1491

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December 3, 1984

Mrs. Juanita Ellis
President, CASE
1426 South Polk Street
Dallas, Texas 75224

Subj: Texas Utilities Electric Company, et al.
(Comanche Peak Steam Electric Station,
Units 1 & 2); Docket Nos. 50-445 and 50-446OL

Dear Mrs. Ellis:

Enclosed is a copy of a letter Applicants transmitted to the Staff regarding Applicants' analysis of the steam generator upper lateral restraints. This letter responds to certain questions raised by the NRC Staff during the November 13, 1984, meeting with Applicants on that topic.

Sincerely,

William A. Horin

William A. Horin
Counsel for Applicants

cc: w/o encl. Remainder of Service List

DS03

TEXAS UTILI S GENERATING COMPANY
P. C. BOX GLEN ROSE, TEXAS 76043

DEC 02 1984

November 21, 1984

Geary Mizuno, Esquire
U. S. Nuclear Regulatory Commission
7735 Old Georgetown Road
Room 10107
Bethesda, Maryland 29814

Subj: Texas Utilities Electric Company (Comanche Peak Steam Electric Station, Units 1 and 2); Docket Nos. 50-445 and 50-446

Reference: 1) Gibbs & Hill letter GTN-69363 dated August 21, 1984
2) Transcript of Meeting of November 13, 1984 in Bethesda, Maryland between Applicants, the NRC and NRC Consultants

On November 13, 1984 a meeting was held between the NRC and representatives of the Applicants, to discuss Applicants analyses employed in the justification of the adequacy of the steam generator upper lateral support (see Applicants' Motion for Summary Disposition Regarding Upper Lateral Restraint Beam and accompanying Affidavit of R. C. Iotti).

At the conclusion of the meeting Applicants were requested to provide written statements on several items as listed below:

1. A justification of the approach taken in the analyses of the upper lateral restraint beam proper and the concrete to which it is attached,

2. A configuration of the maximum calculated MSLB temperature and of the temperature used in the Affidavit analyses,

3. A confirmation of which of the load cases examined in the Affidavit analyses is addressed by the calculations shown on page 60 of Reference 1,

4. A clarification and modification of the statement appearing as item 5.b(3) on page 4 of the minutes of the meeting transmitted by Reference 1,

5. A clarification and modification of item 6C on page 5 of the same minutes,

6. A clarification of how shear loads and stresses are handled at the fixed boundary chosen for the structural model executed for the case of the concrete tensile strength equal to zero, and

7. A confirmation that the NASTRAN program employed in the Affidavit analyses has been used exclusively for these analyses, and has not been used in any other analysis or design at Comanche Peak.

Accordingly we provide the following:

a. Applicants used a dual approach to determine the adequacy of the upper lateral restraint beam proper and of the concrete to which it is attached. The dual approach consists of two bounding analyses. As stated in the Affidavit at 4, the first analysis provides the upperbound on the physical

effects on concrete walls (i.e., wall deformation and cracking). For this analysis no credit is given to the tensile capacity of concrete. This analysis overestimates cracking in the concrete but underestimates its real restraining effects on the upper (and lower) lateral restraint beam thermal expansion, since the lesser the extent of cracking is, the stiffer is the concrete wall.

As such, this analysis underestimates the real loads that would occur in the lateral restraints when they thermally expand.

To assess and bound the maximum load on the beam and stresses in reinforcement, the second analysis assumed that the concrete would have a tensile capacity of 450 psi (see Affidavit at 5).

The extent of cracking, its distribution, and therefore, the capacity of the concrete to resist applied loads, including the beams' thermal expansion loads for accident conditions, as predicted by the NASTRAN program with the concrete tensile strength at 450 psi, has been questioned by the NRC and its consultants, because the program does not reproduce experimental results at high applied loads.

Experimental results discussed in the meetings refer to tests of simple concrete beams loaded in the center. The NASTRAN program would predict failure of the beams at higher loads than experiments have shown, where high tensile strength is employed. However, it predicts results similar to experiments when low tensile strengths, i.e., below 120 psi, are used. Consequently, the extent of cracking as predicted by the NASTRAN program is less than that which actually takes place.

The effect of this underprediction is to overestimate the concrete resistance (stiffness) to an applied load. In terms of the analyses performed for the upper (and lower) lateral restraint beams, the overprediction of the concrete stiffness would lead to a conservative evaluation of the loads experienced by the beams themselves, i.e., the NASTRAN program would predict higher loads for the beams than would actually occur.

To ascertain the possible conservatism inherent in the analytical predictions stemming from the NASTRAN program, Applicants have determined the finite elements in which the in-plane shear loads would be sufficiently large that the program may incorrectly predict no crack formation. In plane shears in excess of 120 psi accompanied by principal tensile stresses of comparable magnitude are indicative of conditions where experimental data suggests cracking might initiate and likewise where NASTRAN does not predict cracking if the concrete tensile strength is assumed to be 450 psi. Applicants found that relatively few elements in the vicinity of the beam embedments fall in this category. Had the NASTRAN program predicted that these elements cracked more extensively, the resistance of the concrete would have been lower and the beams' load would have been less than reported in Tables 1 and 2 of the Affidavit under the columns labelled "Concrete Tensile Strength = 450 psi".

Applicants therefore conclude that the dual approach taken to examine the worst condition for concrete (zero tensile strength) and the worst loading for the upper lateral restraint (made even worse by the overprediction of concrete resistance by NASTRAN) provide assurance that the upper lateral restraint and the concrete are adequately designed for the loading conditions examined.

b. There is some confusion as to the values calculated or used for the Affidavit analyses of the Main Steam Line Break accident consequences on the lateral restraints and concrete. Part of the confusion stems from the fact that Applicants utilized a conservative peak figure of 370°F in said analysis (see Affidavit at 10 and Appendix I Figure 2) rather than the peak values actually calculated for the upper and lower lateral restraint from the RELAP 4, HEATING 5 analyses (thermo-hydraulic and heat transfer, respectively) have been reported in the Affidavit as being approximately 355°F at approximately 300 seconds (Affidavit at 10). In addition, on page 6 of the Minutes of the Meeting attached to Reference 1, temperature values calculated for the upper and lower lateral restraint have been reported as 340°F and 350°F respectively at 324 seconds.

The reason for the apparently conflicting information is the lack of a clarifying explanation on these latter values on page 6 of the minutes of the meeting. Whereas 355°F represents the approximate average of the maximum temperature of both beams (and 370°F was actually used in the analyses), the temperatures quoted of 340°F and 350°F are the temperatures of the two beams at the time when the largest difference in temperature exists between the two. They are not the maximum calculated beam temperatures. These temperatures were used to respond to the NRC question which requested an assessment of the effects on the walls of using actual simultaneous beam temperatures rather than maximum temperatures used in the Affidavit analyses. The maximum effect on walls from differences in temperatures between the two beams obviously results where the difference is maximum, and this is why those two temperatures were used.

c. The load case analyzed on page 60 of the calculations attached to Reference 1, is the load combination of nominal differential pressure across the compartment walls of 1 psi, plus peak temperature in the beams which represents the worst condition for the case of the Main Steam Line Break. It corresponds to the case reported under the column labelled "Concrete Tensile Strength - 450 psi" of the Main Steam at 324 seconds.

To further clarify this, we are including a modified sheet No. 60 and a page of pertinent computer output as Exhibit 1. One can verify the correspondence of the case with Table 1 attached, where the axial stress is reported as 13.8 ksi.

d. The statement appearing as Item 5.b(3) on page 4 of the minutes of the meeting transmitted by Reference 1 could be misleading. Accordingly, the following statement should be substituted.

"The NRC pointed out during the audit that the boundary condition used by Gibbs & Hill in the analyses along the z-direction is incorrect in that it does not reflect the freedom of the structure to move. Gibbs & Hill acknowledged that strictly speaking this is true. However, use of a fixed boundary condition in the z-direction permitted a considerable simplification in the analysis by allowing use of a symmetric model, and based on the fact that the seismic stress in the compartment walls obtained from the previous analysis using a full model is relatively small, Gibbs & Hill concluded that the boundary condition used in the analysis has little effect on the result. NRC concurred that the results would be acceptable provided

that Gibbs & Hill calculations demonstrated that the seismic loads were only a small fraction of the total load. Gibbs & Hill is to submit calculations."

Gibbs & Hill has submitted such calculations in Reference 1, calculation set SRB-4C3, Set 2-16 sheets.

e. The statement made in the minutes of the meeting attached to Reference 1 on page 5, Item C, requires some clarification.

In the ASLB Hearings, the only case discussed was the LOCA case. The MSLB case has been introduced by Applicants in their Affidavit. Consequently, the LOCA case had been the only case which had received attention and for which loads had been computed under the assumption that the compartment walls are infinitely rigid. In the minutes of the meetings Gibbs & Hill repeated the same calculations and stated that the beam stresses computed from these calculations (page 55 of calculations attached to Reference 1) are below the yield point. In fact, they would be below 0.9 Fy = 45 ksi since they are 39.36 ksi. The Gibbs & Hill calculations, however, do not address the case of the Main Steam Line Break. For this case, if one were to consider the unrealistic condition that the walls are infinitely rigid, one would compute a beam stress equal to 55.8 ksi, which is in excess of the yield point.

Both calculations, however, are extremely conservative, and not representative of the real stresses resulting in the beams. Nevertheless for the purposes of accuracy, the statement on page 5 Item C is revised as follows:

"c. Calculations were developed and reviewed for the LOCA case, based on the assumption that the beam restraints (compartment walls) are infinitely rigid. These showed beam stresses below the yield point. Gibbs & Hill stated that this upper bound case, although unrealistic because the structure is not rigid, had also been discussed during the 1983 ASLB hearings. An equivalent calculation for the MSLB has not been performed, as that case had not been discussed in the hearings, and would have no merit, considering the detailed analysis that has been performed. In fact, the LOCA case was done because Gibbs & Hill felt it had been requested by the NRC. Had the calculation with infinitely rigid walls been performed for the MSLB, stresses computed in the beam would be above yield."

f. To clarify how shear loads (and stresses) are handled at the fixed boundary of the base of the structural model used in the analyses, the result for one of the finite elements at the base of the model, together with explanation sheets is indicated as an example in Exhibit 2. A similar table is available for each finite element at the base. The particular plate being exemplified by sheet 89 is element 861, which is at the base of S.G. compartment 1, and which can be seen in Figure 3 of Appendix IV of the Affidavit.

g. Applicants have used the NASTRAN program with the cracking concrete feature only in two instances for Comanche Peak. The one instance is the analyses of the load distribution and cracking pattern in the concrete walls and lateral beams performed to provide the information supplied in the Applicants' Affidavit regarding the Upper Lateral Restraint Beam. We have

subsequently identified another instance where use was made of the cracked concrete version of NASTRAN. This instance was for the analyses of a similar steel beam expansion between two concrete beams, which also utilized the boundary cases of 0 and 450 psi tensile strength. This later analysis was employed for evaluation of the loads on concrete beams from support FW-1-097-018-C62R expanding between concrete beams B-13 and B-14 at Elevation 885'-6" in the Containment Building. Its results, however, have not been directly used in preparation of the Affidavit and Motion regarding "Differential Displacements of Large-Framed, Wall-To-Wall and Floor-To-Ceiling Pipe Supports", which include this support but have been used to verify the adequacy of design of the concrete beams.

It is to be noted that in this latter case, in-plane shear stresses for all the elements are well below 100 psi. Hence, the NASTRAN predictions even at the higher tensile strengths are expected to be accurate.

Briefly discussed during the meeting was also the appropriateness of a heading used in the minutes of the meeting of Reference 1, on page 6, wherein a designation "As Designed" was used. A better term would be "As Analyzed" since those values refer to the temperatures employed in the analyses performed for the Affidavit.

We trust to have provided all information that we agreed to provide during the 11/13/84 meetings. Please call if you have any questions.

Very truly yours,

TEXAS UTILITIES GENERATING COMPANY

FOR W. R. Beatherage
J. B. George
Vice-President/Project General Manager

JBG/RCI/cp

cc: W. Horin
R. C. Iotti
J. Eichler
M. Reich
S. Burwell

Subject KBF1 - ANALYSIS FOR ... (CRACKED ...)

Calculation Number SRB-167C SCT 3 Sheet No. 60

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date
Checking Method	↓									
Preparer	SSC	8/16/84								
Checker	MNS	8/.../84								

Case 2 : When compression is maximum:

FROM LOAD CASE (MAIN STEAM BREAK (RUN 9) at 370°F, 450 psi conc. tensile strength

MAX f_a = axial (stress = 13.774 KSI) SRB-119 PG Page # 209

f_{bx} = 0.77 KSI

f_{by} = 1.74 KSI

All these values are from this computer output

$$f_a/F_a = \frac{13.774}{45.00} = 0.306$$

FROM CL 1.6-1a (AISC MANUAL OF STEEL CONSTRUCT.)

$$f_a/F_a + \frac{C_{mx} f_{bx}}{\left(1 - \frac{f_a}{F'_{ex}}\right) F_{bx}} + \frac{C_{my} f_{by}}{\left(1 - \frac{f_a}{F'_{ey}}\right) F_{by}} \leq 1.0$$

where C_m = .85

$$\Rightarrow \frac{13.774}{45.00} + \frac{0.85 \times .77}{\left(1 - \frac{13.774}{1206.67}\right) \times 0.9 \times 50} + \frac{0.85 \times 1.74}{\left(1 - \frac{13.774}{1161.84}\right) \times .9 \times 50}$$

(sh# 56) (Sh# 56)

$$\Rightarrow 0.306 + .015 + .033 \simeq 0.36 < 1 \text{ OK}$$

CONCLUSION: THE SUBJECT RESTRAINT BEAM IS ADEQUATE TO WITHSTAND ALL THE LOADING IN THE MOST SEVERE CONDITIONS.

COMBINED LOAD - U = D + L + TA + RA + 1.5PA SUBCASE 1

S T R E S S E S I N B A R E L E M E N T S (C B A R)

ELEMENT ID.	SA1 / SB1	SA2 / SB2	SA3 / SB3	SA4 / SB4	AXIAL STRESS	SA-MAX / SB-MAX	SA-MIN / SB-MIN	M.S.-T / M.S.-C
10960	0.0	0.0	0.0	0.0	1.096300E-04	1.096300E-04	1.096300E-04	4.1E+03
	0.0	0.0	0.0	0.0		1.096300E-04	1.096300E-04	
10961	0.0	0.0	0.0	0.0	1.165003E-04	1.165003E-04	1.165003E-04	3.9E+03
	0.0	0.0	0.0	0.0		1.165003E-04	1.165003E-04	
11000	0.0	0.0	0.0	0.0	-4.903161E-03	-4.903161E-03	-4.903161E-03	
	0.0	0.0	0.0	0.0		-4.903161E-03	-4.903161E-03	
11001	2.816217E-01	2.540426E-01	-2.816217E-01	-2.540426E-01	-1.373444E+00	-1.091823E+00	-1.655066E+00	
	2.492068E-01	-3.304889E-01	-2.492068E-01	3.304889E-01		-1.042956E+00	-1.703933E+00	
11002	2.492068E-01	-3.304889E-01	-2.492068E-01	3.304889E-01	-1.373444E+00	-1.042956E+00	-1.703933E+00	
	1.720432E-01	-8.702715E-01	-1.720432E-01	8.702715E-01		-5.031729E-01	-2.243716E+00	
11003	1.720432E-01	-8.702715E-01	-1.720432E-01	8.702715E-01	-1.373444E+00	-5.031729E-01	-2.243716E+00	
	5.013076E-02	-1.365305E+00	-5.013076E-02	1.365305E+00		-8.139051E-03	-2.738750E+00	
11004	5.014314E-02	-1.365318E+00	-5.014314E-02	1.365318E+00	-1.373417E+00	-8.119130E-03	-2.738755E+00	1.2E+02
	-1.169509E-01	-1.816101E+00	1.169509E-01	1.816101E+00		4.426639E-01	-3.189538E+00	
11005	0.0	0.0	0.0	0.0	-4.903148E-03	-4.903148E-03	-4.903148E-03	
	0.0	0.0	0.0	0.0		-4.903148E-03	-4.903148E-03	
11006	0.0	0.0	0.0	0.0	-4.917557E-02	-4.917557E-02	-4.917557E-02	
	0.0	0.0	0.0	0.0		-4.917557E-02	-4.917557E-02	
11007	1.744681E+00	-7.131773E-01	-1.744681E+00	7.131773E-01	-1.377468E+01	-1.203000E+01	-1.551936E+01	
	7.699564E-01	-5.106881E-01	-7.699564E-01	5.106881E-01		-1.300473E+01	-1.454464E+01	
11008	7.698361E-01	-5.105678E-01	-7.698361E-01	5.105678E-01	-1.377467E+01	-1.300484E+01	-1.454451E+01	
	-1.643291E-01	-3.567971E-01	1.643291E-01	3.567971E-01		-1.341788E+01	-1.413147E+01	
11009	-1.642088E-01	-3.569174E-01	1.642088E-01	3.569174E-01	-1.377468E+01	-1.341776E+01	-1.413160E+01	
	-1.049406E+00	-2.439556E-01	1.049406E+00	2.439556E-01		-1.272528E+01	-1.482409E+01	
11010	-1.049527E+00	-2.438353E-01	1.049527E+00	2.438353E-01	-1.377467E+01	-1.272515E+01	-1.482420E+01	
	-1.894144E+00	-1.796125E-01	1.894144E+00	1.796125E-01		-1.188053E+01	-1.566882E+01	
11011	0.0	0.0	0.0	0.0	-4.917563E-02	-4.917563E-02	-4.917563E-02	
	0.0	0.0	0.0	0.0		-4.917563E-02	-4.917563E-02	
11012	0.0	0.0	0.0	0.0	-3.180177E-04	-3.180177E-04	-3.180177E-04	
	0.0	0.0	0.0	0.0		-3.180177E-04	-3.180177E-04	
11013	-3.592342E-02	3.989655E-01	3.592342E-02	-3.989655E-01	-3.601571E-01	3.880835E-02	-7.591226E-01	1.4E+03
	2.604386E-01	-1.590302E-01	-2.604386E-01	1.590302E-01		-9.971853E-02	-6.205957E-01	

June 14, 1984
Revised August 20, 1984

EQUIVALENCY OF LOADS & STRESSES LISTED IN TABLES 1 AND 2°

Note: + = compression
- = tension

UPPER LATERAL BEAM

Item	Concrete Tensile Strength = 0 psi				Concrete Tensile Strength = 450 psi			
	Max. Thrust (kips)	Axial Stress (ksi)	Bending Stress (ksi)	Max. Stress (ksi)	Max. Thrust (kips)	Axial Stress (ksi)	Bending Stress (ksi)	Max. Stress (ksi)
... @ 0.5 Seconds ... Comb. P1+T2+S1+M1 ... Nos. 2a,2b,3 and 6	-2138*	-6.0	-12.4	-18.4**	-	-	-	-
... 216 Seconds ...Comb. P2+T1+S2+M0 ... Nos. 1a,1b,5 and 8	+1591* +1178	+4.5 +3.3	+0.8 +3.8	+5.3 +7.1**	+3892*	+10.9	+2.1	+13.0**
@ 216 Seconds Comb. P2+T1+S3+M0	-	-	-	+7.1 +9.75 +16.85**	-	-	-	+13.0 + 9.75 +22.75**
@ 216 Seconds Comb. P2+T1+S1+M0 ...n No. 10	-	-	-	-	+3414*	+9.6	+6.7	+16.3**
STEAM @ 324 Seconds Comb. P2+T1+S0+M0 ...n Nos. 4,7 and 9	+2178*	+6.1	+2.3	+8.4**	+4918*	+13.8	+1.9	+15.7**

° Tables 1&2 in Affidavit of Robert C. Iotti Regarding Upper Lateral Restraint Beam, May 20, 1984
* Values listed in Table 1, **Values listed in Table 2, ***See Calculation Book No. SRB-4C3, Set 1

LEGEND - LOAD COMBINATIONS

P1 = Peak Pressure
P2 = Nominal (1 psi) pressure
T1 = Peak Temperature
T2 = Associated Temperature at given time
M0 = No mechanical loads
M1 = Peak mechanical loads
S0 = No Seismic loads
S1 = Maximum Seismic (incl. primary system seismic)
S2 = Maximum Seismic (w/o primary system seismic)
S3 = Maximum Seismic (incl. primary system seismic added separately)

Calculation Number SRB-167C SET 3 Sheet No. 86

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev	Date	
Checking Method	1										
Preparer	SSC	11-15-84									
Checker	[illegible]	11-15-84									

PURPOSE: IN RESPONSE TO NRC/BNL REQUEST (11-13-84 MEETING) FOLLOWING CALCULATIONS ARE PERFORMED TO EVALUATE THE SHEAR STRESSES AT THE BASE OF S.G WALLS DURING "ZERO PSI CONCRETE TENSILE STRENGTH" CASES.

DISCUSSION THE S.G. WALLS ARE PROVIDED WITH SHEAR REINFORCEMENT FOR THE ENTIRE AREA OF WALLS.

COMPUTER OUTPUT INDICATES SMALL AXIAL TENSION.

AS SPECIFIED IN ACI 318-71 CL 11.4, THE ALLOWABLE SHEAR STRESSES (v_c) ARE REDUCED DEPENDING ON THE TENSILE FORCES EXISTING IN THE PLATES. THE RESULTS ARE TABULATED ON FOLLOWING SHEETS (SH 89 THRU 115)

CONCLUSION THE SHEAR STRESSES ARE WELL BELOW THE ALLOWABLES (REDUCED WHEN TENSION IS PRESENT) FOR THE CONCRETE ITSELF. ADDITIONAL MARGIN IS AVAILABLE WHEN COMBINED CAPACITY OF THE CONCRETE AND SHEAR REINFORCEMENT IS USED.

Checking Method # 1 Line-by-line checking 2 Alternative Calculation Methods compared 3 Identical Calculation Results compared 4 Compare inputs and results of computer with corresponding inputs and results of similar cases

F-166, 7-82

Subject RB-1 – ANALYSIS FOR ACCIDENT TEMP (CRACKED MODEL)
Calculation Number SRB-167C SET 3 Sheet No. 87

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date	
Checking Method	1	X		X		X		X		X	
Preparer	JBL	11-15-84									
Checker	MVS	11.15.84									

EXPLANATION OF DATA USED IN FOLLOWING PAGES

N_x, N_y = IN PLANE AXIAL FORCES IN X & Y DIRECTIONS RESPECTIVELY (K/")
- – COMPRESSION
- + TENSION

V_x, V_y = OUT OF PLANE SHEAR FORCES IN X AND Y DIRECTIONS RESPECTIVELY (K/")

v_{cx}, v_{cy}, $V_{CAP_{STEEL}}$, $V_{CAP_{TOTAL}}$ – SEE SH 88

$|V_x| + |V_y|$ – INDICATES SUM OF ABSOLUTE VALUES – IN KIP/INCH/INCH

REFERENCES

DEPTH OF PLATE – G4H DWG NO
S1-0519 R/4, 0522 R/3
0525 R/5, 0528 R/3

SHEAR REINFORCEMENT – S1-0539 R/5
S1-0541 R/5

Checking Method #
1 Line-by-line checking
2 Alternate Calculation Results compared
3 Alternate Calculation Results compared
4 Compare inputs and results of computer with current and/or results of similar ...

F-156, 7-82

Subject RB#1 — ANALYSIS FOR ACCIDENT TEMP (CRACKED MODEL)

Calculation Number SRB-167C SET 3 Sheet No. 88

Revision	Orig.	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date	
Checking Method #	1	X		X		X		X		X	
Preparer	SSC	11-15-84									
Checker	MNS	11.15.84									

FROM ACI 318-71

MEMBER IN COMPRESSION (CL 11.4.3) $v_c = 2\left(1 + .0005\frac{N_u}{A_g}\right)\sqrt{f_c'}$ (11-6) *

MEMBER IN TENSION (CL 11.4.4) $v_c = 2\left(1 - .002\frac{N_u}{A_g}\right)\sqrt{f_c'}$ (11-8)

v_{cx} & v_{cy} ARE NOMINAL CONCRETE SHEAR STRESS IN x & Y DIRECTIONS RESPECTIVELY

VCAP (STEEL)

FROM CL 11.6.1 $A_v = \frac{(v_u - v_c)\, b_w s}{f_y}$ (11-13)

or $v_u = v_c + \frac{A_s f_y}{b_w s}$

or $V_{CAP(TOTAL)} = (0.85d)\, v_u = 0.85d \times \left(v_c + \frac{A_s f_y}{b_w s}\right)$

putting $v_c = 0$ $V_{CAP(STEEL)} = 0.85d \times \frac{A_s f_y}{b_w s}$

AND

$$V_{CAP(TOTAL)} = 0.85d\left(\overbrace{v_{cx} + v_{cy}}^{v_c} + \frac{A_s f_y}{b_w \cdot s}\right)$$

*NOTE: FOR MEMBER IN COMPRESSION, v_c WILL BE TAKEN AS 0.126 KSI CONSERVATIVELY

T ICO

Subject [illegible] ACCIDENT TEMP. (CRACKED MODEL)

Calculation Number SRB- 167C SET 3 Sheet No. 89

Revision	[illegible]	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date	
[illegible]	1	X		X		X		X		X	
Preparer	MNS	11/14/84									
Checker	MLK	11-15-84									

PLATE ID : 861

CONC. TENSILE STRENGTH = 0.0 psi

COMPARTMENT NO : 1

OVERALL DEPTH = 48 inch ; EFFECTIVE DEPTH = 44"

SHEAR REINFORCEMENT = # 7 @ 20" E.W.

RUN No. (Page #)	N_X (K/")	V_X (K/")	N_Y (K/")	V_Y (K/")	v_{cx} (ksi)	v_{cy} (ksi)	$\lvert V_x \rvert + \lvert V_y \rvert$ (K/"/")	V_{CAP} STEEL (K/")	V_{CAP} TOTAL (K/")
1a (88)	-2.83	-0.0069	-11.24	-0.197	0.126	0.126	0.204	3.37	12.79
1b (88)	-0.365	-0.0236	-4.02	0.0344	↑	↑	0.058	↑	↑
2a (89)	-1.69	-0.176	-12.77	2.498			2.674		
2b (89)	-0.051	0.317	-4.67	1.81			2.127		
3 (89)	-1.30	-0.185	-12.64	2.78	↓	↓	2.965 *	↓	↓
4 (89)	-0.94	-0.004	-8.06	0.293	0.126	0.126	0.297	3.37	12.79

* Max. shear of 2.965^k under LOCA peak pressure with coincident temp. (½ SSE condition)

Checking Method # [illegible]

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