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SHIFFER,J.D. Pacific Gas & Electric Co.
RECIP.NAME RECIPIENT AFFILIATION
KNIGHTON,G.W. Licensing Branch 3

SUBJECT: Addresses recent anonymous allegations involving calculations performed by Bechtel-Gaithersburg personnel,per NRC 850117 request,Method of calculating weld shear stresses & results of calculations acceptable,Related info encl.

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JAMES D. SHIFFER
VICE PRESIDENT
NUCLEAR POWER GENERATION

February 6, 1985

PGandE Letter No.: DCL-85-053

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

Re: Docket No. 50-323
Diablo Canyon Unit 2
Anonymous Allegations Relating to Bechtel-Gaithersburg

Dear Mr. Knighton:

On January 17, 1985, the NRC Staff requested that PGandE address a recent allegation regarding shear stress calculations for Diablo Canyon Unit 2 pipe support welds. The allegation involves calculations performed by Bechtel-Gaithersburg, Eastern Power Division (EPD) personnel who used Bechtel-San Francisco procedures. It is alleged that calculations based on these procedures are less conservative than those based on procedures normally used by EPD.

The subject allegation raised the following two items:

a. Incorrect weld shear stress calculations based on the EPD Diablo Canyon Project (DCP) method, provided in Appendix G of DCP Project Procedure P-6, "Procedure for Assembling Pipe Support Calculation Packages," (Bechtel-San Francisco)

b. Incorrect shear stress calculations of structural members; calculations were not in accordance with the AISC Code

The first item is addressed in Enclosure 1. In summary, the EDP Diablo Canyon Project method of calculating weld shear stresses in accordance with the DCP Procedure P-6 is correct and acceptable. A sample study performed by EPD personnel indicated that the difference between the maximum stresses calculated by the DCP Procedure P-6 criteria and the more conservative method normally utilized by EPD personnel is insignificant. The results of this study are included in Enclosure 1. The results were discussed in an EPD Diablo Canyon Project group meeting on December 19, 1984, as noted in Enclosure 2 to this letter.

A001
1/40

An additional survey was performed at EPD to supplement the above study. Since the shear components of the weld stresses and their effects on the resultant weld stresses are the main points of concern, a short cantilever is the ideal subject for this survey. Eight short cantilever pipe supports were selected for evaluation. The resultant weld stresses were calculated using two methods. The first method used the total weld area to resist the shear force, while the second used only the portion of the weld area that is parallel to the direction of the shear force being considered. The conclusions of the short cantilever survey are as follows:

a. The shear component of the weld stress does not govern. The moment component is always greater than the shear component.

b. The increase in the resultant weld stresses using the second method is insignificant. In all cases, the stresses are within the allowable stresses.

The results of this study are contained in Enclosure 3.

The second item, that of incorrect shear stress calculations for structural members, was also addressed in the sample study. The conclusion of the study as indicated in Enclosure 1 is that member shear stresses were found to be acceptable in accordance with AISC, 7th Edition.

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

Sincerely,

Enclosures

cc: R. T. Dodds
K. Manoly, NRC Region I
J. B. Martin
H. E. Schierling
Service List

ENCLOSURE 1

ENCLOSURE 1

EVERY LITTLE BIT HELPS

Bechtel Power Corporation

Interoffice Memorandum

To: G. V. Cranston

Date: December 7, 1984

Subject: Design Deficiency/Mismanagement
Diablo Canyon Project Unit No. 2
Bechtel Job No. 15320-003

From: G. K. Wang

Of: Project Engineering

At: EPD - 5A4

File:

Copies:
W. N. Adams
D. L. Brannen
H. S. Kassel
T. J. McDonald
K. Y. Lee
S. Bokhari

We have received an IOM dated November 15, 1984 from concerned engineers (Attachment No. A) regarding:

1. Incorrect shearing stress calculation of welds in the project procedure, and

2. Mismanagement of the project group by the group supervisor.

Both statements are incorrect. The project method of shearing stress calculation of welds, which is given in the Appendix G of DCPO Procedure P-6, is acceptable.

This method is described in detail in the book, Design of Weld Structures, by Omer W. Blodgett. There appears to be some confusion between this method and a more conservative method recommended by EPD Hanger Engineering Standard HES-005A and B, of which all the EPD pipe support engineers are familiar with. Both methods are approximate methods and both are considered acceptable. Hence, both methods are listed as references in the EPD Diablo Canyon Project Procedure for pipe support weld calculation. The technical details of these two methods are explained in our IOM to Mr. K. Y. Lee, Civil Structure Chief, Engineer of EPD, dated December 7, 1984. A copy is attached as Attachment No. 2.

Mr. Bokhari is one of the most capable supervisors in EPD, both technically and managerially. This is evident from the quality of the EPD work which has been reviewed constantly by DCPO and audited by NRC. The EPD project under Mr. Bokhari's supervision has been meeting project schedule and allocated budget. Overtime is only used to support project schedule with prior DCPO approval. Mr. Bokhari is an eleven-year veteran of Bechtel. I think his personal records and his previous performance evaluations will speak for him.

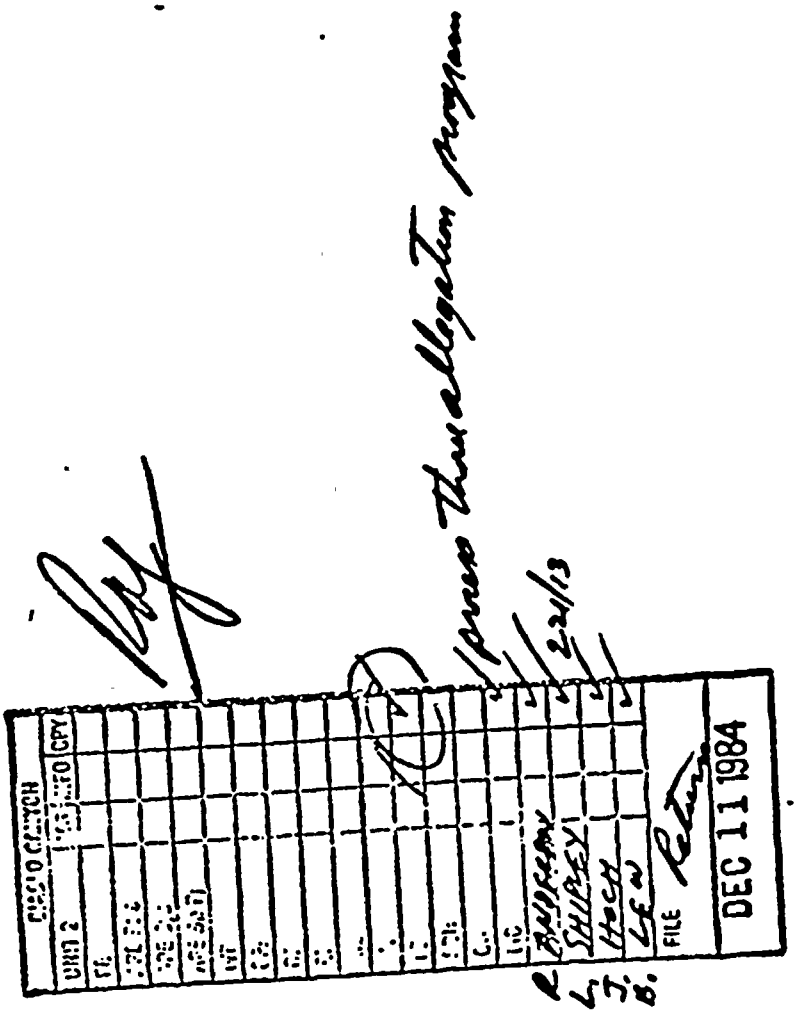
IOM: G. V. Cranston
Bechtel Job No. 15320-003

If you have any questions, please do not hesitate to let me know.

Glenn K. Wang
EPD Project Engineer

GKW:mfa

Attachments: A. IOM to Kenneth Lee, dated November 15, 1984
B. IOM to K. Y. Lee from G. K. Wang, dated December 7, 1984



ATTACHMENT-A (7 pages)

Bechtel Power Corporation

Interoffice Memorandum

To Kenneth Lee

Date Nov. 15, 1984

Subject Design Deficiency/Mismanagement
Diablo Canyon Project
Unit No. 2
Job No. 15320

From Engineers

Of Engineering

At Gaithersburg

Copies W.N. Adams
T.C. McDonald
G.K. Wang

In Light of public safety and the mismanagement of the Diablo Canyon Unit 2 pipe support group supervised by Syed Bokhari, we can not but report to you that the pipe support group has been incorrectly designing and analyzing the welds as well as structural members by using the least conservative approach which is quite inconsistent with the reference material as specified in the design standards(see attached copies) and which is also not in accordance with the A.I.S.C. codes.

The total length of weld or the total area of steel member should not be taken fully to calculate the shear stresses as this will adversely affect the structural adequacy especially for tubing, angle and wide flange shapes. The actual factor of safety for shear can significantly be reduced to ½ (half) of the value for square tubing and angle. Therefore, it will make the structure unsafe.

This incorrect approach has currently and continuously been used since the beginning of the unit 2 project, as of to-date a couple of thousands of pipe supports or more are probably affected by this design approach and the case is considered to be serious and reportable.

Syed Bokhari, the group supervisor and his design supervisors have been constantly reminded and notified about this design deficiency and the engineers were warned and told without further questions to proceed making design packages like in a factory assembly line.

Fair recognition for job accomplishments has never been given to the deserving employees, Syed Bokhari seems enjoying the work achivements and rewards at the expense of his hard working fellow workers. This is totally unfair and unprofessional in any respect.

Syed Bokhari has never attempted, participated or involved in any technical decisions or professional discussions when important circumstances occur, and the responsible engineers always have to make most of the job decisions sometimes very ineffective with a very limited structural knowledge and design background, and they frequently intimidate their subordinates using force-ranking evaluation as a tool to get the work done, a specified work quota is assigned weekly to everyone without considering the complexity and urgency of the problems, over-time is usually given to those preferred people who seldom work or do not usually work hard at all.

At the meeting people were indirectly advised and encouraged to look for new opportunities and new jobs. Checking of late attendance in the morning and noon has never been enforced. Syed Bokhari usually comes late after lunch hour.

In addition, most people feel very often uninformed and frustrated and new people coming to the group like strangers have never been introduced to other co-workers. There is no orientation at all for new people.

In the best interest of the company, we solemnly report this to you for your attention and input.

Enclosed are copies as marked for your reference.

Your full understanding, thorough investigation and corrective actions are required.

CE

Concerned Engineers

CONFIDENTIAL

Sheet of

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON NUCLEAR POWER PLANT UNIT _____ RANGER NO. _____

MADE BY: _____ DATE _____ CALC. REQ. NO. _____ REV. _____

CHECKED BY: _____ DATE _____

EVALUATION OF WELD

WELD LOCATION _____ STRUDL JOINT NO _____

LOADS ON WELD (REF SHT ___)

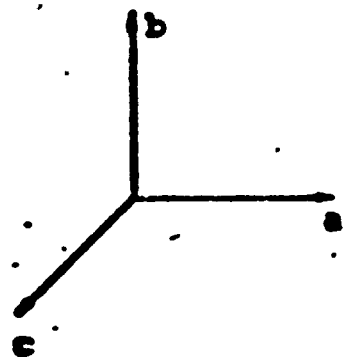
LOAD CASE _____

$F_{\_} = F_a =$ _____ lb $M_{\_} = M_a =$ _____ "lb

$F_{\_} = F_b =$ _____ lb $M_{\_} = M_b =$ _____ "lb

$F_{\_} = F_c =$ _____ lb $M_{\_} = M_c =$ _____ "lb

WELD PATTERN



MEMBER SIZE _____

WELD TYPE _____

WELD SECTION PROPERTIES (IN LOCAL COORD)

$A_w =$ _____ in^2/in

$C_a =$ _____ in (dist along a axis)

$C_b =$ _____ in (dist along b axis)

$S_a =$ _____ in^3/in

$S_b =$ _____ in^3/in

$J_w =$ _____ in^4/in

$$f_1 = \frac{M_c \times C_b}{J_w} + \frac{F_a}{(A_w)} = \_\_\_\_\_ \text{ lb/in}$$

$$f_2 = \frac{M_c \times C_a}{J_w} + \frac{F_b}{(A_w)} = \_\_\_\_\_ \text{ lb/in}$$

$$f_3 = \frac{F_c}{(A_w)} + \frac{M_a}{S_a} + \frac{M_b}{S_b} = \_\_\_\_\_ \text{ lb/in}$$

$$f_r = (f_1^2 + f_2^2 + f_3^2)^{\frac{1}{2}} = \_\_\_\_\_ \text{ lb/in}$$

WELD STRESS per ☐ AISC ALLOWABLES ☐ B31.1 ALLOWABLES

$$\text{WELD REQ'D} = \frac{f_r}{\text{EFFECT TH}} = \_\_\_\_\_ \quad \text{ALLOWABLE} \_\_\_\_\_$$

PACIFIC GAS AND ELECTRIC COMPANY

ABLO CANYON NUCLEAR POWER PLANT UNIT_____ RANGER NO._____

DE BY: _____ DATE_____ CALC. SEQ. NO._____ REV._____

ECKED BY: _____ DATE_____

PIPE SUPPORTS HAVE BEEN DESIGNED IN ACCORDANCE WITH THE FOLLOWING REFERENCES:

CODES AND STANDARDS FOR DESIGN

1. USAS B31.1 CODE, POWER PIPING, 1967 EDITION W/ADDENDA
2. USAS B31.7 CODE, NUCLEAR POWER PIPING, 1969 EDITION W/1970 ADDENDA
3. AISC MANUAL OF STEEL CONSTRUCTION, 7th EDITION
4. DCM M-9 "GUIDELINES FOR DESIGN OF CLASS I PIPE SUPPORTS, REV. 9"
5. STD. PIPE SUPPORTS FOR DESIGN CLASS I PIPING 2" AND SMALLER DIABLO CANYON, PACIFIC GAS AND ELECTRIC DRAWING NO. 049243 REV. 14
6. OFFICE AND FIELD ENG. USERS MANUAL FOR ROUTING AND SUPPORTING TWO INCH AND UNDER PIPING, BECHTEL, GPD DOCUMENT NO. M-18.

DESIGN DATA SOURCES

1. STRESS ISOMETRIC DRAWING FOR APPLICABLE LINE
2. APPLICABLE RESPONSE SPECTRA:
   DCM-C-17 REV. 8, DCM C-25 REV. 3, DCM C-30 REV. 5
3. CRITERIA FOR MAXIMUM BLDG. DISPLACEMENTS DCM C-28 REV. 4

MANUFACTURER'S CATALOGS AND STANDARDS

1. GRINNELL PIPE HANGERS, CATALOG PH74, PH76, PH79, PH81
2. GRINNELL LOAD CAPCITY DATA SHEETS
3. GRINNELL HANGER STANDARDS
4. PACIFIC SCIENTIFIC CATALOG
5. B-P-S INDUSTRIES CATALOG
6. MSS STANDARD, SP-58 SP-69

PIPE SUPPORT COMPUTER PROGRAMS

1. CE 801 - STRUDL PROGRAM REV. 3 OF USER'S MANUAL
2. CE 035 - BASE PLATE II PROGRAM REV. 1 OF USER'S MANUAL

OTHER SOURCES

1. DESIGN OF WELDED STRUCTURES, BY OMER W. BLODGETT.
2. BECHTEL, GPD HANGER ENGINEERING STANDARDS REV. 13
3. BECHTEL, GPD PIPE SUPPORT GROUP, NEWSLETTERS

Combining Properties and Applied Forces To Get Total Force on Weld

The following nomenclature and equations have been developed for the purpose of simplifying and establishing a uniform approach for performing weld calculations:

NOMENCLATURE

La = Effective length of weld carrying shear in "a" direction.
Lb = Effective length of weld carrying shear in "b" direction.
Lc = Effective length of weld carrying tension in "c" direction
SMa = Section Modulus "a" axis.
SMb = Section Modulus "b" axis.
PMI = Polar Moment of Inertia
Ca = "C" fiber distance measured in "a" direction.
Cb = "C" fiber distance measured in "b" direction.
fr = Maximum total vector force on weld (usually kip/inch)
fa = Force per inch of weld acting in "a" direction.
fb = Force per inch of weld acting in "b" direction.
fc = Force per inch of weld acting in "c" direction.

EQUATION FOR FINDING fr

$$fr = \sqrt{(fa)^2 + (fb)^2 + (fc)^2}$$

$$fa = \left(\frac{Pa}{La}\right) + \left(\frac{Mc\ Cb}{PMI}\right)$$

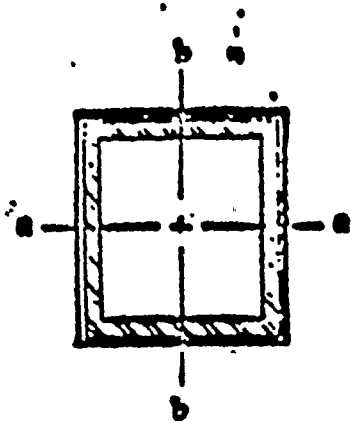
$$SIZE = \frac{fr}{\text{ALLOWABLE STRESS}}$$

$$fb = \left(\frac{Pb}{Lb}\right) + \left(\frac{Mc\ Ca}{PMI}\right)$$

$$fc = \left(\frac{Pc}{Lc}\right) + \left(\frac{Ma}{SMa}\right) + \left(\frac{Mb}{SMb}\right)$$

The equations for fa, fb, and fc have terms or produce forces in each of the three directions which are added directly and then the total force is found by taking the square root sum of the squares of the three forces.

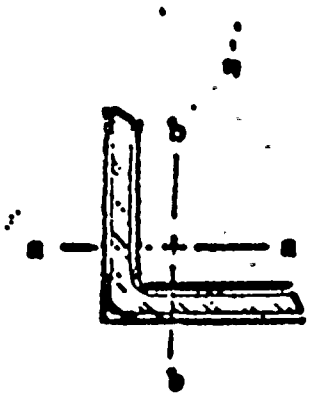
A standard calculation sheet, and an example for the use of that sheet follows.



WELD PROPERTIES

"ALL AROUND" WELD GROUP

SHAPE	LA	LB	LC	SMA	SMB	PBI	CA	CB
TS2X2	4.00	4.00	8.00	5.33	5.33	10.67	1.00	1.00
TS2.5X2.5	5.00	5.00	10.00	8.33	8.33	20.83	1.25	1.25
TS3X3	6.00	6.00	12.00	12.00	12.00	36.00	1.50	1.50
TS3.5X3.5	7.00	7.00	14.00	16.33	16.33	57.17	1.75	1.75
TS4X4	8.00	8.00	16.00	21.33	21.33	85.33	2.00	2.00
TS5X5	10.00	10.00	20.00	33.33	33.33	166.67	2.50	2.50
TS6X6	12.00	12.00	24.00	48.00	48.00	288.00	3.00	3.00
TS7X7	14.00	14.00	28.00	65.33	65.33	457.33	3.50	3.50
TS8X8	16.00	16.00	32.00	85.33	85.33	682.67	4.00	4.00
TS10X10	20.00	20.00	40.00	133.33	133.33	1333.33	5.00	5.00
TS12X12	24.00	24.00	48.00	192.00	192.00	2304.00	6.00	6.00



WELD PROPERTIES

FOR: EQUAL LEG ANGLES

WELD GROUP, ALL AROUND

SIZE	LA	LB	LC	SMA	SMB	PHI	CA	CB
1	2.00	2.00	4.00	.56	.56	.83	.75	.75
1-1/2	3.00	3.00	6.00	1.25	1.25	2.81	1.13	1.13
2	4.00	4.00	8.00	2.22	2.22	6.67	1.50	1.50
2-1/2	5.00	5.00	10.00	3.47	3.47	13.02	1.88	1.88
3	6.00	6.00	12.00	5.00	5.00	22.50	2.25	2.25
3-1/2	7.00	7.00	14.00	6.81	6.81	35.73	2.63	2.63
4	8.00	8.00	16.00	8.89	8.89	53.33	3.00	3.00
5	10.00	10.00	20.00	13.89	13.89	104.17	3.75	3.75
6	12.00	12.00	24.00	20.00	20.00	180.00	4.50	4.50
7	14.00	14.00	28.00	27.22	27.22	285.83	5.25	5.25
8	16.00	16.00	32.00	35.56	35.56	426.67	6.00	6.00

ATTACHMENT - B (11 pages)

EVERY LITTLE BIT HELPS

Bechtel Power Corporation

Interoffice Memorandum

To K. Y. Lee

Date December 7, 1984

Subject Shearing Stress Calculation of Welds
Diablo Canyon Project Unit No. 2
Bechtel Job No. 15320-003

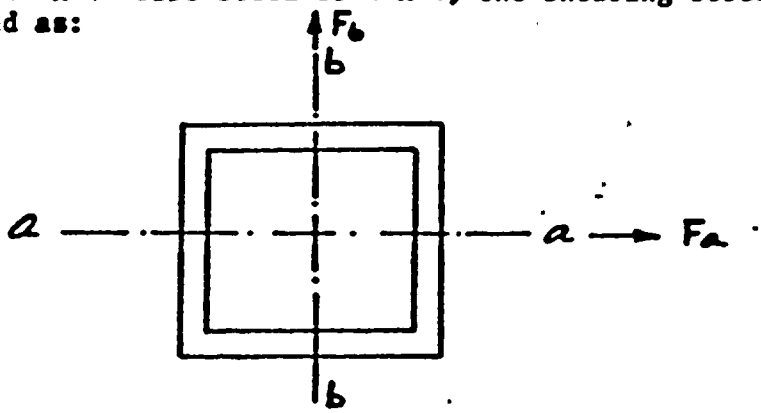
From G. K. Wang
Of Project Engineering
At EPD - 5A4

Copies W. N. Adams, D. L. Brannen, S. Bokhari, P. Perks, H. S. Kassel, T. J. McDonald, L. F. Sirianni

File

A concern was raised recently that the method used by EPD Diablo Canyon Project in calculating the shearing stresses in welds may not be correct, and therefore may result in unsafe structures.

The EPD Diablo Canyon project method (refer to as the DCPO method), which is given in the Appendix G of DCPO Project Procedure P-6, is different from the method used in other EPD projects (as recommended in the EPD Pipe Support Hanger Engineering Standard, HES-005A and B and is referred to as the HES method) in the shearing stress calculation of welds. For example, for an all-around weld of 4" x 4" tube steel TS 4 X 4, the shearing stresses in the welds are calculated as:



DCPO method:

$$\frac{Fa}{\text{Total Weld Length}} = \frac{Fa}{16''}$$

$$\frac{Fb}{\text{Total Weld Length}} = \frac{Fb}{16''}$$

HES method:

$$\frac{Fa}{\text{Weld Length along a-Axis}} = \frac{Fa}{8''}$$

$$\frac{Fb}{\text{Weld Length along b-Axis}} = \frac{Fb}{8''}$$

where Fa and Fb are applied shear forces along a- and b-axis, respectively

IOM: K. Y. Lee
Bechtel Job 15320-003

The differences were recognized at the beginning of the EPD Diablo Canyon Project. The DCPO method was adapted because it was based on a commonly used method in the industry described in the book, Design of Welded Structures, by Omer W. Blodgett. A copy of the relevant page is attached as Attachment No. 1. Both methods are considered as acceptable and are listed as references, Items 1 and 3, respectively, under "Other Sources" in EPD Diablo Canyon Project Procedure for pipe support weld calculation.

Since the shearing stress generally does not control pipe support design, a sampling study was made to show that the differences in the design margin between the two approximate methods are indeed insignificant. Neither one has resulted in unsafe structures. The sampling technique and results are attached as Attachment No. 2.

Based on the discussion above, we plan to continue to accept the DCPO method as well as the HES method in the project calculations. If there are any questions, please let us know.

Glenn

G. K. Wang
Project Engineer

GKW:mfa

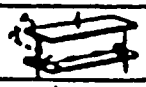
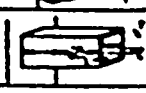
Attachments: 1. Page 7.4-6, Design of Welded Structures, by Omer W. Blodgett

2. Results of 5 Percent Hanger Sample for Comparison of Weld Stresses Calculated by DCPO and HES methods

ATTACHMENT # 1

"DESIGN OF WELDED STRUCTURES" by OMER W. BLODGETT.

TABLE 4—Determining Force on Weld

Type of Loading		standard design formula stress lbs/in²	treating the weld as a line force lbs/in
	PRIMARY WELDS transmit entire load at this point		
	tension or compression	$\sigma = \frac{P}{A}$	$f = \frac{P}{A_w}$
	vertical shear	$\sigma = \frac{V}{A}$	$f = \frac{V}{A_w}$
	bending	$\sigma = \frac{M}{S}$	$f = \frac{M}{S_w}$
	twisting	$\sigma = \frac{TC}{J}$	$f = \frac{TC}{J_w}$
	SECONDARY WELDS hold section together - low stress		
	horizontal shear	$\tau = \frac{VAy}{It}$	$f = \frac{VAy}{In}$
	torsional horizontal shear*	$\tau = \frac{T}{2At}$	$f = \frac{T}{2A}$

A = area contained within center line.
(*) applies to closed tubular section only.

SIMPLE TENSILE, COMPRESSIVE OR SHEAR LOADS ON WELDS

For a simple tensile, compressive or shear load, the given load is divided by the length of the weld to arrive at the applied unit force, lbs per linear inch of weld. From this force, the proper leg size of fillet weld or throat of groove weld may be found.

7. BENDING OR TWISTING LOADS ON WELDS

The problem here is to determine the properties of the welded connection in order to check the stress in the weld without first knowing its leg size. Some design texts suggest assuming a certain weld-leg size and then calculating the stress in the weld to see if it is overstressed or understressed. If the result is too far off, then the weld-leg size is readjusted.

This has the following disadvantages:

1. Some decision must be made as to what throat section is going to be used to determine the property of the weld. Usually some objection can be raised to any throat section chosen.

2. The resulting stresses must be combined and, for several types of loading, this can be rather complicated.

In contrast, the following is a simple method to determine the correct amount of welding required for adequate strength. This is a method in which the weld is treated as a line, having no area, but a definite length and outline. This method has the following advantages:

1. It is not necessary to consider throat areas because only a line is considered.

2. Properties of the welded connection are easily found from a table without knowing weld-leg size.

3. Forces are considered on a unit length of weld instead of stresses, thus eliminating the knotty problem of combining stresses.

4. It is true that the stress distribution within a fillet weld is complex, due to eccentricity of the applied force, shape of the fillet, notch effect of the root, etc.; however, these same conditions exist in the actual fillet welds tested and have been recorded as a unit force per unit length of weld.

8. DETERMINING FORCE ON WELD

Visualize the welded connection as a single line, having the same outline as the connection, but no cross-sectional area. Notice, Figure 14, that the area (A_w) of the welded connection now becomes just the length of the weld.

Instead of trying to determine the stress on the weld (this cannot be done unless the weld size is known), the problem becomes a much simpler one of determining the force on the weld.

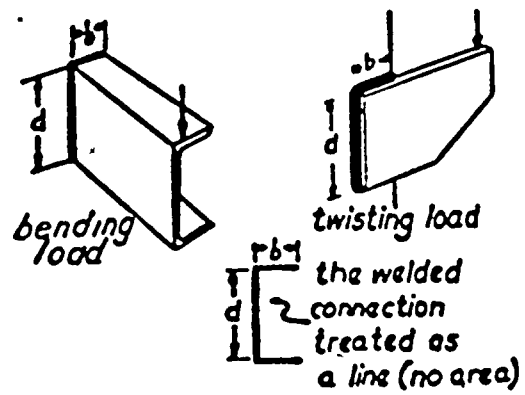


FIG. 14 Treating weld as a line.

By inserting the property of the welded connection treated as a line into the standard design formula used for that particular type of load (see Table 4), the force on the weld may be found in terms of lbs per linear inch of weld.

Example: Bending

Standard design formula (bending stress)	Same formula used for weld (treating weld as a line)
$\sigma = \frac{M}{S} = \frac{\text{lbs}}{\text{in.}^2}$ stress	$f = \frac{M}{S_w} = \frac{\text{lbs}}{\text{in.}}$ force

ATTACHMENT -2

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

DIABLO CANYON PROJECT
CALCULATION SHEET

SHEET NO 1 OF 14
CALC. NO.
REV. NO.

PROJECT DIABLO CANYON UNIT 2
SURVEY OF WELD AREAS RESISTING SHEAR

MADE BY [signature] DATE 12/5/84 CHECKED BY [signature] DATE 12/6/84 JOB NO. 15320

THE PURPOSE OF THIS SURVEY IS TO COMPARE AND EVALUATE WELD CALCULATIONS AS PREFORMED ON PROJECT, IN GAITHERSBURG. THE MAIN CONCERN IS THE USE OF THE TOTAL WELD LENGTH, AW, FOR RESISTING SHEAR FORCES. A MORE CONSERVATIVE APPROACH IS TO USE LENGTHS OF WELD; LA, LB, PARALLEL TO THE LINE OF SHEAR.

THE RESULTS OF THE SURVEY INDICATE THAT IN ALL SAMPLES, THE ACTUAL WELD STRESSES ARE LESS THAN THE ALLOWABLE STRESSES, FURTHER, THE MAJORITY OF THE SAMPLES HAD AN INCREASE IN ACTUAL STRESSES OF LESS THAN 5%

WHEN REVIEWING THE DATA, PLEASE NOTE THE FOLLOWING:

1.) UNLESS NOTED OTHERWISE, THE MAXIMUM OR ENVELOPE ACTUAL STRESS IS COMPARED TO THE LOADCASE I OR NORMAL ALLOWABLE STRESS.

2.) IN CASES WHERE CERTAIN LOADCASES ARE COMPARED WITH HIGHER LOADCASE ALLOWABLES THE REMAINING LOADCASES HAVE BEEN REVIEWED AND FOUND TO BE ACCEPTABLE.

3.) THE AMOUNT OF SUPPORTS REVIEWED REPRESENTS APPROXIMATELY 5% OF THE TOTAL NUMBER ASSIGNED TO GAITHERSBURG. EVERY TWENTIETH SUPPORT FROM THE PIPE SUPPORT STATUS LOG WAS SELECTED FOR REVIEW, UNLESS THAT SUPPORT WAS DELETED, ASSIGNED TO DCPD, OR IN THE PROCESS OF REVIEW FOR NEW LOADS OR AS-BUILT CONDITION. IN THESE CASES, THE NEXT SUPPORT AVAILABLE IN THE FILES WAS SELECTED FOR THIS SURVEY.

4.) ALL STRUCTURAL MEMBERS WERE REVIEWED FOR MEMBER SHEAR STRESSES AND FOUND TO BE ACCEPTABLE PER THE APPLICABLE CODES AND PROJECT SPECIFICATIONS.

5.) A TOTAL NUMBER OF 109 SUPPORTS ARE INCLUDED IN THE SURVEY. 31 SUPPORTS CONTAIN TUBE STEEL WITH WELDED CONNECTIONS.

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON NUCLEAR POWER PLANT UNIT 2 HANGER NO. _____

MADE BY: _____ DATE _____ CALC. SEQ. NO. _____ REV. _____

CHECKED BY: _____ DATE _____

SAMPLE

EVALUATION OF WELD

WELD LOCATION _____ STRUDL JOINT NO _____

LOADS ON WELD (REF SHT _____)

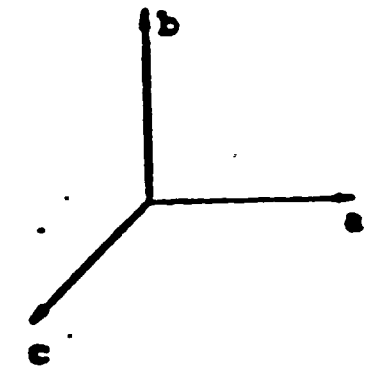
LOAD CASE _____

$F_{\_} = F_a =$ _____ lb $M_{\_} = M_a =$ _____ "lb

$F_{\_} = F_b =$ _____ lb $M_{\_} = M_b =$ _____ "lb

$F_{\_} = F_c =$ _____ lb $M_{\_} = M_c =$ _____ "lb

WELD PATTERN



MEMBER SIZE _____

WELD TYPE _____

WELD SECTION PROPERTIES (IN LOCAL COORD)

$\lambda_w =$ _____ in^2/in

$C_a =$ _____ in (dist along a axis)

$C_b =$ _____ in (dist along b axis)

$S_a =$ _____ in^3/in

$S_b =$ _____ in^3/in

$J_w =$ _____ in^4/in

$$f_1 = \frac{M_c \times C_b}{J_w} + \frac{F_a}{\lambda_w} = \_\_\_\_\_ \text{ lb/in}$$

$$f_2 = \frac{M_c \times C_a}{J_w} + \frac{F_b}{\lambda_w} = \_\_\_\_\_ \text{ lb/in}$$

$$f_3 = \frac{F_c}{\lambda_w} + \frac{M_a}{S_a} + \frac{M_b}{S_b} = \_\_\_\_\_ \text{ lb/in}$$

$$f_r = (f_1^2 + f_2^2 + f_3^2)^{\frac{1}{2}} = \_\_\_\_\_ \text{ lb/in}$$

WELD STRESS per ☐ AISC ALLOWABLES ☐ B31.1 ALLOWABLES

$$\text{WELD REQ'D} = \frac{f_r}{\text{EFFECT TH}} = \_\_\_\_\_ \quad \text{ALLOWABLE} \_\_\_\_\_$$

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON NUCLEAR POWER PLANT UNIT 2 HANGER NO. _____

MADE BY: _____ DATE _____ CALC. SEQ. NO. _____ REV. _____

CHECKED BY: _____ DATE _____

SAMPLE

EVALUATION OF WELD

WELD LOCATION _____ STRUDL JOINT NO _____

LOADS ON WELD (REF SHT ___)

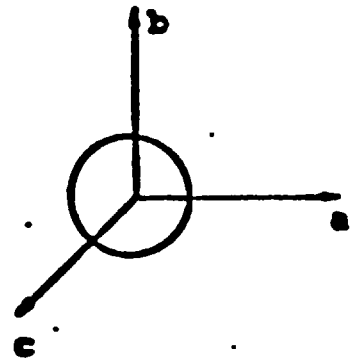
LOAD CASE _____

$F_{\_} = F_a =$ _____ lb $M_{\_} = M_a =$ _____ "lb

$F_{\_} = F_b =$ _____ lb $M_{\_} = M_b =$ _____ "lb

$F_{\_} = F_c =$ _____ lb $M_{\_} = M_c =$ _____ "lb

WELD PATTERN



MEMBER SIZE _____

WELD TYPE _____

WELD SECTION PROPERTIES (IN LOCAL COORD)

$A_w =$ _____ in^2/in

$R =$ _____ in (RADIUS)

$S_w =$ _____ in^3/in

$J_w =$ _____ in^4/in

$$f_a = \frac{(Fa^2 + Fb^2)^{\frac{1}{2}}}{A_w} + \frac{Mc \times R}{J_w} = \_\_\_\_\_ \text{ lb/in}$$

$$f_t = \frac{Fc}{A_w} + \frac{(Ma^2 + Mb^2)^{\frac{1}{2}}}{S_w} = \_\_\_\_\_ \text{ lb/in}$$

$$f_r = (f_a^2 + f_t^2)^{\frac{1}{2}} = \_\_\_\_\_ \text{ lb/in}$$

WELD STRESS per ☐ AISC ALLOWABLES ☐ B31.1 ALLOWABLES

$$\text{WELD REQ'D} = \frac{f_r}{\text{EFFECT TH}} = \_\_\_\_\_ \quad \text{ALLOWABLE} \_\_\_\_\_$$

CALCULATION SHEET

BECHTEL

CALC NO ________ REV NO ________

ORIGINATOR ________ DATE ________ CHECKED ________ DATE ________

PROJECT ________ JOB NO ________

SUBJECT STANDARD WELD CALCULATION SHEET SHEET NO. 5 of 14

SAMPLE

REF: HANGER ENGINEERING STANDARD, HES-005

$$fa = \left(\frac{Pa}{La}\right) + \left(\frac{McCb}{PMI}\right)$$

$$fb = \left(\frac{Pb}{Lb}\right) + \left(\frac{McCa}{PMI}\right)$$

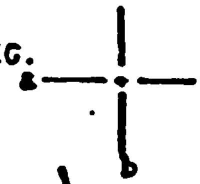
$$fc = \left(\frac{Pc}{Lc}\right) + \left(\frac{Ma}{SMa}\right) + \left(\frac{Mb}{SMb}\right)$$

$$fr = \sqrt{(fa)^2 + (fb)^2 + (fc)^2}$$

$$SIZE = \frac{fr}{\text{ALLOWABLE STRESS}}$$

WELD I.D. ________ ALLOW. STR. ________ KSI

WELD CONFIG.



$fa = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________ $fb = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________

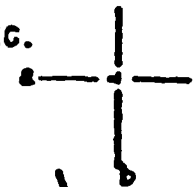
$fc = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________

fr = ________

SIZE = ________

WELD I.D. ________ ALLOW. STR. ________ KSI

WELD CONFIG.



$fa = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________ $fb = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________

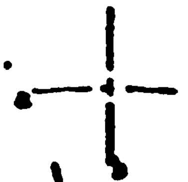
$fc = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________

fr = ________

SIZE = ________

WELD I.D. ________ ALLOW. STR. ________ KSI

WELD CONFIG.



$fa = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________ $fb = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________

$fc = \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) + \left(\frac{\quad}{\quad}\right) =$ ________

fr = ________

SIZE = ________

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS MTD. STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-002-01	35N/42A	✓	✓ 99%	8803 II	8003	9500 I	
G-002-03	413/526V	✓	✓	2987	2987	9450	PULLOUT ONLY
G-002-05	50/26V	✓	✓	1107	1107	8770	
G-002-07	413/105L	✓	✓	4017	4017	19900	
G-002-07	50/32R		✓	3347	3187	19900	
G-003-02	413/213SL		✓	3089	3425	19900	
G-003-02	413/77SL		✓	12341	12487	19900	
G-003-02	48/18V	✓	✓	278	278	9450	PULLOUT ONLY
G-003-02	48/44V	✓	✓	10440	10440	19900	
G-003-03	22/3V	✓	✓	1700	1700	9450	PULLOUT ONLY
G-003-04	22/10V	✓	✓	1019	1019	9450	PULLOUT ONLY
G-003-05	24/40R	✓	✓	26425 III	26425	26467 III	
G-003-06	1547-42		✓	2772.	2999	19900	
G-003-06	78/118SL		✓	4527	4544	18000	

SUBJECT DIABLO CANYON UNIT 2 — SURVEY OF WELD AREAS RESISTING SHEAR

MADE BY [signature] DATE 12-6-84 CHECKED BY [signature] DATE 12-6-84 JOB NO. 15320

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

DIABLO CANYON PROJECT
CALCULATION SHEET

SHEET NO. 6 OF 14
CALC. NO.
REV. NO.

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

DIABLO CANYON PROJECT
CALCULATION SHEET

SHEET NO. 7 OF 14
CALC. NO.
REV. NO.

SUBJECT DIABLO CANYON UNIT 2
SURVEY OF WELD AREAS RESISTING SHEAR

MADE BY [signature] DATE 12-6-84 CHECKED BY [signature] DATE 12/6/84 JOB NO. 16320

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS MTD. STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-003-08	22/17V	✓	✓	1358	1358	9450	PULLOUT ONLY
G-003-09	413/715L		✓	3293	3612	9450	
G-004-02	413/59R	✓	✓	1867	1867	9450	PULLOUT ONLY
G-004-06	413/173R	✓		—	—	—	STRUDL
G-005-01	948/4R	✓		—	—	—	STRUDL
G-005-03	948/95R		✓	19363	19363	19570	LUG 0.6 0.125
G-005-04	413/53R	✓	✓	3949	3949	19900	
G-005-04	48/40R	✓	✓	11160	11160	14100	
G-006-01	23/29R	✓	✓	6429	6429	19900	
G-006-01	77/156L	✓	✓	3882	3882	8200	PULLOUT ONLY

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS MTD. STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-007-01	23/39R		✓	17148	17232	19900	
G-007-01	46/14R		✓	5743	6520	19900	
G-007-01	923-52		✓	274	377	19900	
G-007-04	949-297	✓	✓	1943	1943	19900	
G-008-01	24/47R	—	—	—	—	—	CALC.5 3.5K/IN ALLOW & Qf's BY JUDGMENT LOADS <1K
G-008-02	47/91A	✓	✓ PIPE	4400 I 5530 II 9420 III	4400 5530 9420	7350 II 8770 II 13230 II	
G-008-02	47/136R	✓	✓	2561	2561	19900	
G-008-04	413/74R		✓	15846	16436	19900	
G-009-01	949/193A		✓	18506 MAX	18706	19570 III	(PIPE W STIFFNERS)
G-009-04	413/533SL	✓	✓	3922	3922	9450	WELD ON 2 SIDES REAR BRACKET.
G-009-05	512/41V	✓	✓	610	610	9450	PULLOUT ONLY
G-011-01	947/8R		✓	1124	1128	19900	
G-011-01	947-3		✓	1641	1646	19900	
G-012-02	948/80R		✓	5805	5816	19900	

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

DIABLO CANYON PROJECT
CALCULATION SHEET

SHEET NO. 8 OF 14
CALC. NO.
REV. NO.

SUBJECT DIABLO CANYON UNIT 2
SURVEY OF WELD AREAS RESISTING SHEAR

MADE BY [signature] DATE 12-4-84
CHECKED BY [signature] DATE 12/6/84
JOB NO. 16320

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

DIABLO CANYON PROJECT
CALCULATION SHEET

SHEET NO. 9 OF 14
CALC. NO.
REV. NO.

SUBJECT DIABLO CANYON UNIT 2
SURVEY OF WELD AREAS RESISTING SHEAR

MADE BY [illegible] DATE 12-4-84 CHECKED BY [illegible] DATE 12/6/84 JOB NO. 15320

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS MTD. STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-012-03	949/3R	✓	✓	6192	6192	19900	8330 × 1.75 = 6192
G-012-04	949-539	✓	✓ PIPE	6408	6408	7350	
G-012-05	413/104R		✓	9716 MAX	9840	13970 III	
G-012-05	949/207R	✓	✓	3821 I	3821	19900 I	
G-013-01	404/25R		✓	20230 MAX	20280	26500 III	
G-014-01	413/360SL		✓	10836	10868	19900	
G-014-01	50/90R	✓	✓	5400	5400	19900	
G-014-01	50/122R	✓	✓	4340	4340	9450	WELD ON 2 SIDES
G-014-01	50/123R	✓	✓	6002	6002	9450	WELD ON 2 SIDES
G-016-01	413/367SL		✓	5382	6000	9450	
G-016-02	413/313R	✓		—	—	—	
G-016-02	413/334R	✓	✓	1075	1075	9450	WELD ON 2 SIDES
G-016-02	413/427R		✓	13736	13867	19900	TUBE ASSUME 4" WELD NOT FLAT, OK NOW DESIGN
G-017-02	404/42R	✓	✓	3200	3200	19900	WELD ON 1 SIDES ONLY

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS MTD. STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-018-01	948/81R		✓	1631	1638	19900	
G-018-02	948/54R		✓	7508	7576	9450	
G-018-05	512/30R		✓	17878	19241	19900	
G-018-05	949-411	—	—	—	—	—	5/16 √ 2¾ 114 lbs PULLOUT
G-019-01	49/182R		✓	19604	19692	19900	
G-019-02	49/189R	✓	✓	5794	5794	19900	WELD ON 2 SIDES TUBE
G-019-02	1550-62	✓	✓	576	576	8770	
G-019-04	413/114V	✓	✓	1086 I	1086	9450 I	PULLOUT ONLY
G-019-07	413/32R	✓	✓	9035	9035	19900	WELD ON 2 SIDES TUBE
G-019-07	413/35R	✓	✓	4315	4315	19900	WELD PATTERN IS PRINCIPAL AXIS ANGLE 3x3

SUBJECT DIABLO CANYON UNIT 2 — SURVEY OF WELD AREAS RESISTING SHEAR

MADE BY [illegible] DATE 12-4-84 CHECKED BY [illegible] DATE 12/4/84 JOB NO. 15320

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

DIABLO CANYON PROJECT
CALCULATION SHEET

SHEET NO 10 OF 14
CALC. NO.
REV. NO.

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS MTD. STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-020-01	413/17R		✓	3847	3958	19900	
G-021-04	1548-68	✓	✓	3061	3061	19900	WELD ON 2 SIDES
G-021-07	1548-55	—	—				Fx=631bs, Fz=631bs 1/4 V 7/4
G-023-02	50/49R	✓		—	—	—	HES-005.
G-023-02	413/62A	✓	✓ PIPE	2661	2661	11190	PULLOUT ONLY
G-023-06	76/75L	✓		—	—	—	HES-005
G-024-03	413/1425L	✓	✓	14750	14750	19900	WELD ON 2 SIDES
G-024-04	413/575R		✓	6800 H	7599	9450 H	
G-025-04	35N/68V	✓	✓	3053	3053	9450	PULLOUT ONLY
G-025-07	47/79V	✓	✓	6637	6637	9450	PULLOUT ONLY
G-025-07	74/145L		✓	2890	2901	9450	
G-025-07	404/11R	✓	✓	701	701	8770	PULLOUT ONLY
G-026-01	23/18R	✓		—	—	—	STRUDL
G-026-01.	47/5V	✓	✓	2966	2966	9450	PULLOUT ONLY

SUBJECT DIABLO CANYON UNIT 2
SURVEY OF WELD AREAS RESISTING SHEAR

MADE BY _____ DATE 12-6-84 CHECKED BY _____ DATE _____ JOB NO. 18320

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION
DIABLO CANYON PROJECT -
CALCULATION SHEET

SHEET NO. 11 OF 1
CALC. NO. _____
REV. NO. _____

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

PROJECT DIABLO CANYON UNIT 2
SURVEY OF WELD AREAS RESISTING SHEAR

DIABLO CANYON PROJECT
CALCULATION SHEET

SHEET NO. 12 OF 14
CALC. NO.
REV. NO.

MADE BY [signature] DATE 12-5-84 CHECKED BY [signature] DATE 12/6/84 JOB NO. 16320

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS MTD. STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-026-01	413/109R		✓	8853 MAX	16288	23070 III	
G-026-02	23/9R		✓	6110	6734	9450	
G-026-03	47/60R	✓	✓	4028	4028	19900	
G-026-03	404/4R		✓	6319 MAX	6390	10400 II	
G-026-05	413/105V	✓	✓	3508	3508	9450	PULLOUT ONLY
G-028-02	413/312R	✓	✓	8663	8663	9450	PULLOUT ONLY
G-029-01	413/550R		✓	2558	2597	8770	
G-029-02	2023/11R		✓	12424	12795	18000	OK
G-029-02	2032/65L	✓	✓	9780	9780	11340	PULLOUT ONLY
G-029-04	413/462V	✓	✓	9362	9362	19900	F_a, F_b VERY SMALL
G-030-01	413/553R		✓	2739	2810	8770	
G-030-02	413/285R	✓	✓ OK	2058	2058	8770	
G-030-02	2033/255L		✓	18280 MAX	18545	19900 III	
G-031-02	2033/256L		✓	17954 MAX	18100	19900 III	

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS MTD. STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-031-03	1550-156	✓					STRUDL
G-032-05	413/263R	✓					STRUDL
G-032-05	413/383R		✓	7443	7481	9450	
G-032-05	2040/1V	✓	✓	7536	7536	9450	PULLOUT ONLY
G-032-05	2045/1V	✓	✓	7409	7409	9450	PULLOUT ONLY
G-032-02	2048/255L	✓	✓	2032 MAX	2032	19900 II	
G-071-01	949/209R	✓	✓	2654	2654	19900	WELD ON 2 SIDES
G-081-01	413/217R	✓	✓	2017	2017	9450	PULLOUT ONLY
G-081-01	1548-16		✓	4016	4258	9500	
G-086-05	413/494R	✓	✓	19204	19204	19900	
G-086-07	413/506R	—	—	—	—	—	F_y = 1511 lbs, Flat = 5/16 V 2
G-105-01	1547-157		✓	5644	5891	6360	OK
G-107-01	413/359R	✓	✓	6115	6115	9450	PULLOUT ONLY
G-107-01	2004/2CS	✓	✓	2262	2262	21600	PULLOUT ONLY

PACIFIC GAS AND ELECTRIC COMPANY
BECHTEL POWER CORPORATION

DIABLO CANYON PROJECT
CALCULATION SHEET

SHEET NO. 14 OF 14
CALC. NO.
REV. NO.

SUBJECT DIABLO CANYON UNIT 2
SURVEY OF WELD AREAS RESISTING SHEAR

MADE BY [illegible] DATE 12-5-84 CHECKED BY KP DATE 12/6/84 JOB NO. 15320

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS STRUDL HES-5B	ANALYSIS MTD. P-6	CRITICAL WELD STR. CALCULATED WITH AW ONLY	CRITICAL WELD STR. CALCULATED WITH LA,LB,LC	ALLOWABLE STRESS(PSI)	COMMENTS
G-107-01	2007/225	✓	✓	6382	6382	9450	RUNOUT ONLY
G-107-02	413/45V	✓	✓	3969	3969	9450	
G-108-01	2015/3V	✓	✓	6773	6773	9450	RUNOUT ONLY
G-108-01	2018/3V	✓	✓	8724	8724	9450	RUNOUT ONLY
G-128-01	413/44RV	✓	✓ PPE	300	300	9500	

ENCLOSURE 2

ENCLOSURE 2

Bechtel Power Corporation

Interoffice Memorandum

To W. N. Adams

Date January 2, 1985

Subject Design Deficiency/Mismanagement
Diablo Canyon Project

From K. Y. Lee
Of Engineering

At Gaithersburg

Copies W. Wang
T. McDonald

File

The attached memo from a concerned engineer to me, dated November 15, 1984, raised two issues; one technical and one personal. The purpose of this memo is to inform you of the action taken to resolve these issues.

The technical issue addresses the method used by Diablo Canyon project (DCP) in calculating the shearing stresses in welds. The method was jointly reviewed by the Gaithersburg and San Francisco offices and found to be an acceptable approach. The method was based on Blodgett's "Design of Welded Structures" which is commonly used by the industry.

A comparison was also made between the DCP method and a more conservative method as recommended in the EPD Hanger Engineering Standard, HES-005A and B. A total of 109 supports, which represents 5% of supports assigned to EPD, were chosen. In all cases the calculated weld stresses using the more conservative method are within the code allowables. Furthermore, a majority of the samples have an increase in calculated stresses of less than 5% by using the more conservative method.

Results of the above study were presented to the entire DCP group on December 19, 1984. In that meeting, Tom McDonald and I stressed that it is company policy to encourage employees to bring opinions, criticisms and problems into the open. There was no additional concern raised.

Regarding the personal criticisms on Syed Bokhari, we have no way to dispute or verify the accusations since the source is unknown to us. As a supervisor, Syed has been successful in meeting project schedule and budget. Throughout his eleven years with Bechtel, his performance has been rated "Exceeds Job Requirement". He often coordinated with me and the staff following his lunch hour, which might account for the reason why he was often late after lunch. His performance will solely be judged by his performance reviews.

K. Y. Lee
K. Y. Lee

KYL:aes

Attachment

BECHTEL POWER CORP.
RECEIVED
JAN 7 1985
JOB NO. 15320-003

GPD-99100-B 4/84

ENCLOSURE 3

ENCLOSURE 3

STRESS ANALYSIS	SUPPORT NUMBER	ANALYSIS METHOD P-6	CRITICAL WELD STRESS CALCULATED WITH AW ONLY (Method 1)	CRITICAL WELD STRESS CALCULATED WITH L_A, L_B, L_C (Method 2)	ALLOWABLE STRESS (PSI)	COMMENTS
G-003-02	413/561R	X	5,504*	6,227*	6,780	*Conservative since min. t_e is used; i.e., along sides of process pipe
G-016-01	413/365SL	X	2,045	2,120	19,900	
G-016-02	413/321R	X	15,263	15,610	19,900	
G-018-05	512/30R	X	17,878	19,236	19,900	In another weld, the stress changed from 2,587 (AW) to 4,519 (L_A, L_B, L_C)
G-025-07	75/2SL	X	4,927	5,721	19,900	
G-025-07	404/35R	X	617	872	19,900	
G-026-01	413/584R	X	10,823	11,562	21,500 LC III 11,340 LC II	Load Case I and II are OK by comparison of loads and allowables
G-032-07	413/620R	X	23,440 Max 19,221 II	23,812 Max 19,526 II	26,500 II & IV 19,900 I & II	

Notes:

AW: Total length

L_A: Effective length of weld carrying shear in "a" direction

L_B: Effective Length of weld carrying shear in "b" direction

L_C: Effective Length of weld carrying shear in "c" direction

I, II, III, and IV: Load cases as defined in DCM M-9 for normal, upset, emergency, and faulted contition, respectively.

0088S/0026K