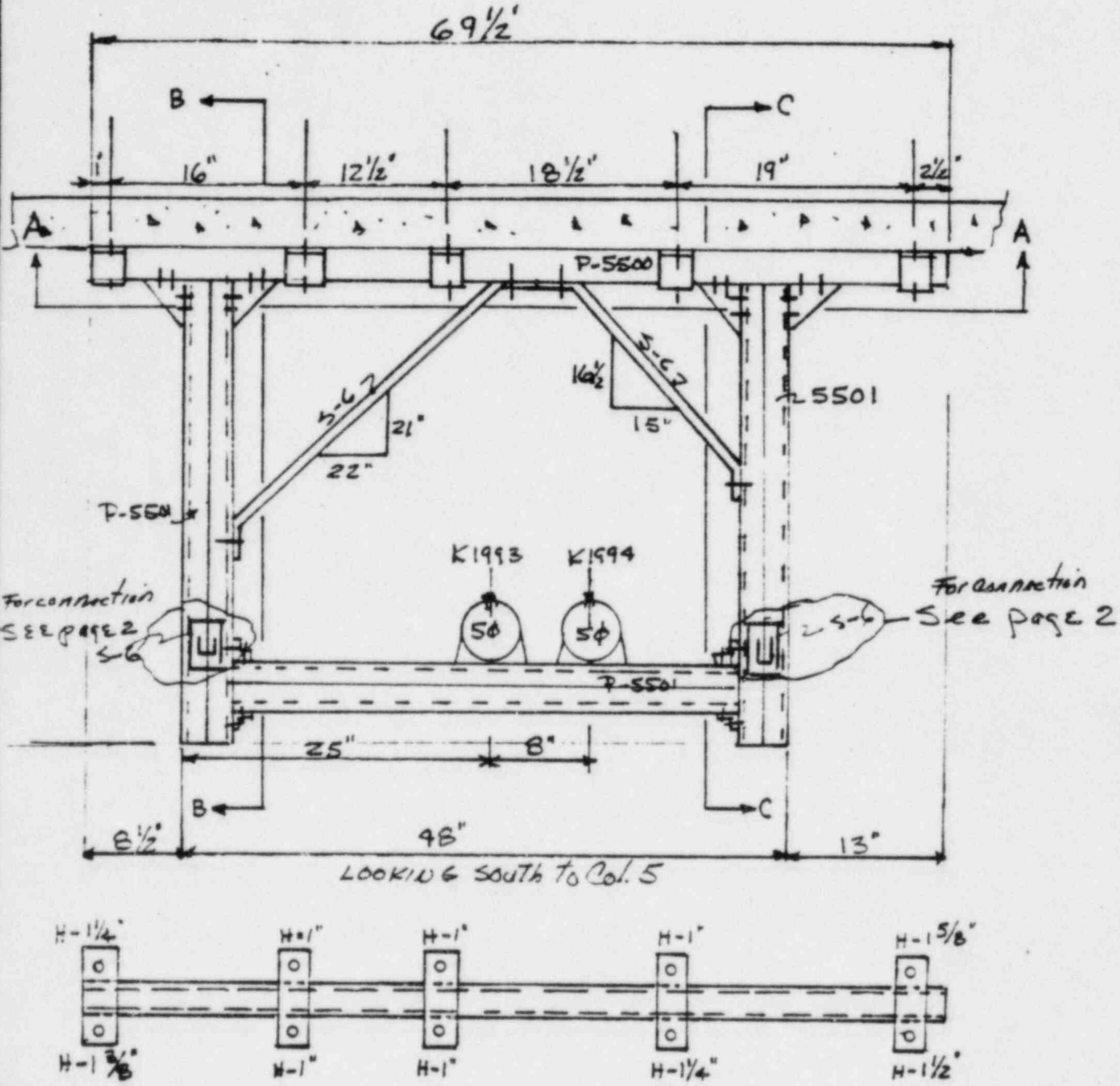
GM	
SUPV.	
DSGN.	
DWN.	
CHKD.	
O.K.	
DATE	SCALE

"AS BUILT"
K-140-9-2
S-18
WALL MOUNTED

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M	
DWG. LIST	
SUPSDS	
SUPSD BY	
SHEET NO.	SHEETS
DRAWING NUMBER	REV.

NOTE: ALL BOLTS 1/2"Ø x 3 3/4" Hilti



Section A-A

R.V. Monterole
GC. STA. ELEC
DEPP 9-8-81

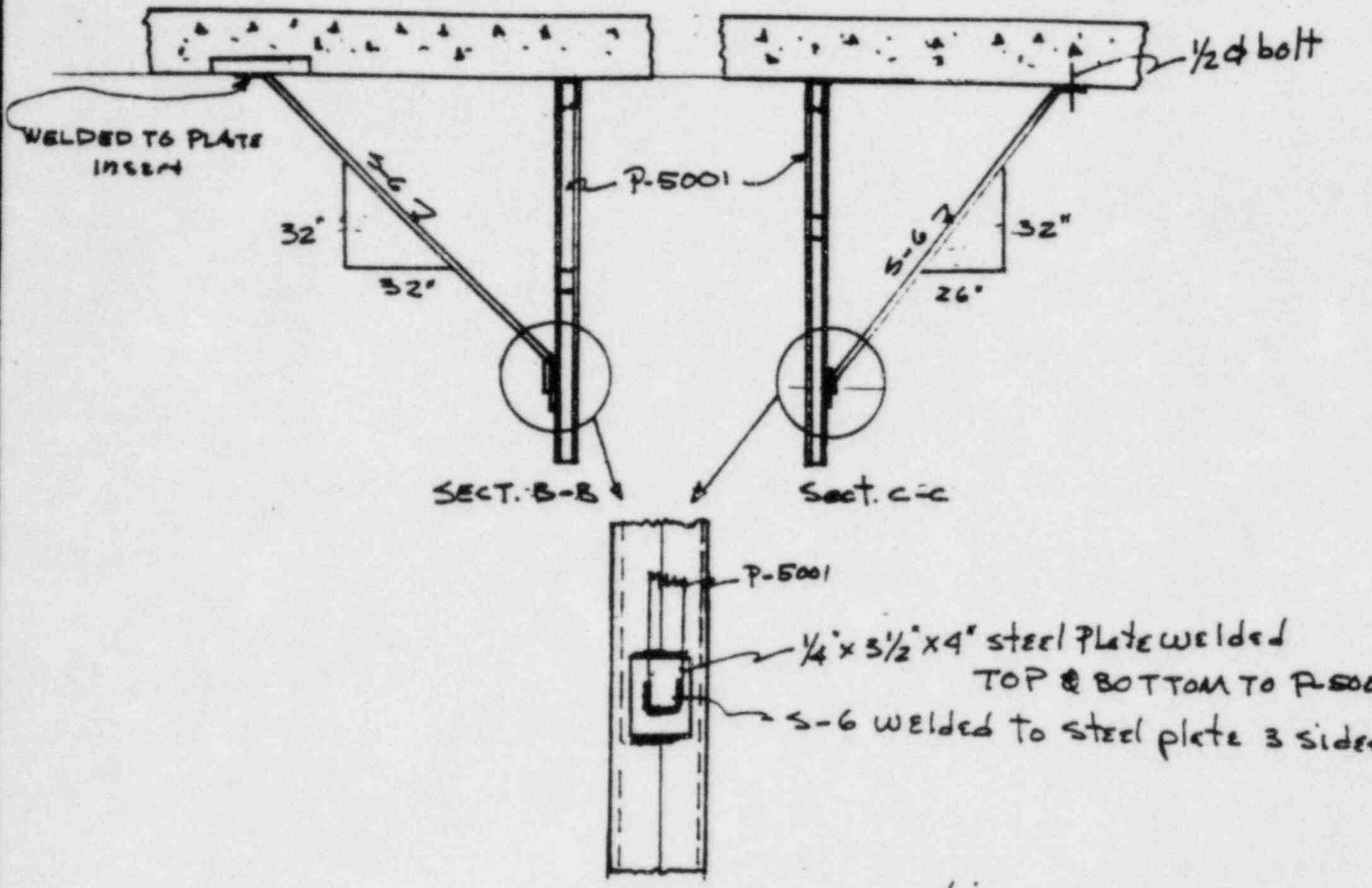
APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD

GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE SCALE

"AS BUILT"
G-140-8-1023 B
S-48
Mounted At Ceiling

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER REV.



TYPICAL S-6 Connection

SPANS

96" TO S226 no tag {K1993 - 5ϕ R1 / K1994 - 5ϕ R1} 6'-3" To S4B (6-140-8-243 B)

R.U. Monterole
G.C. STA. Elec.
DCPP 9-9-82

APPROVED BY		REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD

GM
SUPV.
DSGN.
DWN.
CHKD.
O.K.
DATE | SCALE

"AS BUILT"
6-140-8-1023 B
S-4B
Mounted at Ceiling

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

B/M
DWG. LIST
SUPSDS
SUPSD BY
SHEET NO. SHEETS
DRAWING NUMBER | REV.

PGandE
General Construction
77G-101 10/82

12.

MINOR VARIATION REPORT

IDENTIFICATION	Location Diablo Canyon	Unit No. 2	Reference Spec. No. 8837	Page 1 of 8
Organization Endurance Metal Products			Contractor's Report No.	PGandE MVR No. C-1354
Send Copy to Contractor ☒ Yes ☐ No	Name H. P. Foley Company			

DESCRIPTION OF DISCREPANCY

Item
Supports for Class I Electrical Panels

Explanation
Non Class I - Beams supporting Class I electrical panels were found to have deficient bolted connections as indicated on the attached pages.

Initiated By R. D. Kohler — Date 1/17/84

DISPOSITION

REJECT - Rework in accordance with SMF-0605 attached.

Additional Concurrence, When Required	Name	Date
Senior Site Representative	Forrest M. Benner	1/17/84

REVIEW

This Minor Variation Report (1) ☒ Is Not Reportable; ☐ May be Reportable (Per Title 10 CFR, Part 21)
(2) ☒ Is Not a Nonconformance

		Date
Quality Control	Derek Bell	1/18/84
Senior Site Representative	Forrest M. Benner	1/17/84

DISPOSITION ACCOMPLISHED

Remarks

Inspected By		Date
Quality Control		Date

☒ ATTACHMENTS 1) SMF-0605 (3 sheets)

PRIORITY 400

SUPERSEDED BY REV. 1

PGandE
General Construction
77G-101 10/82

MINOR VARIATION REPORT

5

IDENTIFICATION	Location: Diablo Canyon	Unit No. 1&2	Reference Spec. No. 8837	Page 1 of 8
Organization: Endurance Metal Products			Contractor's Report No.	PGandE MVR No. C-1338

Send Copy to Contractor [X] Yes [ ] No — Name: H.P.Foley Company

DESCRIPTION OF DISCREPANCY

Item
Supports for Class I Electrical Panels

Explanation
Non Class I - beams supporting Class I electrical panels were found to have deficient bolted connections as indicated on the attached pages.

Initiated By: R.D. Kohler — Date: 12/1/83

DISPOSITION
Pending Engineering Evaluation

Additional Concurrence, When Required — Name — Date

Senior Site Representative: [signature] — Date: 12/5/83

REVIEW

This Minor Variation Report (1) [X] Is Not Reportable; (2) [X] Is Not a Nonconformance [ ] May be Reportable (Per Title 10 CFR, Part 21)

Quality Control: [signature] — Date: 12/13/83

Senior Site Representative: [signature] — Date: 12/5/83

DISPOSITION ACCOMPLISHED

Remarks

Inspected By — Date

Quality Control — Date

[ ] ATTACHMENTS

PRIORITY 450

PGandE
General Construction
77G-101 10/82

MINOR VARIATION REPORT

IDENTIFICATION	Location DIABLO CANYON	Unit No. 1&2	Reference Spec. No. 8837	Page 1 of 8
Organization Endurance Metal Products			Contractor's Report No.	PGandE MVR No. C-1338 R

Send Copy to Contractor ☒ Yes ☐ No — Name H.P.Foley Company

DESCRIPTION OF DISCREPANCY

Item
Supports for Class I Electrical Panels

Explanation
Non Class I - beams supporting Class I electrical panels were found to have deficient bolted connections as indicated on the attached pages.

Initiated By R. D. Kohler — Date 12/1/83

DISPOSITION

REJECT-REWORK in accordance with SMF-0605 attached.

Additional Concurrence, When Required	Name	Date
Senior Site Representative	[signature]	Date 1/14/84

REVIEW

This Minor Variation Report (1) ☒ Is Not Reportable; ☐ May be Reportable (Per Title 10 CFR, Part 21)
(2) ☒ Is Not a Nonconformance

Quality Control	Derek Bell	Date 1/17/84
Senior Site Representative	[signature]	Date 1/14/84

DISPOSITION ACCOMPLISHED

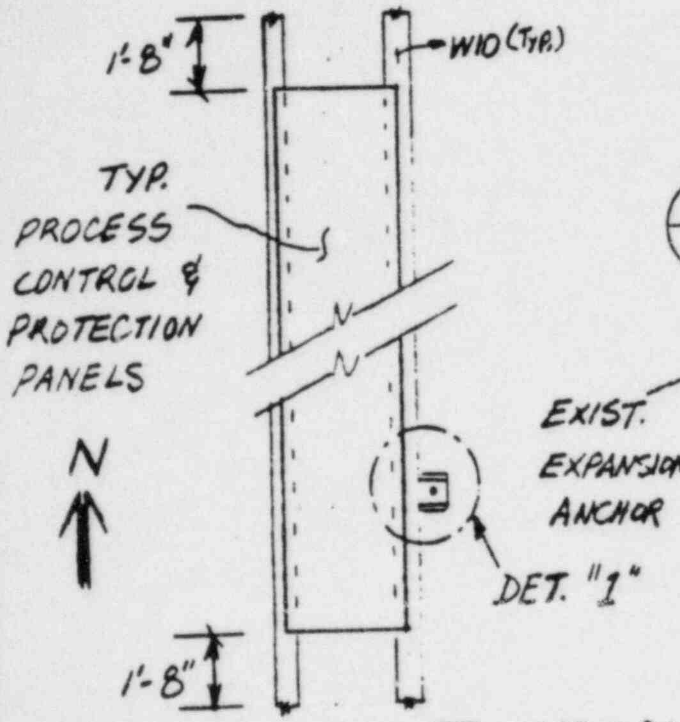
Remarks

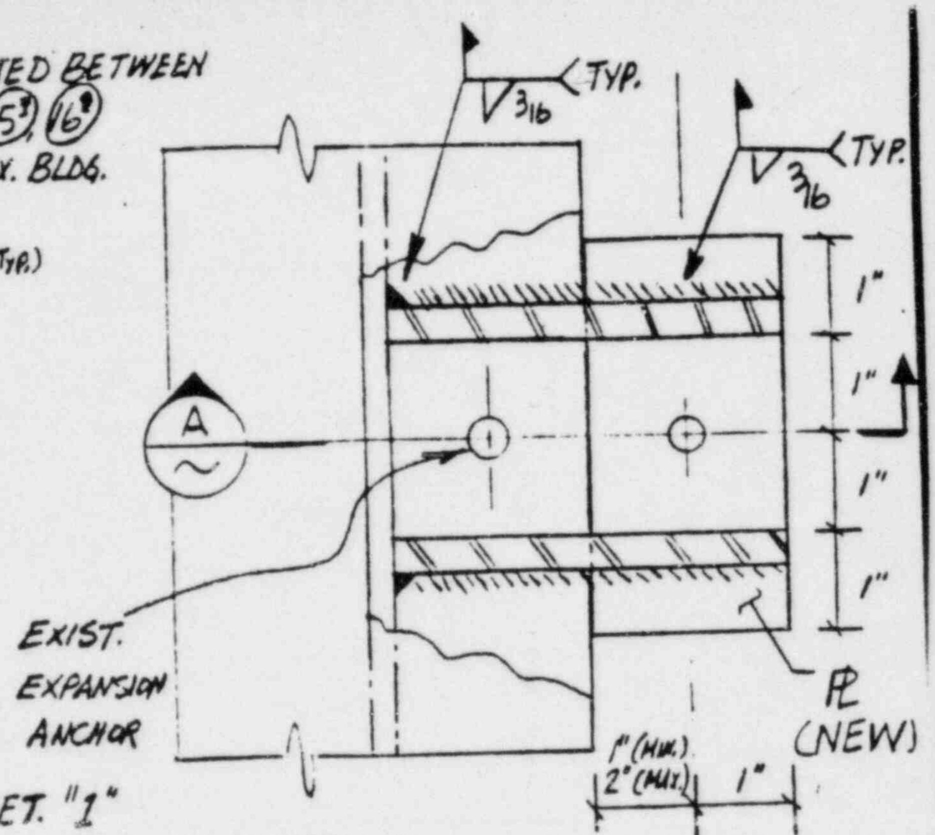
Inspected By	Date
Quality Control	Date

☒ ATTACHMENTS 1) SMF-0605

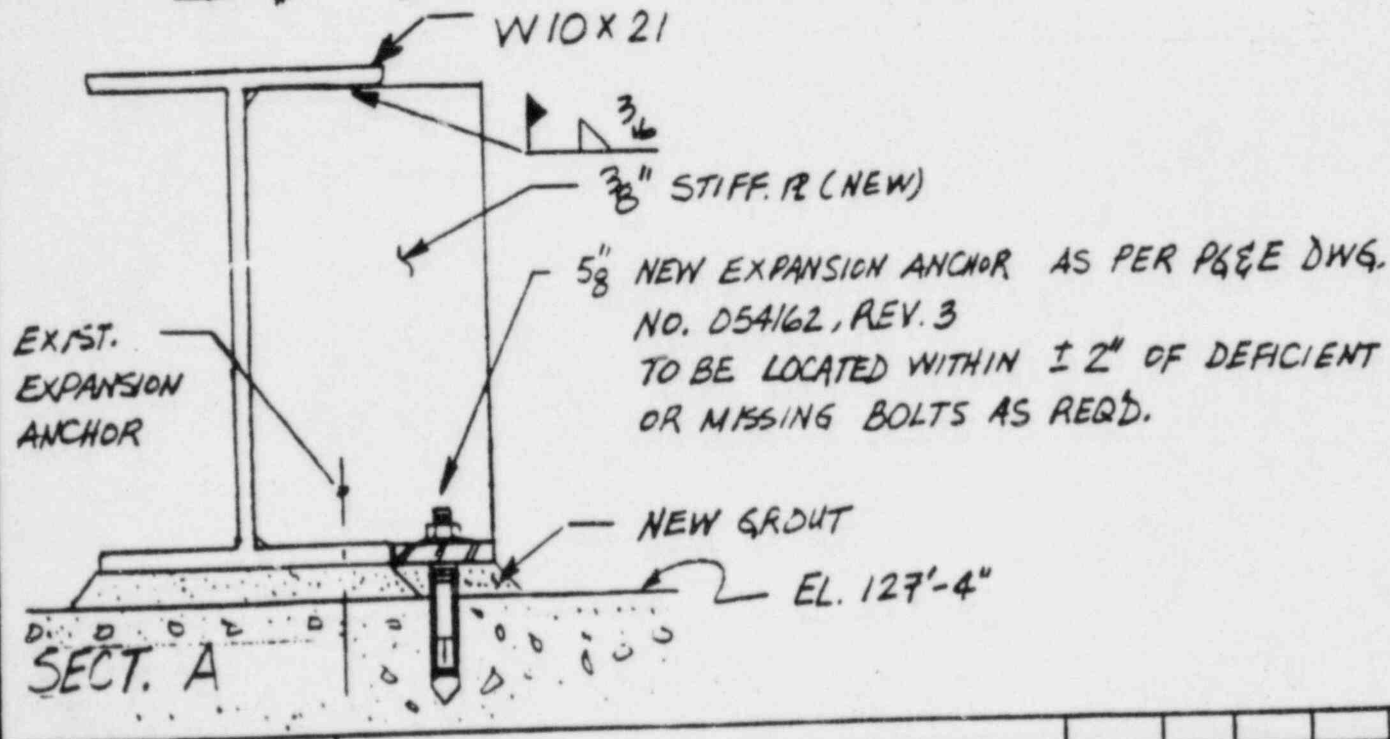
PRIORITY ____

NOTE: ALL PANELS ARE LOCATED BETWEEN COL. LINES (J), (L) & (15³), (16³) ON EL. 127'-4" IN AUX. BLDG.





DET. 1.



SECT. A

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APV
	0	12/16/93	ISSUED FOR MODIFICATION AS SHOWN	167067	JT	CAA	[illegible]	

GM 167067 SUPV. DSGN. J. Tsao DWN. J. Tsao CHKD. C. [illegible] O.K. DATE 12/16/93 SCALE N.T.S.	DIABLO CANYON UINT NO. 1 ANCHOR BOLT MODIFICATION FOR PROCESS CONTROL & PROTECTION PANELS PACIFIC GAS AND ELECTRIC COMPANY SAN FRANCISCO, CALIFORNIA	B/M CALC. NO. EPA- ~~DWG. LIST~~ ~~SUPSDS~~ SUPSD BY SHEET NO. 1 of 1 SHEE DRAWING NUMBER SKJT-EPA-91 REV 0 MICROFILM

61-4343 Rev 7-75

PGandE
General Construction
7?G-101 10/82

MINOR VARIATION REPORT

IDENTIFICATION	Location: Diablo Canyon	Unit No. 1	Reference Spec. No. 8837	Page 1 of 8
Organization: Endurance Metal Products			Contractor's Report No. N/A	PGandE MVR No. C-1338 R2
Send Copy to Contractor ☒ Yes ☐ No	Name: H. P. Foley Comapny			

DESCRIPTION OF DISCREPANCY

Item

Supports for Class I Electrical Panels

Explanation

Non Class I - beams supporting Class I electrical panels were found to have deficient bolted connections as indicated on the attached pages.

Initiated By: R.D. Kohler   Date: 1-17-84

DISPOSITION

Pending Engineering evaluation.

Rev. 1: REJECT - Rework in accordance with SMF-0605 attached.

Rev. 2: Revised to indicate Unit One only. Refer to MVR #C-1354 for Unit Two portion.

Additional Concurrence, When Required | Name | Date

Senior Site Representative: [signature]   Date: 1-17-84

REVIEW

This Minor Variation Report (1) ☒ Is Not Reportable; ☐ May be Reportable (Per Title 10 CFR, Part 21)
(2) ☒ Is Not a Nonconformance

Quality Control: Derek Bell   Date: 1/17/84

Senior Site Representative: [signature]   Date: 1-17-84

DISPOSITION ACCOMPLISHED

Remarks

Inspected By   Date

Quality Control   Date

☒ ATTACHMENTS 1) SMF-0605 (3 sheets)

PRIORITY 450R

2/8

TO 6/28 H. [illegible]

TO: Mr. D.A. Rockwell
Assistant Project Superintendent
Pacific Gas and Electric Company

DESCRIPTION OF PROBLEM: PAGE 1 OF 7.

THE [illegible] BEAMS IN THE CSR 27' ELEV. (UNITS I & II
[illegible] SUPPORTING [illegible] [illegible] CLASS I ELECTRICAL
PANELS HAVE THE FOLLOWING DEFICIENCIES:
1) INSUFFICIENT THREAD ENGAGEMENT (IN MANY CASES)
2) 90% OF ALL THE BOLTS ARE EXCESSIVELY OUT OF ALIGN-
MENT (ANGLE)
3) MANY OF THE BOLTS DO NOT HAVE NUTS.
4) SEVERAL CASES OF ANCHOR HOLES DRILLED ([illegible])
([illegible]) AND NO BOLTS EVER INSERTED. SEE PAGE 2

LOCATION: CSR Elevation 12' Column Line ____, ____

DATE: 10-7-83 REPORTED BY: [illegible signature]
EXT. 1731
NIGHT SHIFT

PLEASE CONTACT ME AT YOUR CONVENIENCE.
A QUICK RESPONSE TO THIS SITUATION WOULD
BE SINCERELY APPRECIATED. THANK YOU.
EARL D. [illegible]

TO: Mr. D.A. Rockwell
Assistant Project Superintendent
Pacific Gas and Electric Company

DESCRIPTION OF PROBLEM:

5.) SEVERAL OF THE BOLTS HAVE BEEN FOUND TO HAVE EXCESSIVE EMBEDMENT [illegible] ONE PARTICULAR BOLT WAS [illegible] TO [illegible] [illegible] THE SURFACE OF THE BOTTOM SECTION OF THE BEAM IN SUCH A MANNER THE NUT COULD NOT BE ATTACHED.

6.) ONE 1/2" DIA. BOLT WAS USED IN PLACE OF THE REQUIRED 5/8" DIA. ANCHOR BOLT. ATTACHED YOU'LL FIND COPIES OF PICTURES REFLECTING THESE PROBLEMED AREAS ALONG WITH A LIST OF AFFECTED CLASS I PANELS.

LOCATION: CSR

Elevation 127' Column Line ______ . ______

DATE: 10-7-83

REPORTED BY: [signature]

4/8

ENGINEERING DISPOSITION TO M&R NO. [illegible]

TO: Mr. D.A. Rockwell
Assistant Project Superintendent
Pacific Gas and Electric Company

PAGE 3 OF 7

DESCRIPTION OF PROBLEM:

SINCE THE ELECTRICAL PANELS HAVE BEEN SEISMICALLY QUALIFIED (E.Q. [illegible]) AND THE FLOOR MEETS SEISMIC REQUIREMENTS, THE BEAMS SHOULD ALSO MEET THE SAME OR SIMILAR SEISMIC REQUIREMENTS. THE TOTAL NUMBER OF DEFICIENT ANCHOR BOLTS AND NUTS CONTAINED CANNOT BE DETERMINED UNTIL THE SUB-FLOOR [illegible] PLATE [illegible] [illegible] [illegible] BACK IN PLACE.

LOCATION: CSR Elevation 187' Column Line ______ . ______

ORIGINAL PICTURES WILL BE SUPPLIED UPON REQUEST.

DATE: 15-7-83 REPORTED BY [signature]

CLASS I

ANELS AFFECTED

-A
1-B
1-C
1-D
1-E

PROTECTION SET

1-A
1-B
1-C
-D

CONT. SET

2-A
2-B
2-C
2-D
2-E

PROTECTION SET

2-A
2-B
2-C
2-D

CONT. SET

3-A
3-B
3-C

PROTECTION SET

RN03-A
RN03-B
RN03-C

CONT. SET

RN04-A
RN04-B
RN04-C
RN04-D
RN04-E

CONT. SET

RNP4-A
RNP4-B
RNP4-C

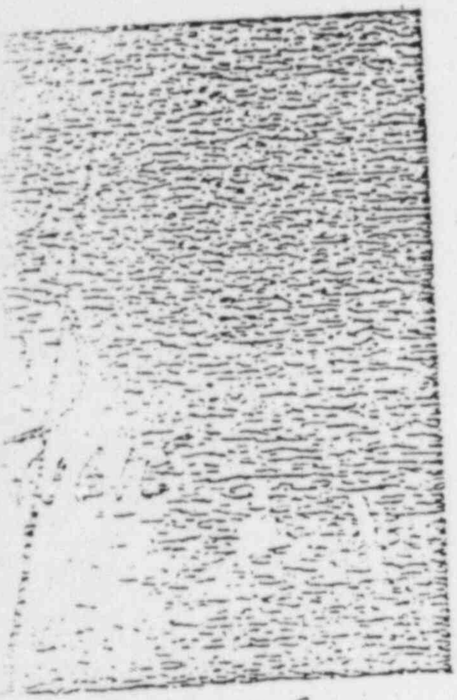
PROTECTION SET

SAFE GUARDS

RELAY

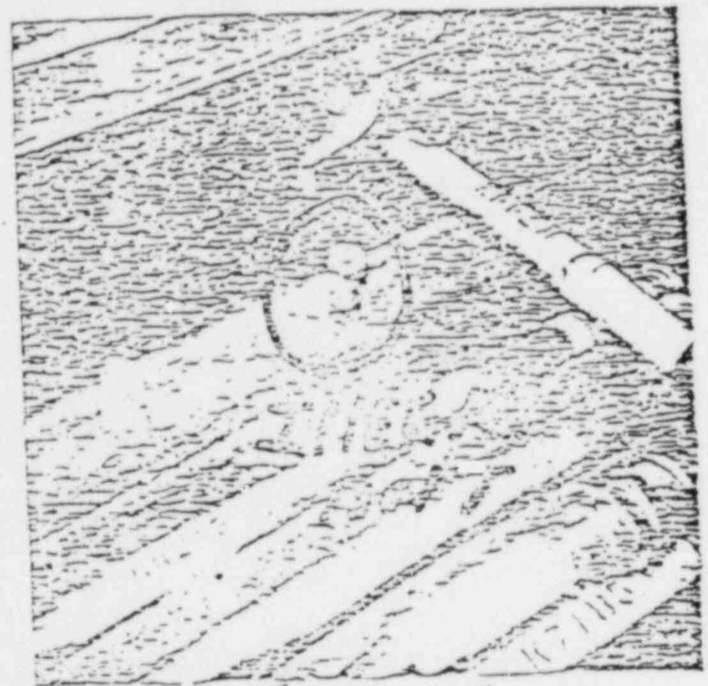
RELAY

7



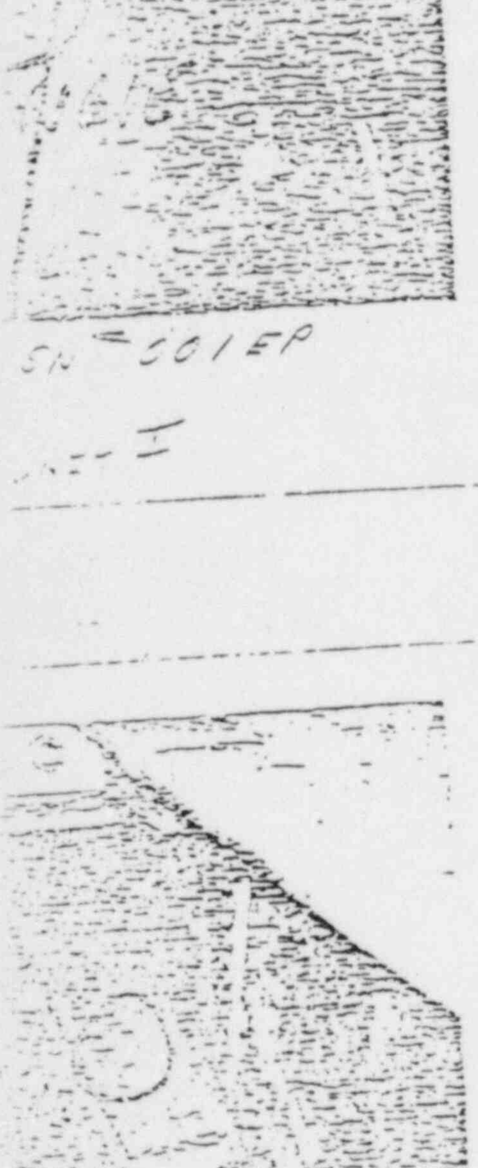
SN #001EP

UNIT I



SN #002EP

UNIT #



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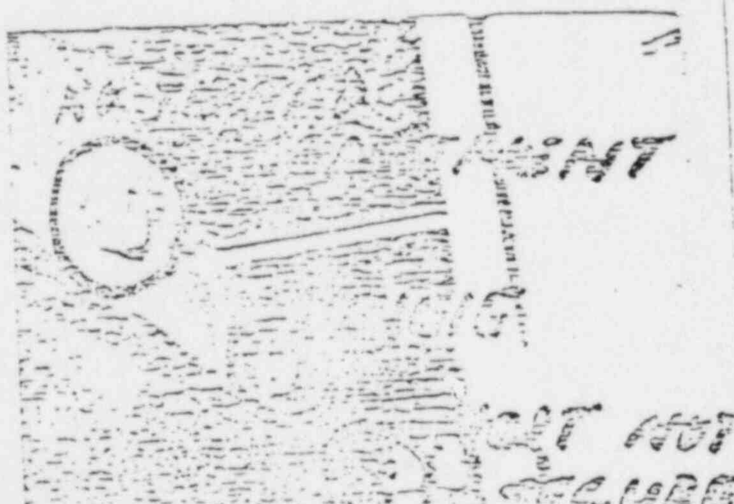
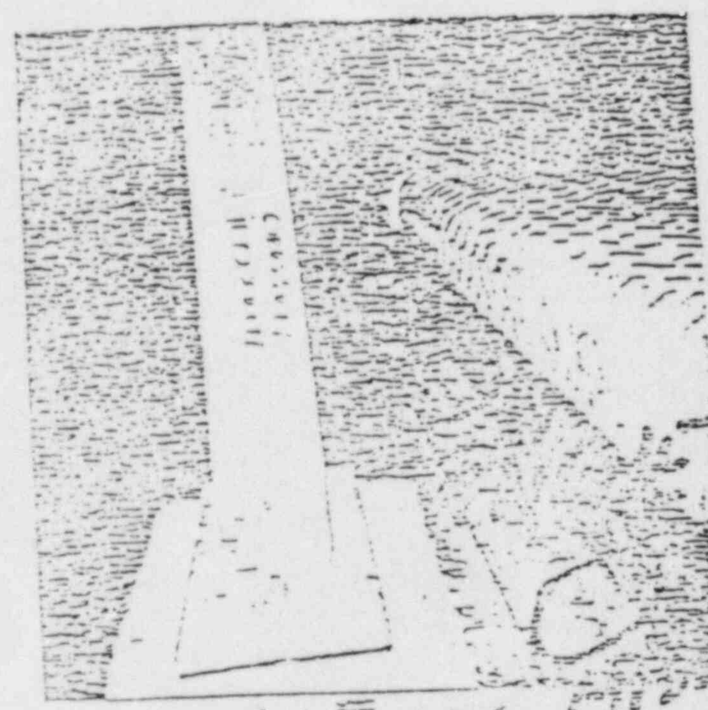
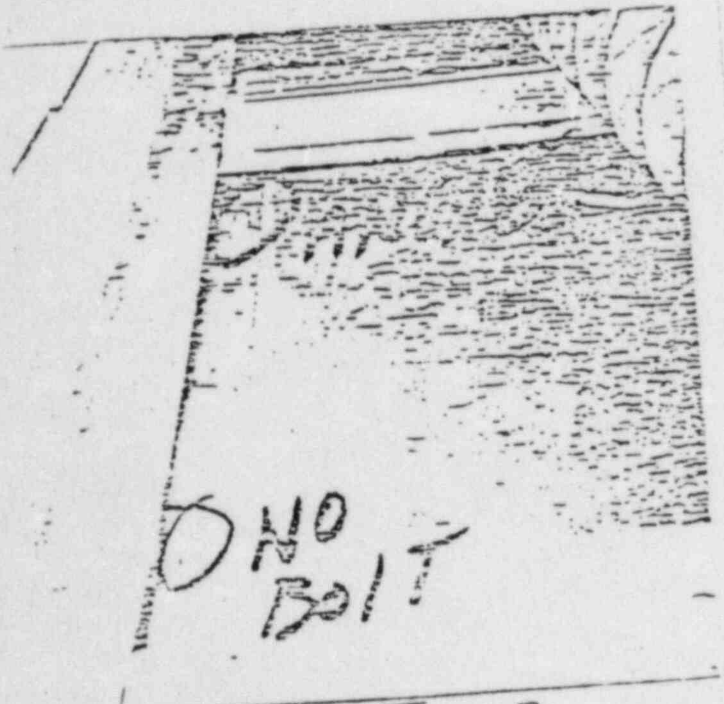


SN #004EP

SN # 005
u = 1



SN # 006
u # .



SN # 007
u # II

7

INTEROFFICE MEMORANDUM

Diablo Canyon Project

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

To F.M. RUSSELL, GENERAL CONSTRUCTION

Date

From F.A. MORSY

File No 912

Of ONSITE PROJECT ENGINEERING GROUP

Subject Requested OPEG/CIVIL response to document # MVR C-1338 UNIT - 1

At JOBSITE Extension (805)595-7351 x3137

SUBJECT: MVR C-1338

LOCATION: AREA "H", EL. 128'-3" (CSR)

DRAWING NO.: 59658

DESCRIPTION OF SUBJECT:

SEE MVR C-1338

DATE OF REPLY: 11 JAN. 84

OPEG/CIVIL RESPONSE:

SEE ATTACHED SKETCH

Steve O'Connor

SIGNED Fathy Morsy

SMF -0605

ENGINEERING DISPOSITION TO MVR NO. C1338

1) INSPECT EXPANSION ANCHORS OF PROCESS CONTROL AND PROTECTION PANELS IN ACCORDANCE TO THE FOLLOWING ANCHOR BOLT SCHEDULE:

TOTAL NUMBER OF PANELS/GROUP	TOTAL NUMBER OF ANCHORS REQUIRED FOR EACH SUPPORT BEAM WITHIN 20" OF E.S.
4	10
5	12
6	15
8	19

2) ALL EXPANSION ANCHORS MUST BE INSTALLED PER PG&E DWG. NO. 054162, REV. 3

(3) WHERE INSUFFICIENT NUMBER OF EXPANSION ANCHORS OR DEFICIENT EXPANSION ANCHORS EXIST, INSTALL NEW ANCHORS PER THE FOLLOWING OPTIONS:

OPTION 1: REPLACE DEFICIENT ANCHORS AND INSTALL ADDITIONAL ANCHORS AS REQUIRED TO MEET MINIMUM NUMBER PER PG&E DWG. NO. 054162, REV. 3

OPTION 2: INSTALL NEW EXPANSION ANCHORS PER DETAIL "1" OF DWG. NO. SKJT-EPA-9-1, REV. 0.

APPROVED BY	REV.	DATE	DESCRIPTION	GM	DWN.	CHKD.	SUPV.	APVD.
	0	12/16/83	ISSUED FOR ENGINEERING DISPOSITION TO MVR # C1338	167067	JT	[illegible]	[illegible]	

GM 167067 SUPV. DSGN. J. TSAO DWN. J. TSAO CHKD. G. GEAR O.K. DATE 12/19/83 SCALE	DIABLO CANYON UNIT NO. 1 ENGINEERING DISPOSITION TO MVR NO. C1338 PACIFIC GAS AND ELECTRIC COMPANY SAN FRANCISCO, CALIFORNIA	B/M DWG. LIST SUPSDS SUPSD BY SHEET NO. SHEETS DRAWING NUMBER REV. MICROFILM

61-4343 Rev 7-75

2-22-84 13.

COPY

PACIFIC GAS AND ELECTRIC COMPANY

PG&E 77 BEALE STREET, SAN FRANCISCO, CALIFORNIA 94106 TELEPHONE (415) 781-4211

February 7, 1984

PGandE Letter No: DCL-84-047

Mr. John B. Martin, Regional Administrator
U. S. Nuclear Regulatory Commission, Region V
1450 Maria Lane, Suite 210
Walnut Creek, CA 94596-5368

Re: Docket No. 50-275, OL-DPR-76
Docket No. 50-323
Diablo Canyon Units 1 and 2
Welding in the Cable Spreading Room

Dear Mr. Martin:

As a result of the recent NRC investigations into the allegations listed in SSER 21, the Staff has raised questions regarding the installation of class I equipment on class II material in the cable spreading room. The enclosure to this letter provides the PGandE response to these questions.

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

by J. D. Shiffer

Enclosure

cc: T. W. Bishop
[redacted] E. Schierling

~~8402090256~~ 840207
PDR ADOCK 05000275
E PDR

Dist: PR Jean Lee

B001
1/1

ENCLOSURE

USE OF NON-CLASS I MATERIAL TO SUPPORT
SAFETY-RELATED EQUIPMENT IN THE CABLE SPREADING ROOMS

Background

The NRC has requested additional information based on their review of the use of non-Class I steel to support safety-related equipment in the cable spreading rooms. The information requested is:

1. Show qualification for the materials and installation.
2. Explain why resolution of the problem has not been accomplished in a more timely manner.
3. Why wasn't the problem discovered by the IDVP or the ITP?
4. Address generic implications, including late identification of the issue as a nonconformance.

Resolution

The following discussion provides a response to each question.

1. Show qualification for the materials and installation.

The non-Class I steel beams used in this installation have been tested to determine chemical and physical properties. The steel was found to have ASTM A-36 properties as required by the design drawings. The beam installations and equipment attachments to the beams have been as-built. Calculations have been performed which show qualification of the as-built installation. Refer to Attachment 1 for details.

2. Explain why resolution of the problem has not been accomplished in a more timely manner.

On October 6, 1983, H.P. Foley Company identified to PGandE a concern regarding the adequacy of anchor bolt installations which fix the steel beams in place. This initial concern was broadened to include the issue of non-Class I material in Class I installations. Resolution has required preparation of additional as-built drawings, material removal for testing and analysis, and design reanalysis. Although resolution has taken approximately four months, when considering the complexity of the issue, we find the duration to closure to be reasonable.

3. Why wasn't the problem discovered by the Independent Design Verification Program (IDVP) or the Internal Technical Program (ITP)?

The IDVP was based on a sampling approach. This installation was not included in their sample. However, their review did identify a generic concern for adequacy of equipment supports. As a result of this generic concern, the equipment attached to the cable spreading room platforms was reviewed by the ITP. The welds from the equipment to the steel beams were found to require modification for structural reinforcement. In addition, the design of the cable spreading room platforms was reviewed by the ITP. The design of the

platform consisted of steel beams installed in a grid pattern fixed to the floor by closely spaced anchor bolts. A senior engineer reviewed this design and judged that margin exists in the design such that as-builting and detailed reanalysis was not warranted. The steel was specified as ASTM A-36, but no certification was required. Since A-36 is a standard commercial grade steel and no welding problems were apparent, the material was judged adequate. The review described above was completed prior to identification of the NRC questions.

Therefore, this installation was reviewed, weld modifications specified, and the remainder judged adequate by the Diablo Canyon Project. Subsequently, the more detailed January 30, 1984 structural analysis and material testing has confirmed the judgments made in the earlier review. Refer to Question 1 for details.

4. Address generic implications, including late identification of the issue as a nonconformance.

The unique nature of the steel-frame raised-floor configuration led to the acceptance of the design and material without the detailed type of as-builting and analysis that was performed for the other structures. This type of configuration exists only in the cable spreading rooms. All other platforms which support Class I equipment have been thoroughly analyzed. Therefore, this installation is not a generic issue. The Nonconformance Report (NCR) associated with this issue will be completed by February 17, 1984.

The Project has initiated a separate NCR to assess the adequacy of the steps taken in addressing timely identification of this issue as a nonconformance. This NCR will establish cause, investigate generic implications, determine corrective action to prevent recurrence, and review reportability.

ATTACHMENT 1

042507

INTEROFFICE MEMORANDUM

Diablo Canyon Project

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

To D. Rockwell/M. Leppke

From J. K. McCall

Of Civil Engineering - Unit 1

At 45/23/B35 Extension 8-1414

Date January 30, 1984

File No. 52.19

Subject Supports for Class I Electrical Panels in the Cable Spreading Room - El. 127 Unit 1

Reference: Minor Variation Report - MVR No. C-1338
Non-Conformance Report - NCR No. DC1-84-SC-N001

Engineering has evaluated the above referenced reports and following is our engineering disposition:

A. <u>10WF21 Supporting Beams</u>

1. <u>Structural Evaluation</u>: Based on as-built information from the field and new panel loads furnished by Westinghouse, supporting beams are found to be structurally adequate when subjected to Hosgri/DDE earthquake.

2. <u>Material</u>: Our calculations are based on the material conforming to ASTM A-36 which requires a minimum yield strength of 36ksi. It has been confirmed that the material does meet the requirements of ASTM A-36 by the mechanical and chemical tests performed on coupons taken from the supporting beams. The test report will be available upon request.

Based upon the above information, existing supporting beams are considered acceptable and, therefore, use as is. The portion of the beams where the coupons were taken shall be ground smooth to remove any irregularities and sharp notches. The cut out portion need not be welded back.

B. <u>Concrete Expansion Anchors</u>

Based on as-built information from the field and new panel loads furnished by Westinghouse, all expansion anchors are found to be structurally adequate when subjected to the Hosgri/DDE earthquake. The capacity of expansion anchors are based on the report "Use of Concrete Expansion Anchors at Diablo Canyon" contained in PGandE Letter No. DCL-84-031 which accounts for embedment and angularity. All existing expansion anchors are acceptable and therefore, use as is.

[MISC10020]

042507

For your reference, the calculation number for the above is EPA-9, Rev. 2 and filed in 52.19.

If there are any questions, please call Ali Vanek at Ext. 8-5953.

J. K. McCall

J. K. McCALL

AV

AVanek:slp

Response Required: No.

cc: HFriend
GHMoore
WHWhite
LERosetta
FRussell
FMorsy
NOShah
BSarkar
AVanek
KTawney

[MISC10020]

PG and E
General Construction
77G-101 10-82

14.

MINOR VARIATION REPORT

IDENTIFICATION	Location	Unit No.	Reference Spec. No.	Page of
	Diablo Canyon	I	8802	1 of 1
Organization			Contractor's Report No.	PGandE MVR No.
PTGC Electrical				E-2773

Send Copy to Contractor ☐ Yes ☒ No | Name N/A

DESCRIPTION OF DISCREPANCY

Item

Class I Electrical Raceway Supports attached to Non-Class I steel

Explanation

NRC field inspection has revealed Class I Electrical Raceway Supports attached to the Non-Class I steel supporting the diamond plate in the cable spreading room, elevation 127'. Example: CSR-127-3-634 detail S-415

CSR-127-3-573 detail S-235

Initiated By [signature] | Date January 17, 1984

DISPOSITION

Refer to Engineering for disposition.

Additional Concurrence, When Required | Name | Date

Senior Site Representative S. J. Glascock | Date January 17, 1984

REVIEW

This Minor Variation Report (1) ☐ Is Not Reportable ☐ May be Reportable (Per Title 10 CFR, Part 21)
(2) ☐ Is Not a Nonconformance

Quality Control | Date

Senior Site Representative S. J. Glascock | Date January 17, 1984

DISPOSITION ACCOMPLISHED

Remarks

Inspected By | Date

Quality Control | Date

☐ ATTACHMENTS

15.

Engineering
76-370 2/81

DCM No. C-15 Revision 3

Date March 1, 1983

File No. 52.7.11.2 x 40.2.4

PACIFIC GAS AND ELECTRIC COMPANY

DESIGN CRITERIA MEMORANDUM

Structure, System, or Component: Diablo Canyon PP - Electrical Raceway Supports

Prepared by: Michael K. Yan Michael K. Yan Date 3/23/83

Group Leader/Supervisor Review J. K. McCall JKMcCall Civil Engineering (Discipline) Date 3/23/83

N. O. Shah
Victor ... FOR N.O. SHAH

Reviewed by Interfacing Disciplines:

Group Leader/Supervisor S. Auer S Auer Date 3-23-83

Electrical
Group Leader/Supervisor C. M. Hazari CMHazari Date 3/23/83

Group Leader/Supervisor Date

Approved by: R.V. Bettinger

Department Chief: R. V. Bettinger Date: 3-31-83

Gary H. Moore 4/2/83

Approved for Project use:

Project Engineer: G. H. Moore Date:
G. V. Cranston GVCranston 4/6/83

Page 2 through 14 attached; describing design inputs. Other attachments as indicated below.
with Attachment A thru H

cc:

☐ Approving Discipline Chief(s)

FOR INFORMATION ONLY

☐ Chief, Engineering Quality Control

☐ Project Engineer

☐ Discipline Group Leader(s)/Supervisor(s)

☐ Manager, Steam Generation

Others

DESIGN CRITERIA FOR SEISMIC REVIEW OF CLASS 1E ELECTRICAL RACEWAY SUPPORTS AT DIABLO CANYON POWER PLANT

1. Introduction

A. This set of design criteria is applicable to design review of Class 1E electrical cable tray, conduit and pull box supports at Diablo Canyon Power Plant. Design of conduits, cable trays, pull boxes and other raceway system components is not included. Design of these supports shall be assumed to conform to the configuration and general and special notes shown on PG&E Drawing 050030, Rev.29 (generic condition), except as modified by as-built data. 3

B. Loads to be considered are:

(1) Dead loads of conduits, trays, and weight of insulated copper conductors (see Attachment A -- letter dated 10-29-81 Herrera/Vahlstrom to Bettinger); applicable dead load of support shall also be included.

(2) Seismic loads are:

a) The current floor response spectra for the Hosgri Earthquake event contained in DCM C-17

b) The current floor response spectra of the Double Design Earthquake (DDE) contained in DCM C-30.

The review shall be based on 7% damped floor response spectra.

C. In determining the amount of dead load which is tributary to a support, the assumption shall be made that supports are spaced at the maximum allowed by the drawing and that the number of cable trays and conduits allowed by the drawing are present on the support (generic condition), unless as-built data indicates otherwise.

2. Seismic Response Calculation

A. Response acceleration in horizontal direction

Total response acceleration in either north-south or east-west horizontal direction shall be computed as follows:

For north-south horizontal motion:

$$A_T^{NS} = A^{NS} + \emptyset^{NS} \cdot X/g$$

For east-west horizontal motion:

$$A_T^{EW} = A^{EW} + \emptyset^{EW} \cdot Y/g$$

where:

A_T^{NS} = Total north-south response acceleration

A_T^{EW} = Total east-west response acceleration

A^{NS} = Translational spectral acceleration due to north-south ground motion

A^{EW} = Translational spectral acceleration due to east-west ground motion

$\emptyset^{NS}$ = Torsional spectral acceleration due to north-south ground motion

$\emptyset^{EW}$ = Torsional spectral acceleration due to east-west ground motion

X = East-west distance from center of mass

Y = North-south distance from center of mass

g = Gravitational constant

Separate calculations of A_T shall be made for Blume and for Newmark spectra. The greater of these shall be used in subsequent calculation of seismic loads.

The above method of calculating response acceleration including effects of structure torsional acceleration is applicable only to structures for which torsional response spectra have been provided. (Torsional effects of Hosgri Earthquake in the Turbine Building have been included in the translational response spectra for that building)

B. Response acceleration in vertical direction

(1) The vertical response acceleration for Hosgri Earthquake shall be obtained from the vertical response spectra in DCM C-17.

(2) The vertical response acceleration for DDE shall be 0.36g. | 3

C. Transverse Seismic Loading | 3

In determining the transverse seismic loading on an electrical raceway support,the more severe of the two horizontal acceleration components described in Sec. 2A shall be assumed acting transverse to the raceway support unless the support is being evaluated based on as-built conditions, in which case, the appropriate horizontal component may be used.

D. Longitudinal Seismic Loading

(1) In the longitudinal direction, conduits and supports shall be considered as systems. The systems shall be analyzed in one of the two ways.

(a) For systems that have a first mode frequency in the longitudinal direction of not less than 33 Hz, equivalent static analysis is used. The total seismic load in the longitudinal direction is calculated using the zero period acceleration (ZPA) of the appropriate floor response spectra. The total seismic load is distributed among the supports proportionally to their longitudinal stiffnesses. 3

(b) Alternatively, dynamic analysis is used to determine seismic load on each support of the system from the appropriate floor response spectrum applied in the longitudinal direction.

(2) Cable trays have been provided with separate longitudinal supports and do not require seismic review of transverse-type supports in the longitudinal direction. The longitudinal-type seismic tray supports shall be reviewed for their tributary longitudinal spans.

E. In determining the spectral acceleration, the spectral ordinate corresponding to the calculated natural period of the raceway support shall be used with the following exception: 3

If the support is being evaluated for its generic condition and if the calculated natural period is greater than the period corresponding to 75% of the peak, the peak value shall be used. See Figure 1

F. Wherever more than one set of response spectra at a particular floor level has been provided, the spectra located closest to the support location shall be used (without interpolating).

G. Interpolating between the spectra at different floor levels to derive spectra at intermediate elevations is permissible and shall be done in accordance with DCM C-17 and DCM C-30.

H. For floor response spectra at Elevation 85' or below, ground response spectra shall be used (see Hosgri Evaluation Report).

3. Load Combinations

All raceway supports shall be evaluated for the transverse seismic loading and the longitudinal seismic loading separately. For each seismic loading condition, the load combination shall be as follows: 3

Maximum stress or member force at each critical location in the support shall be calculated, separately, for seismic loads in the maximum horizontal direction and in the vertical direction. The resulting stresses or member forces due to loads in the maximum horizontal direction shall be combined with the stresses or member forces due to vertical loads by absolute sum. Stress or member force due to dead loads shall be added to the results described above to get total stress/force.

The above paragraph may be expressed symbolically, thus: 3

$$U = D + DA_H \text{ (max hor) } + DA_V$$

where: D = Stress due to dead load of applicable support weight plus tributary weight of raceways spans adjacent to the support.

DA_V = Absolute stress due to applicable vertical seismic load.

DA_H = Absolute stress due to applicable horizontal seismic load. 3

U = Total stress due to seismic loads in horizontal and vertical directions, and dead load. 3

4. Design Specification

Applicable design specifications for this purpose, adapted to reflect the approach described above, are:

A. For hot-rolled steel members, AISC 1969 Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

B. For cold-formed steel members, AISI Specification of Design of Cold-Formed Steel Structural Members, 1968 edition.

5. Material Properties

A. Structural steel (ASTM A-36) used in these raceway supports has a yield point of 36 ksi.

B. Cold formed steel (ASTM A570, Grade 33) used in these raceway supports has an average yield point, F_{ya}, as shown in Table A for each cold-formed channel section. Virgin yield point, F_y, is 33 ksi. Ultimate strength, F_{ult} is 52 ksi.

C. Concrete strength, based on test reports, varies throughout the plant. When applying acceptance criteria, the designer shall use the applicable concrete strength as shown in Attachment E (Table 4-3 of the Hosgri Evaluation Report).

6. Acceptance Criteria

A. Member stress shall not exceed the following acceptance criteria.

(1) Acceptance criteria for hot-rolled steel members.

The provisions of Part 1 of the AISC Specification for the Design Fabrication and Erection of structural steel for Buildings are applicable with the following modification: allowable stresses may be increased by 60% for acceptance limits applicable to load combinations which include seismic. Reference: NRC Standard Review Plan Sec. 3.8.4.

Minor local yielding may be permitted if it can be demonstrated that local yielding does not affect the member strength or its function.

(2) Acceptance criteria for cold-formed steel members

(a) Bending about major axis (ksi)

$$F_b = F_{ya} - \frac{F_{ya}^2}{4.05\pi^2\ EC_b} \cdot \frac{L^2}{d} \cdot \frac{S_{xc}}{I_{yc}}$$

where: F_{ya} = average yield point, ksi (see Table A)

E = elastic modulus, ksi

C_b = bending coefficient; conservatively C_b = 1.0 (see AISI Sec. 3.3)

d = section depth, inches

L = unbraced length, inches

S_{xc} = compression-side section modulus of entire section about centroidal axis perpendicular to loading plane, inches^3

I_{yc} = moment of inertia of compression portion of section about its centroidal axis parallel to the loading plane, inches^4

For particular Unistrut (or equivalent) profiles, the above formula reduces to: | 3

P1000, $F_b = 41 - .0028\ L^2$

P1001, $F_b = 41 - .0010\ L^2$

P3300, $F_b = 45 - .0096\ L^2$

P5000, $F_b = 33 - .0011\ L^2$ See Note

P5001, $F_b = 33 - .0008\ L^2$ See Note

P5500, $F_b = 39 - .0012\ L^2$

P5501, $F_b = 39 - .0009\ L^2$

NOTE: When Unistrut P5000 and P5001 or their equivalents are used as beams, the acceptance limits shown above have been reduced by 12.5% to avoid local buckling of the compression flange.

Conduits and cable trays which are attached to cold-formed channel members and are continuous across the support may be considered as lateral bracing of the member.

(b) Bending about minor axis (ksi)

$F_b = F_{ya}$

(c) Shear (ksi)

$F_v = 0.6\ F_y$

NOTE: Use F_y here, not F_{ya}.

(d) Axial tension (ksi)

$F_t = F_{ya}$ on net section

(e) Axial compression (pounds)
Refer: Column Load Table, Unistrut General Engineering Catalog No. 9 (1978 edition), page 120, and Super Strut Framing Channel and Pipe Hangers Catalog No. 3 - Revision 3, Table III. (See AISC Steel Manual, Table C1.8.1, for advice on selecting K values.)

If $\dfrac{KL}{r_{min}} \leq 118$, $P_a = 1.33 \times$ Column Load in Table

HISTORY OF CONTROLLED DOCUMENT

DISTRIBUTION FOR P-149, P-126, B-75

12/15/83

DOCUMENTS	ISSUED	RETURN RECEIPT REC'D
P-149, P-126		
Rev 8	8/83	9/1/83
Rev 9	11/18	Not Returned As of Yet
B-75		
M 46 - 1	4/15	4/28
Complete manual w/o criteria	4/21	5/2
M 42 - 4	4/25	4/28
M 46 - 2	5/18	6/1
M 46 - 3	6/2	6/7
M 46 - 4	8/15	8/18
M 46 - 5	10/3	10/7
M 46 - 6	11/1	11/8
M 58 - 0	5/2	5/10
M 58 - 1	6/20	7/29
M 58 - 2	8/3	8/5
M 58 - 3	8/24	8/29
M 58 - 4	9/20	9/27
M 58 - 5	10/20	10/28
P 11 -4	5/26	6/1
P 11 - 5	8/31	9/6
P 11 - 6	10/20	11/8
P 33 - 0	5/23	6/1
P 33 - 1	7/7	7/15
P 34 - 0	7/26	8/5
P 27 - 3	10/20	11/8

B - 75 CONTINUED

	ISSUED	RETURN RECEIPT REC'D
I 29 - 1	9/15	9/22
I 41 - 0	7/1	7/12
I 42 - 0	7/1	7/12
I 42 - 1	9/30	10/5
I 50 - 0	8/2	8/5
I 50 - 1	8/12	8/18
I 50 - 2	8/23	8/30
I 50 - 3	9/28	10/6
I 50 - 4	10/27	10/30

If $\frac{KL}{r_{min}} > 118$, $P_a = 1.0 \times$ Column Load in Table

$\frac{KL}{r_{min}}$ shall not exceed 200

B. Acceptance limit stress on fillet welds on cold-formed steel members shall be 60% greater than given in Section 4.2.1 of AISI specification of Design of Cold-Formed Steel Structural Members. Effective size of a fillet weld shall not exceed the thickness of the thinnest element to which the weld is applied.

C. When axial and flexural stresses occur simultaneously at a critical location in a cold-formed steel member, the following interaction formula is applicable:

$p_a/P_a + f_b/F_b \leq 1.0$

where p_a is the calculated axial load, f_b is the calculated flexural stress, P_a is the acceptance limit axial load, and F_b is the acceptance limit flexural stress.

D. Loads on Unistrut (or equivalent) bolts shall not exceed 90% of the proof loads (i.e., shall not exceed 2.7 times manufacturer's allowable loads). Interaction of pullout and slip loads shall be evaluated by the following formula:

$P \leq (P_u/S_u)\ (S_u^2 - S^2)^{\frac{1}{2}}$ Ref. Commentary on AISC Spec. 1.6.3

where: P, S are interaction limit values of pullout and slip loads, respectively, for load combinations including seismic. P_u, S_u are three times manufacturer's allowable pullout and slip loads, respectively.

Neither P nor S shall individually exceed 2.7 times manufacturer's allowable load. For load combinations not including seismic, P_u, S_u shall be 1.0 times manufacturer's allowable loads.

E. Loads on Unistrut (or equivalent) concrete inserts shall not exceed 2.7 times manufacturer's allowable loads in pullout or slip. For evaluating interaction of pullout and slip, use same formula as for Unistrut bolts, above.

F. Design loads for Unistrut (or equivalent) channel connections shall not exceed 2.25 times the manufacturer's allowable loads.

G. Loads on Unitstrut (or equivalent) conduit clamps shall not exceed the values shown in Table B.

H. Loads on concrete expansion anchors shall not exceed twice the allowable pullout and shear loads specified in PG&E Engineering Standard Drawing 054162 - Rev. 3. Interaction of pullout and shear loads shall be evaluated according to Section A2.9 of Dwg 054162.

I. If a support detail shows loads applied in such a way that more severe stress conditions would occur if the loads were shifted to another location on the support, the designer should check as-built conditions unless the worst position of loads can be accommodated. See Figure 2.

J. Vertical supports using vertical rods are not horizontal seismic supports.

K. Unbraced joints made of angle fittings (e.g. P1331, P2626) shall be checked for rotation and fatigue resistance. No checking is necessary for a braced joint. See Figure 3.

The Moment versus Rotation curve and The Fatigue Curves of various combination of angle fittings have been derived from test data and are provided in Attachment G and H respectively. 3

The fatigue resistance of an angle fitting shall be checked with the following equation:

$$\frac{5n_{EQ}}{N_{DE}} + \frac{n_{EQ}}{N_{HOSGRI}} \leq 1.0 \quad \text{Ref. IEEE Standard 344-1975}$$

or

$$\frac{5n_{EQ}}{N_{DE}} + \frac{n_{EQ}}{N_{DDE}} \leq 1.0$$

where: n_{EQ} = total number of load/stress cycle per earthquake = 10 Ref: NRC Standard Review Plan Sec. 3.7.3.

N_{DE} = allowable number of load/stress cycles per DE event

N_{HOSGRI} = allowable number of load/stress cycles per HOSGRI event

N_{DDE} = allowable number of load/stress cycles per DDE event

7. Evaluation Procedures

Step No. 1

1. Use spectra with appropriate damping given in Section 1. | 3
2. Use acceptance criteria given in Section 6.
3. Use weights cited in Attachment A.
4. Compute R, ratio of acceptance criterion to corresponding computed stress or force, for each critical location in the support assembly.
5. If any R-value is less than 1.0, go to Step No. 2.

Step No. 2.

1. Use spectra with appropriate damping given in Section 1. | 3
2. Use acceptance criteria given in Section 6.
3. Use as-built data obtained from field (General Construction Department).
4. Compute R for each critical location in the support assembly.
5. If any R-value is less than 1.0, go to Step No. 3

Step No. 3

1. Provide design modification. | 3
2. Repeat Step No. 2 on as-modified configuration.

Table A
AVERAGE YIELD STRENGTH OF COLD-FORMED STEEL MEMBERS BASED ON AISI SPECIFICATION, SEC. 3.1.1

UNISTRUT	F_{ya} (ksi)
P1000	41
P1001	41
P3300	45
P5000	38
P5001	38
P5500	39
P5501	39

TABLE B
UNISTRUT CLAMPS - ACCEPTANCE LIMITS

Reference: Unistrut Corp. Test Reports C-13-H, C-36-A (dated 10-6-77 and 5-13-77, respectively).
Limits shown are 90% of test ultimate loads (pounds)

CONDUIT SIZE	PIPE CLAMP NO.	PULL OUT	TRANSVERSE SLIP	LONG. SLIP
1/2"	P-1111B	1620	315	180
3/4"	P-1112B	2340	335	315
1"	P-1113B	2585	605	560
1-1/4"	P-1114B	2160	405	315
1-1/2"	P-1115B	3150	380	270
2"	P-1117B	3780	470	270
2-1/2"	P-1118B	3510	855	495
3"	P-1119B	3780	945	875
3-1/2"	P-1120	4725	990	920
4"	P-1121	5355	1665	1485
5"	P-1123	4455	855	630
6"	P-1124	4320	1190	830

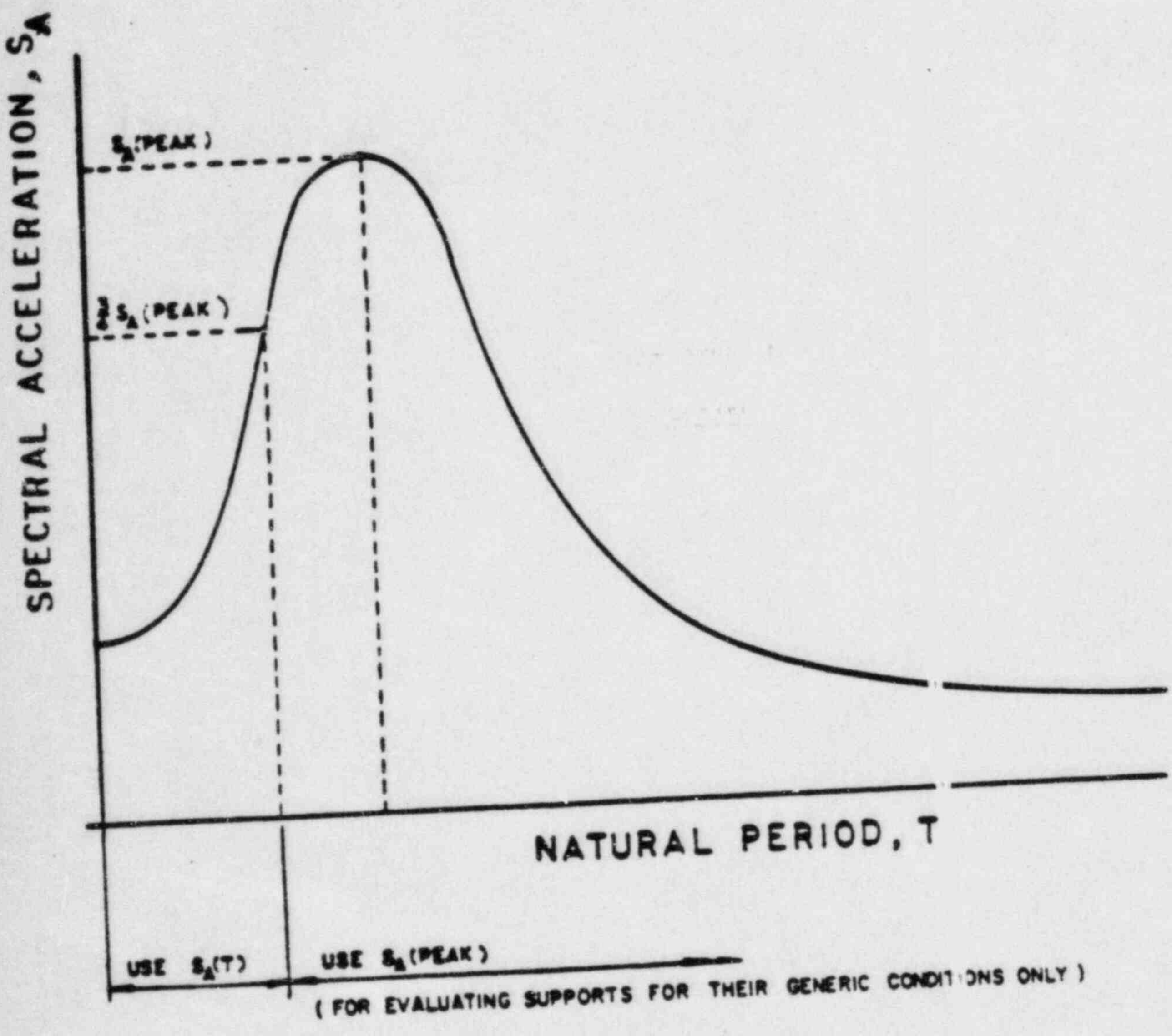

SPECTRAL ACCELERATION, S_A
S_A(PEAK)
$\frac{3}{4}S_A$(PEAK)
NATURAL PERIOD, T
USE S_A(T)
USE S_A(PEAK)
(FOR EVALUATING SUPPORTS FOR THEIR GENERIC CONDITIONS ONLY)

FIGURE 1

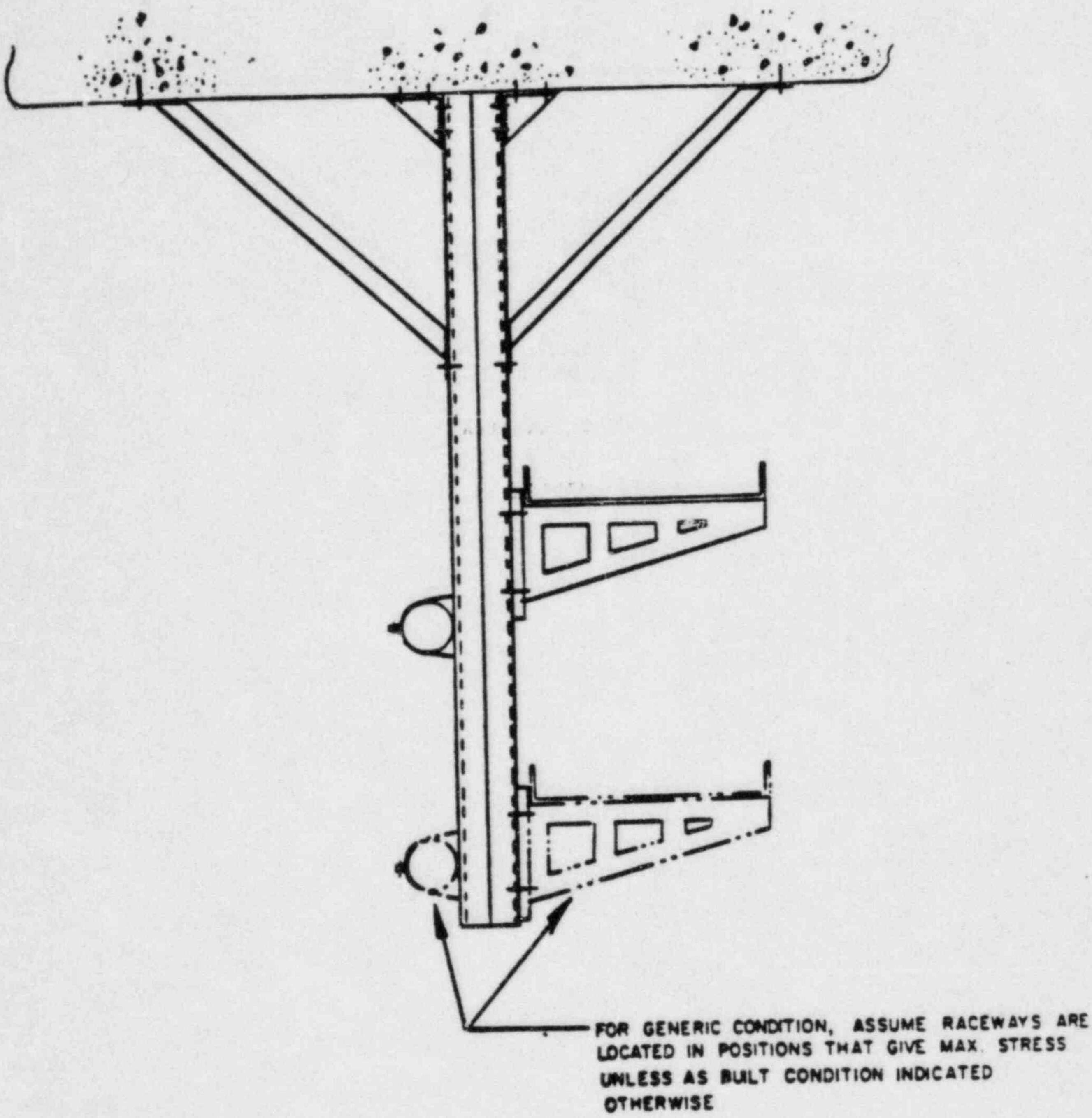
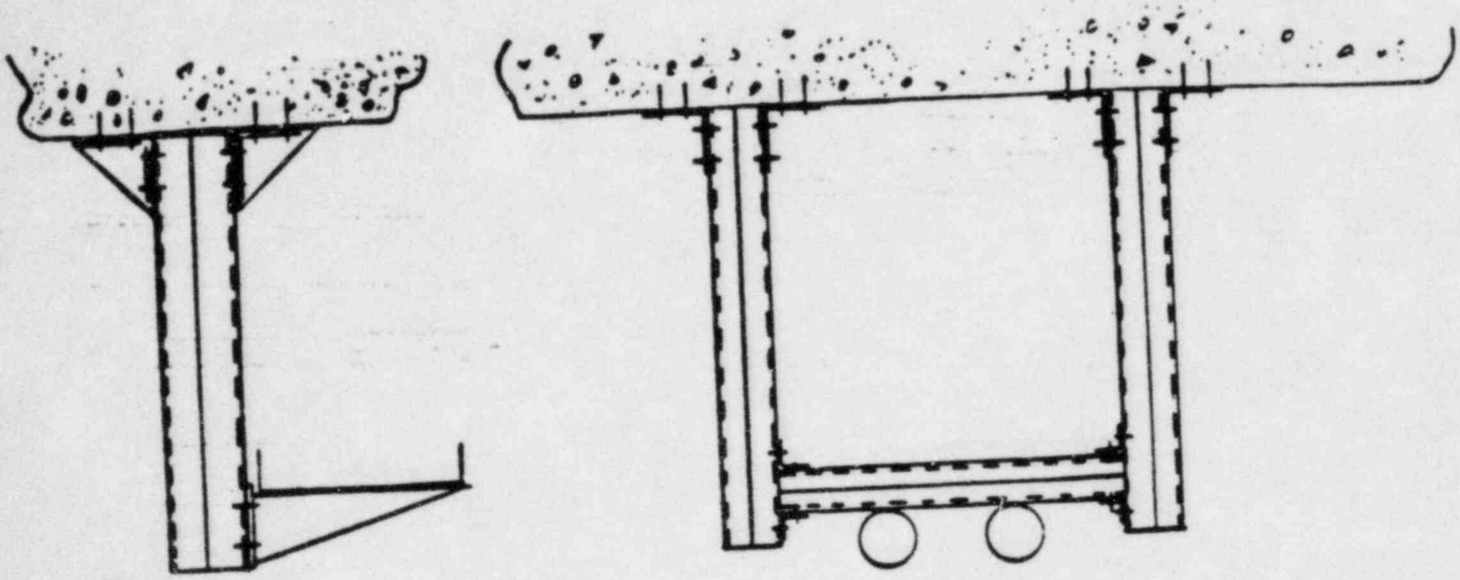
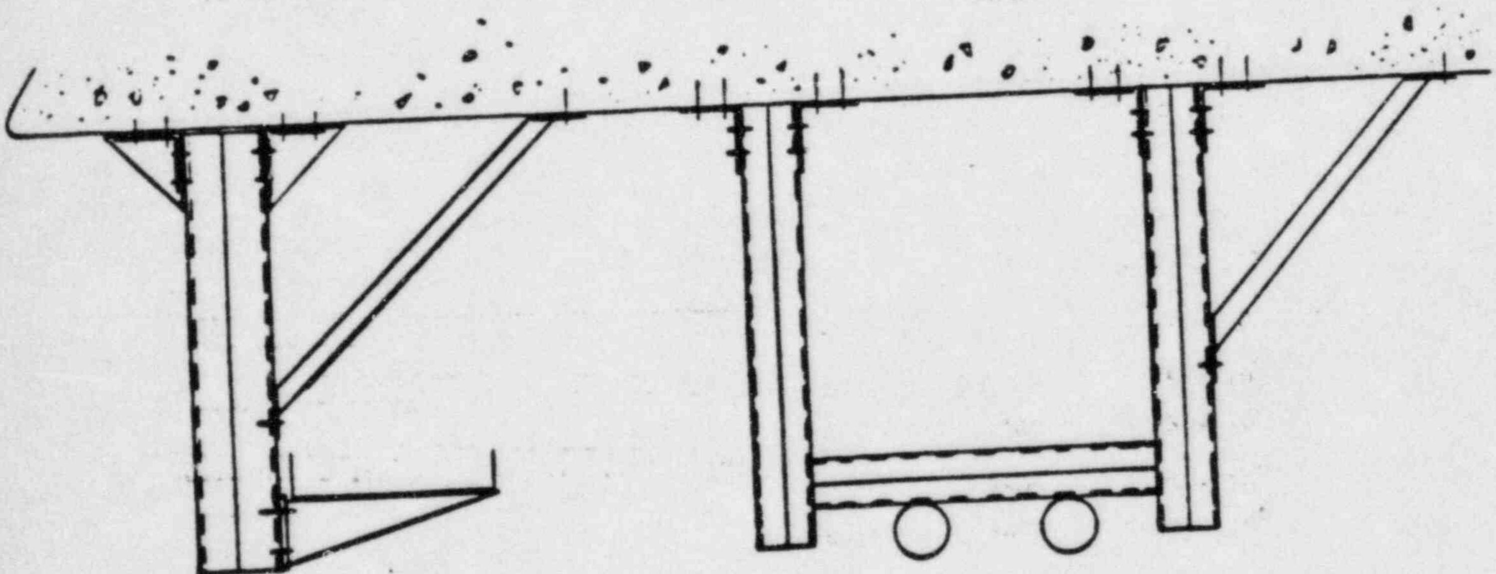

FOR GENERIC CONDITION, ASSUME RACEWAYS ARE LOCATED IN POSITIONS THAT GIVE MAX. STRESS UNLESS AS BUILT CONDITION INDICATED OTHERWISE

FIGURE 2



EXAMPLES OF SUPPORTS THAT REQUIRE CHECKING FOR JOINT ROTATION AND FATIGUE.



EXAMPLES OF SUPPORTS THAT DO NOT REQUIRE CHECKING FOR JOINT ROTATION AND FATIGUE

FIGURE 3

ATTACHMENT

A

DCM C-15
Rev. 3

PG&E
FOR INTRA-COMPANY USES

From Division or Department: ELECTRICAL ENGINEERING

File No.

Re Letter of

Subject: Diablo Canyon
Cable Tray & Conduit Weights

To Division or Department

October 29, 1981

MR. R. V. BETTINGER:

Here are weights which should be used in designing supports for cabl... ...ays and conduits:

CONDUIT

Size (Dia. in.)	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6
Wt (lbs/ft)	1.0	1.4	2.1	3.1	4.1	6.0	8.6	12.5	19.0	28.1	39.7

TRAY

Size (Width, in.)	6	9	12	18	24
Wt (lbs/ft)	12.5	18.8	25.0	37.5	50.0

These weights are based on the following considerations:

Conduit

- assumed to be filled to the maximum (42% by area) with insulated copper conductors.

- conduit assumed to be rigid iron.

Cable Tray

- tray assumed to be NEMA Class II (3 inches high).

- filled weights assumed to be 25 pounds per square foot of tray bottom. These weights are approximately equal to values calculated assuming maximum fill (32% by area) of insulated copper conductors.

General

- these weights will provide very conservative values since average actual weights are about 30% less.

J. R. HERRERA

By W Vahlstrom
W. VAHLSTROM

WV(1214):ds
cc: JWColwell, FJDan

ATTACHMENT B

DELETED

ATTACHMENT C

DELETED

ATTACHMENT D

DELETED

ATTACHMENT E

TABLE 4-3

Average Concrete Strength and Modulus of Elasticity

Structure and Component	Concrete mix*	Average f'_c (test value) (psi)	E_c (psi)
Containment Structure			
Base Slab to Elevation 87'	A	6330	4.53×10^6
Skin Pour at Elevation 89'	A	6330	4.53×10^6
Interior	A	6330	4.53×10^6
Skin Pour	B	3850	3.54×10^6
Soldier Beams	B	3850	3.54×10^6
Exterior Walls	B	3850	3.54×10^6
Dome	B	3850	3.54×10^6
Auxiliary Building			
Skin Pour	B	3920	3.57×10^6
Walls and Slabs Below Elevation 85'	B	3920	3.57×10^6
Slabs 4 Feet and Thicker at Elevation 85'	B	3920	3.57×10^6
Columns Below Elevation 85'	C	5650	4.28×10^6
Walls and Slabs Above Elevation 85'	C	5650	4.28×10^6
Slabs Less Than 4 Feet Thick at Elevation 85'	C	5650	4.28×10^6
Columns Above Elevation 85'	C	5650	4.28×10^6
East Walls Above Elevation 115'	C	5650	4.28×10^6
Other Exposed Walls	C	5650	4.28×10^6
Exterior Slabs at Elevation 140'	C	5650	4.28×10^6
Other Roof Slabs	C	5650	4.28×10^6
Turbine Building			
Slab at Elevation 140'	A	6590	4.63×10^6
Skin Pour	B	3870	3.55×10^6
Slabs Except at Elevation 140', Columns and Pedestal	B	3870	3.55×10^6
Exterior Walls Above Elevation 85' Except Shear Wall Along Line (1) & (35)	B	3870	3.55×10^6
Shear Wall Along Line (1) and (35)	C	5500	4.23×10^6
Shear Walls Along Lines (5), (17), (19), and (31)	C	5500	4.23×10^6
Remainder	B	3870	3.55×10^6
Intake Structure	B	3630	3.43×10^6

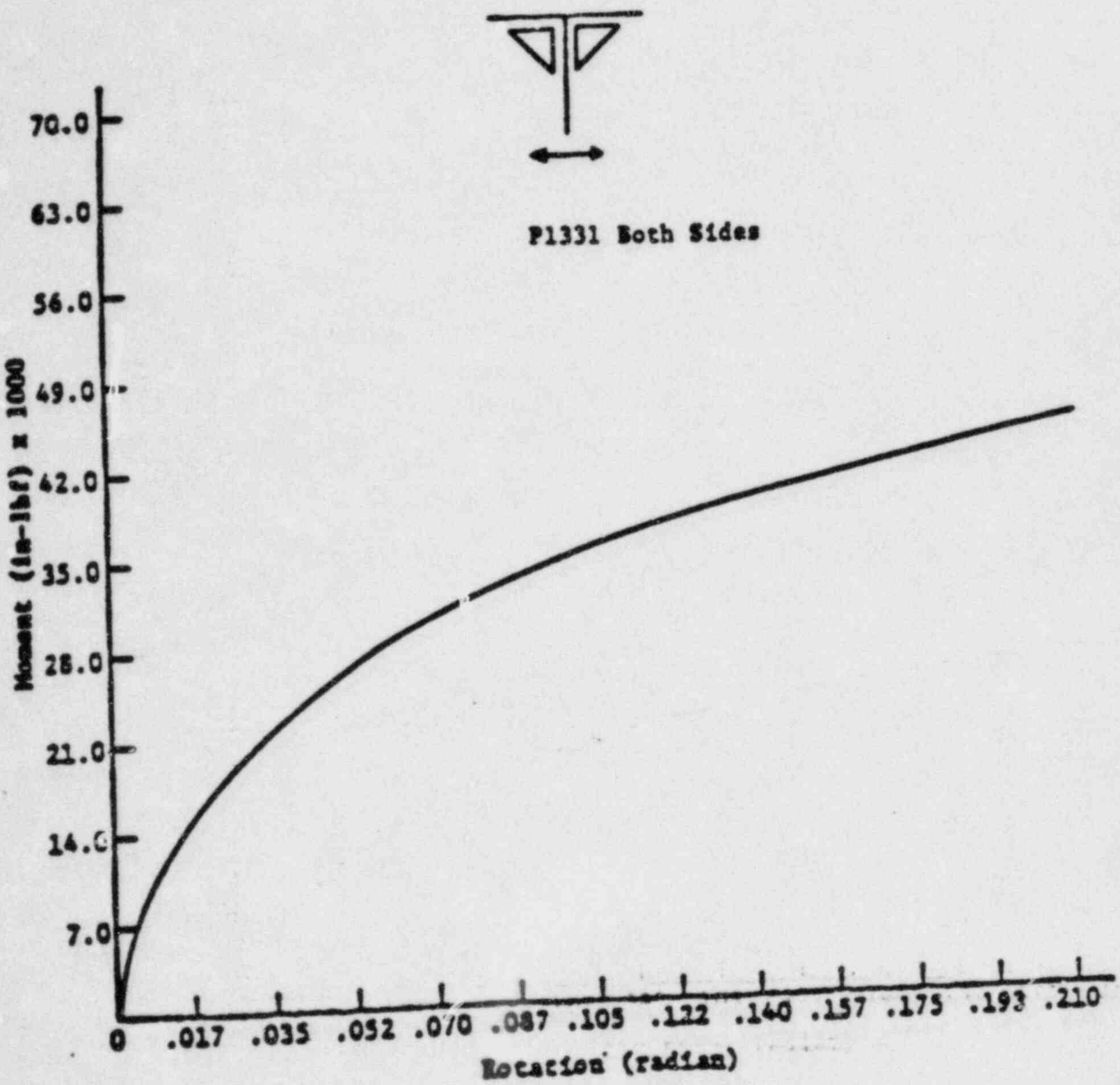
*Reference 1

ATTACHMENT F

DELETED

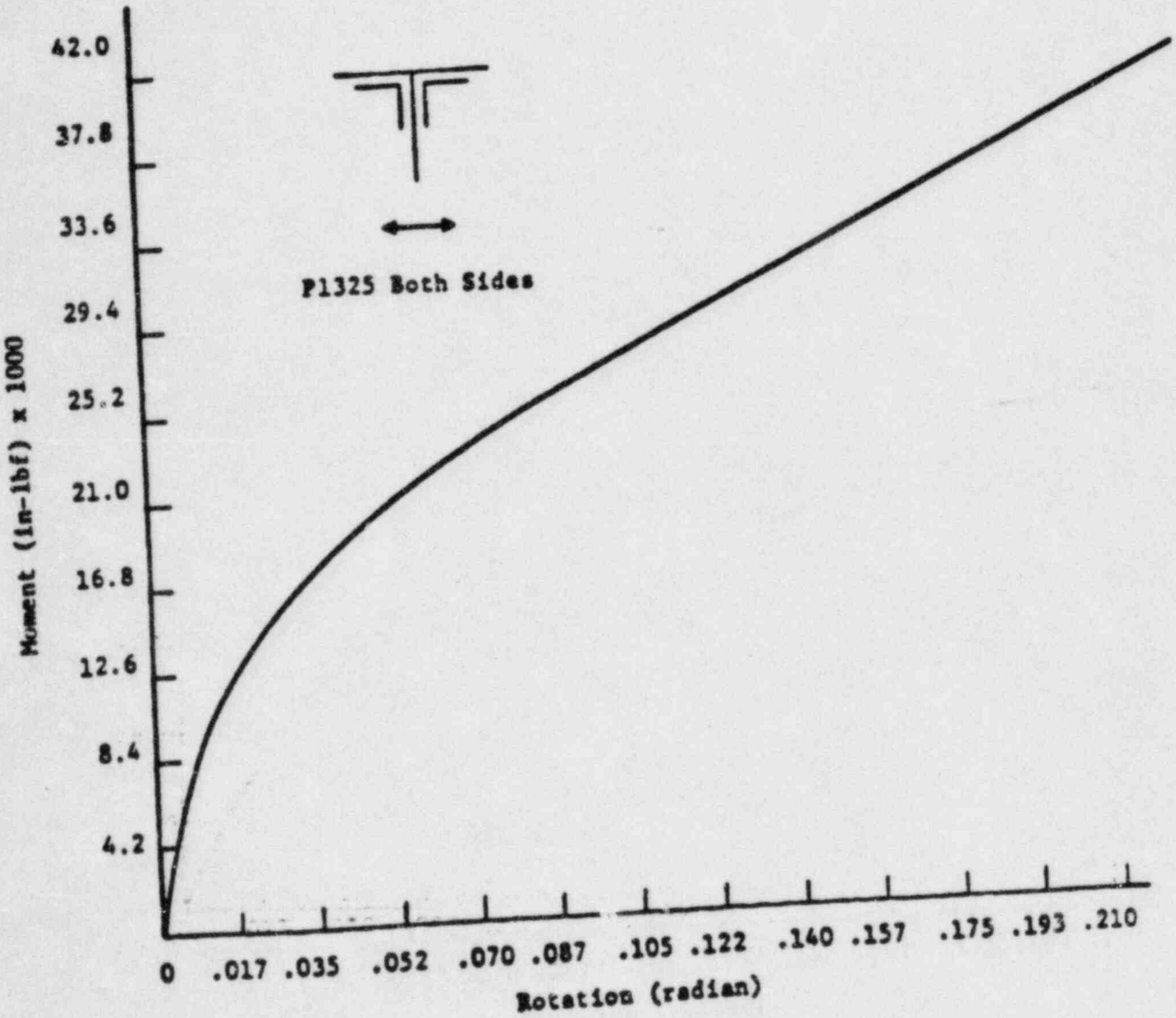
Attachment C.

Moment Versus Rotation



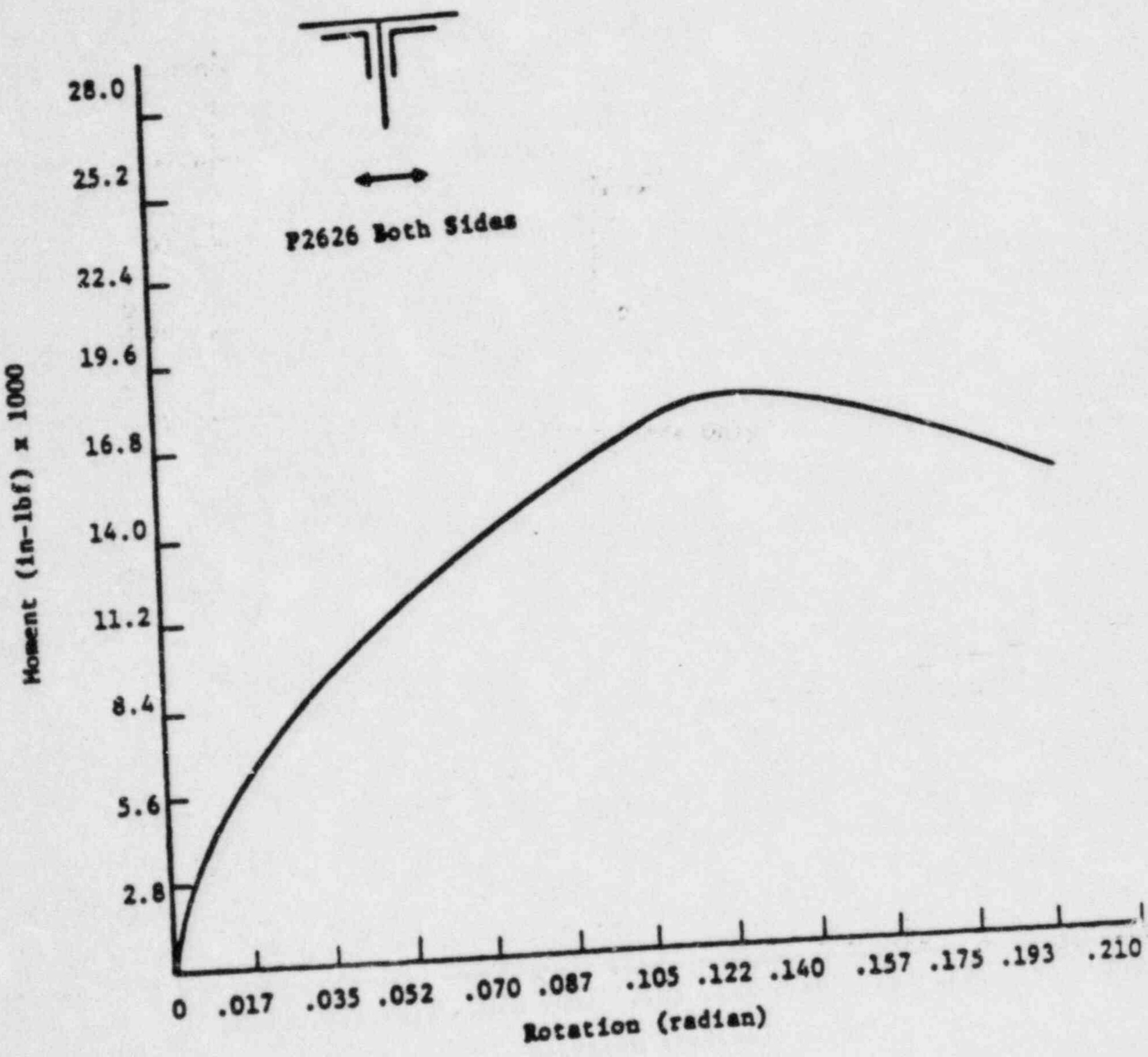
Attachment C.

Moment Versus Rotation



Attachment G.

Moment Versus Rotation



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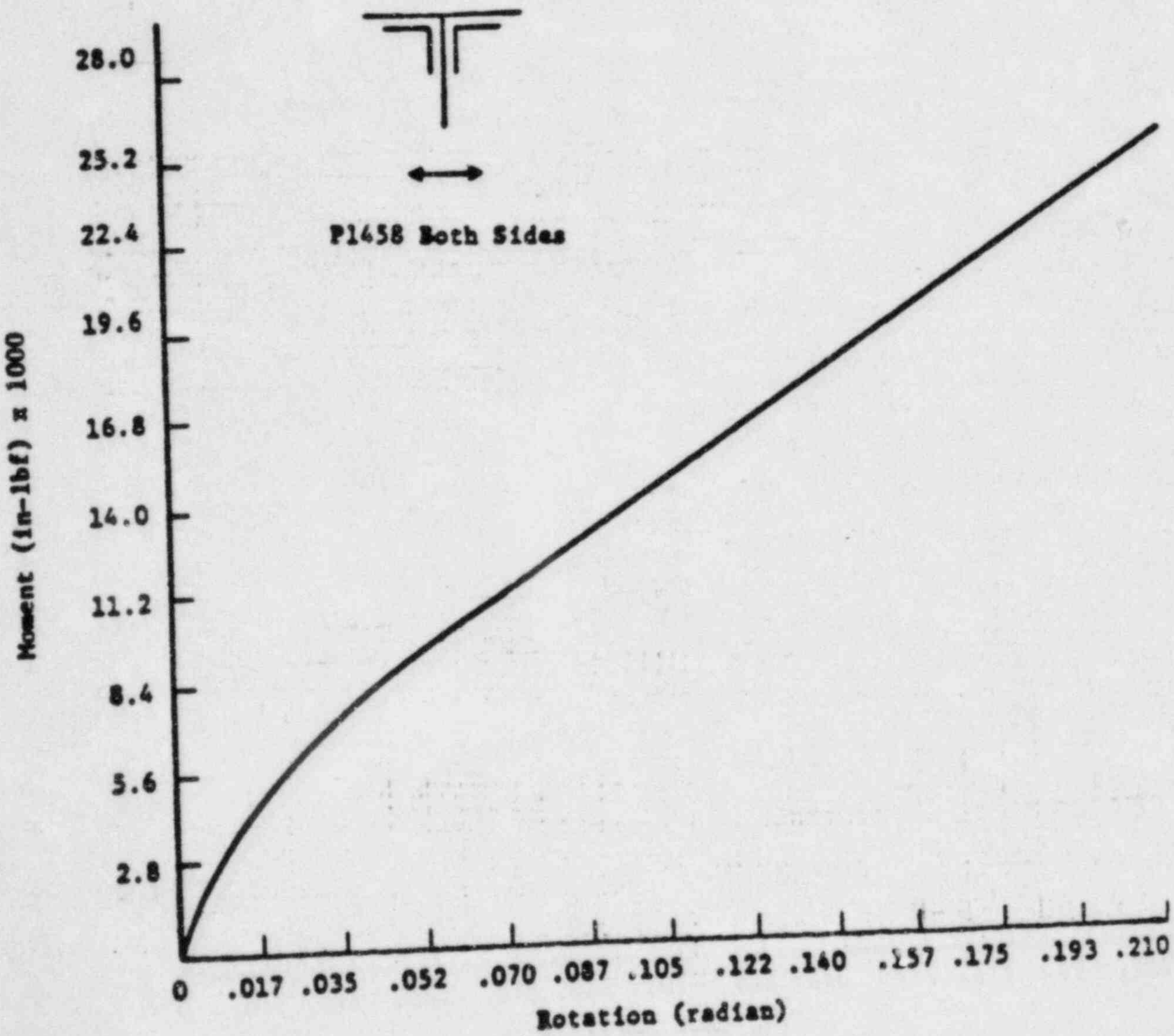
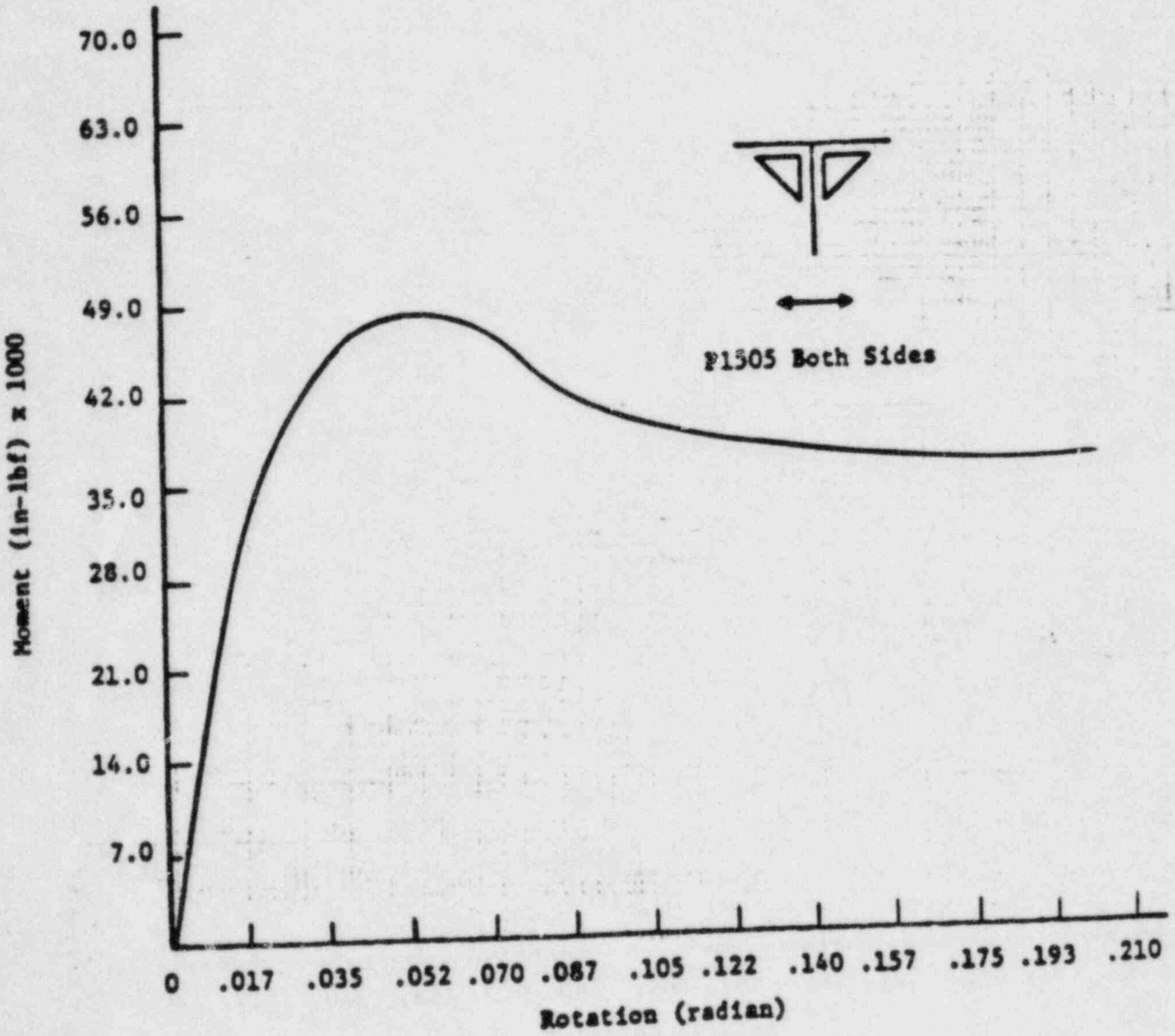
Moment Versus Rotation



Attachment G.

Moment Versus Rotation



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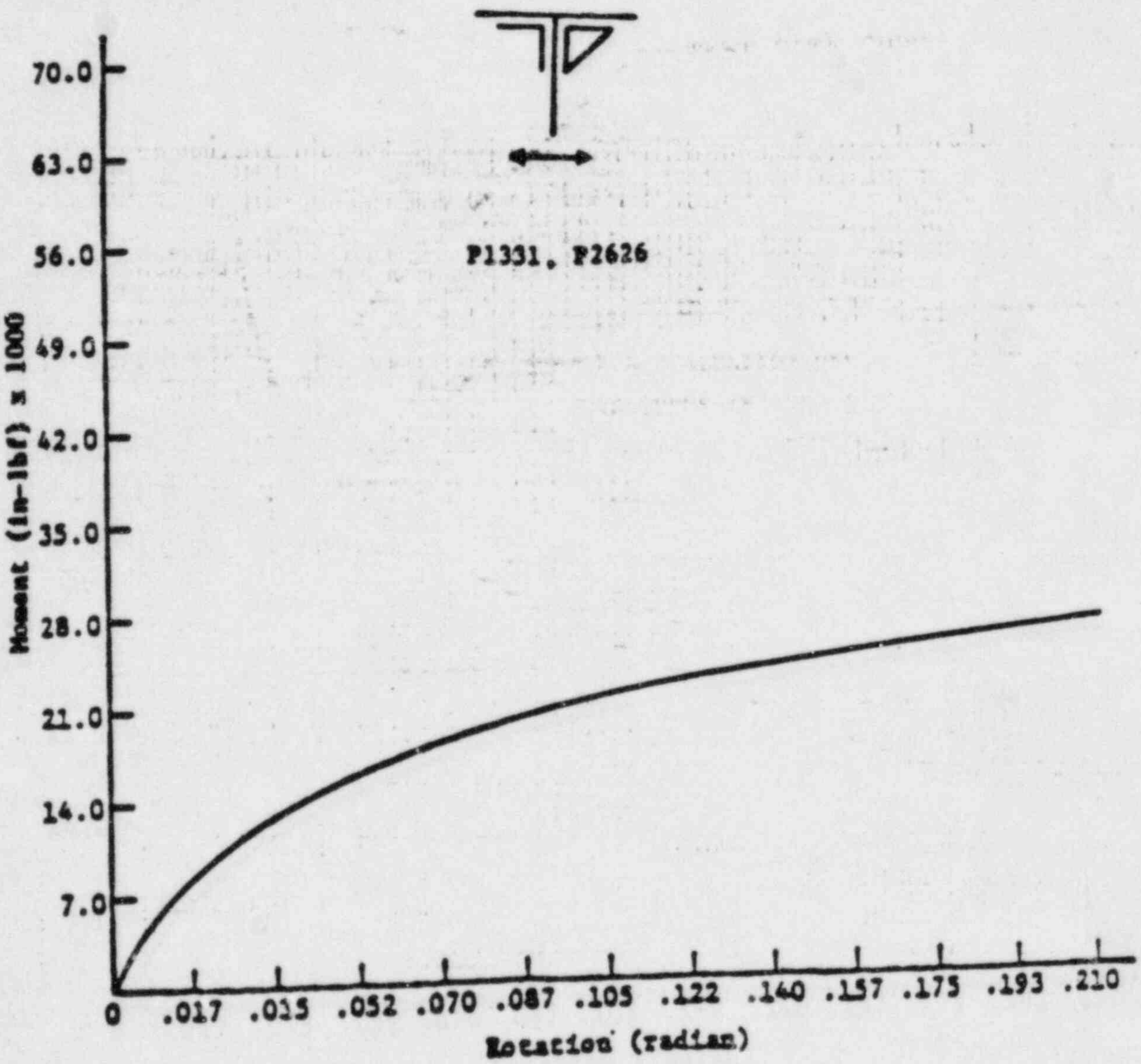
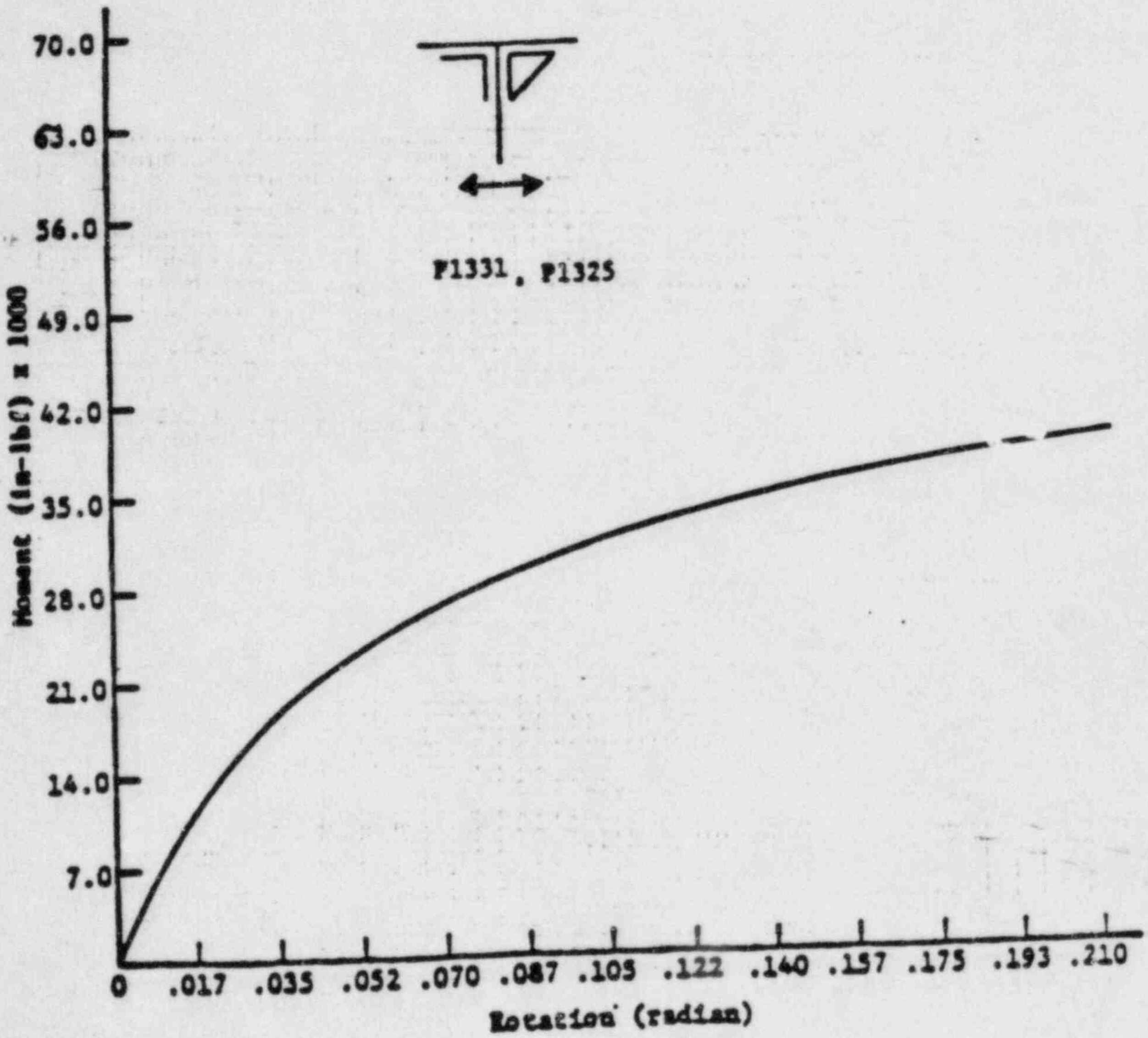
Moment Versus Rotation



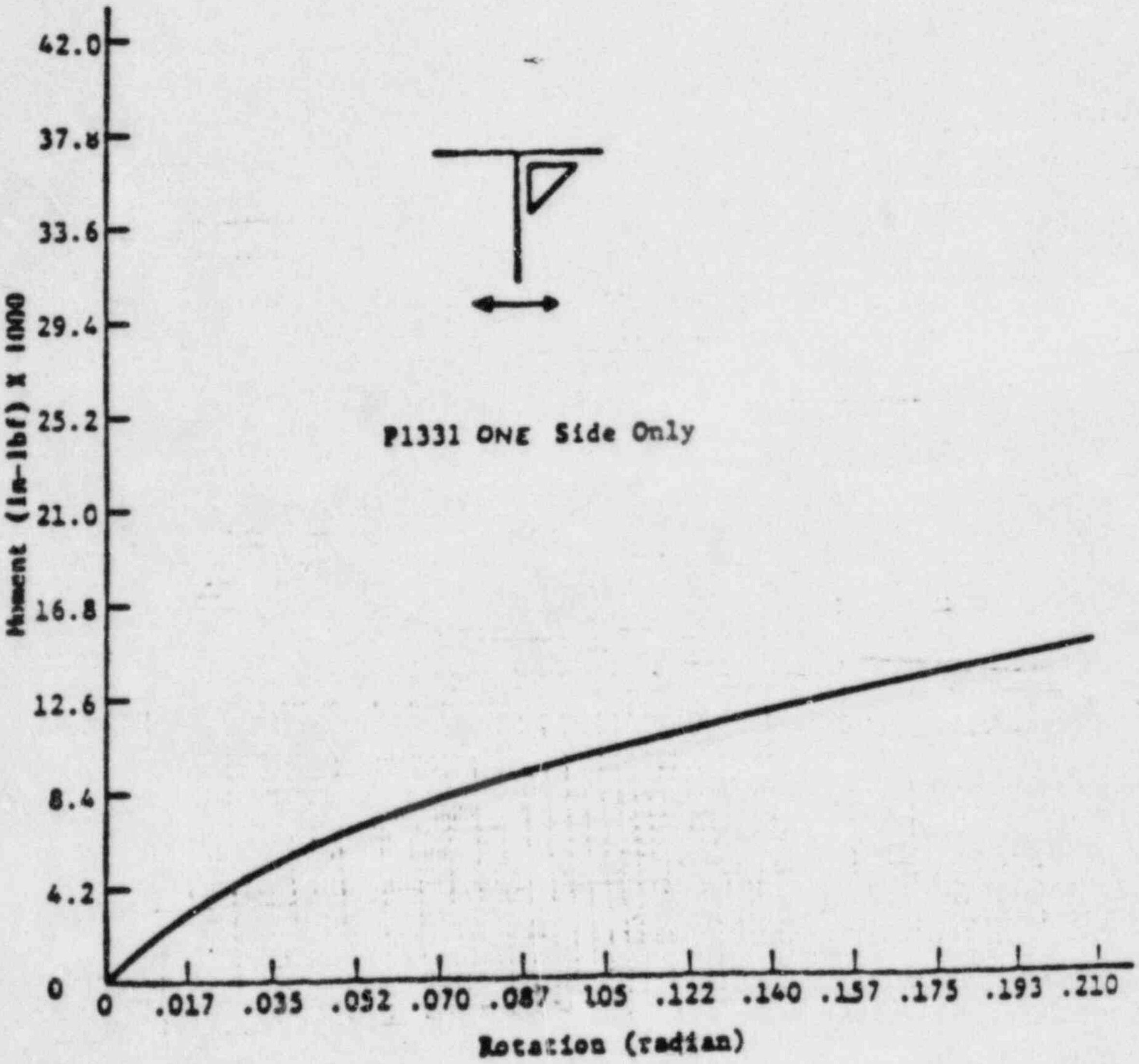
Attachment C.

Moment Versus Rotation



Attachment G.

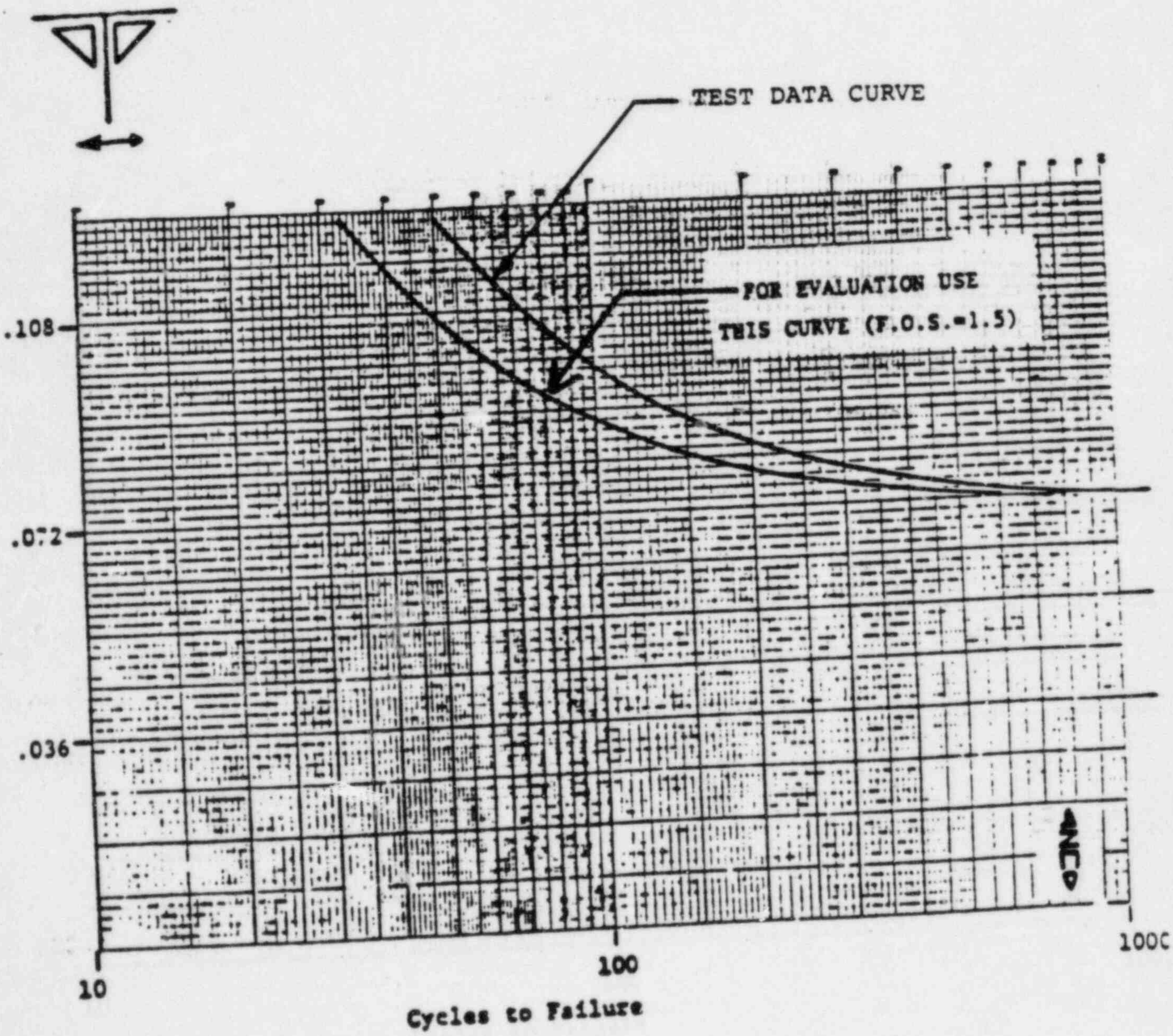
Moment Versus Rotation



Attachment H.

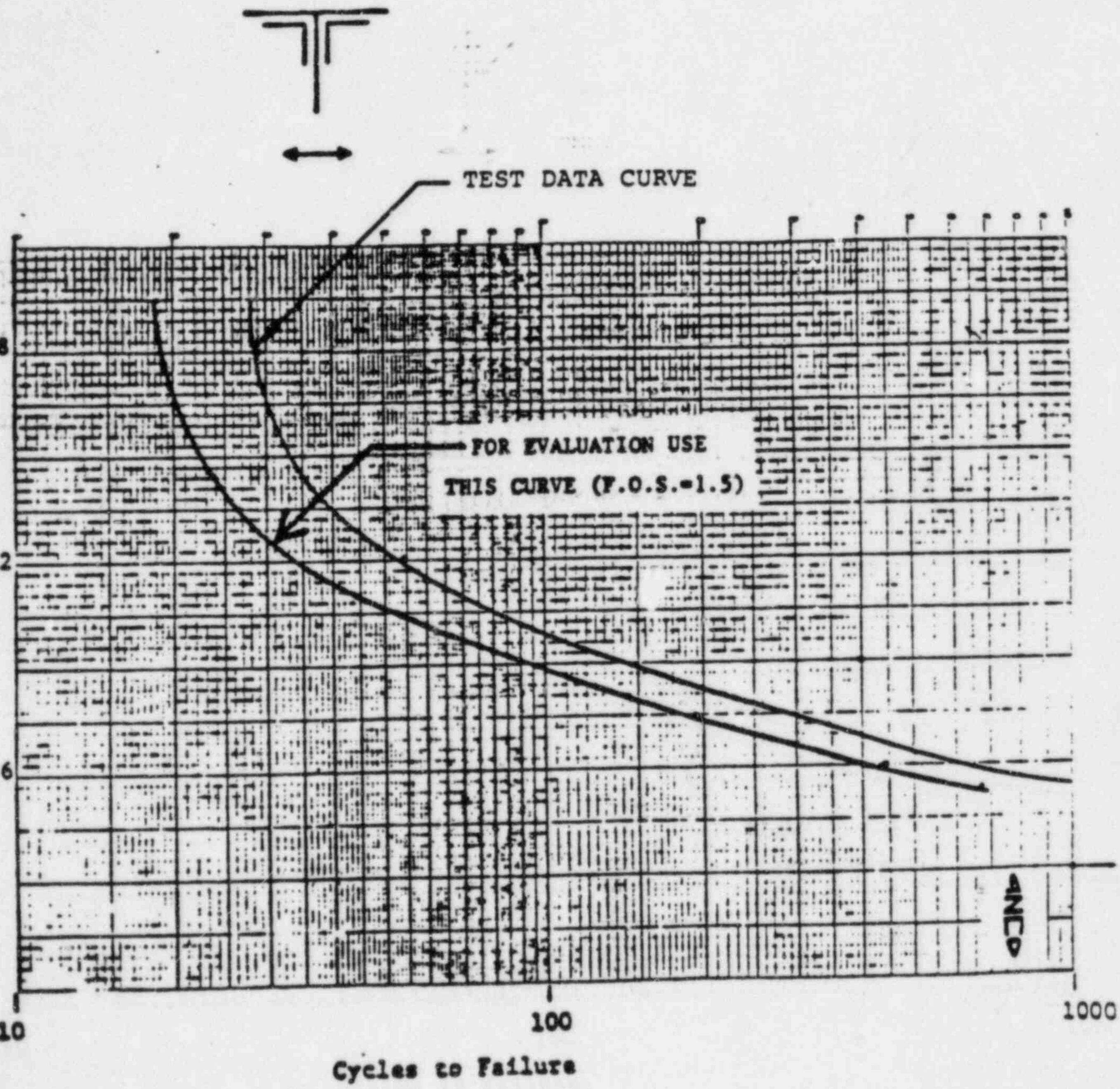
Rotation Versus Cycles

P1331 Both Sides



Attachment B.
Rotation Versus Cycles

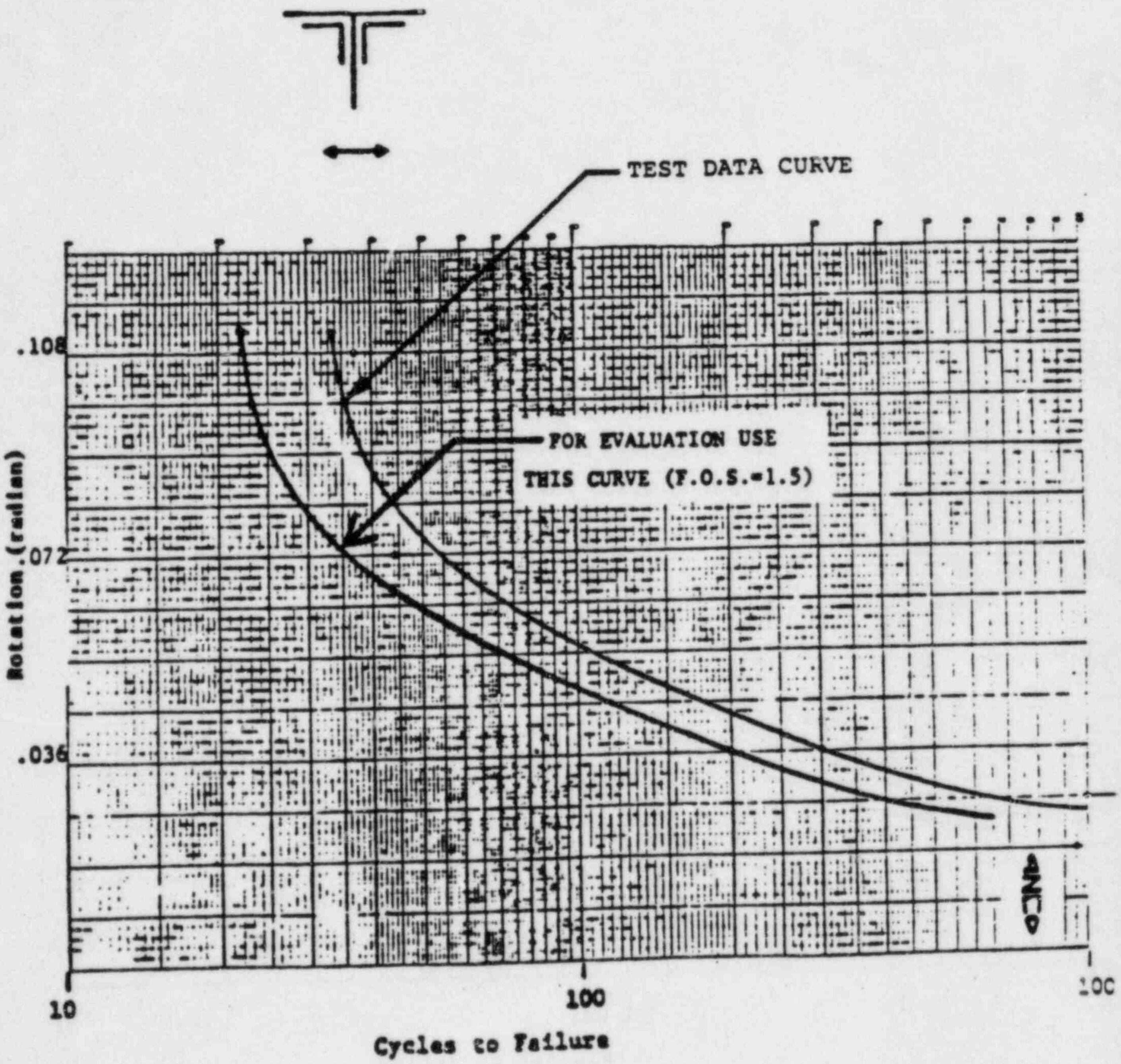
P1325 Both Sides



Attachment E.

Rotation Versus Cycles

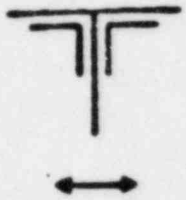
P2626 Both Sides

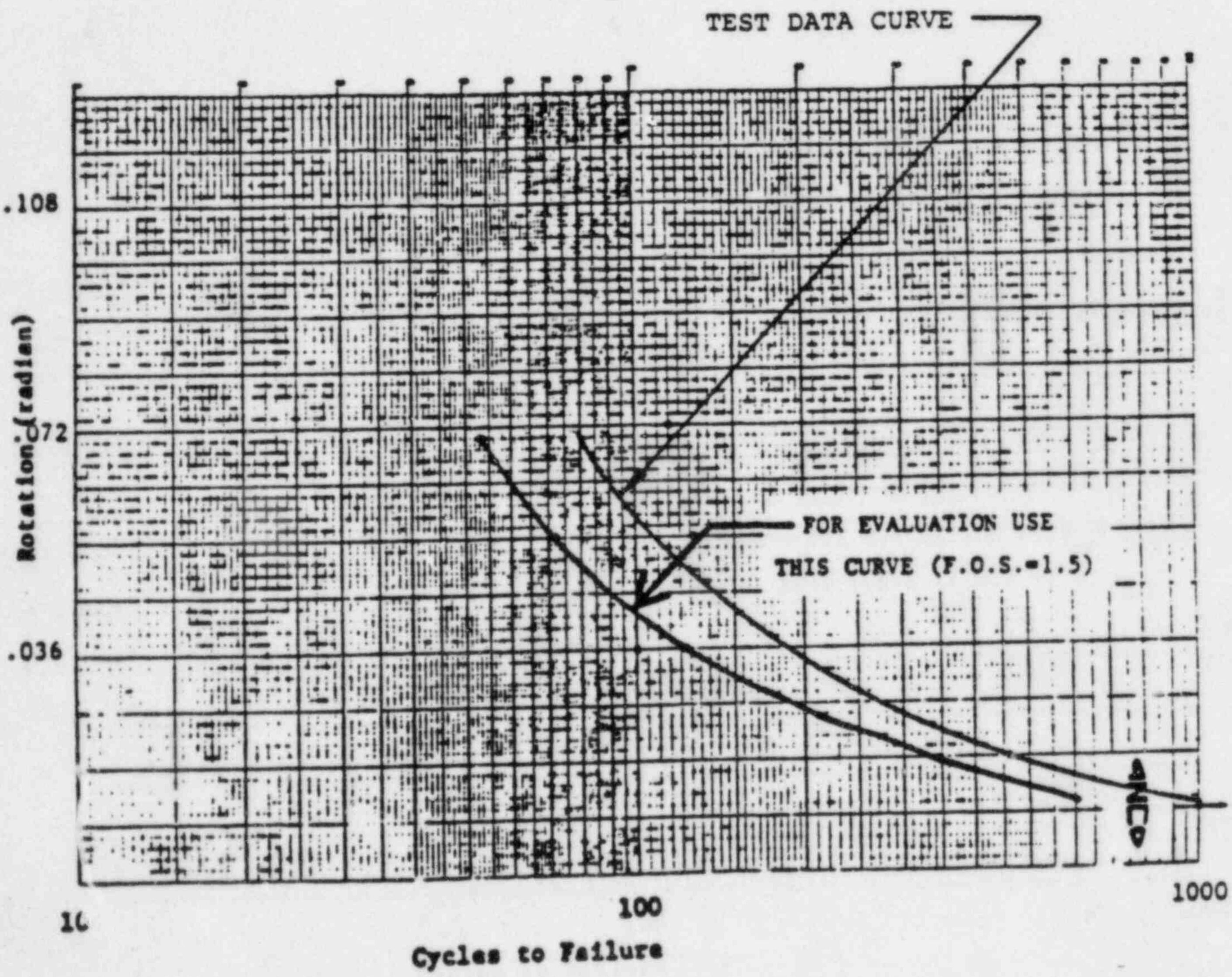


Attachment H.

Rotation Versus Cycles

P1458 Both Sides

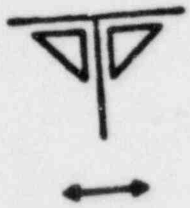


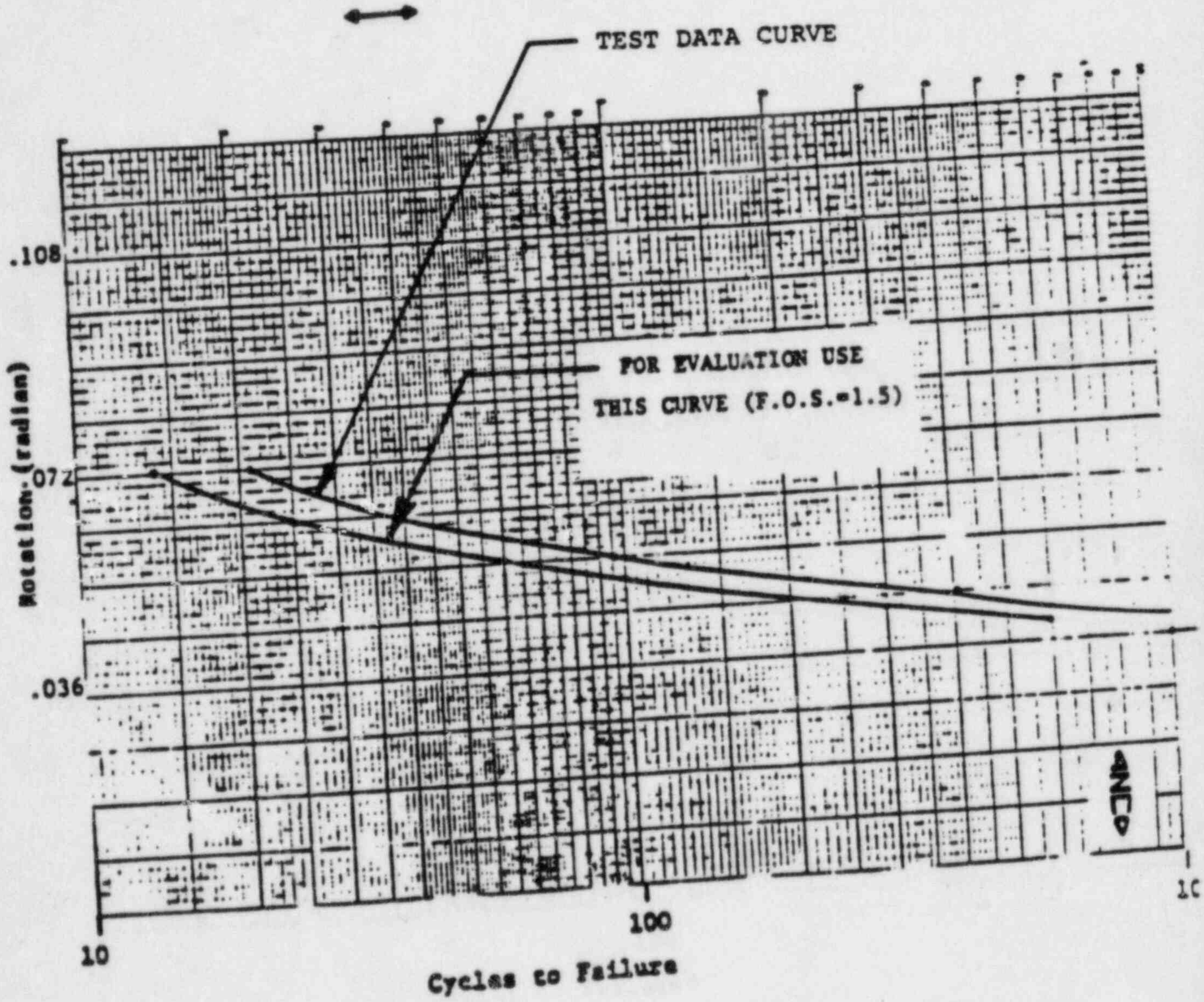


Attachment E.

Rotation Versus Cycles

P1505 Both Sides

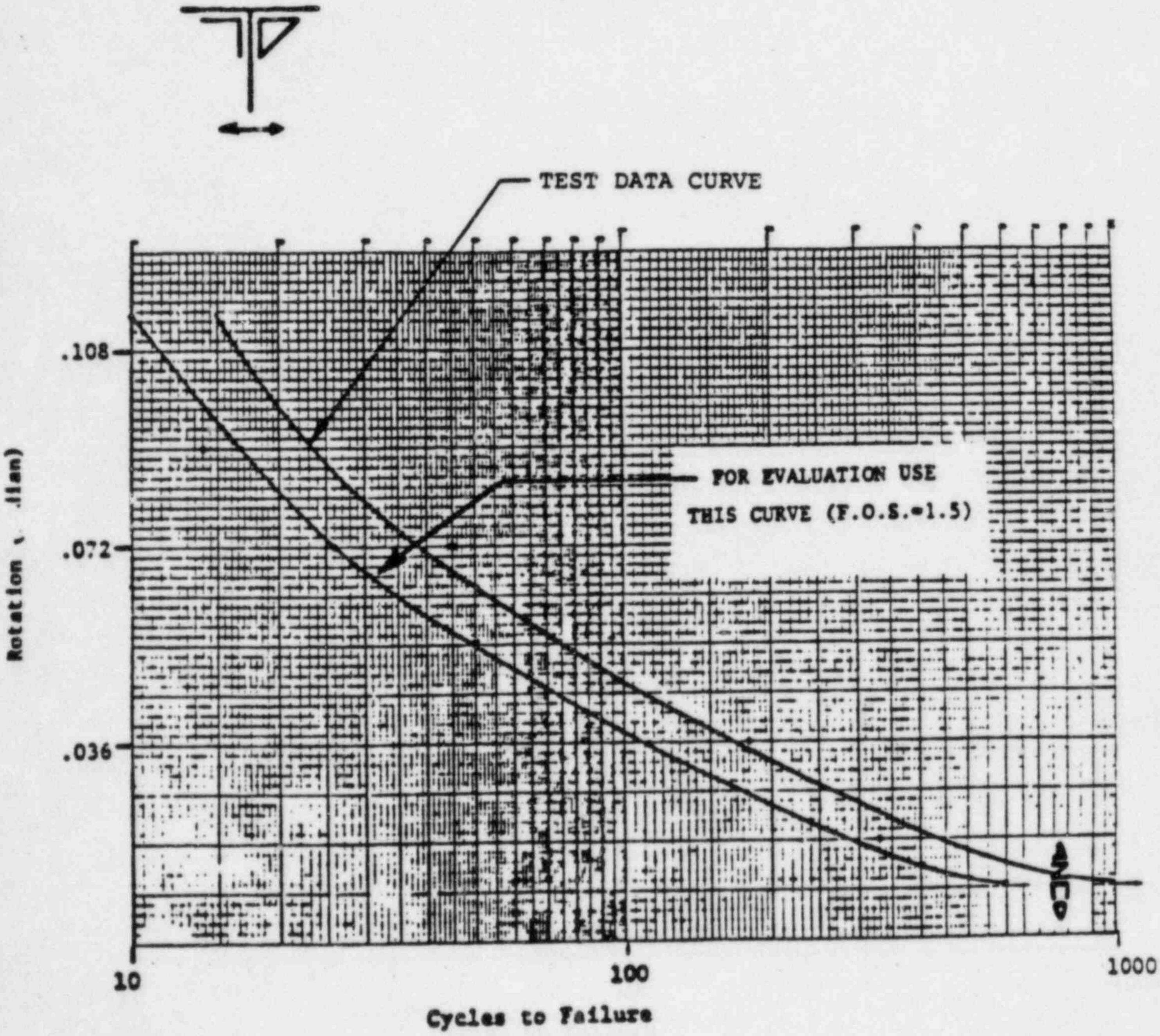




Attachment E.

Rotation Versus Cycles

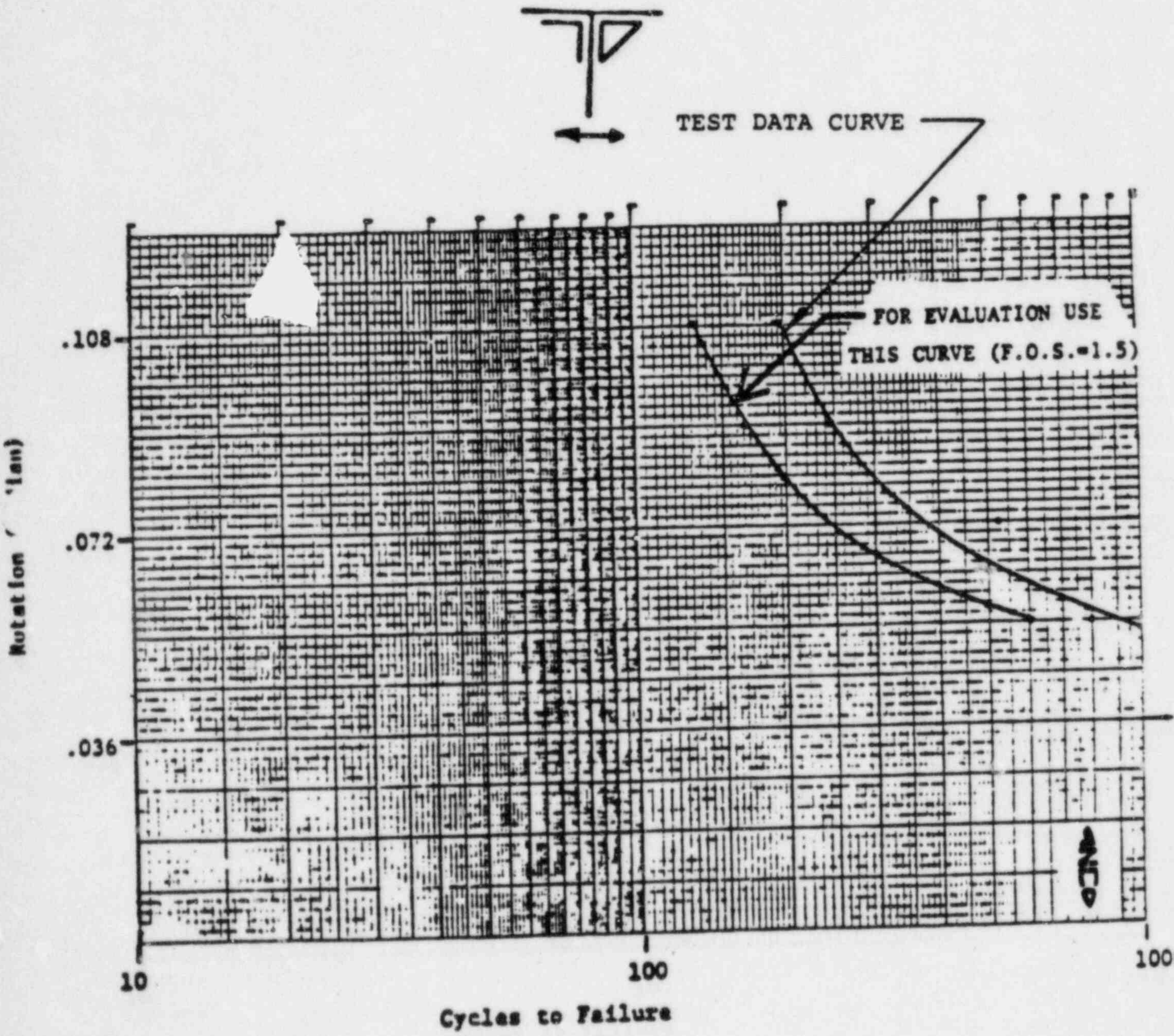
P2626 AND P1331



Attachment E.

Rotation Versus Cycles

P1325 AND P1331



PROCEDURE FOR INSPECTION
OF EXISTING CONCRETE EXPANSION ANCHORS
IN HANGER INSTALLATIONS

REV. 0
REV. 1 2-14-77

DIABLO CANYON NUCLEAR POWER PLANT
UNITS I & II
QAI 98

PREPARED BY TITLE

DATE 1/21/77

CHIEF FIELD ENG. DATE 1-21-77

APPROVED BY TITLE

PG&E DATE 1/21/77

Pullman Kellogg DATE 1/21/77

FOR INFORMATION ONLY

PROCEDURE INDEX

1.0 PURPOSE

1.1 To provide instruction to personnel performing inspections of existing concrete expansion anchors.

2.0 SCOPE

2.1 Inspection of all accessible concrete anchors as defined and outlined by the M. W. Kellogg program for inspection of existing concrete anchors.

3.0 REFERENCE MATERIAL

3.1 The following reference material will be used in providing instruction and for performing inspections of installed concrete anchors.

3.1.1 Anchor Manufacturer data and instructions.

3.1.2 P.G.& E. and M. W. Kellogg hanger drawings.

3.1.3 M. W. Kellogg program for inspection of existing concrete expansion anchors.

4.0 PERSONNEL

4.1 Personnel performing and documenting anchor inspections shall meet the following requirements.

4.1.1 Pass visual acuity test as outlined in M. W. Kellogg procedure E.S.D. 256.

4.1.2 Have a general mechanical or engineering background sufficient to understand and comply with the requirements of this procedure.

4.1.3 Have received sufficient instruction on this procedure to develop an understanding of the apparatus and procedures required to complete the requirements outlined herein. They will not determine the final disposition of the anchors.

5.0 DISCUSSION

5.1 Random inspections of installed expansion anchors have indicated that some existing installations do not meet minimum requirements. Recognizing this, we have performed and anchor failure analysis test to determine to what extent an anchor can deviate from perfect and still meet design requirements. Because of these findings a complete inspection will be performed. Anchors found to be outside the criteria defined herein will be evaluated and, if required, repairs made to assure compliance with design requirements.

FOR INFORMATION ONLY

6.0 PROCEDURE

6.1 HILTI ANCHORS (See Attachment # 1)

6.1.1 These anchors are designed to develop maximum strength when installed as shown in steps 1, 2 & 3 of attachment # 1.

a. The hole must be drilled to the proper depth and size. The depth being the length of the anchor. (Steps # 1)

b. The hole should then be cleaned to remove any remaining chips or powdered concrete. (Steps # 2)

c. The anchor is then placed in the hole, the plug inserted, small end first, and driven to expand the anchor inside the concrete. (Step # 3) This is accomplished with the proper sized setting tool, shown at the bottom of sheet, Attachment # 1.

6.1.2 A perfect installation would be one that leaves the anchor flush, to not more than 1/8" below the surface of the concrete and has the plug driven where the small end is flush with the back of the anchor, and the angle of the anchor is perpendicular to the surface of the concrete.

6.2 PHILLIPS ANCHORS (See Attachment # 2)

6.2.1 These anchors are designed to develop maximum strength when installed as shown in attachment # 2.

a. The anchor itself is used, in a machine designed for installing these anchors, to drill the hole. The hole should be not greater than 1/16" - 1/8" deeper than the length of the anchor. (Step # 1)

b. After the hole is drilled the anchor is removed and the hole cleaned. Care should be taken to assure that the core is removed from the center of the hole. (See Step # 2)

c. After the hole is cleaned the expansion plug is inserted, small end first, into the back end of the anchor (Step 2.a), placed in the hole and, unlike the Hilti, the anchor is driven down on the plug to expand it.

6.2.2 A perfect installation would be one that leaves the anchor flush to not more than 1/8" below the concrete surface and has the anchor driven where the back, large end, of the plug is flush with the back of the anchor, and the angle of the anchor is perpendicular to the surface of the concrete.

6.3 Inspection and Documentation

FOR INFORMATION ONLY

6.3.1 All Accessible anchors will be inspected a d findings recorded as follows.

6.3.1.1 Prepare an Anchor Inspection Che k List. (Attachment # 3)

6.3.1.2 Record the hanger symbol, area and elevation. Line " A "

6.3.1.3 Sketch the base plate and bolt patt rn. Line " B "

6.3.2 Number each bolt in the pattern. Facing the plate start with number 1 in the top left corner, and proceed clock wise. If the plate is floor or ceiling mounted c nsider North as the top of the plate. Mark the number adjacent to each bolt with a permanent, easily identifiable marker. If a support has more than one base plate, identify each plate using letters A, B, etc. Record the number on the check list Line " B ": complete Line " C ".

6.3.3 Remove each accessible bolt in the hanger installation. Record the type and size on the "Check List". IE: ½" H or ½" P. "H" being Hilti and "P" being Phillips. Line " D "

NOTE: Hilti plugs are unpainted and dark grey. Phillips are either "red" anodized or painted. Occasionally a rusted Hilti may appear to be red.

Remove only one bolt at a time unless it can be determined that the hanger will not move if more than one bolt is removed. If, for any reason, the hanger moves during the inspection it shall be noted in the "Remarks" section of the "Check List" and the "Review Required" box checked.

If there is reason to believe that the bolt or anchor will be damaged during bolt removal, other bolts may be loosened to relieve binding. If the bolt still binds and cannot be removed leave as is and note it on the check list, circle the notation, and check the "Rework Required" box.

If any or all bolts cannot be removed because of interference or accessibility note it on the check list and check the "Review Required" box.

6.3.4 After the bolt has been removed, visually examine the anchor for obvious irregularities such as: oversize holes in the concrete or loose anchors, stripped threads or anchors with the wrong type expansion plug. If any of these or other obvious irregularities exist note it in the remarks section of the check list and check the "Review Required" box.

6.3.4 If there is evidence that an anchor has been cut off on the thread end; determine the number of remaining threads and record it on the check list. Line " E "

NOTE: Unmodified Hilti anchors have a 45° internal chamfer on the shoulder. Unmodified Phillips anchors will have a rough shoulder caused by breaking off the driving portion of the anchor after it has been set. The number of remaining threads shall be determined by fully inserting the anchor test guage and counting the number of turns required to remove it. If the remaining number of threads is greater than the number in the chart below it can be recorded as "All" threads remaining.

	NUMBER THREADS	
SIZE	HILTI	PHILLIPS
1/2	8	9
5/8	9	9
3/4	13	11
7/8	------	12

6.3.5 Check the depth of the anchor below the surface of the concrete. If it is not possible to measure the anchor depth, estimate the depth and note that the measurement has been estimated. If the depth is greater than ¼" record the depth in the entry space and circle the entry, Line " F ". Check the "Review Required" box.

6.3.6 Check for Angular Misalignment as follows:

1. Insert the test tool (See Attachment # 4) into the anchor.

2. Measure the angle between the hanger plate and the test tool.

3. If the angular misalignment is greater than 5° from perpendicular to the plane of the plate, record the degree of deviation in the entry space, Line " G ", and check the "Review required" box.

4. Remove the test tool.

6.3.7 Check the bolt for length and thread damage. The length must be sufficient to assure at least 4 full threads engagement in the anchor.

If bolts are found to be short or have thread damage, discard them and after completion of the inspection install new bolts. It is not necessary to record this on the check list.

If bolt threads are stripped and it is determined that contact with the base plate is the reason, leave the bolt out and note the condition in the remarks section of the check list. Check the "Rework Required" box.

6.3.8 Using the appropriate type and size driving tool, the fitter, will drive the plug or anchor to assure it is fully driven. Caution should be exercised to prevent over driving.

Visually examine the hole to determine if the plug is below the bottom thread. If not, measure the length of the exposed remaining thread from the top of the plug to the edge of the anchor, record this dimension and note that the dimension was measured without the use of the test guage.

If the bottom thread is visible above the plug, and the thread end is not cut off, measure with a depth gauge the distance from the top of the anchor to the plug. Record the reading on the check list, Line "H" (See Typ Inspection Aid Attached to Form 110).

> NOTE: Anchor test gauge (Attachment # 5) is to be used for all inspections where the thread end of the anchor is cut off.

If the alternate guage (Attachment # 6) is used so indicate on the check list and add 2" to the readings below.

> NOTE: The anchor test guages will be checked for excessive wear at periodic intervals not to exceed 1 week. When there is evidence of wear the worn guage will be replaced by a new one.

If the readings are outside the ranges given below circle the entry and check the "Review Required" box.

SEE PAGE 7A OF 14 FOR FIELD Q.A. ACCEPTANCE CRITERIA.

FIELD Q.A. ACCEPTANCE CRITERIA

MEASURED WITH GAUGE

HILTI			PHILLIPS		
SIZE	MIN.	MAX.	SIZE	MIN.	MAX.
1/2	2 22/32	3 3/32	1/2	2 17/32	2 31/32
5/8	3 3/32	3 19/32	5/8	3 1/32	3 20/32
3/4	3 17/32	4 5/32	3/4	3 17/32	4 6/32
7/8	------	------	7/8	3 17/32	4 14/32

MEASURED WITHOUT GAUGE

HILTI			PHILLIPS		
SIZE	MIN.	MAX.	SIZE	MIN.	MAX.
1/2	31/32	1 12/32	1/2	21/32	1 16/32
5/8	1 3/32	1 19/32	5/8	25/32	1 18/32
3/4	1 14/32	2 4/32	3/4	1 5/32	1 29/32
7/8	------	------	7/8	1 12/32	2 12/32

6.3.9 After all measurements have been recorded replace the bolts except where it is obvious that repairs must be made. Then spray a spot of orange paint on the hanger plate to indicate that the hanger has been inspected.

6.3.9.1 If the "Review Required" or Rework Required" box is checked on the check list, the inspector will hang a red flag on the hanger adjacent to the base plate.

7.0 DOCUMENTATION

7.1 Upon completion of an inspection the inspector shall review the inspection check list to assure that all required entries are made. Then sign and date the sheet.

7.2 During the shift the check lists will be collected by Q.C. surviellance for review and or rework scheduling as required.

8.0 AUDITS

8.1 The M. W. Kellogg Q.A. Department will perform audits of the inspection program. This will be performed by auditors who will randomly observe the inspection teams to assure that all inspection requirements are met, that measurements are accurate and that the inspeccion check lists are properly documented.

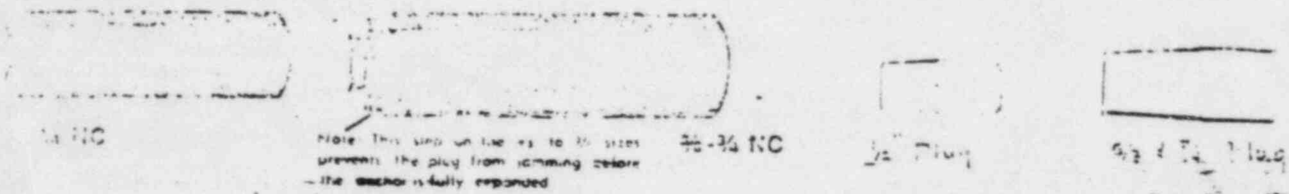
8.2 When an auditor observes an inspection he will initial the check list as an indication that he has observed that inspection and that it was performed correctly.

8.3 If he finds that inspections are being performed or documented incorrectly he will have the inspection team reinspect all previous suspect work.

Repeated discrepancies by an inspection team will be cause for retraining of the individuals or reassignment.

1. Set depth gauge to length of anchor (adding carbide tip length).
2. Drill and clean hole, insert anchor.
3. Fit setting tool into chuck and expand anchor, or use hammer and hand setting tool.

Available in all popular sizes



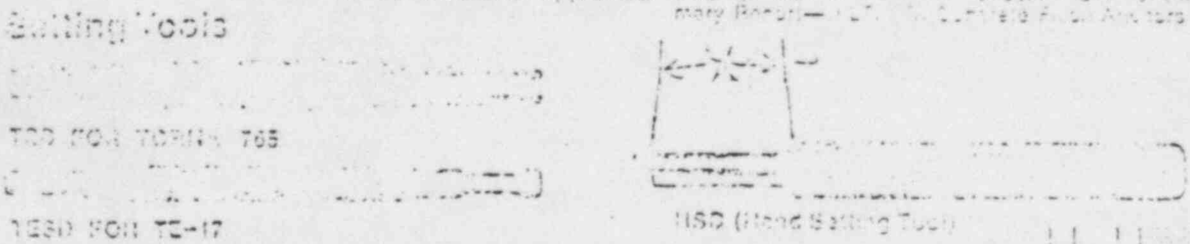
Description	Catalog Number	Bolt Size	Drill Bit Dia.	Bit Color Code	Usable Thread Length	Qty. Per Box	2000 PSI Concrete Pullout	2000 PSI Concrete Shear	4000 PSI Concrete Pullout	4000 PSI Concrete Shear	6000 PSI Concrete Pullout	6000 PSI Concrete Shear
HDI ¼	5490000	¼"	⅜"	Yellow	7/16"	100	1001	1703	2051	1781	3075	3050
HDI ⅜	54000[illegible]	⅜"	½"	Blue	⅝"	50	3174	3970	[illegible]	4225	5050	5000
HDI ½	5490024	½"	⅝"	White	11/16"	50	3997	5873	6701	6224	10200	9350
HDI ⅝	5490032	⅝"	27/32"	Black	⅞"	25	5549	6843	9996	12205	10400	13000
HDI ¾	54900[illegible]0	¾"	1"	Maroon	1⅛"	25	8957	15196	10004	17000	16400	21200

Made in U.S.A. (UL) listed and [illegible] Approved

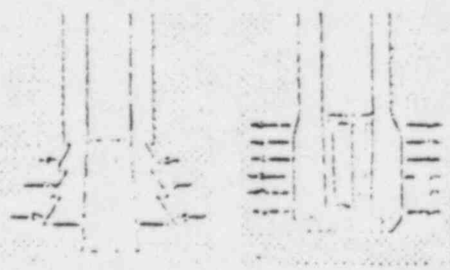
All sizes I.C.B.O. approved.

NOTE: Maximum working loads should not exceed ¼ of the average values for a specific anchor size. Actual factor of safety to be used depends on the application. For comprehensive Independent Laboratory Pullout and Shear data for each anchor size, request "HDI ... Summary Report— ... Concrete Floor Anchors Test Program."

Setting Tools



	Machine Setting				Manual Setting	
	Torna 765		TE 17			
	Desc.	Cat. No.	Desc.	Cat. No.	Desc.	Cat. No.
HDI ¼			TESD 6	5454500	HSD 6	5454504
HDI ⅜			TESD 10	5454516	HSD 10	5454520
HDI ½			TESD 12	5454524	HSD 12	5454528
HDI ⅝	TSD 16	5455056			HSD 16	5454536
HDI ¾	TSD 20	5455060			HSD 20	5454540



Conventional undercut expansion can cause stress concentrations in the concrete and subsequent premature failure

Special expansion provides uniform stress distribution and maximum friction against wall of hole

5

FOR INFORMATION ONLY

[illegible] Stamford, Conn. [illegible]

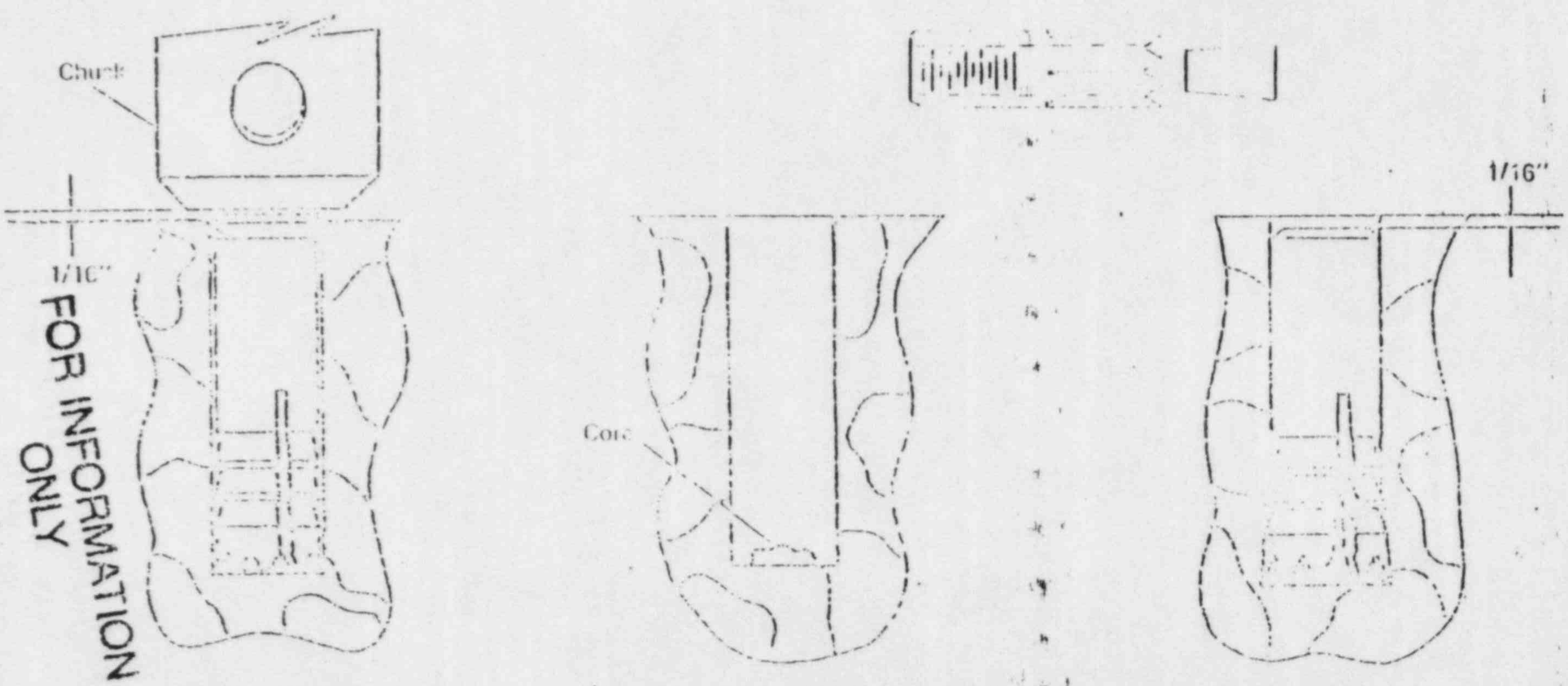
Attachment #2

(1) Drill with anchor using 747 Roto Stop Hammer or Impact Hammer with appropriate chuck assembly until face of chuck is within 1/16" from surface of concrete. Withdraw anchor from hole and expel cuttings.

(2) Holes drilled with S-69 (5/8") or larger anchors may have a piece of concrete core in bottom which should be broken up with a standard chisel or other tool. Clean all cuttings from the hole.

(3) Place red plug into anchor and insert anchor in hole. Expand with impact hammer without rotation until top of anchor is approximately 1/16" below surface of concrete. If necessary, use hand driver to fully expand anchor.

(2.1)



FOR INFORMATION ONLY

ANCHOR INSPECTION CHECK LIST

(A) HANGER SYMBOL __________ AREA & ELV. __________

CONFINEMENT __________

[ ] INSTALLATION ACCEPTABLE

[ ] REWORK

[ ] REVIEW REQUIRED

SKETCH OF ANCHOR PATTERN ON PLATE

(B)

FOR INFORMATION ONLY

(C)	REFERENCE NUMBER	____	____	____	____	____	____	____	____
(D)	SIZE & TYPE	____	____	____	____	____	____	____	____
(E)	# OF THREADS REMAINING (IF LESS THAN 4, CIRCLE)	____	____	____	____	____	____	____	____
(F)	ANCHOR DEPTH (IF MORE THAN ¼)	____	____	____	____	____	____	____	____
(G)	ANGULAR MISALIGNMENT (IF GREATER THAN 5°)	____	____	____	____	____	____	____	____
(H)	AS LEFT PLUG DEPTH (DIM.A)	____	____	____	____	____	____	____	____
	MINUS (DIM.B)	____	____	____	____	____	____	____	____
	EQUALS (DIM.C)	____	____	____	____	____	____	____	____

REMARKS: ______________________________

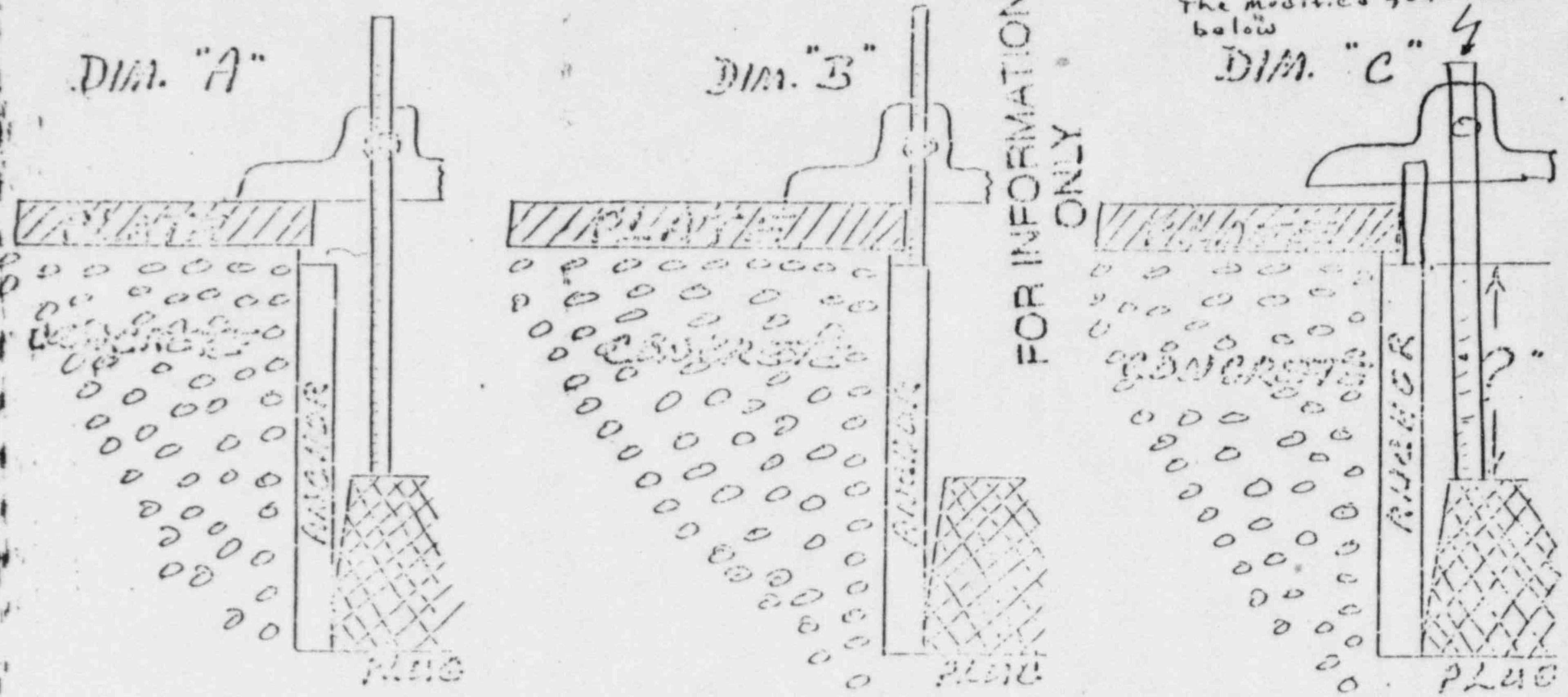
DATA TAKEN BY/DATE ______________

REVIEWED BY ______________

ATTACHMENT # 3

DIMENSION CHECK WITHOUT GAUGE

Note: Dimension "C" MAY be measured directly with The modified gage showd below



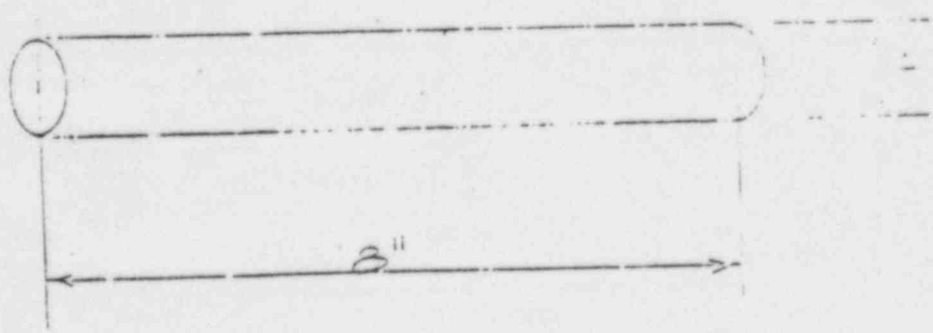
DIMENSION "A" MINUS DIMENSION "B" = DIM. "C"

EXAMPLE

ATTACHMENT #4

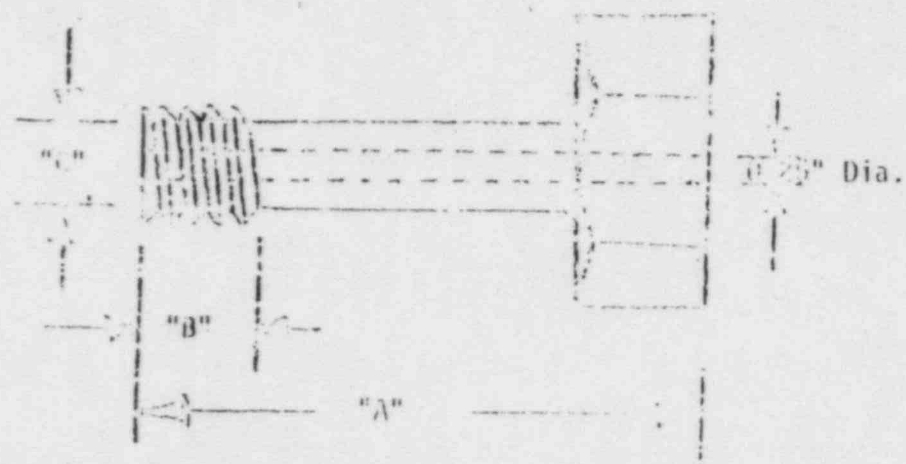
ANCHOR MISALIGNMENT TEST TOOL

ANCHOR SIZE	TOOL DIA. "A"
1/2	15/32
5/8	19/32
3/4	23/32
7/8	27/32



FOR INFORMATION ONLY

ANCHOR TEST GAUGE

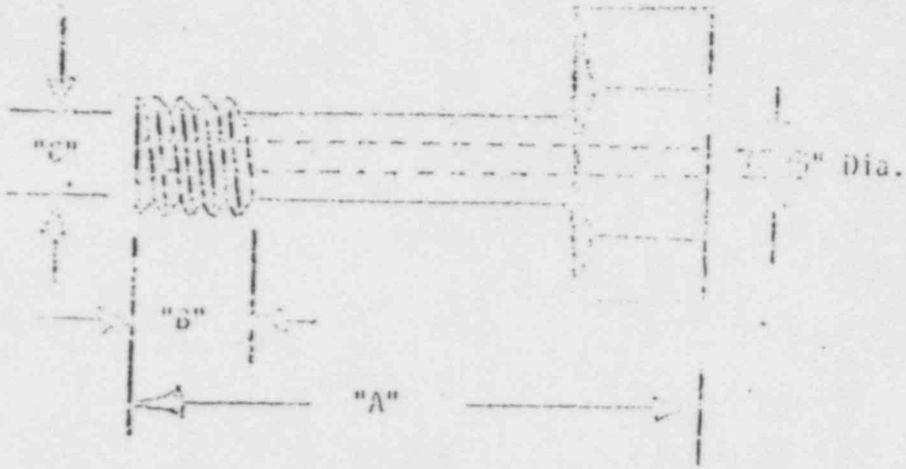


BOLT SIZE	THREADS/IN.	DIMENSION "A"	DIMENSION "B"	DIAMETER "C"
1/2"	13	2.50"	4 FULL THREADS	MINOR DIAMETER
5/8"	11	3.00"	4 FULL THREADS	MINOR DIAMETER
3/4"	10	3.50"	4 FULL THREADS	MINOR DIAMETER
7/8"	9	3.50"	4 FULL THREADS	MINOR DIAMETER

ATTACHMENT # 6

ALTERNATE

[illegible]



BOLT SIZE	THREADS/IN.	DIMENSION "A"	DIMENSION "B"	DIAMETER "C"
1/2"	13	4.50"	4 FULL THREADS	MINOR DIAMETER
5/8"	11	5.00"	4 FULL THREADS	MINOR DIAMETER
3/4"	10	5.50"	4 FULL THREADS	MINOR DIAMETER
7/8"	9	5.50"	4 FULL THREADS	MINOR DIAMETER