170493

GPU NUCLEAR

B/A No. 128108

W/O No. 95-552A-52108

SEISMIC QUALIFICATION

No. SQ - T1 - NS-T-0001

REVISION 0

COMPONENT: NS-T-0001

SUBCOMPONENT(S): _____

_____

_____

Sheet 1 of 181

EVALUATED BY: G. D. Augustine DATE 9-1-93

EVALUATED BY: H Rader DATE 10-14-93 ~~9-7-93~~ sur

05-1 [illegible]

SQUG DATA FILE INDEX

COMPONENT TAG NUMBER NS-T-0001

DESCRIPTION NUC SVC CLOSED COOL SURGE TANK

▸ **DOCUMENTS** — **NUMBERS/STATUS**

SEWS		✓
GMS-2 (TECHNICAL FUNCTIONS DATA SURVEY)		✓
PHYSICAL DRAWING/ASSEMBLY DRAWING	M-5787 (07562)	✓
VENDOR CATALOG/DATA/INSTRUCTION MANUAL		—
INSTALLATION SPECIFICATION		—
SEISMIC ANALYSIS/TEST REPORTS/CALCS		—
CONCRETE OR PAD DRAWINGS, SPECS, BLOCK WALLS		—
EMBEDDED STEEL DRAWINGS		—
ANCHORAGE DRAWING/DETAILS/AIDS	421-119	✓

FIELD CHANGE DOCS/MNCR'S _____

OTHER IE-154-02-005, 423-065

* anchor calcs not available

RL 4/22/93
signature

▸ **GENERIC ISSUES**

___ POTENTIAL OUTLIER

___ BASE PLATE PLUG WELDS

___ OTHERS

▸ **DISPOSITION**

___ NEED MORE DATA

✓ KNOWN OUTLIER

___ SEISMIC DATA ACCEPTABLE, CONFIMATION WALKDOWN ONLY

ANCHORAGE CALCULATIONS: ___ EXIST ___ PERFORM IN FIELD

COMMENTS NOT IN SQUG DATA BASE. COLLECT CALCULATION FOR TANK

___ READY FOR SQUG WALKDOWN

Seismic Capacity Engineer (SCE)

3343-92-178

Use reverse side for COMMENTS.

Status Y N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 2

Equip. ID No. NS-T-0001 Equip. Class 21 - Tanks and Heat Exchangers

Equipment Description NUC SERV CLOSED COOLING WATER SURGE TANK

Location: Bldg. FHB Floor El. 348 Room, Row/Col W OF SFP A

Manufacturer, Model, Etc. (optional) BUFFALO TANKS DIV / BETHLEHEM STEEL

SHELL CAPACITY VS DEMAND

Buckling capacity of shell of large, flat-bottom, vertical tank is equal to or greater than demand: Y N U (N/A)

ANCHOR BOLTS AND EMBEDMENT

Capacity of anchor bolts and their embedments is equal to or greater than demand: (Y) N U N/A

ATTACHMENTS A & B FOR EVALUATION

CONNECTION BETWEEN ANCHOR BOLTS AND SHELL

Capacity of connections between the anchor bolts and the tank shell is equal to or greater than the demand: (Y) N U N/A

ATTACHMENT B FOR EVALUATION

FLEXIBILITY OF ATTACHED PIPING

Attached piping has adequate flexibility to accommodate motion of large, flat-bottom, vertical tank: Y N U (N/A)

TANK FOUNDATION

Ring-type foundation is not used to support large, flat-bottom, vertical tank: Y N U (N/A)

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

05-15-97 09:06:57

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 2

Equip. ID No. NS-T-0001 Equip. Class 21 - Tanks and Heat Exchangers

Equipment Description NUC SERV CLOSED COOLING WATER SURGE TANK

COMMENTS

PHOTO LOG 8-31-92 FRAMES 32 TO 35

Evaluated by: E.D. Augustine Date: 9-1-93

J.L. Rader 9-7-93

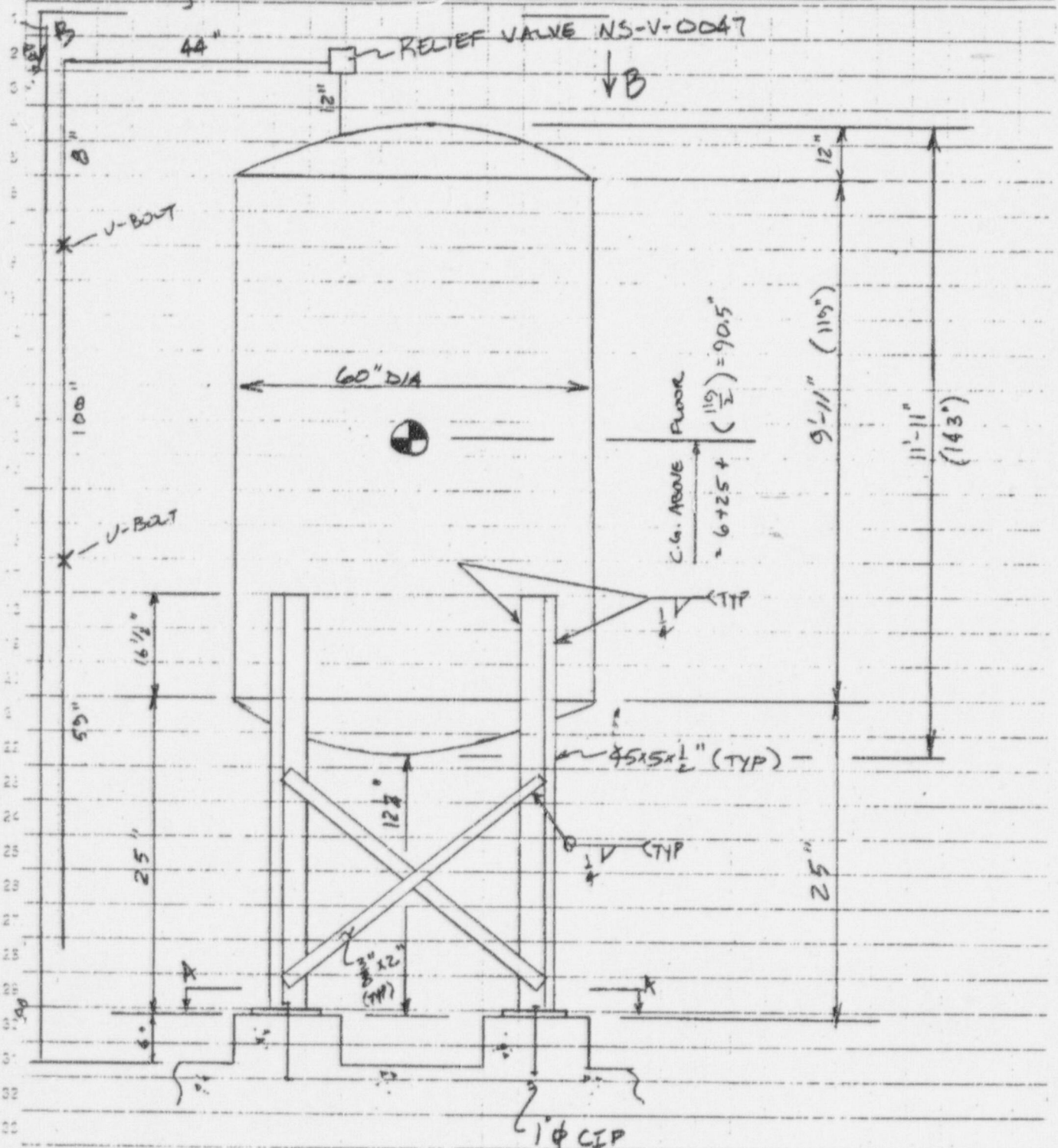
GPU Nuclear

Calculation Sheet

ATTACHMENT A

Subject	Calc No.	Rev. No.	Sheet No.
NS-T-1	WALKDOWN NOTES		A1 of 2

Originator	Date	Reviewed by	Date
B.D. Augustine	8-31-93	[illegible]	9-1-93



- TANK CAPACITY = 1,600 gals

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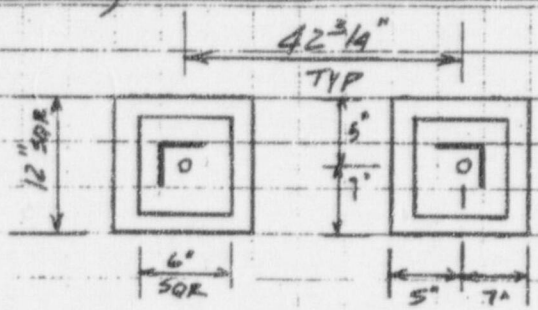
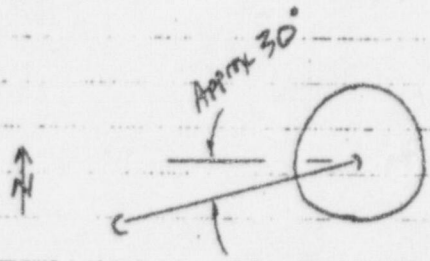
GPU Nuclear **Calculation Sheet** ATTACHMENT A.

Subject	Calc No.	Rev. No.	Sheet No.
NS-T-1	WALKDOWN NOTES		A2 of 2

Originator	Date	Reviewed by	Date
K.D. Augustine	8-31-93	HR Rad	9-1-93



SEC A-A



SEC B-B

05-15-97 09:06:57

GPU Nuclear **Calculation Sheet** ATTACHMENT B

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1		NS-T-1	0	B1 of 9
Originator	**Date**	**Reviewed by**		**Date**
G.D. Augustus	9-1-93	J.K. Raden		10-14-93

PURPOSE Seismic verification of equipment anchorage

METHODOLOGY The methodology as detailed in the GIP will be utilized.

REFERENCES

1) ES-022 Rev 5, Seismic Design Criteria
2) Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment. Rev 2
3) EQE Report No. 42105-R-001
4) Gilbert Drawing No. E-421-119 Rev 5
5) Gilbert Drawing No. S-423-065 Rev 1
6) Buffalo Tank Division Drawing No. M-5787
7) Blevins, "Formulas for Natural Frequency and Mode Shape" 1993

CALCULATIONS

- Per Ref 6 the empty shipping weight of the tank is 3,500#. Per Attachment A the tank capacity is 1600 gal

$$\text{Water Weight} = (1{,}600\ \text{gal})\left(\frac{.1337\ \text{ft}^3}{\text{gal}}\right)(62.4\ \#/\text{ft}^3) = 13{,}350\#$$

$$\text{Total Weight} = 3500 + 13{,}350 = 16{,}850\#$$

- The relief valve mounted on top of the tank is secured with threaded fittings. The piping runs to the SW from the tank where it is rigidly secured to the wall with a U-bolt support. As such, differential displacement between the tank and the wall is a concern.

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Calculation Sheet

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1		NS-T-1	0	B2 of 9
Originator	**Date**	**Reviewed by**		**Date**
B.D. Augustine	9-1-93	LL Lander		10-14-93

- Determine deflection at the top of the tank:

The support frame for the tank consists of welded steel angles which are well braced in both the N-S and E-W directions. As such, neglect the displacement of the frame as it will be very small and assume same stiffness as the tank

Per Ref 6 the tank wall thickness = 0.319" OD = 60"
ID = 59.362"

$I = 0.049087(OD^4 - ID^4)$
$= 0.049087(60^4 - 59.362^4)$
$= 26,630 in^4$

Distributed load $w = \frac{16,850\#}{143"} = 118\#/in$

From Ref 7, Table 8-1, Figure 3 find the natural frequency

$= \frac{1.875^2}{2\pi L^2}\left(\frac{EI}{w}\right)^{1/2}$

NOTE: SEE VERIFIER'S CALC. PG B7, & S 9 FREQUENCY = 22 Hz

$= \frac{1.875^2}{2\pi(156)^2}\left(\frac{29E6(26,630)(386.4)}{118}\right)^{1/2} = 36.6 Hz > 30 Hz$ } RIGID

The tank is located on Elev. 348' of the Fuel Handling Building. From Ref 3 find the following acceleration values:

ZPA N-S = 0.15g (Figure 3-88)
ZPA E-W = 0.18g (Figure 3-89)
ZPA Vert = 0.12g (Figure 3-90)

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GPU Nuclear

Calculation Sheet

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1		NS-T-1	0	B3 of 9
Originator: B.D. Augustus	Date: 9-1-93	Reviewed by: LK Ander		Date: 10-14-93

As the total conservative deflection = 0.003", the existing piping configuration is judged to be adequate.

-Check bolts:

From Ref 4 find the anchor bolts to be type FB12 with 3" projection above the 6" high pad. From Ref 5 find these bolts to be 1" diameter and 21" long

Embedment depth = (21 - 3 - 6) = 12"

Determine bolt loading:

$$\text{Tension} = \left[\left(\frac{16{,}850^{\#}(90.5")(.15^2+.18^2)^{1/2}}{(2\text{ bolts})(42.75)}\right)^2 + \left(\frac{16850(.123)}{4\text{ bolts}}\right)^2\right]^{1/2} - \frac{16850}{4\text{ bolts}}$$

$$= -3^{\#}$$ No net tension

$$\text{SHEAR} = \frac{16850(.15^2+.18^2)^{1/2}}{4\text{ bolts}} = 987^{\#}$$

SEE VERIFICA CHECK Ag. B7, 8 & 9

TENSION = 2387 lbs

SHEAR = 1554 lbs.

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Calculation Sheet

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1		NS-T-1	0	B4 of 9
Originator	**Date**	**Reviewed by**		**Date**
R. O. Augustus	9-1-93	A Rader		10-14-93

CAPACITY REDUCTION FACTORS FOR CAST-IN-PLACE BOLTS WITH NUTS OR HEADED STUDS

NS-T-1

Bolt Dia. (D)inches:	1.000	Concrete Strength f'c (psi) =	3,000
Required Edge Dist. (Emin) inches:	8.75	Actual Edge Dist. (E) inches:	5
Required Embedment (Lmin) inches:	10	Actual Embedment (L) inches:	12
Required Spacing (Smin) inches:	12.625	Actual Spacing (S) inches:	42.75

Note: If actual embedment,spacing, or edge distance exceeds minimum required , use minimum values for calculation of reduction factors.

L = 10 inches S = 12.625 inches E = 5 inches

THETA (edge dist.) = 2 cos-1 (2E/(2L+D))
= 2.15 rad

r = (2L+D)/2
= 10.5

THETA (spacing) = 2 cos-1 (S/(2L+D))
= 1.85 rad

- Edge Distance Check

E = 5.0 >=4D, but not > Emin, pullout reduction factor must be applied

REp = Pullout Capacity Reduction Factor
= A(reduced)/A(nominal)

A(reduced)= (PI)(r^2)-.5((r^2)(THETA edge)-2rE sin (THETA edge /2))
= 274 in^2

A(nominal)= .96(PI/4)((2L+D)^2))
= 333 in^2

REp = 0.82

E = 5.0 >=4D, but not > 8.75D, shear reduction factor must be applied

REs = Shear Capacity Reduction Factor = 0.0131*(E/D)^2
= 0.33

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Calculation Sheet

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1		NS-T-1	0	B5 of 9
Originator	**Date**	**Reviewed by**		**Date**
R.D. Augustine	9-1-93	J.L. Lander		10-14-93

- Concrete Strength Check

GIP Table C.3-1 allowables are based on a concrete strength = f'c = 3500 psi.

Concrete strength < 3,500 psi but >= 2,500 psi. Strength reduction factor required.

Reduction factor (REp) = (REs) = SQRT (f'c / 3500)

= 0.93

- Embedment Check: 10 * D = 10.00 4 * D = 4.00

L >= 10D, no reduction factor required.

- Spacing Check 2 * D = 2.00

Actual spacing equals or exceeds required spacing, no pullout reduction factor required.

Shear capacity reduction factor for closely spaced cast-in-place anchor bolts = RSs:

RSs = 1.00 for actual spacing (S) >= 2 * D

- Revised Allowable Loads

From Table C.3-1 of the GIP, the subject bolt has the following full allowable loads:

For D = 1.000 inches, the allowable pullout capacity (Pu') = 26,690 lbs. and the allowable shear capacity (Vu') = 13,350 lbs.

The revised pullout load = Pu = Pu' * REp * RFp * RLp * RSp

= 20,367 lbs.

The revised shear load = Vu = Vu' * REs * RFs * RLs * RSs

= 4,048 lbs.

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Calculation Sheet

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1		NS-T-1	0	B6 of 9
Originator: G.D. Augustine	Date: 9-1-93	Reviewed by: JLRander		Date: 10-14-93

All other items and welds are acceptable by engineering judgement.

VERIFIER'S CHECK: FOR ANCHORAGE INTERACTION SEE PAGE B9, INTERACTION = 0.5 < 1.0 OK

CONCLUSION The tank and its anchorage are seismically adequate

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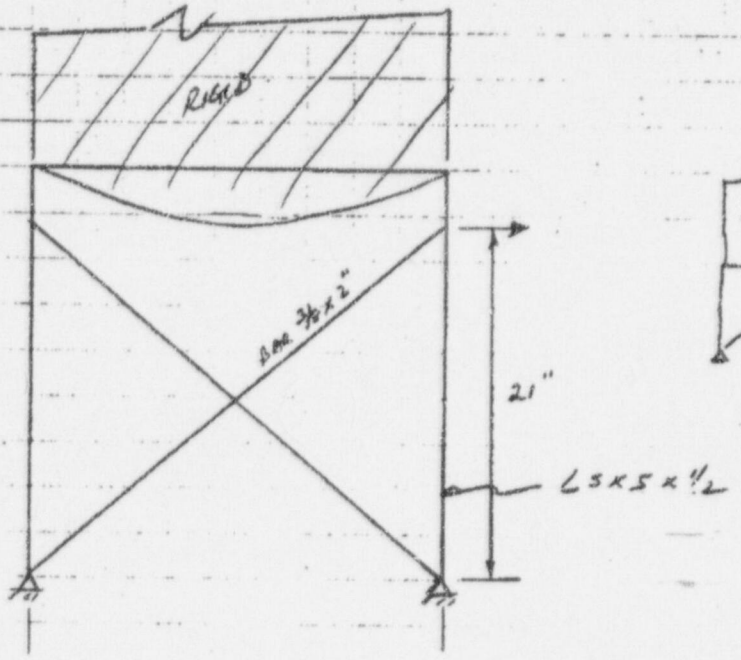
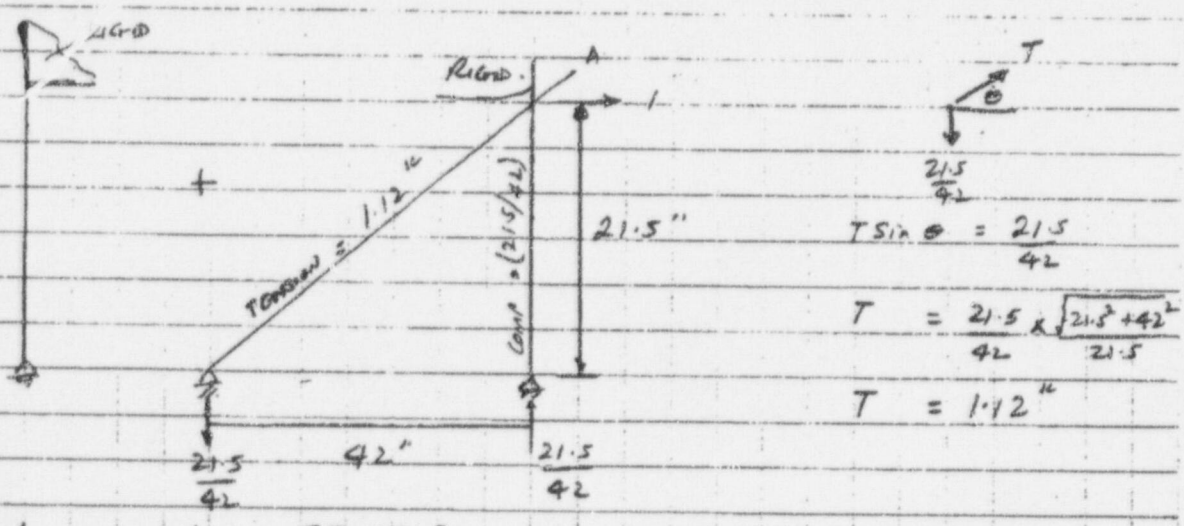
Calculation Sheet

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1 VERIFIER'S CHECK		NS-T-1 SENS	0	B7 of 9
Originator	Date	Reviewed by		Date
	10-14-93	N/A.		

DETERMINING STIFFNESS OF FRAME:



THE X BRACE ACTS TO RESIST TENSION ONLY. WHEN THE LOAD ACTS TO THE LEFT, THE STIFFNESS IS DERIVED FROM THE FOLLOWING TWO SYSTEMS.



$T \sin\theta = \frac{21.5}{42}$

$T = \frac{21.5}{42} \times \frac{\sqrt{21.5^2 + 42^2}}{21.5}$

$T = 1.12"$

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Calculation Sheet

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1 VERIFICAS CHECK		NS-T-1 SELS	0	88 of 9
Originator	Date	Reviewed by		Date
	10-14-93	N/A		

STIFF 2

CALCULATE DEFLECTION USING VIRTUAL WORK METHOD.

$$\Delta QD = \sum_{i=1}^{n} \frac{PPL}{EA}$$

MEMBER	p	P	L	A	PPL/A (lb²/in)
1	+ 1.12	+1.12	47"	0.75 in²	78.6
2	- 0.51	-0.51	21.5"	4.75 in²	1.18
					79.78

$$116 \times \Delta = \frac{1}{29 \times 10^6}(79.78) = 2.75 \times 10^{-6} \text{ in.}$$

$$\therefore K_2 = \frac{1}{\Delta} = 3.63 \times 10^5 \text{ lb/in.}$$

STIFF 1 $\quad L5 \times 5 \times 1/2$, $I = 11.3 \text{ in}^4$, $L = 25"$

$$K_1 = \frac{3EI}{L^3} = \frac{3 \times 29 \times 10^6 \times 11.3}{25^3} = 0.63 \times 10^5 \text{ lb/in}$$

TOTAL STIFFNESS

SINCE THERE ARE TWO BRACES IN EACH DIRECTION

$$\Sigma K_1 = 2 \times 0.63 \times 10^5 = 1.26 \times 10^5 \text{ lb/in}$$

$$\Sigma K_2 = 2 \times 3.63 \times 10^5 = 7.26 \times 10^5 \text{ lb/in}$$

TOTAL STIFFNESS $\Sigma K = \Sigma K_1 + \Sigma K_2 = 8.52 \times 10^5$ lb/in.

FREQUENCY $f = \frac{1}{2\pi}\sqrt{\frac{K}{M}}$, $M = 16850/386 = 43.65$ lb-mass

$$f = \frac{1}{2\pi}\sqrt{\frac{8.52 \times 10^5}{43.65}} = 22.3 \text{ Hz}$$

GPU Nuclear

Calculation Sheet

Subject		Calc No.	Rev. No.	Sheet No.
NS-T-1 VERIFIED CHECK		NS-T-1 SENS	0	B9 of 9
Originator	Date	Reviewed by		Date
JKRader	10-14-93	N/A		

ACCELERATION CORRESPONDING TO 22Hz SAY 20 Hz ARE AS FOLLOWS.

FIG. 3-88, NS DIRECTION = 0.2
FIG. 3-89, EW DIRECTION = 0.31
FIG 3-90, VERTICAL (RIGID) = 0.12.

DETERMINE BOLT LOADING.
REFER TO PAGE B3.

$$\text{TENSION} = \left(\left(\frac{16850(90.5)(.2^2+.31^2)^{1/2}}{2\times 42.75}\right)^2 + \left(\frac{16850(.12)}{4}\right)^2\right)^{1/2} - \frac{16850}{4} = 2387 \text{ lbs}$$

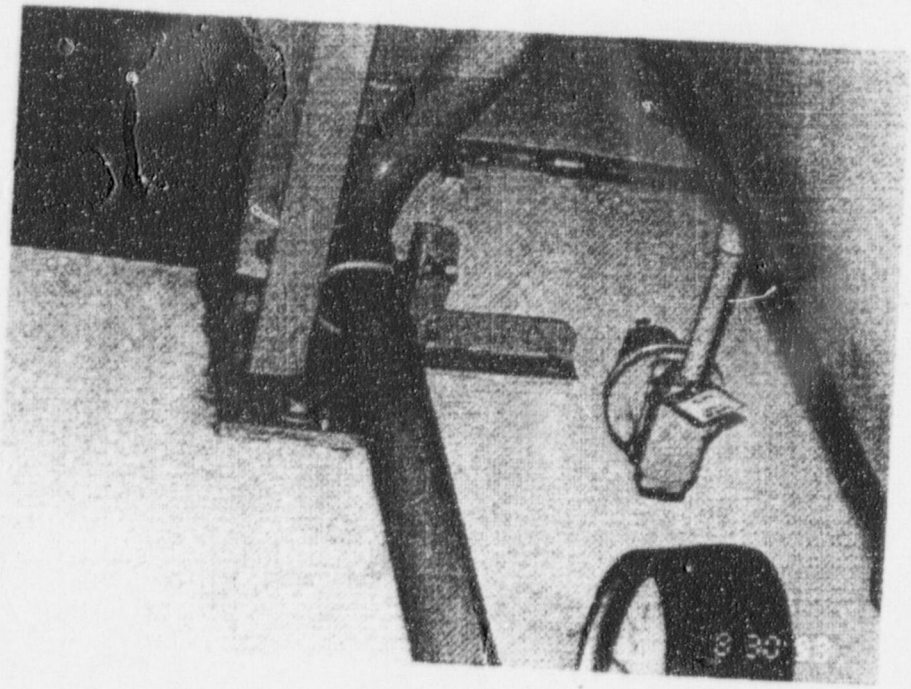
$$\text{SHEAR} = \frac{16850}{4}(.2^2+.31^2)^{1/2} = 1554 \text{ lbs.}$$

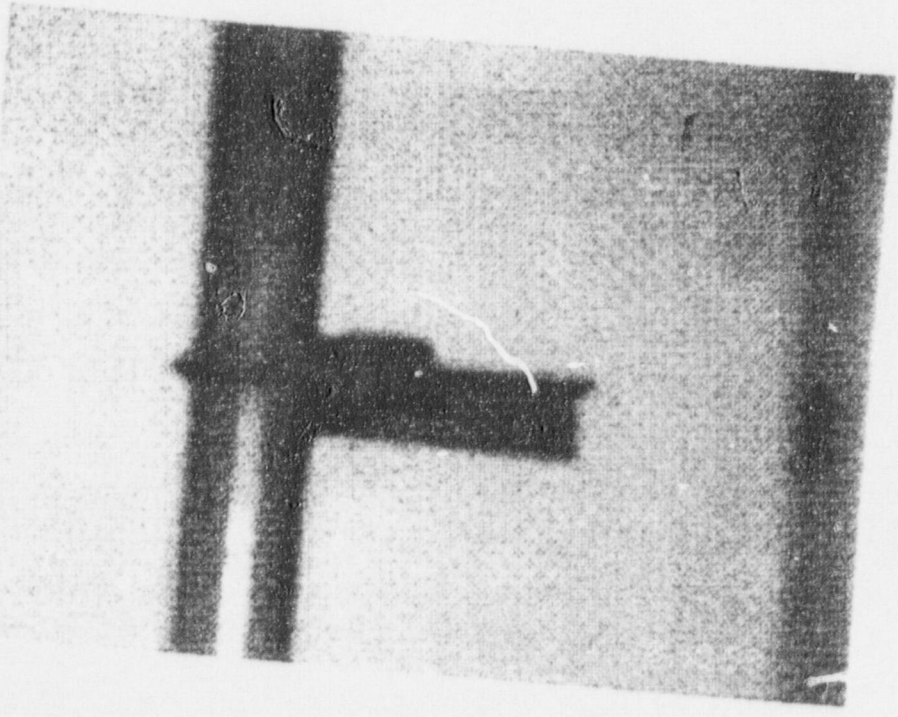
REFER TO PAGE B5

T_{all} = 20367 lbs
V_{all} = 4048 lbs

$$\frac{T}{T_{all}} + \frac{V}{V_{all}} = \frac{2387}{20367} + \frac{1554}{4048} = 0.5 < 1.0$$

NS-T-0001





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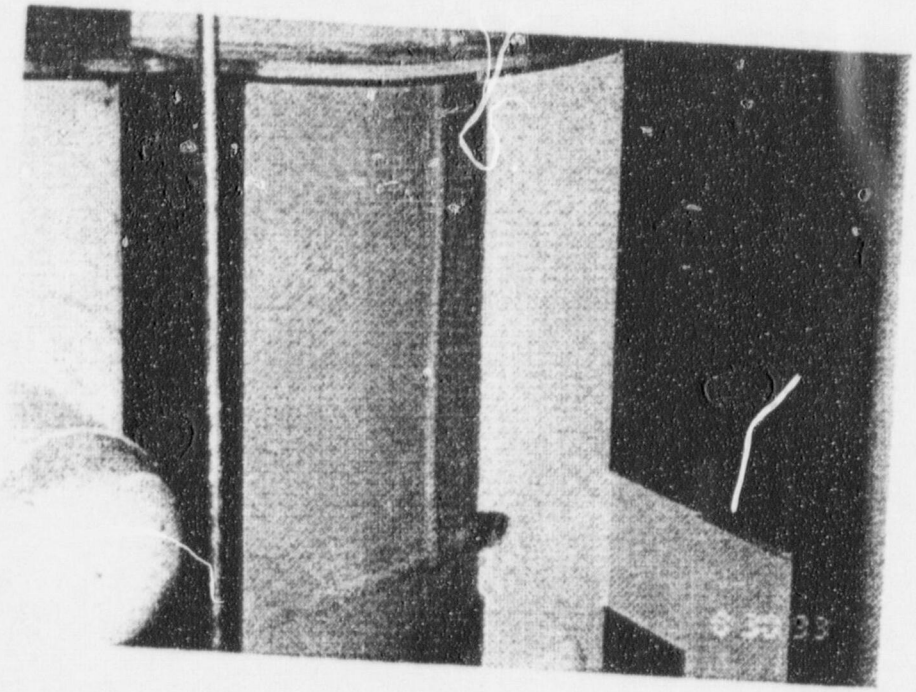

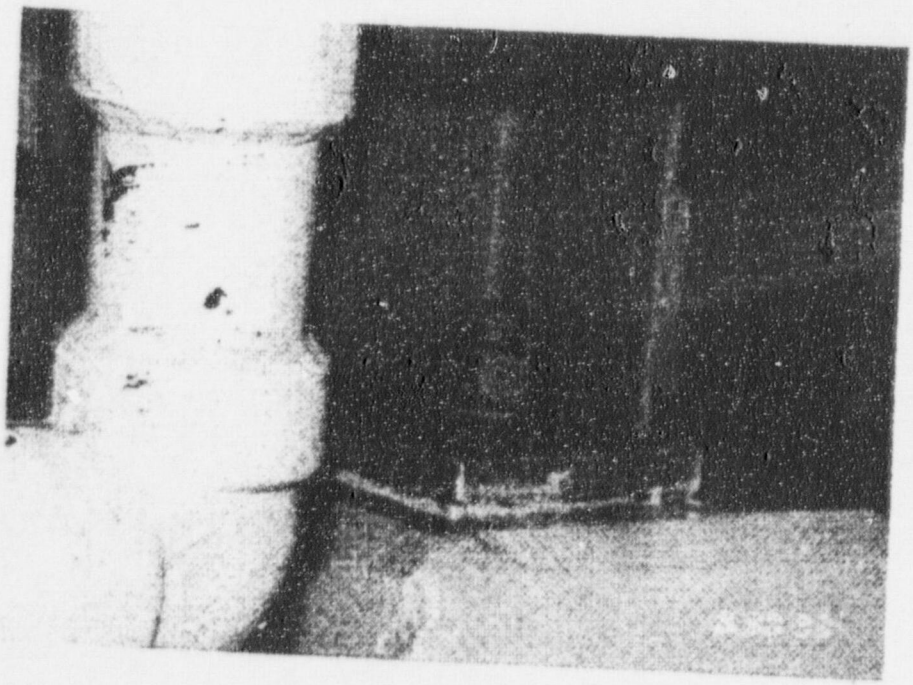

NS-T-0001