FOLEY
ELECTRICAL CONTRACTORS

GI - I
Rev. 2
Date: 9/29/78

APPENDIX B D

1/13

PROCEDURE FOR

INSPECTING IN

THE GRID

Approved by Virg Tennyson 9/29/78

FOR INFORMATION ONLY

DIABLO CANYON

NUCLEAR POWER PLANT

THE
HOWARD P. FOLEY
COMPANY
P. O. BOX 327
AVILA BEACH, CALIF.
93424
805-595-2322

Every support inspected in the Grid shall be documented on an HPF/SIWS form. The form shall be filled out as follows:

INSPECTED FROM _____

List the document which initiated the inspection. I.E. "CI" C.O. #, etc. In the case of the Grid survey enter "N/A".

RACEWAY I.D. _____ & REMARKS _____

List one conduit and/or tray which is mounted on the support noting whether it is:

(A). Vital
(B). Non-Vital
(C). Non-Vital that cross over vitals -or-
(D). Non-Vital that requires Class I Supports per the design Dwg.

If a conduit does not have an I.D. SPELL IT OUT. I.E. "Unidentified 3/4" emt. conduit.

SUPPORT IDENTIFICATION # _____

This number will be the appropriate Grid number followed by the sequential number of that particular support in the Grid. I.E. "GE/GW-140-2-28" where "GE/GW-140-2" is the Grid number, and this support was the 28th support to be inspected in the Grid.

DETAIL _____ & REV. _____

Fill in the appropriate Detail number and current revision. If the support is from a drawing other than 050030, then that drawing must be listed. I.E. 501879, Detail B.

UNIT # _____

Fill in I or II.

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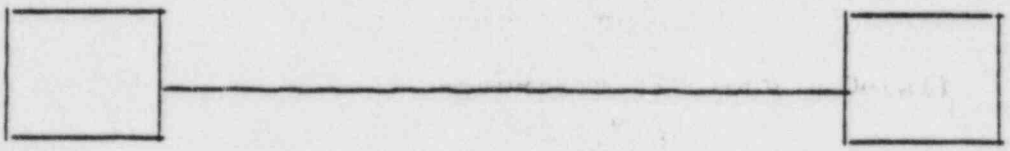
DRAWING NUMBER, REV., AREA, ELEV. _____

Fill in the number of the drawing referenced on the Grid drawing and the rest of the appropriate information.

SUPPORT LOCATION



Please disregard this space on the SIWS as no location diagram of the support in question will be made.

ATTRIBUTE ACPT REJ TAG# _____

For each of the attributes listed, either the inspectors initials should be entered in the "ACPT" column indicating that the current criteria for that item has been met or else the letters A,B,C,D & ETC shall be filled in the "Rej Tag #" column indicating a discrepancy. If there is a discrepancy in more than one attribute, each "Rej Tag #" should be a different letter. Each attribute must be filled in with either an initial, a letter or "NA". If any attribute is rejected, then "Workmanship" must also be rejected with a letter.

TAG # DISCREPANCY DESCRIPTION TAG COORD.

For each attribute which has been rejected with a letter, list that letter in the "Tag #" column and fill in a description of the rejected item in the appropriate box. Refer to the attached list of standard wording to be used to explain discrepancies. Leave the "Tag Coord" column blank unless the rejected item might possibly be an "Accept as is"

discrepancy, in which case enter "No tag" (See attached explanation of "No tag" discrepancies).

CORRECTIVE ACTION TAKEN

(A) If an item which was originally rejected is corrected, the responsible production person will enter the steps taken to correct the discrepancy and the responsible foreman shall initial and date the corrective action entry.

or

(B) If an originally rejected item is an "Accept as is" discrepancy, this will be determined by a responsible engineering dept. person who will then fill in "Accept as is" and enter the number of the appropriate document which justifies this acceptance.

Q.C. ACCEPT. & DATE

This column will be signed and dated by the responsible QC inspector after:

Corrective action has been taken and, upon reinspection, the originally discrepant item is found to be Acceptable.

or may be signed by a responsible engineer or Q.C. person after:

"Accept as is per . . . " with the supporting document listed has been entered by the responsible Engineering Dept. person.

Q.C. Inspector _____ Date _____

A signature and date of original inspection will be filled in by the QC Inspector who originally inspected the support.

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The QC inspector will affix a key tag to the support inspected identifying that support with the same number listed on the HPF/SIWS for "Support Identification #". Any support which has a discrepancy that is not a "No Tag" item will have an HPF/SIWS/Hold Tag attached to it by the QC inspector at the time of original inspection. This tag will list the appropriate "Support Identification #", the number of one conduit on the support, the date and the signature of the inspector who performed the original inspection.

Any errors on the HPF/SIWS will be corrected with a single line through the errant item, the correction, if any, and the initials of the correcting party and the date.

"Welds" can not be initialed for unless there is a weld acceptance sticker affixed to the support. When welds are initialed as being acceptable, the name or initials and the date on the sticker need to be noted next to "welds" in the attribute section of the HPF/SIWS.

Following is a list of discrepancies which are "No tag" items when found on supports that are stenciled with a white background.

1. Anchor bolts installed closer to
   (a) other anchor bolts
   (b) abandoned bolt holes
   (c) edge of concrete
   then is permitted by the current approved criteria. This is in Unit I only.

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2. Anchor bolts installed at angle exceeding 5°, but not exceeding 15°.

3. Anchor bolts installed flush to top of hex nut, but without a full thread showing past the top plane of the nut.

4. Anchor bolts which have not been properly embedded deep enough.

5. Supports which vary from the existing detail only in that they are built stronger than the detail calls for EXAMPLES:

   (a) An extra S-6 brace has been added.

   (b) A 3-hole angle bracket has been installed instead of the required 2-hole type.

   (c) The detail specifies P-1000 without saying "Minimum" and P-5501 has been installed.

6. Supports that are welded but do not have a weld sticker.

All other current criteria which has not been met must be red tagged.

The only time these discrepancies are not "No-tag" items when they are on supports with a white background is when the support inspection has been initiated by a CI dated later than the "Accept as is" date. IE 4/19/77 for anchor bolt embedments; 3/27/78 for certain anchor bolt spacing and 4/25/78 for anchor bolts installed flush to nut but w/o a full thread showing.

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Following is a list of the standard wording to be used in the discrepancy description area of the HPF/SIWS. This particular wording is necessary for the responsible engineering personnel to be able to properly disposition the needed Corrective Action.

Anchor Bolt Problems:

"Anchor Bolt (or A/Bolt) installed at angle exceeding 5° but not over 15°."

"A/Bolt installed at angle exceeding 15°."

"A/Bolt is only embedded ____, should be 2½ (or however deep it is supposed to be)."

"A/Bolt installed flush to nut, but without a full thread showing."

"A/Bolt installed without a full thread and also is not flush to nut."

"A/Bolt installed W/I 12 dia. of anchor on another support."

"A/Bolt has been cut off."

"A/Bolt installed W/I 4.5 dia. of abandoned bolt hole (needs grout)."

"A/Bolt installed without 3" of solid concrete to edge of concrete."

"A/Bolt installed without ½" of solid concrete to edge of emb. unistrut."

"A/Bolt installed W/I 12 dia. of bolt into emb. unistrut."

"A/Bolt installed W/O ½" of solid concrete to edge of abandoned bolt hole.

Detail Problems:
If a support is not to detail because something is missing, is in the wrong place, or is the wrong size spell it out!

"S-6 brace is missing on inside of Strut" or

"Strut only extends down 6" should be 14" min." or

"Crossmember is 42" long. Detail shows 2'4" max." or

"S-6 Brace installed on wrong side of strut" or

"P-1026 installed where detail shows P-1331" or

"Ceiling strut is P-1000 detail shows P-5501 min." etc.

If the support is not built to any recognizable detail, spell it out.

"Support stenciled S-49, is not built to this or any 050030 Detail" or

"Support not built to any 050030 Detail."

If support is not to detail simply because it is over built, spell it out.

"Support is over-built where 3-hole bracket is used instead of P-1331" or

"Support is over-built where extra S-6 brace has been added." etc.

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WELDS

If the support is not to detail because of welding deficiencies, spell it out.

"Detail call for 4-1½" welds. Support only has two." or

"Not to detail where welds are on wrong side of strut."

When a support has been welded and there is no "weld acceptance" sticker on it, the welds must be rejected. The explanation needs to be as follows:

"No weld sticker, welds cannot be inspected due to Z.R.C.and/or paint."

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Following is a list of the current criteria for:

Anchor bolts:

(1) Anchor bolts must be installed at an angle not exceeding 5°.

(2) Anchor bolts must be installed with at least one full thread showing past the top plane of the hex nut.

(3) Minimum embedment for 1/4" anchors is 2"
Minimum embedment for 3/8" anchors is 2½"
Minimum embedment for 1/2" anchors is 2½"
Minimum embedment for 5/8" anchors is 2 7/8"
Minimum embedment for 3/4" anchors is 3½"

(4) Anchor bolts are not to be installed closer to each other than 12 dia. of the larger bolt in question. (See Dwg. HPF-100 for explanation of where and how this measurement is to be made.)

(5) Abandoned bolt holes which are within 4.5 bolt dia. of an installed bolt needs to be grouted. (Unfilled bolt holes are <u>not</u> to be filled with an anchor bolt).

(6) Anchor bolts are not to be installed closer than ½" to the edge of an abandoned bolt hole which is to be grouted.

(7) Anchor bolts are not to be installed closer than 6 dia. to the edge of concrete. In no case are anchor bolts to be installed closer than 3" to the edge of concrete. (Edge of concrete is defined as a place where the concrete changes planes in a <u>convex</u> direction. I.E. a camfered edge and <u>not</u> where the concrete meets an embedded weld plate or embedded unistrut member.

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(8) Anchor bolts which are still part of a support are not to be cut off.

(9) Anchor bolts are not to be installed closer than 12 bolt dia. to a bolt into embedded unistrut. (An exception to this is where the support detail specifically calls for anchors to be installed closer to bolts into embedded unistrut which are part of the same support). (See Dwg. HPF-100 for explanation of where and how this measurement is to be made.)

(10) Anchor bolts are not to be installed closer than ½" to the edge of an embedded weld plate or steel sleeve where the wall thickness of the sleeve is a minimum of ¼".

(11) Anchor bolts are not to be installed closer than ½" to the edge of an embedded unistrut member where there also is no bolt into the embedded unistrut within 12 bolt dia. of the anchor bolt in question. (See Dwg. HPF-100 for explanation of where and how this measurement is to be made.)

(12) Anchor bolts used to support any conduit or combination of conduits greater in total weight than the equivalent of a single 2" conduit must be ½" in dia. or greater (an exception to this is where the support is either an S-19A or an S-19B, in which case the table provided on the detail shall apply).

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Note: Distances:

(a) Between Anchor bolts
(b) Between an anchor bolt and a bolt into an embedded unistrut member
(c) Between an anchor bolt and an abandoned bolt hole which needs to be filled.

are to be measured from center to center of the items in question.

Distances:

(a) To edge of embedded weld plate or steel sleeve
(b) To edge of "unloaded" embedded unistrut
(c) To edge of concrete
(d) To edge of abandoned bolt hole which has been or is to be grouted

are to be a measurement of the solid concrete between the items in question.

Other miscellaneous criteria:

1. Dimensions on supports may vary from the dimension shown on the detail by:
   ± 7% for dimensions less than 4 feet
   ± 6" for dimensions equal to or greater than 4 feet
2. For vertical dimensions which are not called out as "minimum" any dimension which is less than the detail calls for shall be acceptable.
3. All new supports installed after June 1, 1978 must have detail stenciled on yellow background.

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4. All nuts and bolts except anchors installed on supports shall be installed at least "Flush" to the nut.

5. Note #13 of 050030 only applies to supports which are shown as being acceptable with <u>single</u> unistrut. If the original support detail calls for the surface mounted strut to be double unistrut then this double unistrut can not be notched.

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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					
	DATE	DESCRIPTION			

CH. ENGR.	
SUPV.	M.C.
DESIGN	S.A., A.B.
DRN.	J.F.
CHKD.	B.S.
DR.	M.C.
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):

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

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, f'c									
	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	.90	.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.

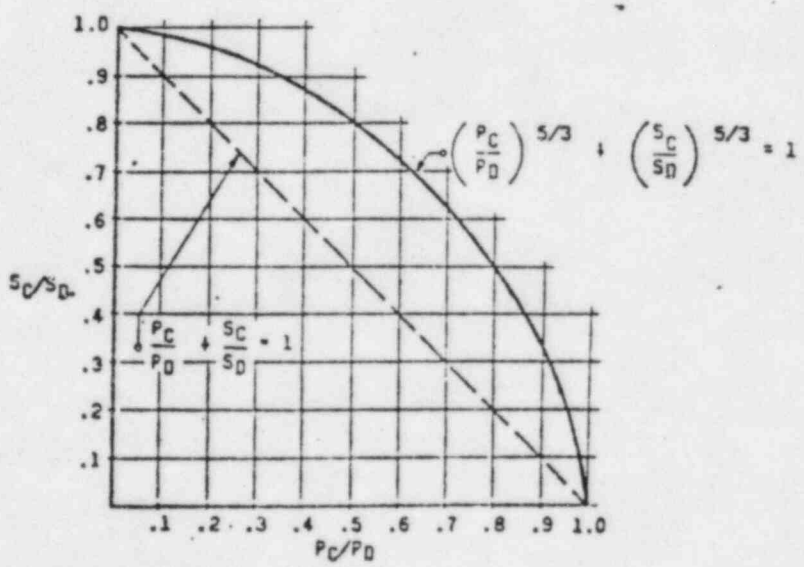


FIGURE 1
REDUCTION FACTORS FOR COMBINED PULLOUT AND SHEAR

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 8, 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^{0} 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 8.

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 2 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

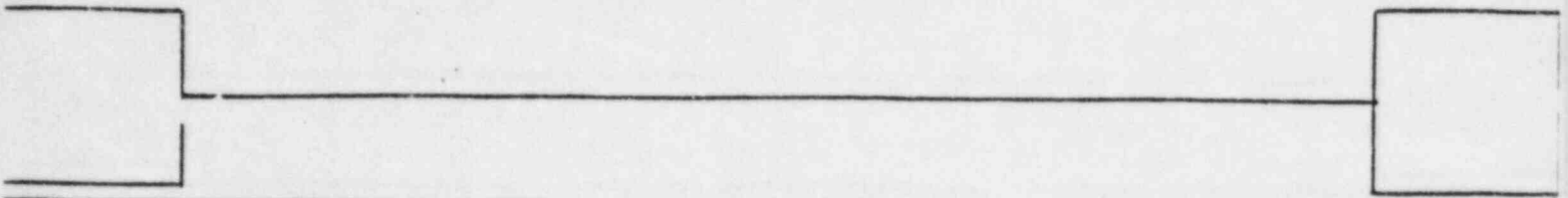
MINIMUM EMBEDMENT REQUIRED FOR STUD-TYPE EXPANSION ANCHORS INSTALLED IN CONCRETE

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

ANCHOR BOLT INSTALLATION INSPECTION REPORT RCWY I.D. 22.

UNIT #_____ AREA _____ ELEV. _____ GRID #_____ DWG & REV # _____ △

SUPPORT LOCATION DIAGRAM



BOLT # / INSP. PT.	1	2	3	4	5	6	7	8
ANCHOR BOLT TYPE								
ANCHOR BOLT SIZE								
DIA. & DEPTH OF ANCHOR BOLT HOLE								
LENGTH OF EXPOSED BOLT AFTER SETTING								
LENGTH OF EXPOSED BOLT AFTER TIGHTENING								
ANGLE OF BOLT TO CONCRETE 90° ± 5°								
DETAIL # AND REVISION								
DATE INSPECTED								
INSPECTOR								

TAG #	DESCRIPTION OF DISCREPANCY	CORRECTIVE ACTION TAKEN	Q.C. ACCEPT AND DATE

REMARKS: _____

HPF/ABIIR 10/23/80

23.

Quality Assurance
69-032 a (Rev. 1/83)

SUPPLIER AUDIT FINDING REPORT (SAFR)

(Over for Instructions)

032532
034405

1. SAFR NUMBER: 8 3 3 1 7 A - 0 1

2. SUPPLIER: Engineering

3. REQUIREMENT, REFERENCE: Criteria V "Instructions, Procedures . . .

4. FINDING: Requirements for the tensioning and associated testing of concrete anchor bolts used in Electrical, HVAC, and Instrumentation supports have not been specified by Engineering.

5. SUGGESTED RESOLUTION: Issue a specification.

FOR INVESTIGATION ONLY

6. LEAD AUDITOR: C. W[illegible]rd DATE: 9-22-83

7. PROPOSED CORRECTIVE ACTION (BY SUPPLIER):
See Proposed Corrective Action on next page

8. DATE CORRECTIVE ACTION WILL BE COMPLETED: N/A

9. Civil EGS 10/13/83
TITLE SIGNATURE DATE

10. ACCEPTED: _____ REJECTED: _____

11. COMMENTS: _____

12. LEAD AUDITOR: _____ VERIFICATION DATE: _____

13. SENIOR QA ENGINEER: _____

14. DISTRIBUTION: SPECIFYING ENGINEER _____
QUALITY CONTROL _____

SAFR 83317A-01

PROPOSED CORRECTIVE ACTION

A specification is not required. Nuts or bolts used to attach HVAC, electrical and instrumentation supports to adjacent structures need not be torqued to a specific value. Standard construction practise is a "snug tight" condition which is adequate for the above application. The ultimate strength of the bolt is not affected by the magnitude of the torque applied to the nut or bolt head, subject to the condition that the torque is not used to reduce the shear on the bolt. This condition is not a consideration in the design of these supports. (See Section 17 of "Guide to Design Criteria for Bolted and Riveted Joints", J.W. Fisher and J.H.A. Struik, John Wiley and Sons).

24.

Pullman Power Products		ESD 264 DOCUMENT NO.
PREPARED BY: R. Northrop	APPROVED BY: H. Karner	ISSUE DATE: 9-15-78
	TO BE USED ONLY ON JOB # 7177	PAGE NO. FORM F-65

5/11/82

REV. 5-11-82
FORM F-65
* HOLD POINTS
✓ QC VERIFICATION POINTS

PULLMAN POWER PRODUCTS
GENERAL FIELD SUPPORT PROCESS SHEET

SUPPORT NO. | DRAWING NO. REV. NO.
PREPARED BY F.E. DATE | FITTER/WELDER BADGE NUMBER | Q.C. DATE & INITIAL

1. LOCATION OF SUPPORT COMPLIES WITH DRAWING. ✓
2. DRAWING CHANGES NOTED AND COMPONENTS COMPLY WITH MATERIAL LIST ✓
3. ANCHORS INSTALLED AND WITNESSED BY Q.C. A. Holes drilled to tolerance and Check adjacent anchors *
   B. Shield/Plug Driven to Tolerance TYPE: Hilti/Phillips *
   C. Type Stud Installed SIZE | MIN. EMB. | TYPE: Hilti/Phillips *
   D. Anchors Torqued SIZE | VALUE | WRENCH SERIAL NUMBER *
   E. Unused holes dry packed *
4. BACK OFF BOLTS PRIOR TO WELDING ON BASE PLATES *
5. FIT-UPS: A. Pipe attachments installation: (1) Heat No: ✓ (2) P.O. No: ✓
   B. Support Members: | ITEMS | SPECIAL INSTRUCTIONS
   (1) Groove & Full Pen Welds * *
   C. Purge Established where required *
6. WELD PREP ZONES CLEAN OF PAINT, OIL
7. WELDING OF PIPE ATTACHMENTS (PER SEPARATE PROCESS SHEET) F.S.# *
8. WELDING OF HANGER SUPPORT MEMBERS ONLY: | IDENTIFICATION | WELD CODE
   SPECIAL WELDING INSTRUCTIONS: CS/CS 7/8T; ↓ 5B/6W; SS/SS 12W; ↓ 13/14; 15/S3
9. OTHER INSTRUCTIONS:
10. FINAL WELD CONDITION-SUPPORT MEMBERS: A. Weld Surface Clean ✓
    B. Arc Strikes Removed/Minimized ✓
    C. Weld Size Complies with drawing ✓
11. REVIEW FOR GENERAL WORKMANSHIP AND CONFIGURATION: | FOREMAN INITIAL/DATE | Q.C. DATE & INITIAL
    A. Components and Dimensions Comply W/Dwg. & Mat'l. List ✓
    B. Pipe Clearance in Accordance with Drawing ✓
    C. Riser Clamp Bears upon Lug ✓
    D. Hanger is Level and Plumb ✓
    E. All Bolts/Nuts Installed and Tight ✓
    F. Wall & Ceiling Plates Shimmed where Necessary ✓
    G. Grout Request Submitted ✓
    H. Lug Clearance within Tolerance ✓
12. SNUBBERS: A. Installed per Separate Process Sheet *
    B. Grinnell Fig./# Size | C. PSA Size | D. TYPE: SF SCH-GP
13. SUPPORT ACCEPTED BY Q.C. (Complete Installation Review) Q.C. SIGNATURE________
    DATE________

FOR INFORMATION ONLY

Pullman Power Products		ESD 264 DOCUMENT NO.
PREPARED BY: R. Northrop	APPROVED BY: H. Karner	ISSUE DATE: 9-15-78
REV. 2/27/81 REV. 7/28/81 R. Oldenkamp	TO BE USED ONLY ON JC8 # 7177	PAGE NO. FORM F-65 BACKSIDE

FORM F-65
BACKSIDE

PRE-INSPECTION CHECKLIST	CHECKED	
	I.C.	INSPECTION
1. ALL HOUSINGS INSTALLED		
2. WELDS: Inaccessible ends/or Undercuts		
3. TAPS: S-Holes, Two Shoes and Legs		
4. COUNTED PLACES: Screws Removed or Holes in Place		
5. SKIDS: Tack Welds		
6. NUTS NOT FULLY ENGAGED		
7. ARC STRIKES		
8. MATERIAL SIZE		
9. OVERSIZED HOLES IN PLATE: Measure		
10. WARPED BASE PLATES/MEMBERS		

PRE-INSPECTION REMARKS:

FINAL INSPECTION COMMENTS: INSPECTOR DATE

25.

PACIFIC GAS AND ELECTRIC COMPANY

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

J. O SCHUYLER

January 27, 1984

PGandE Letter No: DCL-84-031

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
Diablo Canyon Unit 1
Response to Allegations 25, 58 and 96 - SSER 21

Dear Mr. Martin:

Enclosed is the PGandE response to allegations 25, 58, and 96 described in SSER 21 pertaining to expansion anchors. PGandE's response to the concern regarding the H. P. Foley procedure governing the installation of anchor bolts will be submitted next week.

In addition, PGandE is currently developing responses to the other allegations and concerns which require resolution prior to criticality.

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

Sincerely,

J. O. Schuyler

Enclosure

cc: D. G. Eisenhut
H. E. Schierling
Service List

8402030258
18 pp.

In the following years, a series of anchor installation inspections were performed to verify that the anchors were properly installed. Extensive walkdowns were performed on the piping, raceway, and HVAC supports. The relatively few deviations that were found (2 to 3 percent of all installations) demonstrate that the installation procedures were understood and were properly executed. In order to determine the acceptability of anchors deviating from the established installation requirements, analytical evaluations and testing programs were performed. Attachment 1 is a chronology describing the continuous reviewing and monitoring of the use of expansion anchors at Diablo Canyon. The chronology shows that when problems were encountered in one contractor's installation, the existence of similar problems in the other contractors' work was investigated. Resolutions of specific concerns are addressed in Attachments 2 through 6. The dynamic testing program for the DCPP expansion anchors is described in Attachment 7.

In 1979 the NRC recommended minimum design margins for piping support anchors in I&E Bulletin 79-02. The Diablo Canyon piping support anchors were then requalified in conformance with this bulletin.

In 1982 and 1983 the Diablo Canyon verification program reviewed the usage of expansion anchors. Factors of safety achieved in the installations using drawing 054162 (e.g., raceway, HVAC, and instrumentation supports) were quantified. These safety factors were summarized in a report attached to the verification program EOI 1016 (Attachment 8, Ref. 1). Previously approved deviation reports were also reviewed. The verification program did not address each individual anchor with a deviation. Rather, the verification program established the acceptability of expansion anchors as follows:

(1) For anchors installed in accordance with drawing 054162, a factor of safety of at least 3 between demand and capacity was confirmed (see Attachment 2).

(2) For anchors not conforming with drawing 054162, the previous resolutions were reviewed. Based on these previous resolutions, it was established that the deviations would not cause an unsafe condition.

(3) Expansion anchors with known installation deviations were sampled. The anchor capacities were analytically reduced and, in every case, the evaluation found a factor of safety greater than 3.

(4) The support systems using expansion anchors are highly redundant, such that the existence of a few anchors with factors of safety less than 3 would not reduce design margins unacceptably or in any way compromise the integrity of the supported systems.

In conclusion, expansion anchor usage at Diablo Canyon has always been carefully implemented and reviewed. As shown in the attachments, a high degree of confidence in the adequacy of the anchor installation has been established. In the verification program the factors of safety were quantified. For properly installed anchors, factors of safety of at least 3 were verified in every case reviewed and most anchors were shown to have factors of safety markedly above 3. While the potential exists that 2 to 3 percent of the expansion anchors may have lower factors of safety due to installation deviations, the overall margin and redundancy in the design of expansion anchors at DCPP is reasonable, conservative, and acceptable.

Attachment 1 - Expansion Anchor Chronology

Governing Procedure	Date	Inspection (I) or Test (T)	Description
Manufacturers' Instructions	Mar 1972	T	PGandE performed static tests to validate data in manufacturers' catalogs. Approximately 54 tests of Wej-it, Kwik-Bolt, Parabolt, Phillips anchors were performed.
Manufacturers' Instructions	May 1972	T	PGandE performed 18 dynamic (sine) tests at UC Berkeley to define the performance of expansion anchors when subjected to dynamic loads. 16 static tests were performed as well.
Drawing 054162	Nov 1974	-	PGandE Standard Drawing 054162 was issued. (Foley procedures were issued in 1975.)
Drawing 054162	Feb 1975	I	Foley was instructed to sample expansion anchor spacing. Some spacing violations were found which led to a complete walkdown in July 1975. Some edge distance violations were found which led to testing in September 1975.
Drawing 054162	July 1975	I	A 3-month-long 100% walkdown of all raceway installations was made. Construction tagged and logged all spacing violations. Engineering established a review criteria and inspected all violations. Modifications were made when necessary.
Drawing 054162	Oct 1975	-	PGandE Calculation Binder 52, sheets 150 through 156, contains calculations addressing spacing violations arising from the July 1975 walkdown.

Governing Procedure	Date	Inspection (I) or Test (T)	Description
Drawing 054162	Oct 1975	T	PGandE tested performance of anchors close to chamfered edges of concrete. 12 tests in shear and pullout were done for 1/2" dia. and 5/8" dia. Hilti anchors.
Drawing 054162	Feb 1976	I	Discrepancy report DR E-1235 documented edge distance violations discovered in the July 1975 walkdown and resolved by the October 1975 tests.
Drawing 054162	Dec 1976	I	Piping expansion anchors were inspected per Inspection Procedure for Installed Flush Shell Concrete Anchors. The following items were inspected: obvious flaws, cut off anchors, over embedment, angular alignment, and depth that expansion plugs were driven.
Drawing 054162	Dec 1976	T	Procedure for Establishing Acceptance Criteria for Concrete Anchor Installations was implemented. Testing was performed for various setting depths for expansion plugs (approximately 80 tests), cut off anchors (approximately 30 tests), angular misalignment (7 tests), and over-embedment (10 tests).
Drawing 054162	Feb 1977	I	Discrepancy report 282 documented the generic review of expansion anchors used in piping supports.

Governing Procedure	Date	Inspection (I) or Test (T)	Description
Drawing 054162	Mar 1977	I, T	Discrepancy report 283 extended the anchor review into HVAC area. A generic review was made on sampling basis (77 anchors). Anchors were inspected for: obvious flaws, cut off ends, overembedment, angular alignment, and depth that expansion plugs were driven. 3 anchors had plugs not "fully driven." 11 anchors were tested and all exceeded allowable load values. No other deviations were found.
Drawing 054162	Mar 1977	I	Use of 2-3/4" long Hilti Kwik-Bolts identified as a potential problem. Usage had stopped in January 1975.
Drawing 054162	Apr 1977	I, T	Discrepancy report 288 was issued documenting raceway support anchor embedment inspections. For 3/8" dia. anchors, 448 were checked by measuring bolt projections and 64 were UT inspected. For 1/2" dia. anchors, 508 were measured. Testing program WA-1 was performed in which 110 anchors were tested at embedments less than required by drawing 054162.
Drawing 054162	May 1977	I, T	Discrepancy report 3373 was issued. Spacing between good and abandoned holes/anchors did not always meet drawing 054162 requirements. 65 tests were performed to evaluate problem. 1/2" dia., 5/8" dia., and 3/4" dia. Hilti wedges and 5/8" dia., 3/4" dia., and 7/8" dia. Phillips wedges were tested.

Governing Procedure	Date	Inspection (I) or Test (T)	Description
Drawing 054162	Sep 1978 (through 1980)	I	NCR DCI-80-RE-002 documented a generic (grid) raceway support review. Foley procedure GI-I was followed and checked 100% of raceway installations, including inspecting anchors for: spacing, edge distance, angular alignment, nut engagement, embedment depth, and cut off bolts.
Drawing 054162	Oct 1980	I, T	A procedure was issued for developing ultimate pullout capacity criteria for imperfectly installed shell-type concrete anchors. In 1976 piping anchor problems were resolved (DR 282), but to meet IEB 79-02 additional tests were performed. Expansion plug depths were varied and the anchors were pulled to define their ultimate strength. Approximately 150 tests were done for 1/2" dia., 5/8" dia., and 3/4" dia. HDI anchors and 1/2" dia., 5/8" dia., 3/4" dia. and 7/8" dia. Phillips self-drilling anchors.
Drawing 054162	Nov 1980	I, T	A report was issued concerning inspections, tests, analyses, and rework of seismic Category I pipe supports and concrete expansion anchors in conformance with IEB 79-02. The acceptability of piping anchors was confirmed. Testing was performed to better define shear-tension interaction (refer to Teledyne report TR 4121-1, July 1980).
Drawing 054162	Oct 1981	T	PGandE performed a series of in-situ tests on raceway supports to confirm their behavior. The static tests showed linear behavior.

Governing Procedure	Date	Inspection (I) or Test (T)	Description
Drawing 054162	Jun 1982	I	The grid program inspection data was reviewed in the verification program. All anchor bolt deviations were reviewed (3746 problems were identified in the grid walkdown). The verification program reviewed the acceptability of these anchors.
Drawing 054162	Jun 1982	-	EOI 1016 report was prepared to address factors of safety inherent in the drawing 054162 allowable loads.
Drawing 054162	Dec 1982	I	55 anchors with threads cut off had been identified in the June 1982 grid walkdown review. These anchors were re-inspected and dispositioned in compliance with verification program criteria.
Drawing 054162	Jan 1983	I	44 anchors with insufficient embedment identified in the grid walkdown were UT examined. Based on the UT results, the design calculations were revised and the embedment problem was resolved.
Drawing 054162	Sep 1983	I	NCR-DCI-83-RM-N004 required testing tightness of 2400 HVAC bolts. Only 8 were found loose and were all able to be reset without replacement.
Drawing 054162	Dec 1983	I, T	Per NRC's request, 40 raceway anchors were torque-tested to determine adequacy of installation. All were found to be tightly installed. These 40 were then UT inspected and 1 had less embedment than required by drawing 054162 (2-3/4" long Hilti anchor).

Attachment 2 - Factors of Safety

Table A of drawing 054162 gives allowable loads for expansion anchors. These values have been used in design of expansion anchors at Diablo Canyon. In response to verification program EOI 1016 (Ref. 1), the factors of safety achieved by using the Table A allowable loads were quantified. This demonstrated that factors of safety ranging from nearly 4 to 9.1 were achieved between maximum allowable working level loads (DE seismic loads) and the anchor capacities published in the manufacturers' brochures. In accordance with drawing 054162, the allowables in Table A were doubled for severe environmental level loads (Hosgri and DDE seismic loads), thus reducing by half the safety factors stated above.

A review of the electrical raceway support calculations was recently performed. This review shows that for 100% of the raceway supports, with properly installed anchors, a factor of safety of at least 3 has been maintained between demand and capacity for Hosgri and DDE level loads. A sample of 45 raceway support calculations found the following distribution in the factors of safety:

Factor of Safety	% of Supports
≥ 3	100
≥ 4	98
≥ 5	89
≥ 10	82

A similar sampling was made of 50 HVAC duct support calculations with the following results:

Factor of Safety	% of Supports
≥ 3	100
≥ 4	80
≥ 5	62
≥ 10	26

The factors of safety listed in the tables above are conservative for the following reasons:

(a) Many calculations envelope loads to expedite the analysis.

(b) Expansion anchor capacities are based on concrete strengths achieved in the 28-day and 60-day cylinder break tests. Concrete typically strengthens 35 to 50% between the test cylinder strength and the 2-year strength. This would result in a 20 to 25% increase in capacity for most anchors.

(c) Most anchors are subjected to both shear and pullout loads. The 5/3 interaction equation specified on drawing 054162 was used to combine shear and pullout loads. This equation results in a conservative design when compared to test results.

Instrumentation supports were also designed using drawing 054162. The instrumentation supports have higher design margins than the raceway and HVAC supports because the instrumentation supports are almost always very lightly loaded.

Traditional factors of safety for expansion anchors range from 3, recommended by Appendix B of the ACI 349 code, to 4 or 5, recommended by NRC I&E Bulletin 79-02. Factors of safety for expansion anchors have been set at these high levels primarily to account for variability in workmanship (installation) and to account for reduced capacity in case a concrete crack subsequently passes through the anchor's location (tension zones of reinforced concrete elements). Reference 2 addresses expansion anchor performance in cracked concrete. This report concludes that a factor of safety of 3 (to account for variations in installation) is adequate even for anchors in cracked concrete.

As shown in the preceding tables, the overall margins in the Diablo Canyon expansion anchor designs are large. Factors of safety of at least 3 (and usually much more) have been maintained in the support designs. Only in cases where anchors were not properly installed is there a potential for the factor of safety to be less than 3. Installation deviations, addressed in the following attachments, have been reviewed and it has been found that the factors of safety have not been reduced to unacceptable levels.

Attachment 3 - Embedment

In order to achieve the pullout strengths which were used to compute the factors of safety listed in Attachment 2, minimum embedments of the expansion anchors into the concrete structures must be achieved. The manufacturers' brochures and drawing 054162 specify the required minimum embedments.

In 1977, a discrepancy report (DR 288) documented a potential embedment deficiency in electrical raceway support anchors. Between 1972 and 1975 approximately 14,000 1/2"-diameter, 2-3/4"-long, wedge-type expansion anchors were bought by the electrical contractor (raceway supports are estimated contain a total of approximately 125,000 expansion anchors). To install 1/2"-diameter anchors at the required 2-1/4" embedment, only 1/2" of the anchor stud would project out from the concrete surface; thus, any of these that were used would likely have been installed at less than required embedment.

Under the assumption that some of these "short" anchors were used in safety-related raceway supports, a testing program was undertaken in 1977. Test anchors were installed at 1-1/2" of embedment and were successfully proof-loaded to Hosgri design level loads. A field sampling program was then undertaken in which over 500 1/2"-diameter expansion anchor embedments were measured. This sampling program found all anchors have at least the 1-1/2" embedment used in the testing program. The combination of field sampling and proof testing provided assurance that the use of 2-3/4"-long anchors was acceptable (factor of safety of at least 1).

Between 1978 and 1980, a systematic (grid) program inspected the conformance of all raceway supports to the design drawing requirements. In this inspection, anchor embedment was determined by subtracting the projecting length of the anchor from the overall anchor length. It was assumed that expansion anchors were at least 3-3/4"-long. While this grid program would not have identified 2-3/4"-long anchors that were set at less than required embedment, it verified that the vast majority of the raceway anchors had the expected embedment.

In the 1982 verification program, the data compiled in the 1978 grid inspections were reviewed. Only 44 out of approximately 125,000 anchors were found to have less than required embedment. The embedment of each of these anchors was checked by UT examination and the allowable loads on these anchors were appropriately reduced in the verification program calculations. Every one of the 44 cases was found to be acceptable (factor of safety greater than 3) when the reduced allowables were compared to the actual demand.

In December 1983, 40 raceway support anchors were selected for torque-testing. Results showed that all 40 anchors were properly set. The embedment on the 40 anchors was then measured. One of the 40 was found to have less than the minimum embedment required by drawing 054162 and was a 2-3/4"-long anchor. Assuming that the 40 anchors were randomly selected, this sample would indicate, to about a 75% confidence level (as determined by a statistical consultant), that 2-1/2 percent of the raceway support anchors were the 2-3/4"-long anchors.

An evaluation of the significance of short embedment for the raceway support anchors was made recently. Forty-five raceway support calculations were selected for review. Under the assumption that all anchors had been set at 1-1/4" embedment*, the capacities of all anchors were analytically reduced. The factors of safety for the anchors were then calculated and exhibited the following distribution:

Factor of Safety	Percentage of Supports
$\geq$ 1	100
$\geq$ 3	82
$\geq$ 4	80
$\geq$ 5	76
$\geq$ 10	51

The results above overwhelmingly demonstrate the safety margins in the raceway support designs. Since only about 2-1/2 percent of all anchors are likely to have reduced embedment, and since only 18 percent of all anchors would have a factor of safety less than 3 even if embedded at 1-1/4", the combined probability that any particular anchor would actually have a factor of safety less than 3 is very low. Even with short embedments, the factors of safety for the raceway support anchors would be between 1 and 3 and would not create an unsafe condition.

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*The grid program inspections verified 2-1/4" embedment for anchors assumed to be 3-3/4"-long. So if some anchors were actually 2-3/4"-long, their actual embedments would be at least 1-1/4".

Attachment 4 - Spacing

Drawing 054162 and manufacturers' brochures specify minimum spacing requirements for installation of adjacent anchors. Spacing between anchors is important for the anchors whose capacities are controlled by pullout of concrete cones around the anchor. When anchors are placed close together, their pullout cones overlap and reduce their pullout capacities.

In 1975, anchor inspections revealed numerous spacing deviations. Resolution of the deviations was achieved by inspecting all supports using expansion anchors. Anchors with spacing deviations were entered in a construction log and red-tagged for engineering disposition. In July 1975, a 3-month-long walkdown was performed by PGandE engineering. Each spacing deviation was resolved in one of the following ways:

(a) One of the two adjacent anchors was very lightly loaded; i.e., anchors securing grounding cables, lighting conduits, etc. More than 50 percent of all violations were of this type.

(b) Both of the adjacent anchors would not experience simultaneous loading. For example, one anchor might be installed in a brace designed to resist north-south seismic loads, while the other anchor was installed in an east-west seismic brace.

(c) Both of the adjacent anchors were loaded in shear only. Shear capacities are governed by the shear capacities of the individual anchor's steel shank, not by anchor spacing.

(d) The design loads were less than the reduced allowable loads. Engineering reviewed the design calculations of some deviations and analytically reduced the anchor strengths in accordance with drawing 054162.

(e) Physical changes to the supports were made. Modifications were made to eliminate the spacing deviations in cases that were not resolved by the means described above.

In 1982 and 1983, extensive walkdowns and design calculation reviews of the supports were made for the verification program. Where spacing deviations occurred between anchors installed within one support, anchor capacities were reduced in accordance with drawing 054162. For spacing deviations occurring between anchors installed in different supports, the deviations were resolved as follows:

(a) A sampling of design calculations qualifying supports containing anchors with support-to-support spacing deviations was made. In all cases the actual demand, when compared to reduced capacity, resulted in factors of safety greater than 3.

(b) The spacing deviation acceptance criteria used in the 1975 walkdown (items (a) through (e) above) were reviewed. With the exception of the deviations sent to engineering for review, the 1975 criteria remain valid. Thus, the 1975 walkdown satisfactorily resolved the majority of the spacing deviations.

(c) Analytical techniques (Ref. 3) for reducing anchor pullout strength, based on overlapping cones, show anchor capacity to be relatively insensitive to reductions in spacing. For example, at half the required spacing, 80 percent of the capacity remains.

(d) A series of spacing tests (Ref. 4) was performed by Doberne and Elgenson in 1962. Phillips Red-Head Self-Drilling expansion anchors were set at varying spacings and pulled to capacity. Evaluation of the test data showed 100 percent capacity available at 10 diameters (10d) spacing (drawing 054162 requires 12d) and 80 percent capacity available at 5d spacing. These data agree with the analytical method referenced above and corroborate the relative insensitivity of anchor capacity to reduced spacing.

The 1975 spacing review resolved spacing deviations on a case-by-case basis. In 1982, the verification program resolved spacing deviations on a sampling basis. Every case sampled was found to have an adequate factor of safety (greater than 3). While some spacing deviations may exist in which there are factors of safety less than 3, these would be very few and would not result in unsafe conditions.

Attachment 5 - Angular Alignment

Drawing 054162 and the contractor's procedures require expansion anchors to be installed not more than 5° out-of-plumb. This angular tolerance was based on the engineering judgment that a 5° misalignment would have no effect on the anchor's strength. At one time some of the manufacturers' brochures included a 5° misalignment tolerance, also based upon engineering judgement.

PGandE Engineering subsequently approved anchors installed up to 15° out-of-plumb, although the installation procedures retained the 5° tolerance. Thus, the only time that the 15° tolerance was used was when an anchor had inadvertently been installed at an angle greater than 5°.

The Engineering acceptance of 15° angularity was based on two sets of tests. The first were proof load tests performed in conjunction with discrepancy report 288 (Ref. 5). Wedge-type test anchors were installed 20° out-of-plumb and proof loaded in pullout to the Hosgri design load levels (twice Table A values). The second testing program was performed for piping anchors in conjunction with DR 282 (Ref. 6). These shell-type test anchors were installed 15° out-of-plumb and were proof loaded to more than 150 percent of the Hosgri design level loads (three times Table A values). All anchors in both test programs held the proof loads.

Bechtel is currently performing ultimate strength (failure) tests on expansion anchors installed 10° out-of-plumb. Preliminary results from tests on 3/4" diameter Hilti Kwik-Bolts (wedge-type anchors) indicate that there is no reduction in ultimate strength due to 10° misalignment, thus establishing that the factors of safety are retained in cases when the anchors are misaligned.

Although none of the tests referenced above were performed explicitly on Phillips Stud anchors, the anchorage mechanism on the stud-type anchors is identical to that used on the shell-type anchors. As mentioned above, the shell-type anchors installed 15° out-of-plumb were successfully proof tested to loads 50 percent above the Hosgri level allowables.

In summary, expansion anchors installed between 5° and 15° out-of-plumb are very rare occurrences. All of the test data cited above indicate that the anchors perform satisfactorily when installed within the 15° tolerance. Therefore, approval of the use of anchors at angles up to 15° is reasonable and acceptable.

Attachment 6 - Miscellaneous Irregularities

The inspection and walkdown reports referenced in Attachment 1 note a few irregularities in anchor installation that are not addressed in Attachments 3 through 5. Examples of these irregularities include tapping stud anchors sideways to improve alignment and torquing anchors to achieve full nut engagement. These are extremely rare occurrences and no test data are available to quantify the effects, if any, that these irregularities have on anchor capacities.

As noted on page 2 of this submittal, it is expected that 2 to 3 percent of all anchors experienced some deviations (or irregularities) in installation. These deviations could reduce an anchor's factor of safety below 3 if that specific anchor were required to carry the maximum load allowed by drawing 054162. However, it is believed that the irregularities of the type mentioned above would have only minimal adverse impact on the anchor capacities and a factor of safety of at least 3 exists between demand and capacity.

Due to the infrequency of occurrence and the large factor of safety built into the design, installation irregularities would have no significant effect on the overall safety of the attached components.

Attachment 7 - Simulation of Expansion Anchors in Dynamic Testing Program

In 1983, dynamic testing of the Diablo Canyon raceway supports was performed at ANCO Engineers, Inc., at the testing facility. In this dynamic testing program, it was not feasible to use expansion anchors due to limitations in mounting concrete slabs on the shake-table. Therefore, A307 machine bolts were used in lieu of expansion anchors. The A307 bolts were torqued to produce a preload of about 1050 pounds. The torque necessary to produce this preload was small, typically 10 to 12 ft-lbs. This preload value was used because it provided a reasonable representation of the expansion anchors in field conditions. Further justifications for the use of a 1050-pound preload are:

(a) It is a common practice to torque expansion anchors to produce a preload about equal to the working design load (1025 pounds for 1/2"-diameter bolts in 4000 psi concrete). For example, Hilti recommends 3 or 4 turns after finger-tight condition, which produces the desired preload.

(b) The use of a wrench for installing expansion bolts is necessary and experience has shown that 12 ft-lbs torque is very easily attained when the nut is turned, even with a 6-inch wrench. This was further verified in the three field-sampling programs, described below. During an onsite audit, NRC inspectors examined 140 raceway supports. All but 12 anchors were found to be at least snug-tight. Estimating 4 anchors per support, only 2 percent did not have a preload. In another NRC inspection, 40 anchors were randomly selected and all 40 were found to be snug-tight. A third program, executed in response to an NCR (Ref. 7) sampled the tightness of 2400 HVAC duct support bolts. All except 8 bolts were found to be tightly installed.

In the dynamic testing, at intermediate level shaking (average Hosgri design load level), almost all of the A307 bolts retained their preload. In the supports where there was some loosening of the A307 bolts, no adverse changes occured in the support's response.

Numerous field inspections have shown that with the exception of an occasional loose bolt, the concrete expansion anchors in place at Diablo Canyon are installed snug-tight. This condition was reflected in the ANCO testing by using preloaded A307 bolts. As observed in the testing, bolt preload did not preclude bolt loosening and the supports performed satisfactorily. Therefore, modeling of the expansion anchors in the dynamic testing with preloaded A307 bolts was reasonable and appropriate.

Attachment 8 - References

(1) "Resolution of RLCA EOI 1016," Diablo Canyon Project Electrical Raceway Support Calculation EOI 1016, Rev. 0, June 1982.

(2) "Expansion Anchor Performance in Cracked Concrete," R. W. Cannon, Tennessee Valley Authority, 1981.

(3) "Structural Engineering Aspects of Headed Concrete Anchors and Deformed Bar Anchors in the Concrete Construction Industry," KSM Welding Systems Division, Omark Industries, 1971.

(4) "Pullout Capacities of Phillips Red Head Concrete Anchors as Affected by Spacing," Doberne and Elgenson, File 626, September 1962.

(5) "Test Procedure WA-1, Concrete Wedge Anchors," Rev. 1, PGandE, March 1977.

(6) "Procedure for Establishing Acceptance Criteria for Concrete Anchor Installations," Rev. 2, PGandE, December 1976.

(7) Nonconformance Report DC1-83-RM-N004, September 1983.

26.

~~J. P. Knight~~

COPY

PACIFIC GAS AND ELECTRIC COMPANY

PG&E 77 BEALE STREET, SAN FRANCISCO, CALIFORNIA 94106 TELEPHONE (415) 781-4211

John Fair

February 7, 1984

PGandE Letter No: DCL-84-048

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
Diablo Canyon Unit 1
SSER 21 - Allegations 25, 58, and 96
Concrete Expansion Anchors

Dear Mr. Martin:

As a result of the NRC exit interview on January 19, 1984 at Diablo Canyon, and the NRC review of PGandE letter DCL-84-031, dated January 27, 1984, only two issues remain to be resolved regarding the allegations listed in SSER 21 on concrete expansion anchors. These issues are (1) review of H. P. Foley Company Procedure QCP-9 that governs installation of expansion anchors and (2) PGandE expansion anchor sampling program.

With respect to the first issue, the review of QCP-9 is complete and the results are presented in Enclosure 1. For the second issue, the NRC Staff and PGandE had agreed that a successfully executed field sampling program would add significantly to the confidence that the expansion anchors used in the electrical raceway supports are adequately installed. Enclosure 2 contains a copy of the instructions that were prepared for this sampling program. The sampling program has been initiated and is expected to be complete on February 8, 1984. Evaluation of the data will then be performed. A report to the NRC, containing the results of the sampling and of the data evaluation, is scheduled to be submitted by February 13, 1984.

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

Enclosures

cc: T. W. Bishop
D. G. Eisenhut
[redacted]
R. E. Schierling

~~8402090343~~

18 pp.

ENCLOSURE 1

FOLEY QA PROCEDURES

All of the electrical raceway construction at Diablo Canyon has been performed by one contractor, the H. P. Foley Company. Foley's construction procedures address many components of raceway installation. One of these components is expansion anchors. The portions of Foley's procedures that govern installation of expansion anchors have never been revised in a way that significantly altered the installation process. The attached table tracks the pertinent installation requirements through the revisions of Foley's procedures, from their first issuance in 1973 to those in use today. It should be noted that most of the procedure revisions pertain to aspects of raceway construction that do not affect expansion anchor installation. However, the revisions affecting expansion anchors show increasing attention to QC verification of the expansion anchor installations, which parallels the nuclear industry's increased awareness in the benefits of anchor inspections.

In a recent NRC site inspection, the QC expansion anchor inspection records were reviewed. These records indicated cases in which the anchors were (1) straightened to improve alignment and (2) torqued to improve nut engagement. As stated in PGandE's letter DCL-84-031, dated January 27, 1984, the frequency of these occurrences is so low that there would be no significant effect on the overall safety of the raceway support system. To further quantify the rate of occurrence, the QC inspection records are being reviewed to identify all recorded cases of bolt straightening after installation and torquing to improve nut engagement. The results of this review will be analyzed to verify that the frequency of occurrence supports the position that no further action is required. The results will be reported to the NRC by February 13, 1984. Should we determine additional action is necessary, it will be included in the report.

In summary, Foley Company did not make any significant changes in the expansion anchor installation requirements. This procedural consistency helps maintain consistency in installation. QC inspection was increased over the years, yet no significant changes in the installation procedures were found necessary. Thus, the procedures governing raceway expansion anchor installation at Diablo Canyon have proven to be consistent and adequate.

ATTACHMENT A TO ENCLOSURE 1

Date	Procedure Number and Title	Description
12/28/73	IDR-1, Quality Control Procedure for Inspection and Documentation of Raceways	This procedure required inspection of conduit and cable trays after installation, but did not specifically address supports or expansion anchors.
7/16/74	QCP-9, Rev. 1, Quality Control Procedure for Inspection and Documentation of Raceways (was procedure IDR-1)	This procedure contained the same requirements as IDR-1, except that an inspection block for supports was added to the inspection form.
2/24/75	QCP-9, Rev. 2, Quality Control Procedure for Raceways, Junction and Terminal Boxes	Installation acceptance requirements for expansion anchors were added to the procedure. The following acceptance requirements for expansion anchors were specified: - Acceptable anchor types: McCulloch Kwik Bolts, Phillips Red Head Wedges, Hilti Kwik Bolts - Center-to-center spacing: 12 diameters - Edge distance: 6 diameters - Minimum embedments: Anchor Size / Min. Embedment 1/4"-dia. / 2" 3/8"-dia. / 2-1/2" 1/2"-dia. / 2-1/2" 5/8"-dia. / 2-7/8" 3/4"-dia. / 3-1/2" In addition, an inspection block for expansion anchors was added to inspection forms.
5/6/75	QCP-9, Rev. 3, Quality Control Procedure for Raceways, Junction and Terminal Boxes	Changes did not affect expansion anchors.
5/30/75	QCP-9, Rev. 3, Procedure Change Notice 1 (PCN 1)	Changes did not affect expansion anchors.

ATTACHMENT A TO ENCLOSURE 1

Date	Procedure Number and Title	Description
7/21/75	QCP-9, Rev. 3, PCN 2	Changes did not affect expansion anchors.
7/15/75	QCP-9, Rev. 3, PCN 3	Changes did not affect expansion anchors.
7/10/75	QCP-9, Rev. 3, PCN 4	Changes did not affect expansion anchors.
7/17/75	QCP-9, Rev. 3, PCN 5	Changes did not affect expansion anchors.
9/29/75	QCP-9, Rev. 4, Quality Control Procedure for Installation of Raceways, Junction and Terminal Boxes	The following additions were made to the expansion anchor installation requirements: - Edge distance measurements were clarified requiring consideration of concrete corners and embedded items. - Spacing between good and abandoned anchors/holes was specified as 1" clear.
1/23/76	QCP-9, Rev. 4, PCN 7 (PCNs to QCP-9, Rev. 4 start with no. 7)	Changes did not affect expansion anchors.
5/6/76	QCP-9, Rev. 4, PCN 8	Changes did not affect expansion anchors.
6/29/76	QCP-9, Rev. 4, PCN 9	Phillips Stud anchors were added to the list of acceptable anchor types.
8/9/76	QCP-9, Rev. 4, PCN 10	Edge distance measurements were clarified requiring chamfers to be considered as concrete edges.
11/9/76	QCP-9, Rev. 4, PCN 11	Changes did not affect expansion anchors.
12/15/76	QCP-9, Rev. 4, PCN 12	Changes did not affect expansion anchors.
12/30/76	QCP-9, Rev. 4, PCN 13	Changes did not affect expansion anchors.

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Date	Procedure Number and Title	Description
3/4/77	QCP-9, Rev. 4, PCN 14	The following additions were made to the expansion anchor installation acceptance requirements: - The use of Phillips Stud anchors was limited to sizes up to 3/4" diameter. - The 12d spacing requirement was clarified to mean 12 times the diameter of the larger of the two adjacent anchors. - Empty holes within 4.5 diameters of a good anchor were required to be filled with grout. In addition, quality control inspections were required to be performed on a periodic basis.
11/23/77	QCP-9, Rev. 4, PCN 15	Changes did not affect expansion anchors.
2/15/78	QCP-9, Rev. 4, PCN 16	Changes did not affect expansion anchors.
4/7/78	QCP-9, Rev. 4, PCN 17	In this PCN, the following changes were inadvertently made regarding spacing and edge distance requirements. (These changes were made due to a misinterpretation of the engineering requirements on drawing 054162 and were promptly corrected - see PCN 19. This is of no concern because almost no raceway was constructed during the period that reduced spacing was allowed): - Acceptable spacing revised from 12d to 6d. - Acceptable edge distance revised from 6d to 3d. Also in this PCN, the acceptable clear distance between good and abandoned holes was reduced from 1" to 1/2".

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Date	Procedure Number and Title	Description
6/8/78	QCP-9, Rev. 4, PCN 18	In this PCN, an anchor inspection form was added which provided verification blocks for the following items: - Anchor type - Anchor size - Anchor hole diameter and depth - Length of bolt exposed after setting - Length of bolt exposed after torquing - Anchor not more than 5° misalignment (with respect to perpendicular)
8/11/78	QCP-9, Rev. 4, PCN-19	Spacing requirements were changed back to the correct values in this PCN: - Acceptable spacing returned to 12d. - Acceptable edge distance returned to 6d. Also in this PCN, anchor spacing was clarified to include anchors installed in Unistrut members.
10/2/78	QCP-9, Rev. 4, PCN 20	Changes did not affect expansion anchors.
10/18/78	QCP-9, Rev. 4, PCN 21	Changes did not affect expansion anchors.
1/4/79	QCP-9, Rev. 4, PCN 22	Changes did not affect expansion anchors.
5/30/80	QCP-9, Rev. 4, PCN 23	Changes did not affect expansion anchors.
11/25/80	QCP-9, Rev. 4, PCN 24	Changes did not affect expansion anchors.

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ATTACHMENT A TO ENCLOSURE 1

Date	Procedure Number and Title	Description
6/24/81	QCPE-9, Rev. 0, Quality Control Procedure for Installation of Electrical Raceways, Junction and Terminal Boxes (was QCP-9) (was QCP-9)	In this revision the following additions and clarifications were made: - Acceptable anchor types were revised to "Phillips Red Head Stud anchor or approved equal." - 10% QC inspection of anchors was required. For new installations, the following requirements were added: - At least 1 bolt thread must be exposed above its nut. - A 12" minimum distance from pipe supports must be maintained.
8/10/81	QCPE-9, Rev. 0, PCN 1	Changes did not affect expansion anchors.
11/9/81	QCPE-9, Rev. 0, PCN 2	Changes did not affect expansion anchors.
5/6/82	QCPE-9, Rev. 0, PCN 3	Changes did not affect expansion anchors.
5/6/82	QCPE-9, Rev. 0, PCN 4	Changes did not affect expansion anchors.
5/6/82	QCPE-9, Rev. 0, PCN 5	Changes did not affect expansion anchors.
6/15/82	QCPE-9, Rev. 0, PCN 6	Changes did not affect expansion anchors.
6/17/82	QCPE-9, Rev. 0, PCN 7	Changes did not affect expansion anchors.
7/16/82	QCPE-9, Rev. 0, PCN 8	Changes did not affect expansion anchors.

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ATTACHMENT A TO ENCLOSURE 1

Date	Procedure Number and Title	Description
7/15/82	QCPE-9, Rev. 0, PCN 9	Changes did not affect expansion anchors.
8/18/82	QCPE-9, Rev. 0, PCN 10	Changes did not affect expansion anchors.
4/15/83	QCPE-9, Rev. 0, PCN 11	Changes did not affect expansion anchors.
4/15/83	QCPE-9, Rev. 0, PCN 12	Changes did not affect expansion anchors.
5/23/83	QCPE-9, Rev. C, PCN 13	Changes did not affect expansion anchors.
-----	QCPE-9, Rev. 0, PCN 14	This PCN was not issued.
6/28/83	QCPE-9, Rev. 0, PCN 15	Changes did not affect expansion anchors.
8/8/83	QCPE-9, Rev. 0, PCN 16	Changes did not affect expansion anchors.
8/5/83	QCPE-9, Rev. 0, PCN 17	Changes did not affect expansion anchors.
9/23/83	QCPE-9, Rev. 0, PCN 18	Changes did not affect expansion anchors.
9/23/83	QCPE-9, Rev. 0, PCN 19	Changes did not affect expansion anchors.
9/12/83	QCPE-9, Rev. 0, PCN 20	Changes did not affect expansion anchors.
9/19/83	QCPE-9, Rev. 0, PCN 21	Changes did not affect expansion anchors.
11/7/83	QCPE-9, Rev. 1, Quality Control Procedure for Raceways, Junction and Terminal Boxes	Expansion anchor requirements were deferred to QCP-9, Rev. 5 (QCPE-9 no longer addresses expansion anchors).

ATTACHMENT A TO ENCLOSURE 1

Date	Procedure Number and Title	Description
11/7/83	QCP-9, Rev. 5, Quality Control Procedure for Installation and Inspection of Stud and Shell Concrete Expansion Anchors (QCP-9, Rev. 5 was issued 4/13/82 for general use)	QCP-9, Rev. 4, addressed all aspects of raceway installation. QCP-9, Rev. 5, only addressed expansion anchors (for use in raceways or any other work done by Foley). QCP-9, Rev. 5 requires detailed inspections and documentation for new work.

ENCLOSURE 2

INSTRUCTIONS FOR SAMPLING CONCRETE EXPANSION ANCHORS INSTALLED IN ELECTRICAL RACEWAY SUPPORTS

1.0 General

These instructions shall be followed to obtain data from a random sampling of the concrete expansion anchors used in the Diablo Canyon Unit 1 electrical raceway supports. Questions or modifications regarding these instructions shall be discussed with Project Engineering or their on-site representative.

2.0 Sample Size

The data defined in Section 3.0 shall be recorded for 100 raceway supports. Attachment A provides a list of 200 randomly selected raceway supports from which the samples shall be taken. Starting with the first support on the list and proceeding sequentially down the list, each support shall be located. If the support cannot be found, does not contain any concrete expansion anchors, or if the support is inaccessible, it shall be so noted on a sampling form (Attachment B) and sampling shall be continued with the next support on the list. When data on 100 supports have been recorded, the sampling shall be terminated. If more support numbers are required, Project Engineering shall be contacted.

3.0 Recording Data

The form provided in Attachment B shall be used for recording data, outlined below, that shall be compiled for each support.

A) The sample number and the support number (from Attachment A) shall be recorded.

B) The date that the support was installed shall be recorded. If the support was subsequently modified, the date of the original installation shall be used. If the actual date is not readily available, it should be specified if installation occurred before or after January 1975.

C) The quantity of expansion anchors used in the supports shall be recorded. When more than one anchor has been used, a simple sketch of the support shall be made. Each anchor's location within the support shall be noted on the sketch and shall be given a sequential number.

For each expansion anchor in the support, the following data shall be recorded. The individual anchor data shall correspond to the anchor numbering sequence established on the support sketch prepared in Section 3.C, above.

D) The anchor diameter (1/2" diameter, 5/8" diameter, etc.) shall be recorded.

E) The anchor type (wedge type, Phillips Stud type or shell type) shall be recorded.

F) The anchor embedment (for stud or wedge type anchors only) shall be determined by using the following method:

F.1) The overall anchor length, determined by UT measurement, shall be recorded.

F.2) The exposed length of anchor that projects out beyond the concrete surface shall be recorded.

F.3) The embedment, determined by subtracting the projecting length (F.2) from the overall length (F.1), shall be recorded.

G) The angular alignment of the anchor (the anchor of the axis of the anchor with respect to perpendicular) shall be recorded..

H) The distance (spacing) to the closest adjacent expansion anchor, whether in the sampled support or in any other adjacent support, shall be recorded. If the distance is greater than 10 bolt diameters, simply state: 10d.

I) The (edge) distance to the nearest concrete edge (chamfer), embedded plate or other embedded item shall be recorded. If the distance is greater than 5 bolt diameters, simply state: 5d

J) The engagement of nuts (for stud or wedge type anchors only) shall be recorded, noting the number of exposed threads on the anchors.

K) It shall be determined if the anchor has been tightly installed. Tight is defined as being unable to turn the nut (or bolt in a shell anchor) by hand.

4.0 Sampling of Adjacent Supports

If one or more anchors in a sampled support has an overall length of 2-3/4" or less (as determined by UT examination per section 3.F.1) and adjacent support along the conduit run, selected from either side of the sample support, shall be added to the sample set. This adjacent support shall be inspected in accordance with Section 3.0, above, and shall be

clearly identified, on its data form, as an addition to the original sample.

If the adjacent support also contains a 2-3/4" long anchor, a second adjacent support shall be added to the sample set as described above.

5.0 As-Built Sketches

As-built sketches of the sampled supports shall be prepared when installation deviations, as defined below, are found. The as-built sketches shall be prepared in accordance with "Minimum As-Built Requirements" which was attached to December 13, 1983 meeting minutes (Chron No. 040424)

As-built sketches shall be prepared when any of the following deviations are found:

(a) the embedment, determined per Section 3.F.3, is less than that specified on drawing 054162 (e.g., less than 2-1/4" for 1/2" diameter anchors)

(b) the angularity, determined per Section 3.G, is greater than 5°.

(c) the spacing, determined per Section 3.H, is less than 10d. In addition to the sampled support, any other support(s) involved in the spacing deviation shall also be as-built.

(d) the edge distance, determined per Section 3.I, is less thazn 5d.

6.0 Quality Assurance

All data compiled for this sampling shall be recorded on the forms provided in Attachment B and shall be signed by the originator and a checker.

The UT machine shall be calibrated prior to use.

7.0 Data Transmittal

All data sheets and as-builts compiled in this sampling program shall be expeditiously transmitted to Project Engineering, Attention: J. K. McCall.

ATTACHMENT A TO ENCLOSURE 2

Sample No.	Support No.	Support Type	Conduit No.
1.	CSR-127-4-13	S-296	K7887
2.	K-73-2-12	S-19A	K8591
3.	C-140-9-23	S-149	K2704
4.	A-140-3-39	S-48	K2652
5.	K-140-3-31	S-596	K9796
6.	B-104-5-35	S-415	KA730
7.	K-115-3-34	S-20	KT571
8.	GE/GW-140-4-857	S-102	K7353
9.	GE/GW-140-4-370	S-288	K6592
10.	H-115-5-27	S-288	K8393
11.	GE/GW-115-2-104	S-115	K6097
12.	GE/GW-115-3-202	S-7	K6310
13.	TGB-140-2-3	S-197	KA109
14.	GE/GW-140-6-61	S-20	K6132
15.	GE/GW-140-4-740	S-415	K5769
16.	K-115-4-157	S-19A	K9108
17.	G-140-7-243	S-48	K1993
18.	GE/GW-140-7-137	S-19A	KT573
19.	G-140-8-541	S-19A	KX208
20.	GE/GW-140-4-1020	S-87	KT152
21.	K-85-5-32	S-194	K6679
22.	K-115-4-104	S-289	KH323
23.	C-104-10-12	S-149	K2724
24.	A-119-5-13	S-415	K2635
25.	C-104-2-15	S-415	K4012
26.	J-115-5-8	S-20	K8066
27.	GE/GW-115-2-48	S-1B	K6099
28.	D-104-2-31	S-243	K2415
29.	K-140-1-155	S-19A	KT879
30.	H-128-3-237	S-19B	K7788
31.	GE/GW-100-1-108	S-19B	K6114
32.	H-73-5-4	S-87	KK617[nv]
33.	K-100-1-191	S-252	K9242
34.	L-140-4-33	S-20	K8212
35.	G-140-4-45	S-102	K9507[nv]
36.	CSR-127-3-461	S-88	K9759
37.	E-140-5-13	S-20	K7002
38.	A-107-6-32	S-454	BTA201
39.	FE/FW-140-1-17	S-19A	K5776
40.	GE/GW-115-2-77	S-1B	K6397
41.	A-107-12-34	S-172	K2449
42.	GE/GW-140-6-206	S-172	K6769
43.	H-128-1-95	S-104	ERA[na]
44.	K-154-1-350	S-243	KV160

ATTACHMENT A TO ENCLOSURE 2

Sample No.	Support No.	Support Type	Conduit No.
45.	GE/GW-15-3-124	S-1B	K6392
46.	GE/GW-15-2-282	S-415	K8770
47.	CSR-127-6-431	S-19B	K7911
48.	J-115-5-3	S-20	K8066
49.	CSR-127-5-297	S-19A	KT366
50.	F-140-1-58	S-41	KX895
51.	G-117-2-(68)	S-197	YKX394
52.	CSR-127-3-391	S-19A	KT358
53.	GE/GW-140-4-817	S-19A	KT148
54.	GE/GW-115-4-58	S-415	KT598
55.	GE/GW-115-4-48	S-85	KT286
56.	GE/GW-140-4-797	S-243	K5779
57.	CSR-127-5-76	S-102	KT069
58.	CSR-127-4-310	S-19A	K7137
59.	K-100-1-54	S-183	K9336
60.	D-140-5-54	S-171	K5275
61.	D-140-5-33	S-415	K5252
62.	K-185-1-24	S-19AK	K6843
63.	K-154-1-324	S-87	KV106
64.	GE/GW-115-4-361	S-202	K8496
65.	H-128-11-43	S-20	K8873
66.	K-115-4-133	S-19A	K9107
67.	A-107-4-39	S-372	K2339
68.	A-140-4-1	S-415	K2859
69.	G-117-1-638	S-202	KX616
70.	GE/GW-115-3-127	S-288	KT319
71.	CSR-127-4-11	S-87	K2449
72.	K-115-2-23	S-19A	K3853nv
73.	L-140-7-106	S-202	KT967nv
74.	A-107-11-19	S-5B	K2641
75.	GE/GW-115-2-141	S-387	K7307
76.	K-115-3-148	S-314	KH323
77.	K-140-9-135	S-23	KH569
78.	K-115-1-15	S-20	KT589
79.	G-117-1-106	S-19A	KX525
80.	L-140-2-12	S-20	K8256
81.	K-140-1-156	S-289	KT510
82.	A-107-4-27	S-20	K2480
83.	GE/GW-140-6-117	S-288	K6429
84.	CSR-127-5-175	S-88	K811
85.	J-115-1-56	S-243	K8235
86.	L-140-4-71	S-20	K8281
87.	CSR-127-5-196	S-121	KT003
88.	H-85-1-42	S-288	KT959

ATTACHMENT A TO ENCLOSURE 2

Sample No.	Support No.	Support Type	Conduit No.
89.	CSR-127-3-387	S-140	K8615
90.	GE/GW-140-4-372	S-288	K6592
91.	K-140-9-119	S-23	KH545
92.	D-104-5-12	S-195	K4879
93.	A-107-3-3	S-7	K2408
94.	GE/GW-140-6-134	S-20	KT573
95.	A-107-4-37	S-392	K2339
96.	A-119-8-1	S-20	K2453
97.	H-128-11-8	S-242	K8725nv
98.	GE/GW-100-2-12	S-87	K6764
99.	G-140-6-885	S-102	KX991
100.	J-140-4-141	S-87	KK713
101.	L-165-2-53	S-20	K8471, K8469nv
102.	H-115-2-53	S-80A	K6014, FNED, FNAD, FNEC, FNAC
103.	H-115-3-134	S-183	K7107nv, K7108nv, K7109nv, K7110nv
104.	GE/GW-140-4-886	S-87	K8764
105.	CSR-127-6-96	S-19-B	K6510nv
106.	CSR-127-5-241	S-438	TRAnv, KR015nv
107.	F-140-5-20	S-20	KX498
108.	K-154-1-3006	S-87	K6515
109.	D-104-5-84	S-20	KX4846
110.	H-115-1-48	S-85	KT781
111.	D-104-5-95	S-20	K5049
112.	GE/GW-140-6-113	S-19-A	K6429
113.	J-115-1-63	S-20	K8237
114.	J-115-2-21	S-149	K8098
115.	A-85-5-12	S-115	K2631
116.	F-165-6-(10)	S-19-A	FX460
117.	K-100-6-76	S-19-B	K9786
118.	G-140-7-257	S-20	K1503, K1504, KX875nv
119.	CSR-127-4-453	S-87	K145H
120.	K-140-3-68	S-288	K6094
121.	CSR-127-7-125	S-91	K7246
122.	G-117-2-31	S-415	K1541nv, KX462
123.	FE/FW-117-2-15	S-415	K5907
124.	K-140-4-187	S-264	K9913, K9799, K9982

ATTACHMENT A TO ENCLOSURE 2

Sample No.	Support No.	Support Type	Conduit No.
125.	GE/GW-140-1-69	S-104	TARnv, KS643nv, K6120, K6121, KT062
126.	H-115-5-83	S-19A	K7130nv
127.	K-140-9-166	S-172	KH550
128.	FE/FW-140-1-55	S-415	K5839
129.	CSR-127-5-399	S-19-A	KK303
130.	CSR-127-5-137	S-288	KT765
131.	CSR-127-6-168	S-69	KT777
132.	B-104-10-24	S-415	K3214nv
133.	CSR-127-5-221	S-286	K7221
134.	G-140-4-(11)	S-214	KX211
135.	G-140-1-92	S-19-A	KX678nv, KX498
136.	CSR-127-5-400	S-97	KK300
137.	K-140-3-31	S-596	K9796
138.	FE/FW-140-1-4	S-19-A	K5774
139.	H-128-2-145	S-202	K5969
140.	J-115-10-71	S-370	KK807nv
141.	K-115-4-161	S-19-A	K3853
142.	CSR-127-6-50	S-19-B	K6503
143.	H-128-3-8	S-114	KK528nv, K7006nv, K7016, K7010
144.	G-140-7-510A	S-102	KX050nv
145.	F-117-6-17	S-618	EJCA
146.	FE/FW-117-1-281	S-231	KT610
147.	K-100-2-21	S-20	KH340, KH546
148.	K-140-9-46	S-87	KH532
149.	F-165-3-711	S-415	K1428
150.	GE/GW-115-3-210	S-172	K6091
151.	K-154-1-126	S-19A	KV068
152.	F-140-2-162	S-214	K1729
153.	GE/GW-140-6-114	S-19-A	K6429
154.	J-115-9-13	S-387	K8931
155.	H-128-5-51	S-202	K7660nv, K7493, K6585nv, K6633nv
156.	A-140-6-22	S-19-A	K2855nv
157.	GE/GW-100-1-605	S-87	K8909nv
158.	GE-GW-140-5-163	S-243	K6530
159.	F-165-4-764	S-20	KX864, KX865
160.	CSR-127-6-25	S-19-B	KT830nv

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Sample No.	Support No.	Support Type	Conduit No.
161.	K-185-1-22	S-19-A	K6843
162.	GE/GW-140-4-370	S288	K6592
163.	K-85-4-95	S-19-A	K6024
164.	GE/GW-140-4-884	S-19-B	K6227nv, K7250
165.	H-115-4-45	S-576	K6748
166.	CSR-127-7-415	S-19-A	K7168
167.	GE/GW-140-4-159	S-20	KT628, K6494, K6235nv
168.	H-115-4-3	S-20	KT630
169.	GE/GW-115-1-168	S-20	K6543
170.	C-104-3-2	S-216	K3904
171.	B-104-16-10	S-149	K2415
172.	C-104-10-12	S-149	K2724
173.	K-115-4-4	S-410	KK524
174.	G17.5-4-48	S-172	K1093
175.	GE/GW-140-1-304	S-183	TARFnv, K6001, K4312
176.	GE/GW-100-1-276	S-243	K7191
177.	CSR-127-5-58	S-243	KT538nv
178.	H-128-3-180	S-289	KK305
179.	GE/GW-140-4-429	S-20	K5562nv, K5625nv, K7266, KT124
180.	K-85-4-21	S-87	K6679
181.	F-140-2-(33)	S-214	K1729
182.	GE/GW-100-1-194	S-19-A	KK767
183.	GE/GW-140-4-1171	S-102	K7266
184.	G-140-6-(11)	S-20	KX572
185.	K-140-1-142	S-20	KT940
186.	CSR-127-3-230	S-288	K8657nv
187.	2K-100-2-68	S-7	K9440
188.	CSR-127-3-545	S-19-A	K7159
189.	K-154-1-346	S-87	KV170
190.	CSR-127-7-347	S-83	K7952
191.	CSR-127-3-451	S-19-B	K7866
192.	GE/GW-140-4-1132	S-202	K2894
193.	GE/GW-100-1-546	S-202	K3474nv
194.	GE-GW-100-1-565	S-19-A	K4143nv
195.	J-115-1-63	S-20	K8237
196.	FE/FW-117-1-380	S-415	K5834
197.	K-85-4-161	S-87	K8897
198.	GE/GW-140-4-822	S-19-A	K8770
199.	A-119-5-25	S-288	K2773
200.	GE/GW-140-7-193	S-102	KT169, K5763

ATTACHMENT B TO ENCLOSURE 2

Expansion Anchor Sampling Data Form

SUPPORT DATA

A) Sample No. _____ Support No. _____

If data has not been compiled, specify why not: _____

B) Date Support Installed: _____

C) Quantity of Anchors in Support: _____

Sketch Numbering the Individual Anchors Attached? Yes___ No___

ANCHOR DATA	Anchor #1	Anchor #2	Anchor #3	Anchor #4
D) Anchor Diameter				
E) Anchor Type				
F.1) Overall Length				
F.2) Exposed Length				
F.3) Embedded Length				
G) Angularity				
H) Spacing				
I) Edge Distance				
J) Nut Engagement (specify no. of exposed threads)				
K) Tightness (specify tight or loose)				

SIGNATURES

Originator(s) _____ _____ Checker(s) _____ _____

Date(s) _____ _____ Date(s) _____ _____