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TEXAS UTILITIES GENERATING COMPANY
P. O. BOX 1002 · GLEN ROSE, TEXAS 76043

September 20, 1979
TXX-3048

Mr. K.V. Seyfrit, Director
U.S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 1000
Arlington, Texas 76011

COMANCHE PEAK STEAM ELECTRIC STATION
1981-83 2300 MW INSTALLATION
OMISSION OF SHEAR TIE REINFORCING STEEL
UNIT NO. 2 - REACTOR CONTAINMENT BUILDING
FILE NO. 10110

Dear Mr. Seyfrit:

This letter supplements our report concerning the inadvertent omission of shear tie reinforcing steel from the 32nd lift of the Comanche Peak, Unit No. 2 Reactor Containment Building (RCB) exterior wall just below the springline.

This supplemental report incorporates the expanded engineering analysis referenced in paragraph three of the "Detailed Engineering Analysis (Safety Implications)" on page two of our September 17, 1979 TXX-3044.

The attached Gibbs and Hill, Inc. letter GTN-40006 and calculation sheets and sketches supersedes the calculation package submitted previously under GTN-39821.

If you have any further questions, please advise.

Very truly yours,

R. J. Gary

RJG:pew
cc: L. F. Fikar

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A 7912030 040

Gibbs & Hill, Inc.
ENGINEERS DESIGNERS CONSTRUCTORS

DIRECT DIAL EXTENSION
(212) 760- 4450

September 19, 1979

GTN-40006

Texas Utilities Generating Company
Post Office Box 1002
Glen Rose, Texas 76043

Attention: Mr. J. T. Merritt
Manager of Construction and Engineering

Gentlemen:

TEXAS UTILITIES GENERATING COMPANY
COMANCHE PEAK STEAM ELECTRIC STATION
1981-83 - 2300 MW INSTALLATION
G&H PROJECT NO. 2323
UNIT 2 CONTAINMENT WALL REINFORCEMENT
REF: GTN-39821

Subsequent to the NRC meeting of September 14, 1979, CPSES Engineering (New York) has prepared additional calculations to support the conclusions reached in the referenced letter. These calculations are attached for your information.

In addition, we are providing copies of reference documents consisting of correspondence among CPSES Site, TUSI and G&H.

If we can be of further assistance please advise.

Very truly yours,

GIBBS & HILL, Inc.

R.E. Ballard

Harvey R. Rock
Manager of Projects

HRR-REBa:lc
1 Letter + Attachment
CC: ARMS (B&R Site) OL + 1A
H. C. Schmidt (TUSI Dallas) 2L 2A
R. Heim (G&H Site) 1L
B. George (TUSI Site) 1L 1A

1466 092

REV. 2

Date SEPT....1979..

Calc By P. K. Bangia

Chk'd/Apprd. By C.Z. 9/11/79

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2 SC 9/13/79 CZ 9/13/79

3/1 4/1

Filing Code SRB-122C.

Sheet No. 1 ... Of 18..

G & H Job No. 2323-001.

UNIT-2

Subject TUSI : CONTAINMENT WALL [redacted]

Checkers Comments Accepted By ..... Safety Related: YES ☑ NO ☐

Materials: CONC. : f'_c = 4 Ksi ..... REBAR : f_y = 60 Ksi

Ref. Codes: ASME - ACI 359

Ref. FSAR: SEC. 3.8

Other Ref.: FIELD DCA # 5536 REV. 1 DATED SEPT. 10, 1979 (COPY ENCLOSED).

Assumptions: FIELD TWX - 11384 DATED AUG. 28, 1979 (COPY ENCLOSED)

RESULTS

OBJECT:

3 Rows of Addl. # 6 shear bars as shown in drg. # 2323-52-0505 REV. 5 bet. EL. 993'-1½" and 996'-9½" were omitted in the field.

This became known after concrete was poured upto EL. 997'-6" (Refer TWX-11384). Add'l. # 6 shear bars at closer spacings were added above EL. 997'-6". This is shown in detail on enclosed Field DCA # 5.536 REV. 1 dated Sept. 10, 1979.

The object is to determine if this as-built condition without additional shear ties between EL. 993'-1½" and 996'-9½" is acceptable.

CONCLUSION:

As-built condition is acceptable without additional shear ties between EL. 993'-1½" and EL. 996'-9½". See detail calculations on pages ~~3/2 to 3/16~~ 4/2 to 4/23

REV. 2
PKB 9-17-79 C.Z. 9/18/79

REV. 2

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4/2 (2) SC 9/13/79 C.Z 9/13/79

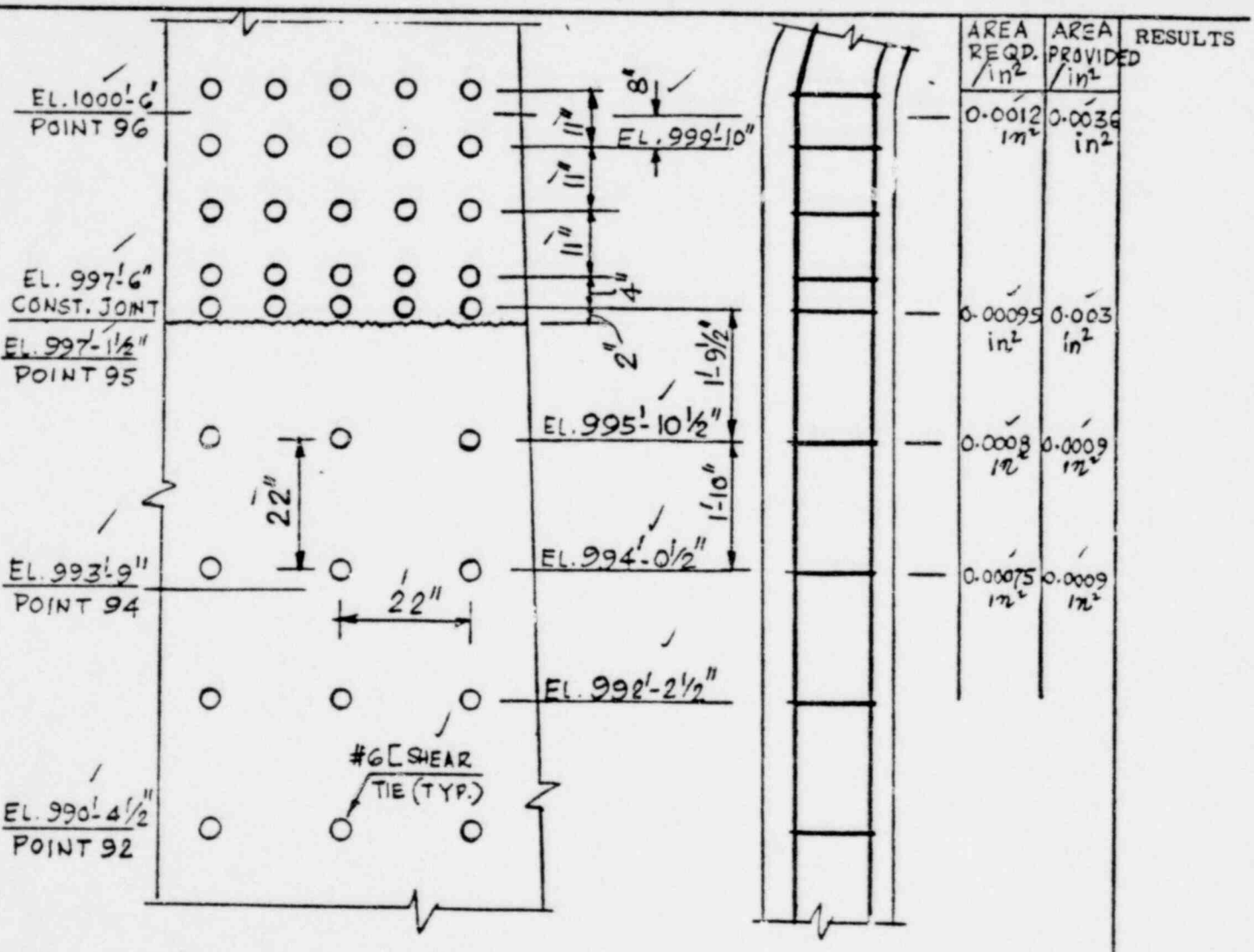
Date ..SEPT...1979.
Calc By ..PKB.....
Chk'd/Apprd. By C.Z...9/11/79
Filing Code ..SRB-122C.
Sheet No. ..2.... Of .....
G & H Job No. 2323-001

Subject .TUSI:..CON.T...WALL.-.UNIT.2.....

Checkers Comments Accepted By ..... (2) ..... Safety Related: YES ☑ NO ☐

Materials: .....
Ref. Codes: SEE PAGE 3/# 4/1 PKB 9-17-79 C.Z 9/17/79
Ref. FSAR: .....
Other Ref.: .....

Assumptions: ...SEE...BELOW.....



PART ELEVATION OF WALL SHOWING AS-BUILT SHEAR REINFORCEMENT

WALL SECTION

(REFER DCA # 5536 REV. 1 ~~DCA # 5536~~ & TWX - 11384

(2)

PKB 9-17-79 C.Z 9/17/79

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Calc By P.K.B. — Sheet No. 4 of .....

Chk'd/Apprd. By C.Z. 9/11/79 — G & H Job No. 2323-001

Subject T.U.S.I. CONT. WALL UNIT 2 — SC 9/13/79

Checkers Comments Accepted By ✓ — Safety Related: YES ☑ NO ☐

Materials: .....

Ref. Codes: SEE PAGE 4/1 PKB 9-17-79 C.Z 9/17/79

Ref. FSAR: .....

Other Ref.: .....

Assumptions: SEE BELOW

RESULTS

Maximum radial shear acts during accident pressure and temperature condition. In this case, the magnitudes of axial tensions $N\phi$ and $N\theta$ associated moments $M\phi$ and $M\theta$ are such that concrete will crack in both vertical and horizontal directions in all Models (Model 1, Model 2 and Model 3).

Therefore, for design purposes, it will be inappropiate to consider maximum values of radial shear for Models 1 and 2. As such, Containment wall section between EL. 993'-1½" and 996'-9½" will be checked for maximum values of radial shear occuring in Model 3 only. This will be further confirmed in the following pages by performing calculations to ascertain the validity of Completly cracked section in both vertical and horizontal directions.

It is to be noted that below the spring line EL. 1000'-6", radial shear forces 'Q' occur in the containment wall as a result of design loadings, due to discontinuity between the wall and the dome.

REV. 2 PKB 9-17-79 C.Z 9/17/79

~~REV.1~~ REV.2

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Calc By T.K.B. Sheet No. 3 ... Of .....

Chkd/Apprd. By C.Z. 9/11/79 4/3 2 SC 9/13/79 G & H Job No. 2323-001.

Subject T.U.S.I. CONTAINMENT WALL UNIT-2 (C2 9/12/79

Checkers Comments Accepted By ..... Safety Related: YES ☑ NO ☐

Materials: .....

Ref. Codes: SEE PAGE ~~3/F~~ 4/1 3 2 PKB 9-12-79 C.Z. 9/12/79

Ref. FSAR: .....

Other Ref.: .....

Assumptions: SEE BELOW

RESULTS

Three different models are investigated in the analysis of the containment shell. Each model assumes a different degree of concrete cracking. Model 1 assumes a completely uncracked Section. Model 2 assumes only vertical cracks ~~throughout structure, so that~~ the stiffness in the direction perpendicular to cracks ~~cracked direction~~ is represented by the properties of rebar only, neglecting stiffness of concrete. Model 3 assumes both vertical and horizontal cracks throughout structure; the stiffness of concrete is ignored in both directions, with only properties of rebar considered. ✓

REV. 1 PKB 9-12-79 9/12/79 OUT REV. 1 PKB 9-12-79 C.Z 9/12/79

In the original design, the requirement for worst condition occuring in any model was conservatively considered for disign of shear reinforcement. However, the requirements for Models 1 and 2 are not relevant for disign of shear reinforcement at the location in question. This is explained in the following page. ✓

REV. 2

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Calc By PKB | Sheet No. 5 Of

Chk'd/Apprd. By C.Z. 9/11/79 | G & H Job No. 2323-001

Subject TUSI: CONT. WALL UNIT-2

Checkers Comments Accepted By ✓ Safety Related: YES ☑ NO ☐

Materials:

Ref. Codes: SEE PAGE -3- PKB 9-17-79 C.Z 9/17/79

Ref. FSAR:

Other Ref.:

Assumptions: SEE BELOW

RESULTS

RADIAL SHEAR Q

The following tables # 1A, 1B & 1C show max^{m} values of radial shear acting on the cont. between EL. 990'-4½" and 1000'-6". The max^{m} radial shear Q along with associated axial tensions and moments in meridional and circumferential directions (N_ϕ, M_ϕ, N_θ and M_θ) are obtained from Computer output Book # SRB-97P and SRB-99P ✓

Furthermore, the tables # 2A, 2B & 2C show the corresponding maximum values of radial shear occuring during Condition when the containment is subjected to safe-shutdown earthquake but with no accident pressure and accident temperature ~~accident pressure and temperature inside containment~~. Shear reinf. requirements in Models 1 & 2 under this condition is less than that which is required for Model 3 under accident pressure and temperature condition as is evident in the following Tables.

PKB 9/17/79 C.Z. 9/17/79

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REV. 2

Date SEPT. 1979

Calc By PKB

Chk'd/Apprd. By C.Z. 9/11/79

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NEW YORK

3 4/6 2 SC 9/13/79 C.Z 9/12/79

Filing Code SRB-122C

Sheet No. 6 Of

G & H Job No 2323-001

Subject T.U.S.I. CONT. WALL - UNIT 2

Checkers Comments Accepted By ..... Safety Related: YES ☑ NO ☐

Material: ..... 2 PKB 9-17-79 C.Z 9/17/79

Ref. Codes: ..... SEE PAGE 3# 4/1

Ref. FSAR: .....

Other Ref.: .....

Assumptions: SEE BELOW

MAXM. RADIAL SHEAR WITH ACC. PRESS. & TEMP. (Q)

RESULTS

LOADING COMBINATION: CL 410 : U = D + Ts, + 1.5 Pa + Ta
CL 430 : U = D + Tw + 1.5 Pa + Ta

F.S.A.R. / SEC. 3.8.1-32.2a

TABLE 1A

NOTE: FOR LEGEND OF TERMS, SEE PAGE 4/23

REV. 2 PKB 9-17-79 C.Z 9/18/79

MODEL - 1

MERIDIAN	POINT	Q (K/in)	Nφ (K/in)	Mφ (K-in/in)	Nθ (K/in)	Mθ (K-in/in)	LOADING COMB.
8	92	-1.7	44.4	270	67.6	348	CL 430
8	94	-2.29	44.5	190	66.6	334	CL 430
8	95	-2.9	44.7	86	66.9	316	CL 430
8	96	-3.45	44.8	-42	69.4	294	CL 430

TABLE 1B

MODEL - 2

MERIDIAN	POINT	Q	Nφ	Mφ	Nθ	Mθ	LOADING COMB
8	92	-2.09	36.9	190	57.0	63	CL 430
8	94	-2.56	36.7	97	56.8	63	CL 430
8	95	-3.02	36.4	-15	57.0	63	CL 430
8	96	-3.47	36.2	-146	57.8	63	CL 430

TABLE 1C

REFER PAGE 4/22 FOR LOCATION OF MERIDIANS 6 AND 8

REV. 2 PKB 9-17-79 C.Z 9/12/79

MODEL - 3

MERIDIAN	POINT	Q	Nφ	Mφ	Nθ	Mθ	LOADING COMB.	
8	92	-1.04	32.6	110	55.0	124	CL 430	EL. 990'-4½"
6	94	-1.5	36.7	-109	57.6	-51	CL 410	EL. 993'-9"
6	95	-2.05	36.3	-181	56.6	-51	CL 410	EL. 997'-1½"
6	96	-2.61	35.9	-275	56.8	-51	CL 410	EL. 1000'-6"
8	94	1.49	32.4	60	53.3	124	CL 430	EL. 993'-9"

REV. 2

Date . SEPT. . 1979 . .

Calc By . . . PKB . . . . . .

Chk'd/Apprd. By C.2. 9/11/79

Subject . TUSI : CONT. WALL : UNIT 2 . . . . . .

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3 4/7 2

SC 9/13/79
9/12/79

Filing Code SRB-122.C.

Sheet No. . 7 . . Of . . . . . .

G & H Job No. 2323-001

Checkers Comments Accepted By . . . . . Safety Related: YES ☑ NO ☐

Materials: . .

Ref. Codes: . SEE PAGE ~~3/5~~ 4/1

Ref. FSAR: . .

Other Ref.: . .

Assumptions: . . SEE BELOW . . .

REV. 2
PKB 9-17-79 C.2 9/11/79

'Q' DURING SAFE SHUTDOWN EARTHQUAKE AND WITHOUT ACCIDENT PRESSURE & ACC. TEMP.

MAXM. RADIAL SHEAR ~~WITHOUT ACC. PRESS & TEMP.~~ (Q)

RESULTS

LOADING COMB. CL 713 : $U = D + T_{S_1} + (E_c - E_V)$

CL 731 : $U = D + T_W + (E'_t + E'_V)$

REFER F.S.A.R. SEC. 3.8.1.3.2.2.b2

TABLE 2A

MODEL - 1							
MERIDIAN	POINT	Q (K/in)	Nφ (K/in)	Mφ (Kin/in)	Nθ (K/in)	Mθ (Kin/in)	LOADING COMB.
8	92	-0.53	+1.8	327	-5.3	355	CL 731
8	94	-0.68	+1.6	304	-5.4	351	CL 731
8	95	-0.83	1.5	276	-5.2	346	CL 731
5	96	-0.95	1.5	241	-4.5	339	CL 731

NOTE : FOR LEGEND OF TERMS, SEE PAGE 4/23

REV. 2
PKB 9-17-79 C.2 9/11/79

TABLE 2B

MODEL - 2							
MERIDIAN	POINT	Q	Nφ	Mφ	Nθ	Mθ	LOADING COMB
8	92	-0.63	1.8	217	-4.0	62	CL 731
8	94	-0.71	1.7	192	-3.9	62	CL 731
8	95	-0.78	1.5	163	-3.6	62	CL 731
8	96	-0.83	1.4	132	-3.0	61	CL 731

TABLE 2C

REFER PAGE 4/22 FOR LOCATION OF MERIDIANS 5 AND 8

REV. 2
PKB 9-17-79 C.2 9/11/79

MODEL - 3							
MERIDIAN	POINT	Q	Nφ	Mφ	Nθ	Mθ	LOADING COMB.
8	92	0.17	-7.0	-51	4.0	-51	CL 713
8	94	0.27	-6.5	-43	4.6	-51	CL 713
8	95	0.4	-6.0	-31	5.1	-51	CL 713
8	96	0.54	-5.6	-13	5.5	-51	CL 713

REV. 2

Date SEPT. 1979 — Gibbe & Hill Inc. — ENGINEERS, DESIGNERS, CONSTRUCTORS — NEW YORK — Filing Code SRB:122C.

Calc By PKB — Sheet No. 8 Of

Chk'd/Apprd. By C.Z. 9/13/79 — G & H Job No. 2323-001.

Subject TUSI: CONT. WALL - UNIT 2 — SC 9/13/79 — C.Z 9/13/79

Checkers Comments Accepted By (2) — Safety Related: YES ☑ NO ☐

Materials: / Ref. Codes: SEE PAGE 4/1 — PKB 9-17-79 C.Z 9/17/79 / Ref. FSAR: / Other Ref.:

Assumptions: SEE BELOW

RESULTS

I) RADIAL SHEAR: (FACTORED LOADING: ULTIMATE STRENGTH)

(A) POINT 96: (EL. 1000'-6")

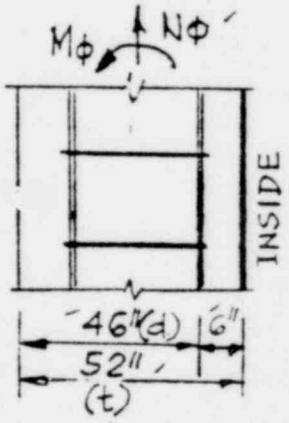
$Q = -2.61$ K/in
$N\phi = 35.9$ K/in
$M\phi = -275$ Kin/in
$N\theta = 56.8$ K/in
$M\theta = -51$ Kin/in

MODEL 3 CL410
SEE TABLE 1C on Page 4/6 (2) — PKB 9-17-79 C.Z 9/17/79

$Q = \pm 0.098$ K/in $\approx \pm 0.1$ K/in } ROT. PLAT. LOAD COMP. BOOK # SRB-116 P1 LOADING FL2, MOD. 3 MERI. 1, POINT 73

$\therefore \sum Q = -2.61 - 0.1 = (-)\ 2.71$ K/in

CHECK WHETHER ENTIRE SECTION IN TENSION:



$N\phi = 35.9$ and $M\phi = (-)275$

$\therefore$ Tension acting on Inside face

O/A Min.m depth of Section = 4'-3 5/8" + 3/8" (Liner)
= 4'-4" = 52"
(Refer Field Transmittal # CPPA 2793 dated 9-10-79)

$\therefore$ Eff. depth = $d = 52 - 6 = 46$ in

$\therefore d - t/2 = 46 - \frac{52}{2} = 46 - 26 = 20$ in.

$\therefore M_{US} = M_\phi - N_\phi (d - t/2) = -275 + 35.9 \times 20 = (+)\ 443$ Kin/in.

Since M_{US} becomes negative, entire section is in tension in vert. direction.

M_{US} = Moment acting if axial force $N\phi$ is assumed to act at centroid of tension reinf. (2) PKB 9-17-79 C.Z 9/17/79

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Calc By PKB | Sheet No. 9 Of

Chk'd/Apprd. By C.Z. 9/4/79 | G & H Job No. 2323-001

Subject T.U.S.I.: CONT. WALL - UNIT 2 SC 9/13/79 C.Z 9/13/79

Checkers Comments Accepted By ... Safety Related: YES ☑ NO ☐

Materials:

Ref. Codes: SEE PAGE 4/1 PKB 9-17-79 C.Z 9/17/79

Ref. FSAR:

Other Ref.:

Assumptions: SEE BELOW

RESULTS

Similarly, $N\theta = 56.8$ $M\theta = -51$

Tension is large compared to moment.

∴ Entire section in tension in horz. direction.

concrete has cracked in both directions.

∴ Model 3 applies.

CHECK ALLOWABLE CONCRETE SHEAR STRESS:

Allow. Conc. shear stress = v_c

$$v_c = 2\sqrt{f'_c}\left(1 + \frac{0.002\, N\phi}{A_g}\right)$$ ASME-ACI: 359 Sec. C.C. 3411.4.1.C

$$\therefore v_c = 2\sqrt{4000}\left[1 + 0.002\,\frac{(-)\,35900}{52\times 1'}\right]$$

$\therefore v_c = 2 \times 63.2\,(1 - 1.38)$ Result is negative

$\therefore v_c = 0$

Similarly, in the other direction, $N\theta = 56.8$

$\therefore v_c = 0$

∴ Concrete has cracked in both directions.

∴ Model 3 applies. PKB 9-17-79 C.Z 9/18/79

NOTE: For another approach to determine that the concrete has cracked, see page 4/19 2

REV. 2

Date SEPT. 1979

Calc By PKB

Chk'd/Apprd. By C.Z. 9/11/79

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Filing Code SRB-122C

Sheet No. 10 Of

G & H Job No. 2323-00

Subject T.U.S.I. CONT. WALL : UNIT 2 SC 9/13/79 C2 9/13/79

Checkers Comments Accepted By Safety Related: YES ☑ NO ☐

Materials:
Ref. Codes: SEE PAGE 4/1 PKB 9-17-79 C.Z 9/17/79
Ref. FSAR:
Other Ref.:

Assumptions: SEE BELOW

RESULTS

∴ Shear Stress $v_u = \frac{Q}{0.85\,bd} = \frac{2.71 \times 1000}{0.85 \times 1 \times 46} = 69.31$ psi

C.Z. 9/17/79

PKB 9-17-79 DCA # 5536 REV. 1 2

As per Field ~~DC/DDA # 5536,~~

#6 [Shear bars provided @ 11" V & H.

∴ $A_{v\,Reqd.} = \frac{v_u \times s \times h}{f_y} = \frac{69.31 \times 11 \times 11}{60000} = 0.14$ in^2

Area provided : 1 - #6 bar (Area = 0.44 in^2)

O.K.

ALTERNATE CALCULATION (SEE SKETCH ON PAGE ~~4/2~~ 4/1 2)

PKB 9-17-79 C.Z 9/17/79

$A_{v\,Reqd.} = \frac{69.31 \times 1 \times 1}{60000} = 0.0012$ in^2/inch in both direc.

$A_{v\,provided} = \frac{0.44}{11 \times 11} = 0.0036$

O.K.

1466 102

REV. 2

Date: SEPT. 1979
Calc. By: PKB
Chk'd/Apprd. By: C.2 9/11/79

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Book No. SRB-122C
Sheet No. 3/11 (4/11)
G & H Job No. 2323-05

Subject: TVSI: CONT WALL @ UNIT 2

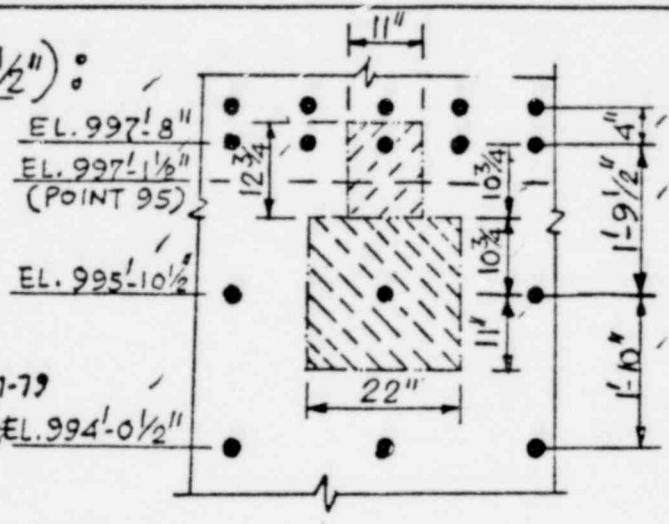
SC 4/13/79 C.2 9/12/79

Checkers Comments Accepted By: Nuclear Safety Related: YES ☑ NO ☐

Materials: SEE PAGE 3/4/1 PKB 9-17-79 C.2 9/17/79
Ref. Codes:
Ref. FSAR:
Other Ref.:
Assumptions: SEE BELOW

RESULTS

(B) POINT 95 (EL. 997'-1½"):



$Q = -2.05$, $N\phi = 36.3$, $M\phi = -181$, $N\theta = 56.6$, $M\theta = -51$ — MODEL 3, CL 410, TABLE 1C ON PAGE 4/6 PKB 9-17-79 C.2 9/17/79

$Q = \pm 0.1$ K/in ROT. PLAT. LOAD
COMP OUTPUT BOOK SRB-116 PI
LOADING PL 2, MOD. 3, MERI. 1, POINT 71

$\therefore \Sigma Q = -2.05 - 0.1 = -2.15$ K/in

O/A Minm depth of section = 4'-4" = 52"
(obtained by interpolation bet. approx. EL 992' and 999' from Field Transmittal # CPPA 2793 dated 9-10-79)

Total Radial Shear at EL. 997'-8" (obtained by interpolation bet. points 95 & 96)

$$Q = 2.15 + \frac{(2.71 - 2.15) \times 6.5}{40.5} = 2.24 \text{ K/in}$$

Total Radial Shear at EL. 995'-10½" (obtained by interpolation between points 95 & 94)

[Note: ΣQ at point 94 = -1.58 K/in (see Page 4/14) PKB 9-17-79 C.2 9/17/79]

$$Q = 1.58 + \frac{(2.15 - 1.58) \times 25.5}{40.5} = 1.95 \text{ K/in}$$

REV. 2

Date SEPT 1979
Calc. By PKB
Chk'd/Apprd. By c.2 9/11/79

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New York

Book No. SRB-122C
Sheet No. 3/12 4/12 PKB 9-17-79 c.2 9/17/79
G & H Job No. 2323-001

SC 9/13/79 c.2 9/11/79

Subject TUSI : CONT. WALL : UNIT 2

Checkers Comments Accepted By ..... Nuclear Safety Related: YES ☑ NO ☐

Materials
Ref. Codes SEE PAGE 4/11 PKB 9-17-79 c.2 9/17/79
Ref. FSAR
Other Ref.
Assumptions SEE BELOW

RESULTS

CHECK WHETHER ENTIRE AREA IN TENSION :

$N\phi = 36.3$, $M\phi = -181$ ∴ Tension on Inside face

$d = 52 - 6 = 46''$ $t = 52''$

Since Tension is large compared to moment, Entire Section in tension in Virt. direction

Similarly $N\theta = 56.6$, $M\theta = -51$

∴ Entire Section in tension in horz. dir.

∴ Concrete has cracked in both directions

∴ Model 3 applies.

CHECK ALLOWABLE CONCRETE SHEAR STRESSES :

$N\phi = 36.3$

Refer calculations done on page 4/9 PKB 9-17-79 c.2 9/17/79 ∴ $v_c = 0$

$N\theta = 56.6$ ∴ $v_c = 0$

∴ Concrete has cracked in both dir.

∴ Model 3 applies. PKB 9-17-79 c.2 9/17/79

Rad Shear Q at EL. 997'-8" (See Page 4/11) = 2.24 K/in

∴ Shear Stress $= v_u = \frac{2.24 \times 1000}{0.85 \times 1 \times 46} = 57.29$ psi

REV. 2

Date SEPT. 1979
Calc. By PKB
Chk'd/Appld. By C.2 9/11/79

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NEW YORK

Book No. SRB-122 C1
Sheet No. 3/13 4/13
G & H Job No. 2323-001

Project TUSI: CONT. WALL: UNIT 2

SC 9/13/79 C2 9/13/79

Checkers Comments Accepted By ..... Nuclear Safety Related: YES ☒ NO ☐

Materials
Ref. Codes — SEE PAGE 3/4 4/1
Ref. FSAR
Other Ref.
Assumptions — SEE BELOW

PKB 9-17-79 C.2 9/17/79

RESULTS

Refer Sketch on Page 4/11 (3/11) S = 11" and h = 12¾"

$$\therefore A_{v_{Reqd.}} = \frac{57.29 \times 11 \times 12.75}{60000} = 0.134 \text{ in}^2$$

Area provided = 1-#6 bar (0.44 in²) O.K.

PKB 9-17-79 C.2 9/17/79

ALTERNATE CALCULATION (SEE SKETCH ON PAGE 4/12 (3/12))

$$A_{v_{reqd.}} = \frac{57.29 \times 1 \times 1}{60000} = 0.00095 \text{ in}^2/\text{inch in both dir.}$$

$$A_{v_{provided}} = \frac{0.44}{11 \times 12.75} = 0.003$$

PKB 9-17-79 C.2 9/17/79

Radial Shear Q at EL. 995'-10½" (See Page 4/11) = 1.95 K/in

$$\therefore v_u = \frac{1.95 \times 1000}{0.85 \times 1 \times 46} = 49.87 \text{ psi}$$

PKB 9-17-79 C.2 9/17/79

Refer Sketch on Page 4/11 (3/11) S = 22" and h = 21.75

$$\therefore A_{v_{Reqd.}} = \frac{49.87 \times 22 \times 21.75}{60000} = 0.40 \text{ in}^2$$

Area provided: 1-#6 bar (0.44 in²) O.K.

PKB 9-17-79 C.2 9/17/79

ALTERNATE CALCULATION: (SEE SKETCH ON PAGE 4/12 (3/12))

$$A_{v_{Reqd.}} = \frac{49.87 \times 1 \times 1}{60000} = 0.0008 \text{ in}^2/\text{inch in both dir}$$

$$A_{v_{Provided}} = \frac{0.44}{22 \times 21.75} = 0.0009$$

Date SEPT. 1979
Calc. By PKB
Chk'd/Apprd. By C.Z 9/11/79

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NEW YORK

Book No. SRB-122G
Sheet No. 4/14
G & H Job No. 2323-001

Project TUSI: CONT. WALL : UNIT 2

Checkers Comments Accepted By ..... Nuclear Safety Related: YES ☑ NO ☐

Materials
Ref. Codes
Ref. FSAR
Other Ref.
} SEE PAGE 4/11

Assumptions SEE BELOW

RESULTS

(C) POINT 94 (EL. 993'-9"):

$Q = -1.5$
$N\phi = 36.7$
$M\phi = -109$
$N\theta = 57.6$
$M\theta = -51$

Mod. 3
CL 410
TABLE 1C ON PAGE 4/6

$Q = \pm 0.08$ K/in

ROT. PLAT. LOAD
MOD. 3, MERI. 1, POINT 68
BOOK # SRB-116 P1
LOADING PL2

$\therefore \sum Q = -1.5 - 0.08 = -1.58$ K/in

O/A depth of Section $t = 4'-4" = 52"$
(Refer Page 4/11)

Total Radial Shear at EL. 994'-0½" (obtained by interpolation bet. points 95 & 94)

$$Q = 1.58 + \frac{(2.15 - 1.58) \times 3.5}{40.5} = 1.63 \text{ K/in}$$

NOTE: Since $N\phi$ and $N\theta$ are approx. Same as for point 95, therefore the following conclusions can be drawn:

Concrete has cracked in both dir.

$\therefore$ Model 3 applies.

Shear stress = $v_u = \dfrac{1.63 \times 1000}{0.85 \times 1 \times 46} = 41.69$ psi
($d = 52 - 6 = 46'$)

Refer sketch on Page 4/2

$S = 22"$, $h = 22"$

REV. 2

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Book No. SRB-122C
Sheet No. 3/15 (4/15)
G & H Job No. 2323-001

Subject TUSI : CONT. WALL : UNIT-2 SC 9/13/79 C.2 9/12/79

Checkers Comments Accepted By 2 PKB 9-17-79 C.2 9/17/79 Nuclear Safety Related: YES ☑ NO ☐

Materials
Ref. Codes SEE PAGE 3/4 4/1
Ref. FSAR
Other Ref.

Assumptions SEE BELOW

RESULTS

$$\therefore A_{v_{Reqd}} = \frac{41.69 \times 22 \times 22}{60000} = 0.336 \text{ in}^2$$

Area provided: 1 - #6 bar (Area = 0.44 in²)

a-K

ALTERNATE CALCULATION: (SEE SKETCH ON PAGE 3/4 4/2) PKB 9-17-79 C.2 9/17/79

$$A_{v_{Reqd.}} = \frac{41.69 \times 1 \times 1}{60000} = 0.00069 \text{ in}^2/\text{inch in both dir.}$$

$$A_{v_{Provided}} = \frac{0.44}{22 \times 22} = 0.0009$$

CHECK POINT 94 FOR MERIDIAN 8:

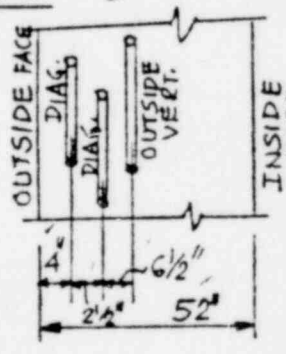
Q = 1.49
N_ϕ = 32.4
M_ϕ = 60
N_θ = 53
M_θ = 124

MOD. 3 REV. 2 C.2 9/17/79 PKB 9/17/79
CL 430
TABLE 1C 3
ON PAGE 4/6

Since M_ϕ is positive, tension acts on outside face of concrete.

Rebars on outside face:

2 # 18 Diag. @ 12" = 0.333 in²/in
18 Vert. @ 11" = 0.364 in²/in



$$\therefore \text{C.G of rebars from outside face} = \frac{\frac{1}{2} \times 0.333 (4 + 6.5) + 0.364 \times 13}{2 \times \frac{1}{2} \times 0.333 + 0.364} = \frac{1.75 + 4.73}{0.697} = 9.3 \text{ in.}$$

$\sum Q$ at EL. 994'-0½" (See Page 4/14) = 1.63 K/in 2 PKB 9-17-79 C.2 9/17/79

$\therefore$ Eff depth = d = 52 - 9.3 = 42.7 in

$$\therefore \text{Shear stress } v_u = \frac{Q}{0.85 bd} = \frac{1.63 \times 1000}{0.85 \times 1 \times 42.7} = 44.90 \text{ psi}$$

$$\therefore A_{v_{Reqd.}} = \frac{44.9 \times 1 \times 1}{60000} = 0.00075 \text{ in}^2/\text{in. in both dir.}$$

.0009

REV. 2

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Book No. SRB-122C
Sheet No. 4/16
G & H Job No. 2323-001

Project TVSI : CONT. WALL : UNIT-2

Checkers Comments Accepted By: Nuclear Safety Related: YES ☑ NO ☐

Materials
Ref. Codes SEE PAGE 4/1
Ref. FSAR
Other Ref.
Assumptions SEE BELOW

RESULTS

NOTE:

If Concrete does not crack, Model 1 Shear forces are to be used. As the Concrete has not cracked, concrete has the full shear capacity of $2\sqrt{f_c'}$ = 126 psi ✓

Maxm Radial Shear in Model 1 at point 96 (See Table 1A on Page 4/6) = 3.45 ✓ k/in

Effective depth = d = 46 in. (See Page 4/8)

∴ Concrete Shear Stress assuming entire shear is resisted by concrete

$$v_u = \frac{Q}{0.85\,bd} = \frac{3.45 \times 1000}{0.85 \times 1 \times 46} = 88.2 \text{ psi}$$

< 126 ✓ O.K.

NOTE:

Another approach is to find what would be the shear stress in concrete if the steel was fully stressed even though this is not likely to happen. For details of computation, see page 4/20

PAGES 2

BOOK SRB-122C

4 | 17 | 2

SC 9/13/79
CZ 9/13/79

ED BEZKOR/VON GH-NY STRUCTURAL

PKB 9/11/79 verified C.Z. 9/11/79

Page 1 of 1

COMANCHE PEAK STEAM ELECTRIC STATION
DESIGN CHANGE AUTHORIZATION

(WILL) ~~XXXXXXXX~~ BE INCORPORATED IN DESIGN DOCUMENTS

AUTHORIZATION NO. 5536-REV.1

SAFETY RELATED DOCUMENT X YES ___ NO

1. DESCRIPTION:

A. APPLICABLE ~~SPEC~~/DWG/~~DOCUMENT~~ 2323-S2-0505 REV. 5

NOTE: THIS DOCUMENT SUPERSEDES AND VOIDS DCA-5536-Rev.0.

B. DETAILS In lieu of shear reinforcement above elevation 997'-6" as shown on the design drawing, additional shear reinforcement has been placed as follows:

Four rows of #6 [at approximate elevation 997'-8", elevation 998'-0", elevation 998'-11" and elevation 999'-10" spaced at 0'-11" horizontally.

SOLUTION: Shear reinforcement as placed above exceeds the design requirements and is therefore acceptable.

2. SUPPORTING DOCUMENTATION

RECEIVED BY TELECOPIER
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DATE 9/14/79 TIME 9:20

3. SIGNATURES: CRH/ss 9-10-79

A. APPROVED BY: C B Williams (G&H Representative) 9-10-79 (Date)

B. APPROVED BY: C R Hooton (Originating Engineer) 9-10-79 (Date)

4. STANDARD DISTRIBUTION:

B&R Field (Original) (1)
G&H New York (1)
G&H Dallas (1)

1466 109

BOOK # SRB-122C
PAGE: 3[illegible]

4/18 2 SC 9/13/79
To CZ CZ 9/13/79

PKB 9/11/79
verified CZ 9/11/79

8-29-79

8/28/79

CH ENG NY

TUGCO-GRSE

AUGUST 28, 01979
TWX: 11,384
ATTN: H.R. ROCK/M.L. BERGMAN
PPE: REACTOR BUILDING UNIT #2
EXTERIOR GALL REINFORCEMENT
REF: 2323-S2-0505

ADDITIONAL #6 SHEAR TIES AT 1'-10" VERTICAL AND 1'-10" APPROXIMATE HORIZONTAL ALTERNATE WITH MAIN SHEAR BARS BEGINNING AT EL. 993'-1&1/2" AND ENDING A. [illegible]7&1/2" HAVE NOT BEEN PLACED. MAIN SHEAR REINFORCEMENT HAS BEEN PLACED IN ACCORDANCE WITH THE DESIGN DRAWING. CONCRETE HAS BEEN PLACED IN ACCORDANCE WITH THE DESIGN DRAWING. CONCRETE AS BEEN PLACED TO APPROXIMATE EL. 997'-6".

REQUEST ENGINEERING EVALUATION OF THE THREE OMITTED ROW OF SHEAR TIES AT EL. 993'-1&1/2", 994'-11&1/2" AND 996'-9&1/2" FOR ACCEPTANCE TO USE-AS-IS.

ADDITIONAL SHEAR REINFORCEMENT CAN BE PLACED BETWEEN MAIN REINFORCEMENT STARTING AT AND CONTINUING TO WHATEVER ELEVATION IS REQUIRED.

CONCRETE PLACEMENT TO EL. 1000'-6" IS TENATIVELY SCHEDULED FOR 8-29-79. PLACEMENT WILL BE HELD UNTIL RESOLUTION OF THIS DEFICIENCY.

R.E. HEIM/C.R. HOOTON
CPSES JOBSITE
REH/CRH/JG

GH ENG NY

1466 110

REV. 2

Date SEPT. 1979 | Gibbs & Hill, Inc. ENGINEERS, DESIGNERS, CONSTRUCTORS NEW YORK | 4/19

Book No. SRB-122C
Sheet No. 4/19
G & H Job No. 2328-001

Calc. By P.K.B
Chkd/Apprd. By C.Z 9/18/79

Subject TUSI: CONT. WALL: UNIT 2

Checkers Comments Accepted By ..... Nuclear Safety Related: YES ☑ NO ☐

Materials
Ref. Codes } SEE PAGE 4/1
Ref. FSAR
Other Ref.

Assumptions SEE BELOW

RESULTS

POINT 96: (EL. 1000'-6") : (CONTINUED FROM PAGE 4/9):

CHECK WHETHER CONCRETE HAS CRACKED:
(ALTERNATE APPROX. METHOD)

N_ϕ = 35.9 K/in
M_ϕ = -275 Kin/in
} MODEL 3 CL 410 Table 1C on Page 4/6

Assume a homogeneous concrete section and ignore the effects of reinforcement.

o/A Min. depth of as-built section = 52 in.
(See Page 4/8)

$$f = \frac{P}{A} \pm \frac{My}{I} = \frac{35.9 \times 1000}{52 \times 1} \pm \frac{275 \times 1000 \times \frac{52}{2}}{\frac{1}{12} \times 1 \times (52)^3}$$

$$f = 690 \pm 610$$

$\therefore f_{max}$ = 1300 psi (Tension)

f_{min} = 80 psi (Tension)

$\therefore$ Entire section in tension and Concrete has cracked.

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Book No. SRB-122C
Sheet No. 4/20
G & H Job No. 2323-001

Calc. By PKB
Ch'd/Apprd. By C.Z 9/18/79

Subject TUSI: CONT. WALL : UNIT 2

Checkers Comments Accepted By ..... Nuclear Safety Related: YES ☑ NO ☐

Materials
Ref. Codes } SEE PAGE 4/1
Ref. FSAR
Other Ref.

Assumptions SEE BELOW

RESULTS

ALTERNATE APPROX. METHOD (CONTINUED FROM PAGE 4/16)

Another approach is to find what would be the shear stress in concrete if the steel was fully stressed to 60 ksi even though this is not likely to happen:

POINT 95 (EL. 997'-1½") AND POINT 94 (EL. 993'9"):

Q at 95 = -3.02 K/in
Q at 94 = -2.56 K/in
} MODEL 2, CL 430, TABLE 1B, PAGE 4/6

Q = ± 0.07 K/in for Rot. Plat. Load, Book #SRB-116A Loading PL2, Mod. 2, Mat. 1, Points 71 & 68

Σ Q at 95 = 3.02 + 0.07 = 3.09
Σ Q at 94 = 2.56 + 0.07 = 2.63

For Sketch on Page 4/11,

Total Radial Shear at EL. 995'-10½" (obtained by interpolation but. 95 & 94)

$$Q = 2.63 + \frac{(3.09 - 2.63) \times 25.5}{40.5} = 2.92 \text{ K/in}$$

Effective depth of section = 46 in
(See Page 4/12)

REV. 2

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Book No. SRB-122C
Sheet No. 4/21
G & H Job No. 2323-001

Calc. By PKB
Ch'd/Apprd. By C.2 9/18/79

Subject TUSI : CONT. WALL : UNIT 2

Checkers Comments Accepted By ..... Nuclear Safety Related: YES ☑ NO ☐

Materials
Ref. Codes } SEE PAGE 4/1'
Ref. FSAR
Other Ref.

Assumptions SEE BELOW'

RESULTS

∴ Shear stress in Section $v_u = \frac{2.92 \times 1000}{0.85 \times 1 \times 46}$

∴ $v_u = 74.7$ psi

Refer sketch on Page 4/11,

#6 [Shear bars have been provided at 22" Horz. and 21½" Vert at EL. 995'-10½"

Area of #6 bar = 0.44 in²

∴ Maxm Shear stress in Section that can be be resisted by Shear reinf. Stressed to 60 ksi

$= \frac{60000 \times 0.44}{22 \times 21.75} = 55.2$ psi

∴ Shear Stress to be resisted by concrete

$= 74.7 - 55.2 = 19.5$ psi $\ll 126$ $(2\sqrt{f_c'})$ O.K.

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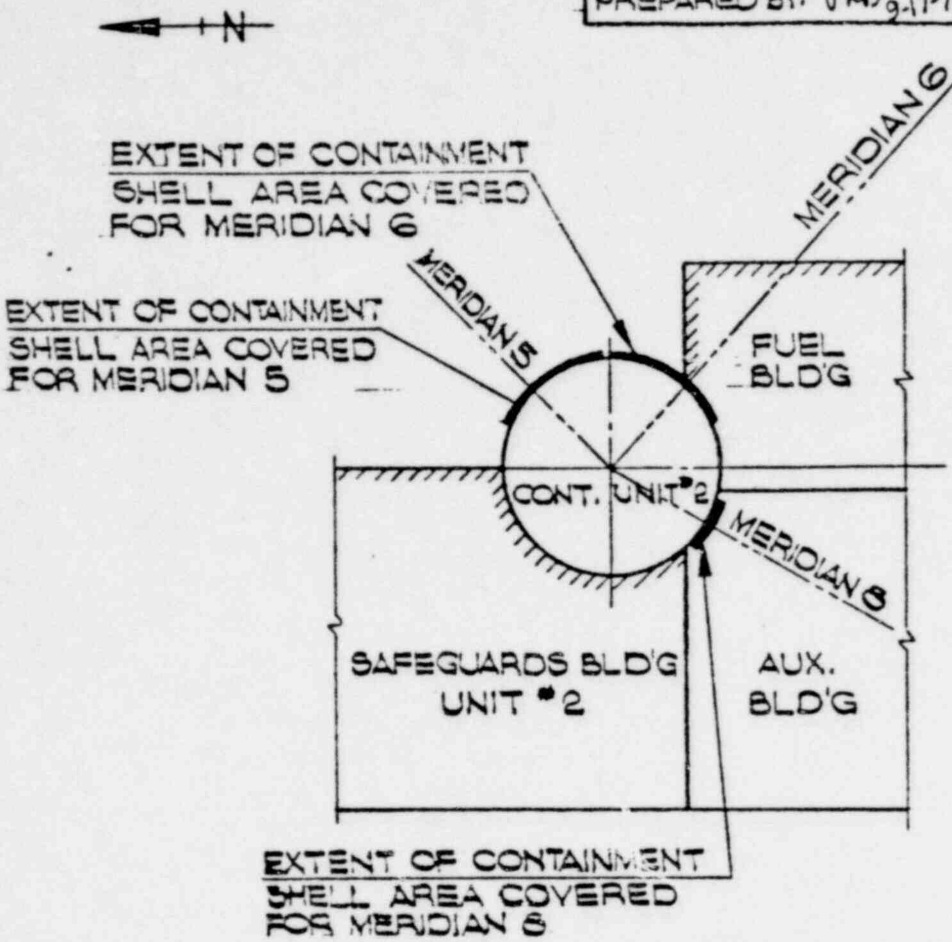
BOOK NO. SRB-122C,	SHEET NO: 4/22
PREPARED BY: PKB 9-17-78	CHECKED BY: C.Z 9/18/78
	REV. 2



LOCATION OF MERIDIANS IN CONTAINMENT

1466 114

TUSI - UNIT #2 COMANCHE PEAK	
LOCATION OF MERIDIANS IN CONTAINMENT	
Gibbs & Hill, Inc. ENGINEERS, DESIGNERS, CONSTRUCTORS NEW YORK	SCALE N.T.S.
JOB NO 2323	

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					APPROVALS									

5/76

REV. 2

Date SEPT. 1979 | Gibbs & Hill, Inc. ENGINEERS. DESIGNERS. CONSTRUCTORS NEW YORK | 4/23

Calc. By PKB | Book No. SRB-122C

Chk'd/Apprd. By C. 2 9/18/79 | Sheet No. 4/23

Subject TUSI : CONT. WALL : UNIT 2 | G & H Job No. 2323-001

Checkers Comments Accepted By ..... Nuclear Safety Related: YES ☑ NO ☐

Materials

Ref. Codes } SEE PAGE 4/1

Ref. FSAR

Other Ref.

Assumptions SEE BELOW

RESULTS

LEGEND OF TERMS:

COMBINED LOADING CL 410: $U = D + T_{S_1} + 1.5\,P_a + T_a$

CL 430: $U = D + T_W + 1.5\,P_a + T_a$] SEE PAGE 4/6

CL 713: $U = D + T_{S_1} + (E'_c - E'_v)$

CL 731: $U = D + T_W + (E'_t + E'_v)$] SEE PAGE 4/7

D = DEAD LOAD OF CONTAINMENT

T_{S_1} = OPERATING THERMAL LOADS IN SUMMER

T_W = OPERATING THERMAL LOADS IN WINTER

P_a = CONTAINMENT PRESSURE LOAD DURING 'LOCA' CONDITION.

T_a = ACCIDENT TEMP LOAD DURING 'LOCA' CONDITION

E'_V = VERTICAL COMPONENT OF SAFE SHUTDOWN EARTHQUAKE.

E'_C = COMPRESSION DEVELOPED BY HORIZONTAL COMPONENT OF SAFE SHUTDOWN EARTHQUAKE

E'_t = TENSION DEVELOPED BY HORIZONTAL COMPONENT OF SAFE SHUTDOWN EARTHQUAKE.

Q = RADIAL SHEAR

N_ϕ = AXIAL FORCE IN VERT. DIR.

M_ϕ = BENDING MOMENT IN VERT. DIR.

N_θ = AXIAL FORCE IN HORZ. DIR.

M_θ = BENDING MOMENT IN HORZ. DIR.

SEE PAGES 4/6 & 4/7