Calculation 50147-C-011, Rev. 1

HCLPF Calculations for Electrical Equipment on the A-46 Safe Shutdown Equipment List

EQE ENGINEERING CONSULTANTS

CALCULATION COVER SHEET

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Project: TVA/BFN A-46/IPEEE EVALUATIONS

Calculation Title: HCLPF CALCULATIONS FOR ELECTRICAL EQUIPMENT ON THE A-46 SAFE SHUTDOWN EQUIPMENT LIST (SSEL)

References: SECTION 4.0

Attachments: A to M

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ATTACHMENTS

A.	SEWS For	3-BDBB-268-0003D	(SSEL# 39016)	11 pages
B.	SEWS For	0-BDBB-219-0000A	(SSEL# 9031)	7 pages
C.	SEWS For	2-BDBB-231-0002A	(SSEL# 9020)	4 pages
D.	SEWS For	0-BDAA-211-0000A	(SSEL# 9012)	10 pages
E.	SEWS For	2-XFA-253-0002A1	(SSEL# 9006)	6 pages
F.	SEWS For	0-0XF-219-TDA	(SSEL# 9004)	6 pages
G.	SEWS For	2-MGEN-268-0002EN	(SSEL# 9141)	4 pages
H.	SEWS For	3-INVT-256-0002	(SSEL# 39075)	6 pages
I.	SEWS For	2-LPNL-925-0032	(SSEL# 9075)	5 pages
J.	SEWS For	0-LPNL-925-0045C	(SSEL# 9094)	5 pages
K.	SEWS For	0-LPNL-925-0041A	(SSEL# 9076)	6 pages
L.	SEWS For	2-PNLA-009-0087	(SSEL# 9072)	8 pages
M.	SEWS For	2-PNLA-009-0081	(SSEL# 9066)	4 pages

TOTAL NO. OF PAGES: 82
(Attachments)

1.0 PURPOSE

To Calculate High Confidence of Low Probability of Failure (HCLPF) Values for the electrical equipment that are on the A-46 Safe Shutdown List (SSEL), as part of the Individual Plant Examination of External Events (IPEEE) program at TVA/BFNP 2 & 3.

2.0 METHOD

The general method for performing HCLPF calculations corresponds to the guidelines established in EPRI Report NP-6041-SL (Ref. 2).

In most cases covered in this calculation, the stress interaction ratios that were either calculated in the original seismic qualification calculations or in the Seismic EValuation Work sheets (SEWS), which were completed as part of the A-46 program in accordance with the GIP guidelines (Ref. 1), were modified such that they correspond to the Ref. 2 guidelines for stress calculations. When the stress ratios are determined to be less than 1.0 for the IPEEE level seismic loading, then the equipment under consideration has a HCLPF $> 0.3g$.

3.0 INPUT DATA

The TVA/BFNP Electrical equipment that are on the safe shutdown Equipment List (SSEL, Ref. 3) were previously evaluated for the USI A-46 issues. These evaluations were documented on seismic Evaluation Work Sheets (SEWS). The SEWS include either a complete calculation for the anchorage adequacy under seismic loading or the seismic qualification calculation in the BFNP system is referenced on the SEWS as the basis for acceptance of the anchorage configuration of a particular equipment. In either case the SEWSs have been used as a primary input source for the IPEEE evaluations performed in this Calculation.

4.0 REFERENCES

1. Seismic Qualification Utility Group (SQUG), "Generic Implementation Procedure (GIP) for seismic Verification of Nuclear Plant Equipment," Revision 2A.

2. Electric Power Research Institute (EPRI) Report No. NP-6041-SL, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," Revision 1.

3. QIR BFEBFN94058, "USI A-46 Electrical Equipment," Safe Shutdown Equipment List, Rev. 7, Nov. 15, 1995.

4. Calculation No. CD-Q0000-940339, "Calculation of Basic Parameters for A-46 and IPEEE Seismic Programs," Rev. 0.

5. CEB 88-05-C, R1, "BFN MARS Report for Seismic Class I Structures", Vols. 1-5.

5.0 EVALUATIONS

The evaluation in this section consists of calculation of High confidence of low Probability of failure (HCLPF) values per guidelines of Reference 2. The following classes of equipment are on the BFNP U2/3 Electrical Safe Shutdown Equipment List (Ref. 3):

Class 01 - Motor Control Centers
02 - Low Voltage Switchgears
03 - Medium Voltage Switchgears
04 - Transformers
13 - Motor Generators
14 - Distribution Panels
15 - Batteries on Racks
16 - Battery chargers and Inverters
18 - Instruments on Racks
20 - Instrument and Control Panels and Cabinets
00 - Other

Some classes of equipment are inherently rugged and could be screened out for IPEEE evaluations (i.e., class 13 and 14). The class 00, "OTHER", consists of power supplies which are housed within panels. These panels are on the SSEL (class 20) and HCLPF values for these panels are determined in section 5.10 of this calculation. The power supplies are rugged equipment and therefore can be screened out for further IPEEE evaluations. (Total no. of power supplies on the Electrical SSEL is 32)

During the A-46 program, the electrical equipment on the A-46 SSEL were evaluated per the GIP guidelines (Ref. 1) for functionality and structural integrity under a DBE level earthquake. These evaluations are documented on Seismic Evaluation Work Sheets (SEWS). The structural integrity of these equipment assessed by either performing new calculations or utilizing the existing BFNP Calculations. In either case the stress calculations (BFNP's Calcs. or documented on SEWS) determined various

5.0 (Cont'd)

stress Interaction Ratios (IR's) for members, connections or anchorage configurations.

For the purposes of determining HCLPF values for these electrical equipment, the previously calculated IR's (based on A-46 level seismic input) are scaled up for the IPEEE level seismic demand and the level of conservatisms utilized in the original calculations are reduced (e.g., accelerat corresponding to 2% damping were used where a 5% damping as recommende by references 1 and 2 could be used, or the original evaluation considered DBE seismic loads but the IR's were calculated using OBE allowables).

When a stress interaction ratio for a particular equipment with the IPEEE level seismic demand is shown to be less than 1.0 then the HCLPF value for that equipment is considered to be greater than 0.3g. Otherwise, an actual HCLPF value is calculated based on the equipment's highest interaction ratio.

Note:
Since the issuance of the Rev. 0 of this calculation, additional equipment items were added to the SSEL. These additional items were evaluated and found to be equivalent to or bounded by the similar equipments evaluated in this Calculation.

FB 6-21-96
JSD 7/15/96

5.1 CLASS 01 – MCC's

Total number of MCC's on the SSEL (Ref. 3) = 20

2 MCCs @ EL. 565' of RB 2/3 (SSEL # 9036 & 39033) → HCLPF > 0.3g by comparison to HCLPF calculation performed for MCC's @ EL 583'-6" of DGB (see sect. 5.1.4)

4 MCC's @ EL. 583'-6" of DGB 1/2/3 (SSEL# 9031, 9032, 9033 & 39005) → HCLPF > 0.3g, (See sect. 5.1.4)

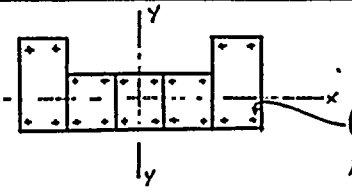
7 MCC's @ EL. 593' of RB 2/3 (SSEL # 9024, 9026, 9027, 9035, 39009, 39031 & 39016)

- 6 MCC's with [redacted] Base configuration and rigid top entry conduit : HCLPF > 0.3g
- 1 MCC with [redacted] Base config. HCLPF > 0.3g (See Sec. 5.1.1 & 5.1.2)

7 MCC's @ EL. 621'-3" of RB 2/3 (SSEL # 9023, 9025, 9034, 39008, 39030, 9028 & 39018)

- 5 MCC's with [redacted] Base config. Anchorage outliers
- 2 MCC's with [redacted] Base config. HCLPF > 0.3g (See Sec. 5.1.1 & 5.1.3)

5.1.1 HCLPF Calculation for the MCC's listed in the table below:

Base configuration: 

Ht = 90", C.G. @ 45" above base (location of 3/8" φ A307 bolts connecting the MCC to its sill channel. Conservatively, use same locations for the 3/4" φ A.B. connecting the sill to floor.)

Total no. of MCCs on SSEL with this type of base configuration = 3:

SSEL	EQUIP. I.D.	Bldg.	ELEV.
39016	3-BDBB-268-0003D	U3/RB	EL. 573'
9028	2-BDBB-268-0002E	U2/RB	EL. 621'-3"
39018	3-BDBB-268-0003E	U3/RB	EL. 621'-3"

Anchorage evaluation performed for these MCCs for A-46 seismic demand loads is included in the SEWS for 3-BDBB-268-0003D (SSEL 39016), (see attachment A)

The reported interaction ratios from the referenced evaluation are:

- 3/8" φ bolts connecting the MCC to sill channel → IR = 0.56
- 3/4" φ Red head A.B. connecting the sill to floor → IR = 0.66

Note that these interaction ratios were calculated conservatively by including a 1035# (D.L.) for top entry conduit and 1250# impact load at top of the MCC due to cable tray interaction. Also, the acceleration values used were those from EL. 621'-3" @ f = 8 Hz (for bounding purposes, since two other MCCs are located @ EL. 621'-3", i.e., SSEL# 9028 & 39018). To calculate a HCLPF value for each of the above MCCs in accordance with the guidelines of EPRI Report NP-6041-SL, Rev. 1. (Ref. 2), the following is performed.

5.1.1 (Cont'd)

By reference to the calculation performed and included in SEWS for SSEL No. 39016, the following parameters are obtained:

↑ (Attachment A)

Cond. wt. @ 90" above bare = 1035 #

cable tray impact load @ 90" above bare = 1250.#

MCC D.wt. = 3752 #

Section Modulus of bolt group : S_{xx} = 165 in

S_{yy} = 363 in

5.1.2 HCLPF Calculation for 3-BDBB-268-0003D (SSEL 39016)

(Note that the impact load due to cable tray is only applicable to this MCC)

Applicable IPEEE accelerations :

↓ (A-46 accel. @ f=8 HZ @ EL.593' of RB, Ref.5)

a_h = 0.63g × 1.88 = 1.18 g

↑ (IPEEE scale factor (Ref.: p.50 of Calc. CD-Q0000-940339 Ref. 4)

↓ ZPA @ EL.593' (Ref.5)

a_V = 0.16 g × 1.88 = 0.30 g

F_x = 1250 + (1035 × 1.18) + (3752 × 1.18) = 6899.#

F_y = (1035 × 1.18) + (3752 × 1.18) = 5649.#

F_z = (1035 + 3752) × 0.30g = 1436.#

M_x = (1035 × 1.18 × 90") + (3752 × 1.18 × 45") = 309,148.#"

M_y = (1250 × 90") + (1035 × 1.18 × 90") + (3752 × 1.18 × 45") = 421,648.#"

$M_z \simeq 0$

5.1.2 (cont'd)

- check 3/8" ϕ bolts

$$V = \left[\left(\frac{6899}{5\times4}\right)^2 + \left(\frac{5649}{5\times4}\right)^2\right]^{1/2} = 446.\#$$

$$f_V = \frac{446}{0.11(in^2)} = 4.1 \text{ ksi}$$

Shear - tension Interaction :

$$26(1.7) - 1.8(4.1) = 36.8^{ksi} > F_t = 1.7 \times 20^{ksi} = 34^{ksi}$$

$\rightarrow$ use $F_t = 34.$ ksi

Tension per 3/8" ϕ bolt :

$$T = \left[\left(\frac{309{,}148}{165"}\right)^2 + \left(\frac{421{,}648}{363"}\right)^2 + \left(\frac{1436}{5\times4}\right)^2\right]^{1/2} - \frac{1035+3752}{5\times4} = 1966\ \#$$

$$f_t = \frac{1966^{\#}}{0.11(in^2)} = 17.9 \text{ ksi} < F_t = 34 \text{ ksi}$$

$$\frac{f_t}{F_t} = \frac{17.9}{34} = 0.53 < 1.0 \quad \text{o.k.}$$

- check 3/4" ϕ Anchor Bolts (Conservatively use same bolt allowables as used for A-46 Eval

$V = 446^{\#} < V_{all} = 4.11^{k}$ $\quad V/V_{all} = 446/4110 = 0.11 < 0.3$ o.k.

$T = 1966^{\#} < T_{all} = 3.166^{k}$ $\quad T/T_{all} = 1966/3166 = 0.62 < 1.0$ o.k.

$\therefore$ HCLPF $> 0.3g$ for 3-DDBB-268-0003D (SSEL 39016)

5.1.3 HCLPF Calculation for 2-BDBB-268-0002E (SSEL 9028) & 3-BDBB-268-0003E (SSEL 39018)

These two MCCs are located @ EL. 621'-3" of RB (U2/3). There is no cable tray impact load on these MCCs. Anchorage evaluation performed on SEWS for 3-BDBB-268-0003D (A-46 evaluation) used applicable accelerations at EL. 621'-3",

Applicable IPEEE accelerations:

@ f=8Hz, RB; EL. 621'-3" (Ref. 5) IPEEE scale factor (Ref. calc. CD-Q0000-940339) Ref. 4

$a_h = 1.0g \times 1.88 = 1.88g$

ZPA @ 621'-3" RB (Ref. 5)

$a_v = 0.16g \times 1.88 = 0.30g$

$F_x = (1035 \times 1.88) + (3752 \times 1.88) = 9000.^{\#}$

$F_y = F_x = 9000^{\#}$

$F_z = (1035 + 3752) \times 0.30g = 1436^{\#}$

$M_x = (1035 \times 1.88 \times 90") + (3752 \times 1.88 \times 45") = 492,541.^{\#"}$

$M_y = M_x = 492,541.^{\#"}$

$M_z \approx 0$

- Check 3/8" ϕ bolts

$$V = \left[\left(\frac{9000}{5\times4}\right)^2 + \left(\frac{9000}{5\times4}\right)^2\right]^{1/2} = 636.^{\#}$$

$$f_v = \frac{636}{0.11} = 5.79 \text{ ksi}$$

Shear - Tension Interaction:

$26(1.7) - 1.8(5.79) = 33.8$ ksi $< F_t = 34$ ksi $\rightarrow$ use $F_t = 33.8$ ksi

5.1.3 (Cont'd)

Tension per 3/8" ϕ bolt:

$$T = \left[\left(\frac{492,541}{165}\right)^2 + \left(\frac{492,541}{363}\right)^2 + \left(\frac{1436}{5\times4}\right)^2\right]^{1/2} - \frac{1035+3752}{5\times4} = 3040.^{\#}$$

$$f_t = \frac{3040}{0.11} = 27.6 \text{ ksi} \quad < F_t = 33.8 \text{ ksi}$$

$$\frac{f_t}{F_t} = 0.82 \quad < 1.0 \quad \underline{ok}$$

- Check 3/4" ϕ Anchor Bolts

Conservatively use same bolt allowables as used for A-46 Evaluatio

$$V = 636^{\#} \quad < V_{all} = 4.11^{k} \quad ; \quad V/V_{all} = 636/4110 = 0.15 < 0.3 \quad ok$$

$$T = 3040^{\#} \quad < T_{all} = 3.166^{k} \quad \underline{ok}$$

$$\frac{T}{T_{all}} = 0.96 \quad < 1.0 \quad \underline{ok}$$

∴ HCLPF > 0.3g for 2-BDBB-268-0002E and 3-BDBB-268-0003E.

S.1.4 HCLPF calculation for the MCC's listed in the table below:

SSEL	Equipment I.D.	Bldg.	Elev.
9036	2-BDBB-281-0002C	U2 RB	EL. 565' (1)
39005	3-BDBB-219-0003EB	U3 DGB	EL. 583'-6"
39033	3-BDBB-281-0003C	U3 RB	EL. 565' (1)
9031	0-BDBB-219-0000A	U1/2 DGB	EL. 583'-6"
9032	0-BDBB-219-0000B	U1/2 DGB	EL. 583'-6"
9033	3-BDBB-219-0003EA	U3 DGB	EL. 583'-6"

Note (1) - Bounded by DGB El. 583'-6" (DBE accel @ 7Hz ≈ 0.6g for RB El. 565' < 1.05g)
(Also, IPEEE demand scale factor = 1.88 for RB < 2.18)

By reference to the calculation performed on SEWS for 0-BDBB-219-0000A (SSEL 9031), the HCLPF calculation follows:

↳ See Attachment B

Total MCC wt. = 5600#

wt. per section = $\frac{5600}{12}$ = 467#

Applicable IPEEE acceleration:

a_h = (DBE Accel. corresponding to f=7Hz* @ EL. 583'-6" of DGB (Ref. 5)) 1.05g x 2.18 = 2.30g

↳ IPEEE Scale factor for DGB (Ref. calc. CD-Q0000-940339 Ref. 4)

* See notes 8 and 9 on SEWS for SSEL No. 9031 regarding MCC

a_v = ZPA @ EL. 583'-6" (Ref. 5) 0.18g x 2.18 = 0.39g

T = tensile load per 1/4" ϕ D&T screws = $\left[\left(\frac{467 \times 2.3g \times 45"}{18" \times 2}\right)^2 + \left(\frac{467 \times 0.39g}{4}\right)^2\right]^{1/2} - \frac{467}{4}$

= 1227 #

V = shear load per 1/4" ϕ screw = $\left(\frac{467 \times 2.3g}{4}\right)\sqrt{2}$ = 380 #

5.1.4 (cont'd)

$$f_V = \frac{380}{\frac{\pi(.25)^2}{4}} = \frac{380}{0.049} = 7.74 \text{ ksi} \qquad < F_V = 10 \times 1.7 = 17 \text{ ksi} \qquad \text{ok}$$

Shear - tension interaction

$$26 \times 1.7 - 1.8 \cdot (7.74) = 30.3 \text{ ksi} \qquad < F_t = 20 \times 1.7 = 34 \text{ ksi}$$

$\rightarrow$ use $F_t = 30.3$ ksi

$$f_t = \frac{T}{A} = \frac{1227^{\#}}{.049} = 25.0 \text{ ksi} \qquad < F_t = 30.3 \text{ ksi}$$

$$\frac{f_t}{F_t} = 0.83 \qquad < 1.0 \qquad \text{ok}$$

$\therefore$ HCLPF $> 0.3g$ for MCC's listed on previous page

Note that the conservatively used multimode factor of 1.5 (in anchorage calc. performed in SEWS for SSEL No. 9031) is not used here for the HCLPF calculation. This is justified by the fact that the predominant mode for tall and slender motor control centers is that of a cantilever beam and as such the mass participating in the first mode is almost 100% of total system mass. Therefore, the applicable acceleration is that corresponding to the first mode frequency. The first mode frequency of this type of MCC with its anchorage system is in order of 3-7 HZ per test data (See SEWS for SSEL 9031). However, since accel @ 7 HZ frequency is greater than the accel. @ 3-5 HZ, the above calculation conservatively uses the acceleration values corresponding to 7 HZ. The reason for conservatism is that since there are flexible top entry conduit to these MCC as well as the fact that the anchorage configuration of these MCC's are very flexible, the fundamental frequency is closer to 3-5 HZ rather than the 7 HZ upper limit.

5.2 Class 02 - Low Voltage Switchgears

Total number of LVSG's on the SSEL (Ref. 3) = 6

2 LVSG's @ EL. 621'-3" of RB U1 → Anchorage outliers
(SSEL # 9018 & 9019)

2 LVSG's @ EL. 621'-3" of RB U2 → HCLPF > 0.3g (See sect. 5.2.1)
(SSEL # 9020 & 9021)

2 LVSG's @ EL. 621'-3" of RB U3 → Anchorage outliers
(SSEL # 9022 & 39007)

5.2.1 HCLPF Calculation for 2-BDBB-231-0002A (SSEL 9020) & 2-BDBB-231-0002B (SSEL 9021)

The stress interaction ratio for the above LVSG's is calculated in the SEWS for SSEL no. 9020. This ratio is 0.39 and corresponds to the stress ratio for anchorage plug welds. (see Attachment C)

Since the IPEEE spectra scale factor for RB is 1.88 (Ref. Calc. CD-Q0000-940339) The weld stress interaction ratio for IPEEE could conservatively be calculated as:

$$IR_{IPEEE} = 0.39 \times 1.88 = 0.73 \quad < 1.0$$

∴ Therefore, it is concluded that the HCLPF for the above switchgears is greater than 0.3g.

5.3 Class 03 - Medium Voltage Switchgears

Total no. of MVSG's on the SSEL (Ref. 3) = 8

2 MVSG's @ EL. 565' of DGB 3 → Anchorage Outliers
(SSEL # 9017 & 39020)

2 MVSG @ EL. 583.6' of DGB 3 → Anchorage Outlier
(SSEL # 9016 & 39001)

2 MVSG's @ EL. 593' of RB 1/2 → HCLPF > 0.3g (Per calc. on SEWS for SSEL No. 9012, $IR_{A-46} = 0.09$)
(SSEL # 9013 & 9015)

2 MVSG's @ EL. 621' of RB 1/2 → HCLPF > 0.3g (Per Calc. on SEWS for SSEL no. 9012, $IR_{A-46} = 0.09$)
(SSEL # 9012 & 9014) (See Attachment D)

5.4 Class 04 – Transformers

Total number of transformers on the SSEL (Ref.3) = 24

8 Neutral Gnd XFMR's @ El. 565' of DGB 1/2/3 → Anchorage outliers
(SSEL # 9160 to 9167)

2 4kv/480V XFMR's @ 583'-6" of DGB 1/2 → HCLPF ≥ 0.26g (see sect. 5.4.1).
(SSEL # 9004 & 9005)

2 Regulating XFMR's @ EL 593' of RB 2/3 → HCLPF > 0.3g (see sect. 5.4.2)
(SSEL # 9009 & 39050)

2 480-120/208V XFMR's @ EL. 593' of RB 2/3 → HCLPF > 0.3g. See A-46 SEWS (Attachment E) for SSEL 9006. $IR_{IPEEE} = 0.31 \times 1.88^{*} = .51 < 1.0$
(SSEL # 9008 & 39049)

2 Regulating XFMR's @ EL 621'-3" of RB 2/3 → HCLPF > 0.3g (see sect. 5.4.2)
(SSEL # 9007 & 39041)

2 480-120/208V XFMR's @ EL. 621'-3" of RB 2/3 → HCLPF > 0.3g. See A-46 SEWS for SSEL 9006. $IR_{IPEEE} = .31 \times 1.88^{*} < 1.0$
(SSEL # 9006 & 39040)

6 4KV/480V XFMR's @ EL. 621'-3" of RB 1/2/3 → HCLPF > 0.3g (see sect's 5.4.3 & 5.4.4)
(SSEL # 9001, 9002, 9003, 39006, 9194 & 9282)

XFMR-TS 1A & 1B

XFMR-TS 2A, 2B, 3A & 3B

* 1.88 is the IPEEE Scale factor per Calculation CD-Q0000-940339, Rev.0 (Ref.4) for the Reactor Bldg.

5.4.1 HCLPF Calculation for 0-0XF-219-TDA (SSEL 9004) / 0-0XF-219-TDB (SSEL 9005) @ El. 583'-6" DGB 1/2

By reference to the A-46 anchorage calculation performed on SEWS for SSEL 9004 the following input data is obtained: (see Attachment F)

- Total wt. = 3.95^{K}
- 4-1"ϕ C.I.P. anchors arranged in a 24½" x 29" configuration, connecting the sill to the concrete floor.
- 4-1"ϕ A307 (or equivalent) bolts arranged in a 24½" x 29" configuration, connecting the transformer to its sill.
- a_H^{Peak} = 2.134g (@ f=12 HZ, DGB, EL. 583'-6", DBE spectra) Ref. 5
- a_V^{ZPA} = 0.182g (Ref. 5)

From calc. CD-Q0000-940339 (Ref. 4), the IPEEE scale factor for DGB A-46 input accelerations is 2.18. The fundamental frequency of these transformer is greater than 8 HZ. But since the peak of the horiz. spectra in DGB is between 12 and 15 HZ use the peak spectral accelerations

→ a_h^{IPEEE} = 2.134g x 2.18 = 4.652g

→ a_V^{IPEEE} = 0.182g x 2.18 = 0.397g

F_h = 3.95^{K} x 4.652g = 18.375^{K}

F_V = 3.95^{K} x 0.397g = 1.568^{K}

5.4.1 (cont'd)

Pull out force per 1"φ CIP or 1"φ A307 bolt:

$$T = \left[\left(\frac{10.375 \times 54^{k}}{2 \times 24.5^{"}}\right)^2 + \left(\frac{18.375 \times 54^{"}}{2 \times 29^{"}}\right)^2 + \left(\frac{1.568}{4}\right)^2\right]^{1/2} - \frac{3.95}{4}$$

$$= 25.53^{k}$$

$$V = \sqrt{2}\left(\frac{18.375}{4}\right) = 6.50^{k}$$

- check 1"φ C.I.P:

$$\frac{V}{V_{allI}} = \frac{6.50}{13.35} = 0.49 \quad > 0.3$$

$$\frac{T}{T_{allI}} = \frac{25.53}{26.69} = 0.957 \quad < 1.0$$

$$IR = 0.7(0.957) + 0.49 = 1.16 \quad > 1.0 \quad \text{(HCLPF is less than 0.3g)}$$

$$\therefore \underline{HCLPF = \frac{1}{1.16}(.3) = 0.26\,g} \quad \text{(Controls, see also HCLPF value below)}$$

- check 1"φ A-307 bolts: $A_n = \frac{\pi}{4}(1)^2 = 0.785\ in^2$

$$f_v = \frac{6.5}{0.785} = 8.28\ ksi$$

$$F_t = (1.7 \times 26) - 1.8(8.28) = 29.3\ ksi$$

$$f_t = \frac{25.53}{0.785\ in^2} = 32.5\ ksi \quad > F_t = 29.3\ ksi \quad \text{(HCLPF is less than 0.3g)}$$

$$\therefore HCLPF = \frac{29.3}{32.5} \times .3g = 0.27\,g \quad \text{(does not control, see HCLPF value above)}$$

JOB NO. 50147 JOB TVA / BFNP A-46/IPEEE BY JBeij DATE 12-4-9

CALC. NO. C-011 SUBJECT HCLPF for Elect. Equip. CHK'D J.D. Rizzo DATE 12/27/9

5.4.2 HCLPF Calculation for 4-Regulating Transformers @ RB 2/3, EL. 593' & 621'-3"

2_XFA_253_0002B2	(SSEL 9009)	@ EL. 593'
3_XFA_253_0003B2	(SSEL 39050)	@ EL. 593'
2_XFA_253_0002A2	(SSEL 9007)	@ EL. 621'-3"
3_XFA_253_0003A2	(SSEL 39041)	@ EL. 621'-3"

The anchorage of above transformers are shown to be seismically adequate in calculation CD-Q3253-900446, R3. The highest interaction ratio calculate in this referenced calculation is 0.974 which corresponds to D/C ratio of 5/8" ϕ SSD anchor bolts. This interaction ratio is based on very conservati assumptions and much lower allowables than those in the GIP. The followin is performed to calculate a more realistic IR based on the GIP guidelines for A-46 program:

Used in Calc. CD-Q3253-900446

- Peak accel. @ 639', 2% Damping
- Multimode factor of 1.5
- $a_h = 6.42g$
- $a_v = 2.1g$
- 5/8" ϕ SSD: $T_{all} = 2.1^K$, $V_{all} = 2.25^K$

Could use per GIP

- say peak @ 639', 5% Damping (still conservative)
- MMF = 1.0
- $a_h = 2.48g \times 1.25 = 3.1g$ } (Ref. 5) ← To adjust to Mod. dir.
- $a_v = 0.73g \times 1.25 = 0.91g$
- 5/8" ϕ SSD: $T_{all} = 3.17^K \times .9 = 2.85^K$, $V_{all} = 3.79^K$ ← f'c factor

Conservatism factor, Referenced Calc. vs. GIP

$$= \frac{6.42g}{3.1g} \times \frac{2.85^K}{2.1^K} = 2.81$$

$IR = 0.974$ ⟶ $IR_{A\text{-}46} = \frac{0.974}{2.81} = 0.35$

↓ IPEEE Scale Factor (Ref. Calc. CD-Q0000-940339)

$IR_{IPEEE} = 0.35 \times 1.84 = 0.65 < 1.0$

$\therefore$ HCLPF $> 0.3g$

5.4.2 (Cont'd)

Used in Calc. CD-Q3253-700446

- ½" ϕ A307 Bolts: $F_t = 20$ Ksi, $F_v = 10$ Ksi
- Back plate: $F_b = 0.75(36) = 27$ Ksi

$M = 5389$ #"

$t_{req'd} = 1/2"$

Could use per GIP

- ½" ϕ A307 Bolts: $F_t = 20 \times 1.7 = 34$ Ksi, $F_v = 10 \times 1.7 = 17$ Ksi
- Back plate: $F_b = 27 \times 1.7 = 45.9$ Ks (worst ratio)

$M = 5389^{\#"} \times \frac{3.1g}{6.42g} = 2602^{\#"}$

$t_{req'd}^{A-46} = \left[\frac{6 \times 2602}{45900 \times 5}\right]^{1/2} = 0.26" < 1/2"$

$t_{req'd}^{IPEEE} = 0.26 \times 1.88 = 0.49" < 1/2"$ ok

Conservatism Factor, Ref. Calc. vs. GIP

$= \frac{6.42g}{3.1g} \times 1.7 = 3.52$

$IR = 0.67$

$IR_{A-46} = \frac{0.67}{3.52} = 0.19 < 1.0$

$IR_{IPEEE} = 0.19 \times 1.88 = 0.36 < 1.0$

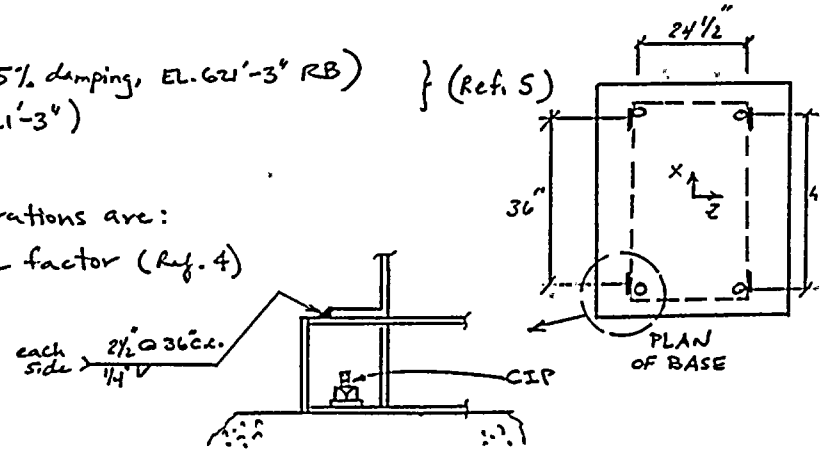
∴ HCLPF > 0.3g

∴ HCLPF > 0.3g

5.4.3 HCLPF Calculation for Transformers 1-XFA-231-TS1A (SSEL 9194) } @ EL. 621'-3" RB, 41
1-XFA-231-TS1B (SSEL 9282)

The anchorage configuration of these transformers is shown below. Per the SEWS for these XFMRs, their fundamental frequency is greater than 8 HZ. Therefore, use horizontal acceleration corresponding to $f = 8$ HZ from Ref. 5.

$a_L = 1.0g$ (DBE, @ f=8HZ, 5% damping, EL. 621'-3" RB) } (Ref. 5)
$a_V = 0.16g$ (ZPA, RB, EL. 621'-3")



The corresponding IPEEE accelerations are:

$a_L^{IPEEE} = 1.0g \times 1.88 = 1.88g$ ← IPEEE scale factor (Ref. 4)

$a_V^{IPEEE} = 0.16g \times 1.88 = 0.30g$

By reference to section 5.4.1, the horizontal and vertical seismic forces acting at the centroid of the above transformers are:

$F_h = 6.2^k \times 1.88g = 11.66^k$ (D.L. from DWG. 1-45N336, R2)

$F_V = 6.2^k \times 0.30g = 1.86^k$

$$\Rightarrow \quad T = \left[\left(\frac{11.66 \times 54"}{2 \times 24.5"}\right)^2 + \left(\frac{11.66 \times 54"}{2 \times 36"}\right)^2 + \left(\frac{1.86}{4}\right)^2\right]^{1/2} - \frac{6.2}{4} = 14.0^k$$

$$V = \sqrt{2}\left(\frac{11.66}{4}\right) = 4.1^k$$

- Check 1" ϕ C.I.P:

$$\frac{V}{V_{411}} = \frac{4.1}{13.35} = 0.31 \quad , \quad \frac{T}{T_{411}} = \frac{14.0}{26.69} = 0.52$$

$$I.R. = 0.31 + 0.7(0.52) = 0.67 < 1.0 \quad \text{ok}$$

5.4.3 (cont'd)

- check welds between the transformer and its mounting base:

$F_W = 30.6^{ksi} \times 0.707 \times 1/4" = 5.41$ k/in

$f_{W_x} = \frac{11.66}{4 \times 2.5"} = 1.2$ k/in (due to F_x)

$f_{W_z} = \frac{11.66}{4 \times 2.5"} = 1.2$ k/in (due to F_z)

$f_{W_{y_x}} = \frac{11.66\,(54"-6")}{(2 \times 2.5")(36")} = 3.1$ k/in (due to F_x)

$f_{W_{y_z}} = \frac{11.66\,(54"-6")}{(2 \times 2.5")\,24.5"} = 4.57$ k/in (due to F_z)

$f_{W_{y_y}} = \frac{1.86^k}{4 \times 2.5"} = 0.19$ k/in (due to f_y)

$f_{W_{D.L.}} = \frac{-6.2}{4 \times 2.5} = -0.62$ k/in (due to D.L.)

$f_{W_y} = \left(f_{W_{y_x}}^2 + f_{W_{y_z}}^2 + f_{W_{y_y}}^2\right)^{1/2} - f_{W_{D.L.}} = 4.91$ k/in

$f_{W_T} = \left(f_{W_x}^2 + f_{W_z}^2\right)^{1/2} = 1.70$ k/in

$$\left(\frac{f_{W_y}}{F_W}\right)^2 + \left(\frac{f_{W_T}}{F_W}\right)^2 = \left(\frac{4.91}{5.41}\right)^2 + \left(\frac{1.7}{5.41}\right)^2 = 0.92 < 1.0$$

ok

∴ HCLPF > 0.3g

5.4.4 HCLPF Calculation for 4KV/480V Transformers

SSEL No.	Component I.D.	Bldg.	EL.
9001	2-XFA-231-TS2A	RB2	621'-3"
9002	2-XFA-231-TS2B	RB2	621'-3"
9003	3-XFA-231-TS3A	RB3	621'-3"
39006	3-XFA-231-TS3B	RB3	621'-3"

The above transformers' base anchorage have been qualified in calculations CD-Q2303-87195,R2 ; CD-Q2303-87196,R1 and CD-Q0303-922125, Rev. 7. The acceleration values used for anchorage evaluation are:

$$a_h = 3.0\,g$$
&
$$a_V = 0.63g.$$

Also, the method of load combination consisted of one horizontal load plus vertical load.
The applicable accelerations to be used for IPEEE evaluation, considering that the lowest natural frequency of these types of transformers was shown to be 9HZ by shake table testing (see Ref. 6.4 on Calc. no. CD-Q2303-87195) are:

@ f=9HZ → $a_h^{IPEEE} = 0.79\,g \times 1.88 = 1.49\,g$ (IPEEE Scale Factor (Ref. Calc. CD-Q0000-940330) (DBE, 5%, RB, EL. 621'-3") Ref. 5

@ ZPA → $a_V^{IPEEE} = 0.16g \times 1.88 = 0.30\,g$

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5.4.4 (Cont'd)

To account for all 3-directions of earthquake simultaneously (GIP and IPEEE method of load combination) conservatively multiply the above accelerations with a factor of $\sqrt{2}$. This is justified as the contribution of stresses due to vertical excitation is almost negligible compared to that of the horizontal exitation. This is especially true when SRSS of the response of three directions is used.

$$\left[\approx \sqrt{a_{h_{E/W}}^2 + \underbrace{a_{h_{N/S}}^2}_{\sim a_{h_{E/W}}^2} + \underbrace{a_V^2}_{\sim 0}} \rightarrow a_{h_{E/W}}\sqrt{2} \right]$$

Therefore, the equivalent acceleration to be considered for IPEEE analysis is:

$$a_{h_{equiv}}^{IPEEE} = 1.49g \times \sqrt{2} = 2.1\,g \quad < \quad a_h = 3.0\,g.$$

Since the original seismic qualification calcs. (Referenced on previous page) used higher accelerations (3.0g vs. 2.1g and 0.63g vs. 0.30g) and showed the transformers to be adequate for seismic loading, it is concluded that the transformers are also adequate for the IPEEE level seismic input by comparison.

$\therefore$ HCLPF $> 0.3\,g$

5.5 Class 13 - Motor-Generators

There are a total of 4 Motor-Generators (MG-sets) on the SSEL (Ref. 3) . . (SSEL # 9140, 9141, 39015 & 39017).

Three of these MG sets are @ EL. 621'-3" of RB2/3 and one is at EL. 639' of RB2. These equipment are inherently rugged and are therefore screened out for IPEEE → ∴ HCLPF > 0.3g

(see also anchorage evaluation performed on SEWS for 2-MGEN-268-0002E SSEL no. 9141 and the significant margin)
↳ (See Attachment G)

5.6 Class 14 - Distribution Panels

There are a total of 91 equipment on the SSEL (Ref. 3) classified as Distribution Panels. These equipment are mostly wall-mounted with exception of a few which are floor-mounted panels. The anchorage evaluations performed on some selected and bounding panels in the A-46 program (see respective SEWS* for anchorage evaluation) showed high factors of safety (> 2.0). Therefore, this class of equipment is screened out for IPEEE.

∴ HCLPF > 0.3 g

*Ref.: See SEWS for SSEL #'s: 9146 - 9149, 9156, 9157, 9037 - 9039, 9116 - 9118, 39051, 39052, 39042 - 39044. Also, SSEL #'s; 9132, 9179, 39100, 39101, 9120, 9123, 9126, 9129, 9177.

5.7 Class 15 - Batteries on Racks

There are a total of 16 Battery Racks on the SSEL (Ref. 3)

8 Battery Racks @ EL. 565' of DGB 1/2/3 → HCLPF > 0.3g. (see sect. 5.7.1)
(SSEL # 9142, 9143, 9144, 9145, 9154, 9155, 39002 & 39021)

1 Battery Rack @ EL. 583'-6" of DGB 3 → HCLPF ≒ 0.3g (See sect. 5.7.2)
(SSEL # 9131)

3 Battery Racks @ EL. 593' of RB 1/2/3 → HCLPF > 0.3g for #9138 & 9139
HCLPF = 0.3g for #9137
see sect. 5.7.3
(SSEL# 9137, 9138, 9139)

4 Battery Racks @ EL. 621'-3" of RB 1/2 → HCLPF > 0.3g (See sect. 5.7.4)
(SSEL# 9119, 9122, 9125, 9128)

5.7.1 HCLPF Calculation for Battery Racks @ EL. 565' of DGB 1/2/3

(SSEL #'s 9142-9145, 9154, 9155, 39002 and 39021)

These racks support the 125 V DC Diesel batteries. The anchorage configuration as well as member stresses for these racks have been seismically qualified in calculation CD-Q0999-900691, Rev.5. The method used in the referenced calculation is extremely conservative. The elements of conservatism in the referenced calc. are listed below:

- Peak accelerations are used ($a_h = 2.68g$, $a_v = 0.72g$) } (p. 6a of the ref'd calc.
- 2% Damping is used
- Multimode factor of 1.5 is used (p. 11 of the ref'd calc.)

Per testing performed on these racks the fundamental frequencies for these racks are: (Ref. p.32 of the ref'd calc.)

$$f_{long.} = 15.5 \text{ HZ}$$

$$f_{Trans.} = 20.0 \text{ HZ}$$

$$f_{Vert} = 30.0 \text{ HZ}$$

Since there would be no or insignificant overturning due to longitudinal loads due to aspect ratio of the racks, its effect on anchor bolt or welds tensile loads can be ignored. Therefore, the method of 2-D load combination used in the referenced Calc. (1-Horiz. + Vertical Acceleration) would have insignificant difference with that of GIP method (3-D Comb.)

In order to estimate the equivalent worst stress interaction ratio for IPEEE evaluation, the overly conservative approach used in the above referenced calc. can be adjusted (per GIP guidelines) as follows:

$a_h = 0.56\,g$ (DGB, EL. 561', 5% damping @ f=20 HZ) Ref. 5

$a_v = 0.17\,g$ (DGB, EL. 561', ZPA) Ref. 5

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5.7.1 (cont'd)

Factor to be applied to the stress interaction ratios obtained in the referenced calc. to calculate an estimate of IR_{IPEEE}:

accel. to be used for IPEEE/HCLPF calc. → 0.56g / (2.68g × 1.5) × 2.18 = 0.30 *

← IPEEE scale factor for DGB (Ref. Calc. CD-Q0000-94339 Ref. 4)

↑ accel used in orig. qualification ref'd calc. ↑ Multi. Mode. Factor

The highest stress interaction ratio reported in Calc. CD-Q0999-900691, Rev.5 is 1.09 (corresponding to welded stud, Page 30), The estimated equivalent IR for IPEEE evaluation is

$$IR_{IPEEE} = 1.09 \times 0.3 = 0.33 < 1.0$$

∴ HCLPF > 0.3g

* It is noted that the GIP (Ref. 1) and IPEEE guidelines (App. P, Ref. 2) also allow an increase factor of 1.7 and 1.87, respectively, to be applied to weld allowables, as well as, an increase factor of 1.7 that could be used for member and bolt stress allowables. These factors are not considered here and as such the above IR_{IPEEE} is still a conservative number.

5.7.2 HCLPF Calculation for the Battery Rack @ EL. 583'-6" of DGB 3 (SSEL # 9131)

This rack supports the 250V Batteries (3-BATA-248-0003EB). The seismic qualification of this rack is contained in calculation no. CD-Q3248-910432, Rev. 2. Stress interaction ratios for all components of the battery rack (members, connections and anchorage) are summarized and listed on page 52 of the referenced calc.

Some of the highest IR's from this table are selected here in order to calculate an upper bound equivalent IR for IPEEE methodology.

- IR = 0.86 for $5/16''$ ϕ THRD'D Tie Rods (Ref. pp. 27 & 52 of Calc. CD-Q3248-910432)

The above IR was calculated by using elastic section modulus of the tie rod. Per GIP & IPEEE methodology, plastic section modulus could be used to obtain realistic ductile failure capacity (Sect. 6, Ref. 2)

$$IR_{IPEEE} = 0.86 \times 2.18 \times \frac{1}{1.7} \times \frac{1}{1.333} = 0.83 \quad < 1.0 \quad \text{ok}$$

(2.18: IPEEE scale factor (CD-Q0000-940339); 1.7: allowable stress increase factor per GIP; 1.333: shape factor for circular solid sections ($S_x \rightarrow Z_x$))

∴ HCLPF > 0.3g

- IR = 0.74 for L2x2x1/4" cross-brace (Ref.: pp. 18 & 52 of CD-Q3248-910432)

$$IR_{IPEEE} = 0.74 \times \frac{2.18}{1.7} = 0.95 \quad < 1.0 \quad \text{ok}$$

(0.74: see above)

∴ HCLPF > 0.3g

5.7.2 (Cont'd)

- IR = .77 for weld between Cross-brace & TS 2x2x1/4 (Ref.: pp. 40 & 52, CD-Q 3248-910432)

$$IR_{IPEEE} = 0.77 \times \frac{2.18}{1.7} = 0.99 \quad < 1.0$$

$\therefore$ HCLPF = 0.3 g

- IR = 0.86 for 1/2" ℄ @ wall (Ref.: pp. 50 & 52, CD-Q 3248-910432)

$$IR_{IPEEE} = 0.86 \times \frac{2.18}{1.7} \times \frac{1}{1.5} = 0.74 \quad < 1.0 \quad \text{OK}$$

$\frac{2.18}{1.7}$: IPEEE scale factor for DGB

Allowable stress increase factor per GIP

$\frac{1}{1.5}$: shape factor for solid rectangular cross-section to convert elastic section modulus, that is used to calculate IR=.86 in the referenced calc., to plastic section modulus as allowed for IPEEE evaluation per EPRI NP-6041-SL Report for ductile components (Sect. 6, Ref. 2)

$\therefore$ HCLPF > 0.3 g

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CALC. NO. C-011 SUBJECT HCLPF for Elect. Equip. CHK'D J.D.Stevenson DATE 12/28/95

5.7.3 HCLPF Calculation for 3 Battery Racks @ EL. 593' of RB

SSEL NO.	Equipment I.D.	Building	EL.
9137	0-BATA-248-0001	RB	593'
9138	0-BATA-248-0002	RB	593'
9139	0-BATA-248-0003	RB	593'

Seismic qualification of battery racks #2 & 3 (SSEL 9138 & 9139) is performed in calculation no. CD-Q0248-910430, Rev. 0. The lowest natural frequency of these racks are found to be 14.3 HZ by frequency analysis performed utilizing STRUDL computer program. The analysis uses a conservative structural damping of 2% in determining the acceleration corresponding to 14.3 HZ. Additionally, a multimode factor of 1.5 is used. Other conservatisms in the calculation correspond to the fact that forces and stresses are determined using SSE loading but they are compared to OBE allowables. The method of load combination is 2D-absolut sum (Vertical + one horizontal accelerations), however, critical elements are checked using envelop of all load cases which then considers loading in all three directions. This method is then more conservative than the SRSS of three directions, especially considering that a higher acceleration value is used in the above referenced calc.

$a_{x_{used}} = 1.52g$ (Calc. CD-Q0248-910430, R0 @ f=14.3 HZ, RB, EL. 593', 2%, DBE, w/ MMF=1.5)

(@ f=14.3 HZ, RB, EL. 593', 5%, DBE, Ref. 5)

$a_{x_{IPEEE}} = 0.54g \times 1.88 = 1.02g$

↑ IPEEE Scale factor for RB (Ref. Calc. CD-Q0000-940339 Ref. 4)

5.7.3 (Cont'd)

The highest stress ratios reported in the referenced calculation are: (Ref. pp. 60 & 61 of calc. CD-Q0248-910430, R0)

	Ref.	IR for IPEEE Evaluation [2]
TS 2x2 x 1/4"	0.85	$0.85 \times \frac{1.88}{1.7} = 0.94$ (1.88 = IPEEE scale factor; 1.7 = allowable stress increase factor per GIP & EPRI NP-6041-SL)
L 2 x 2 x 1/4	0.91	$0.91 \times \frac{1.88}{1.7} = 1.0$
Tie Rod (3/8" ϕ)	0.94	$0.94 \times \frac{1.88}{1.7 \times 1.333} = 0.78$ (1.333 = shape factor for solid circular section)
Gusset pl & Brace connection	0.86	$0.86 \times \frac{1.88}{1.7} = 0.95$
Weld @ Vert. post and Embed. pl	0.83	$0.83 \times \frac{1.88}{1.7} = 0.92$
Embedded 3/8" ϕ Anchors	0.7	(1)

(1) from p. 54 of Calc. CD-Q0248-910430, Rev. 0 the pull out and shear loads on 3/8" ϕ anchors are: (conservative)

$T = 1188^{\#}$, $V = 193^{\#}$ $\Rightarrow$ $T_{IPEEE} = 1188 \times 1.88 = 2233.^{\#}$, $V_{IPEEE} = 193 \times 1.88 = 363.^{\#}$

From GIP Table C.3-1, the allowable pullout and shear loads for cast-in-place headed studs are:

$T_{all} = 3.74^{k} > T_{IPEEE} = 2233^{\#}$, $\frac{T}{T_{all}} = \frac{2233}{3740} = 0.60 < 1.0$ ok

$V_{all} = 1.87^{k} > V_{IPEEE} = 363^{\#}$, $\frac{V}{V_{all}} = 0.19 < 0.3$ ok

(2) The actual IR for IPEEE eval. is actually lower than calculated here, due to conservatisms reported on the previous page. → HCLPF > 0.3g

(Note: see also the discussion on page 35, which is also applicable to these battery racks.)

5.7.3 (cont'd)

- Seismic qualification of battery rack No. 1 (SSEL#9137) is performed in Calculation no. CD-Q1248-900400, Rev.2. Per table 2-4 of Ref.2, braced racks designed for seismic loads are screened out for seismic margin evaluation, given that rigid spacers between batteries and end restraints are provided. These racks do have rigid spacers and end restraints as well as tight fitting side rails.

In the above referenced calculation, the fundamental frequency of these racks are estimated in each direction by modeling the rack utilizing STRUDL program.

$$f_{longitudinal} = 14.7 \text{ Hz}$$
$$f_{vert} = 12 \text{ Hz}$$
$$f_{Lateral} = 8.5 \text{ Hz}$$

The most critical components {Per above referenced calc.}, based on the calculated stress interaction ratios, were determined to be the welded connections @ L2x2x1/8 members and the bending stress @ the L2x2x1/8 vertical posts ($IR_w = 0.71$, page 14; $IR_w = 0.93$ on page 31, $IR_{bending} = 0.69$ on page 20). Anchorage of these racks are not as critical as the above components (see p.53). The above referenced calculation is conservative in that it decouples the longitudinal model from the transverse model. Also, the longitudinal model does not include some critical bracing members that will redistribute the seismic loads in the longitudinal direction and reduce bending stresses in the vertical post members. The decouple models do not depict the true behavior of the rack as a whole and as such are conservative. Nevertheless, these braced racks as mentioned earlier have performed very well in the past earthquakes and could be screened out for the IPEEE evaluation per reference 2.

∴ HCLPF ≥ 0.3g

5.7.4 HCLPF Calculation for 4 Battery Racks @ EL-621'-3" of RB 1/2

SSEL No.	Equipment I.D.	Bldg.	EL.
9119	0-BATA-248-0000A	RB	621'-3"
9122	0-BATA-248-0000B	RB	621'-3"
9125	0-BATA-248-0000C	RB	621'-3"
9128	0-BATA-248-0000D	RB	621'-3"

- These racks support the 250 V Batteries SB-A, B, C & D. The structural components of these racks, as well as, their anchorage configurations have been seismically qualified in calculation no. CD-Q0248-910431, Rev. 2. In this referenced calculation SSE Loads are used and the resulting stresses are compared to the OBE allowables. The highest interaction ratio listed in the summary table on pg. 40 of the Ref'd Calc. for member stresses and connections is 0.67 (excluding I.R for anchor bolts since the allowable anchor bolt loads for SSE are the same as that for OBE). Ignoring the conservatism used in the calc. for Z-dir. acceleration which utilized a multimode factor of 1.5 (pg. 15 of Ref'd calc.) the equivalent I.R. for IPEEE evaluation is:

$$I.R._{IPEEE} = \frac{0.67 \times 1.88}{1.7} = 0.74 < 1.0 \quad \text{OK}$$

(1.88: IPEEE scale factor in RB (CD-Q0000-940339 Ref. 4); 1.7: stress allowable increase factor per EPRI NP-6041 (Ref. 2) and GIP (Ref. 1))

$$\Rightarrow \quad \therefore \text{ HCLPF} > 0.3\,g$$

5.7.4 (cont'd)

- The stress ratio for the new ½"x10"x10" base plates is reported to be 0.90 (pg. 40 of Calc. CD-Q 0248-910431, R2). This ratio is based on envelop of all load cases and the OBE allowables. To convert this IR to equivalent IR for IPEEE evaluation, we have

$$IR_{IPEEE} = \frac{0.9 \times 1.88}{1.7} = 0.995^{*} < 1.0 \quad \text{ok}$$

(1.88: IPEEE scale factor for RB (Ref. 4); 1.7: stress allowable increase factor per GIP & EPRI NP-6041)

* This ratio is still conservative due to load enveloping, use of MMF in Z-dir loading and use of elastic section modulus instead of plastic section modulus as allowed for IPEEE evaluation for ductile components. (Sect. 6, Ref. 2)

=> ∴ HCLPF > 0.3g

- The highest IR for anchor bolts is reported as 0.89 (see p. 40 of the above Ref'd Calc.). This IR corresponds to the shear-tension interaction ratio for 3/8" Φ wedge bolts.

To conservatively calculate an equivalent IR for the IPEEE evaluat consider the loads reported on p. 33 of the ref'd calc. These loads are the worst case load and are therefore conservative.

Loads from P. 33 of Calc. CD-Q0248-910431, R2

$F_X = 73^{\#}$
$F_Y = 958^{\#}$
$F_Z = 406^{\#}$
$M_{X,jt\,43} = 5673^{\#"}$
$M_{X,jt\,50} = 5098^{\#"}$
$M_{Y,jt\,43} = 227^{\#"}$
$M_{Y,jt\,50} = 41^{\#"}$

Convert to IPEEE level Loads

$F_X = 73 \times 1.88 = 137.^{\#}$
$F_Y = 958 \times 1.88 = 1801.$
$F_Z = 406 \times 1.88 = 763.$
$M_{X43} = 5673 \times 1.88 = 10665.^{\#"}$
$M_{X50} = 5098 \times 1.88 = 9584.$
$M_{Y43} = 227 \times 1.88 = 427.$
$M_{Y50} = 41 \times 1.88 = 77.$

5.7.4 (Cont'd)

conservatively following the same calculation procedure as shown on p. 33 of the Ref.'d calculation, determine the shear & Tensile loads on the 3/8" φ wedge bolts. This procedure is conservative since the pull out loads due to Mx & Fy could be combined by SRSS approach but per Ref.'d calc. they are combined absolute sum.

$$T = \left(\frac{1}{2}\right)\left[F_y + \frac{M_{x43} + M_{x50}}{17.625}\right] = \left(\frac{1}{2}\right)\left[1801 + \frac{10665 + 9584}{17.625}\right] = 1475.\ \#$$

$$V_x = \left[F_x + \frac{\Sigma M_y}{17.625}\right]\left(\frac{1}{2}\right) = \left[137 + \frac{427+77}{17.625}\right] \times \frac{1}{2} = 83.\ \#$$

$$V_z = \left[F_z + \frac{\Sigma M_y}{1.875}\right]\left(\frac{1}{2}\right) = \left[763 + \frac{427+77}{1.875}\right] \times \frac{1}{2} = 516.\ \#$$

↑ conservative

$$V = \left(V_x^2 + V_z^2\right)^{1/2} = \left(83^2 + 516^2\right)^{1/2} = 523.\ \#$$

3/8" φ wedge bolts, allowables per GIP corrected for IPEEE F.S.

$$T_{all} = 1460^{\#} \times \left(\frac{3600}{4000}\right)^{RF_p} \times \frac{3.0}{2.4} = 1643^{\#}$$

(RF_p: reduction factor for pullout allowable per Ref. 2; 3.0/2.4: F.S. for pullout allowable per Ref. 2)

$$V_{all} = 1420^{\#} \times \frac{3.0}{2.0} = 2130.\ \#$$

(3.0: F.S. per GIP (Ref. 1); 2.0: F.S. for shear allowable per EPRI NP-6041SL (Ref. 2))

$$\frac{V}{V_{all}} = \frac{523}{2130} = 0.25 < 0.3 \quad \underline{ok}$$

$$\frac{T}{T_{all}} = \frac{1475}{1643} = 0.90 < 1.0 \quad \underline{ok}$$

$$\Rightarrow \text{ .·. HCLPF} > 0.3g$$

5.8 Class 16 - Battery Chargers and Inverters

There are total of 16 chargers and 4 inverters on the SSEL (Ref. 3)

8 Chargers @ EL. 565' of DGB 1/2/3 (SSEL # 9150, 9151, 9152, 9153, 9158, 9159, 39004, 39023) → HCLPF > 0.3g. Wall mounted chargers screened out for IPEEE. See SEWS for A-46 Anch. eval. & available marg

1 charger @ EL. 583'-6" of DGB 3 (SSEL # 9133) → HCLPF > 0.3g. (See Sect. 5.8.1)

3 chargers @ EL. 593' of RB 1/2 (SSEL # 9134, 9135, 9136) → HCLPF > 0.3g. See SEWS for A-46 anchorage eval. and available margin Screened out for IPEEE.

2 Inverters @ EL. 593' of RB 2/3 (SSEL # 9114, 39070) → HCLPF > 0.3g. See A-46 SEWS for SSEL 39075 for anchorage qualification an margins. ($IR_{IPEEE} = IR_{A-46} \times$ IPEE scale fact $= 0.21 \times 1.88 = 0.39 < 1.0$)

4 chargers @ EL. 621'-3" of RB 1/2 (SSEL # 9121, 9124, 9127, 9130) → HCLPF > 0.3g. (See sect. 5.8.1)

2 Inverters @ EL. 621'-3" of RB 2/3 (SSEL # 9115, 39075) → HCLPF > 0.3g. See A-46 SEWS for SSEL 39075 for anchorage qualification and margins. (Attachment H)

$IR_{IPEEE} = 0.21 \times 1.88 = 0.39 < 1.0$

IR_{A-46} (Ref. SEWS 39075)

IPEEE Scale factor @ RB EL. 621'-3" (Ref. calc. CD-Q0000-94039)

5.8.1 HCLPF Calculation for the Battery Chargers Listed in the Table below

SSEL No.	Component ID	Bldg.	EL.
9133	3-CHGA-248-0003EB	DGB 3	583'-6"
9121	0-CHGA-248-0000A	RB 1	621'-3"
9124	0-CHGA-248-0000B	RB 1	621'-3"
9127	0-CHGA-248-0000C	RB2	621'-3"
9130	0-CHGA-248-0000D	RB2	621'-3"

The anchorage of the above chargers is conservatively qualified in Calculation no. CD-Q0248-910433, Rev. 4. The acceleration values used in the referenced calc. correspond to the peak of the response spectra @ EL. 621'-3" of RB for horizontal directions and for vertical direction at 2% damping. A multi-mode factor of 1.5 is also applied to the acceleration values which are as follows: (See p. 5 of the ref'd calc.)

$a_h^{used} = 5.58\ g$

$a_v^{used} = 1.89\ g.$

=> Highest I.R. calculated in the referenced calculation is 0.965 corresponding to 5/8" ϕ W. Bolts (see p. 9 of the ref'd calc.)

Per C&D Test Report No. QR-31122-01, Rev. 0 (RIMS # W82-920817-136) the lowest natural frequency of these types of chargers in horizontal direction is 15 HZ, and in Vertical direction is 60 HZ.

Using the above resonant frequencies, the applicable accelerations from a 5% damped spectra (Per GIP guidelines for this type of equipment) are:

5.8.1 (Cont'd)

RB, EL. 621'-3" (Ref. 5):

@ f = 15 Hz → a_h = 0.45 g

@ ZPA → a_V = 0.76 g

DGB, EL. 583'-6" (Ref. 5):

@ f = 15 Hz → a_h = 1.97 g

@ ZPA → a_V = 0.18 g

The envelop of the max. accelerations from the two buildings are:

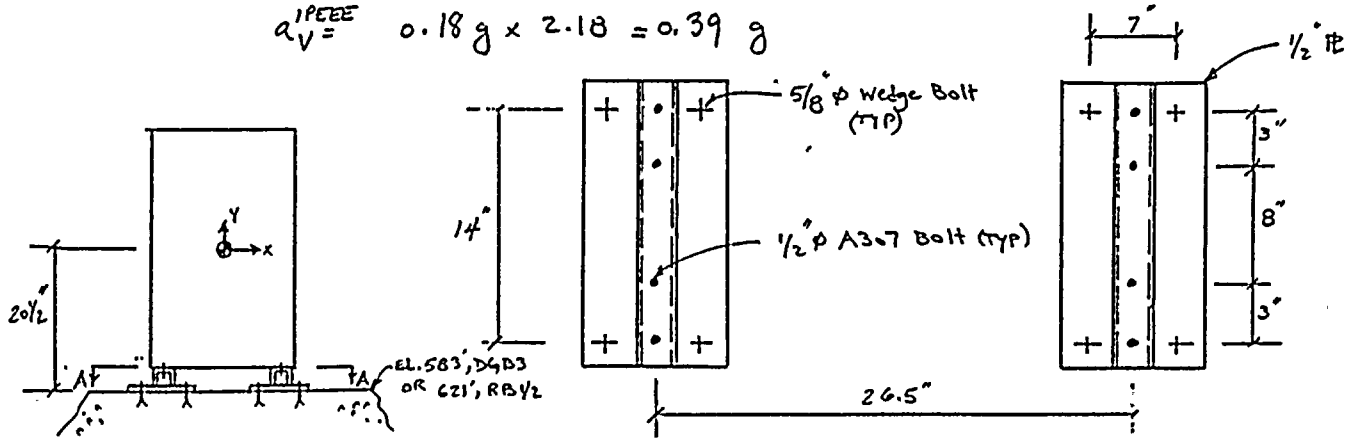
a_h = 1.97 g

a_V = 0.18 g.

The applicable IPEEE input acceleration is then:

a_h^{IPEEE} = 1.97g × 2.18 = 4.29 g ← IPEEE scale factor @ DGB (Ref. calc. CD-Q0000-940337) Ref. 4

a_V^{IPEEE} = 0.18 g × 2.18 = 0.39 g



Elevation

A-A

Charger Dead wt. = 700 lbs (Ref. calc. CD-Q0248-910433, p. 4)

5.8.1 (Cont'd)

$F_x = F_z = 700^{\#} \times 0.29\,g = 3003.^{\#}$

$F_y = 700^{\#} \times 0.39\,g = 273.^{\#}$

$M_x = M_z = 3003^{\#} \times 29'' = 87,087.^{\#''}$ (c.g. is 29" above floor elev, p.4 of ref'd calc. CD-Q0248-910433, RA)

Check 1/2" ϕ A307 bolts

V_b = Shear per A307 bolt = $3003^{\#} \frac{\sqrt{2}}{2} = 2123.^{\#}$ ← conservatively assuming only two corner bolts are effective in resisting shear loads per calc. CD-Q0248-910433, due to oversized bolt holes at some locations

$A_b = \frac{\pi}{4}(1/2)^2 = 0.196\ in^2$

$f_{V_b} = \frac{2123^{\#}}{0.196} = 10.8\ ksi \quad < F_V = 1.7 \times 10 = 17\ ksi$ ok

T_b = tension per A307 bolt = $\left[\left(\frac{87,087^{\#''}}{26.5'' \times 4}\right)^2 + \left(\frac{87,087^{\#''}}{14'' \times 2}\right)^2 + \left(\frac{273^{\#}}{8}\right)^2\right]^{1/2} - \frac{700}{8} = 3130^{\#}$

↑ conservatively only 2 corner bolts considered effective in resisting pull out loads due to M_x

$f_{t_b} = \frac{3130}{0.196} = 15.97\ ksi$

Shear-Tension Interaction per AISC 8th ed.:

$26(1.7) - 1.8(10.8) = 24.76\ ksi \quad < F_t = 1.7 \times 20 = 34\ ksi$

→ use $F_t = 24.76\ ksi$

$f_{t_b} = 15.97\ ksi \quad < F_t = 24.76\ ksi$ ok

IR = 0.64 < 1.0

5.8.1 (cont'd)

• Check 5/8" ϕ wedge bolts

$$T = \left[\left(\frac{87{,}087^{\#''}}{4 \times 26.5''}\right)^2 + \left(\frac{87{,}087^{\#''}}{14 \times 4}\right)^2 + \left(\frac{273}{8}\right)^2\right]^{1/2} - \frac{700}{4} = 1584^{\#}$$

$$V = \left[\left(\frac{3003}{8}\right)^2 + \left(\frac{3003}{8}\right)^2\right]^{1/2} = 531^{\#}$$

Per GIP Table C.2-1 :

$$T_{all} = 3170^{\#} \times \frac{3600}{4000} \times 0.75 = 2140^{\#}$$

(0.75: Relay Reduction factor; 3600/4000: f_c' reduction factor)

$$V_{all} = 3790^{\#} \times .75 = 2843^{\#}$$

$$\frac{V}{V_{all}} = \frac{531}{2843} = 0.19 \quad < 0.3 \quad \text{ok}$$

$$\frac{T}{T_{all}} = \frac{1584}{2140} = 0.74 \quad < 1.0 \quad \text{ok}$$

1/2" Base Pl and weld between the Sill Channel and the Base plate are adequate for IPEEE input loading by comparison to the results of evaluation of these components in Calc. CN-Q 0248-910433

$\therefore$ HCLPF > 0.39

5.9 Class 18 - Instruments on Racks

The Instrument Racks on the SSEL are all rugged and have top bracing (see SEWS for particular Racks). The Instruments are all properly and rigidly mounted on these racks. Consistent with the guidelines of EPRI Report NP-6041-SL, these racks and the instruments on them can be screened out for further IPEEE evaluations.

∴ HCLPF > 0.3g

5.10 Class 20 - Instrument and Control Panels and Cabinets

A total of 222 items on the Mech./Elect. SSEL's are classified as class 20. 103 out of 222 are equipment or instruments that are housed inside panels contained in the Elect. SSEL. (e.g., components such as temperature and pressure instruments, Flow monitors, etc, including sub-components w/in the loop). Actual no. of Class 20 (I&C Panels and Cabinets) is 222 - 103 = 119, as contained in the U2/3 Electrical SSEL (Ref. 3)

The instruments and equipment inside these panels were found to be properly mounted during the A-46 walkdowns and are screened out per GIP's rule-of-the-box.

The following panels were selected for HCLPF calculations based on the calculated factor of safety of less than 2.0 as shown on the anchorage evaluations, which are part of the SEWS for the respective panel.

SSEL	Equip. ID	Max. Interaction Ratio Per Evaluation in SEWS	F.S.
9075	2-LPNL-925-0032	0.88 (see Att. I)	1.14
9094	0-LPNL-925-0045C	0.60 (see Att. J)	1.67
9076	0-LPNL-925-0041A	0.58 (see Att. K)	1.72
9072	2-PNLA-009-0087	0.71 (see Att. L)	1.41
9066	2-PNLA-009-0081	0.98 (see Att. M)	1.02

See following pages for HCLPF calculations for the above panels.

5.10.1 HCLPF Calculation for 2-LPNL-925-0032 (SSEL 9075)

This panel is located @ EL. 621'-3" of RB/2. The weld stress interaction ratio of 0.88, calculated in SEWS for the above panel, used a Knock-down factor of 4 for the plug weld area when subjected to tensile loads. This factor is based on recommendation from EPRI Report NP-5228-SL, vol.1 and (p.2-108) is to account for poor weld workmanship. In the case of welds in the above panel the welds fully cover the 1/2" ϕ holes in the base angle and there are no signs of burn through. Therefore, a more appropriate Knock-down factor of 2.0 could be used for the IPEEE/HCLPF calculations and still be conservative.

It is also noted that the weight of the panel used in the A-46 anchorage calc. (i.e., 3024#) is very conservative as the panel does not contain many heavy equipment or instruments.

From SEWS for the above panel, the following input data are obtained: (See Attachment I, SEWS for SSEL # 9075)

$T_{A\text{-}46}$ = pullout force per plug weld = 993 #, $V_{A\text{-}46}$ = 334 #

$$T_{IPEEE} = \left[\left(\frac{3024\times 1.0g\times 1.88\times 45^{\#}}{(30-2)8}\right)^2+\left(\frac{3024\times 1.0\times 1.88\times 45^{\#}}{(72+24-2)2}\right)^2+\left(\frac{3024\times 0.16g\times 1.88}{16}\right)^2\right]^{1/2}-\frac{3024}{16}$$

(IPEEE scale factor (Ref. Calc. CD-Q0000-940339, Ref. 4); Horiz. A-46 acceleration corresponding to f=8 Hz @ EL. 621'-3" of RB, DBE, 5% (Ref. 5))

$= 1588^{\#}$

$$V_{IPEEE} = \left(\frac{3024\times 1.0\times 1.88}{16}\right)\sqrt{2} = 502^{\#}$$

$A_{WT} = \frac{\pi D}{2} = \frac{\pi(1/2)}{2} = 0.786$ in (weld length for tensile loads)

$A_{WS} = \pi D = 1.57$ in (weld length for shear loads)

$f_{WT} = \frac{1588^{\#}}{0.786} = 2020$ lb/in

$f_{WS} = \frac{502^{\#}}{1.57} = 320$ lb/in

$F_N = 60^{ksi}\times 0.3\times 1.7\times 0.707\times 1/8" = 2.7$ k/in (1.7 = increase factor per EPRI NP-6041SL)

$IR = \left(\frac{2.02}{2.7}\right)^2+\left(\frac{.32}{2.7}\right)^2 = 0.57 < 1.0 \Rightarrow \therefore$ HCLPF > 0.3g

5.10.2 HCLPF Calculation for O-LPNL-925-0045C (SSEL 9094)

This panel is located in RB @ EL. 621'-3". The interaction ratio of 0.60 (calculated on SEWS for this panel for A-46 seismic input) corresponds to shear-tension interaction of 3/8" ϕ anchor bolts. The A-46 calculation (referenced above) used peak accelerations where in reality the acceleration corresponding to the natural frequency of the panel could be used. In the SEWS for this panel it was established that the lowest natural frequency of this panel is greater than 8HZ. Therefore, conservatively use horizontal acceleration @ EL. 639' of RB @ f = 8HZ with 5% damping:

$a_{@\ f=8HZ} = 1.2g$ (Ref.5) , $a_{used} = 2.48 \times 1.25 = 3.1g$

$\downarrow$

$a_{IPEEE} = 1.2g \times 1.88 = 2.26\ g$ ← IPEEE scale factor (see calc CD-Q0000-940339, Ref.4)

Conservatism factor in the A-46 anchorage calc. vs. IPEEE method =

$$\frac{3.1g}{2.26} \times \frac{3}{2.4} = 1.72$$

(3 ← anchorage pullout F.S. for A-46 eval.; 2.4 ← anchorage pullout F.S. for IPEEE eval.)

$IR_{A-46} = 0.60$ (Ref. SEWS for SSEL 9094, Attachment J)

$\downarrow$

$IR_{IPEEE} \approx 0.6/1.72 = 0.35 < 1.0$

∴ HCLPF > 0.3g

5.10.3 HCLPF Calculation for O_LPNL_925_0041 A (SSEL 9076)

This panel is located @ EL. 583'6" in DGB1/2. The interaction ratio of 0.58 calculated in the SEWS for the above panel corresponds to the stress in A307 bolts anchoring this panel to its sill. The anchorage calc. performed as part of A-46 evaluation is conservative, in that peak accel. is used and smallest base bolt diameter (3/8" ϕ) is used. This panel has 4 adjacent bays all bolted together and actually only two bays are anchored with 3/8" ϕ A307 bolts. The other two bays use 1/2" ϕ to 5/8" ϕ bolts.

By reference to the SEWS for the above panel following input data is obtained: (see Attachment K, SEWS for SSEL # 9076)

Wt. = 906#, Bolt config. = 4-3/8" ϕ A307 @ 27.5" x 24" (foot print)

- IPEEE Evaluation:

a_h = 0.73 g (@f=20hz, Ref.5. conservative, since lowest frequency calculated on SEWS for this panel based on base flexibility is about 27 HZ.)

a_V^{ZPA} = 0.18 g (DGB, EL. 583'6", DBE, 5% damping - Ref.5)

→ F_h^{IPEEE} = 906# x 0.73g x 2.18 (IPEEE scale factor (Ref. Calc. CD-Q0000-94039) Ref.4) = 1442 # < F_h^{A-46} = 2412 #

F_V^{IPEEE} = 906 x 0.18 g x 2.18 = 356 # < F_V^{A-46} = 589 #

Since these forces are smaller than those used in the A-46 evaluation (i.e., F_h = 2412# & F_V = 589#) and the max. IR was shown to be 0.58, it is concluded that the IR will also be less than 1.0 for the IPEEE seismic loading and therefore:

HCLPF > 0.3 g

5.10.4 HCLPF Calculation for 2-PNLA-009-0087 (SSEL 9072)

This panel is located @ EL. 593' of control bay in Reactor Bldg (Aux. Instrument Room). The maximum anchor bolt interaction ratio calculated in the SEWS for this panel for A-46 level earthquake is 0.71. This interaction ratio is very conservative as peak acceleration values are used whereas the acceleration corresponding to 8 HZ could be used. (1.34g vs. 0.6g horizontal accel.). Also, the number of anchors resisting shear and tension loads are conservatively discounted to a much lower number. To simply and conservatively obtain an equivalent IR for IPEEE level earthquake we have:

$IR_{A-46} = 0.71$ (See Attachment L, SEWS for SSEL # 9072)

$$IR_{IPEEE} \cong 0.71 \times \frac{1}{1.25} \times 1.88 \times \frac{2.4}{3.0} = 0.85^{*} < 1.0 \quad \text{OK}$$

- $\frac{1}{1.25}$: factor used for A-46 eval. to convert the In-Structure spectra to mod. ctr. spectra
- 1.88: IPEEE scale factor, Ref. calc. CD-Q0000-940339 (Ref. 4)
- $\frac{2.4}{3.0}$: F.S. for A.B. pullout allowable, IPEEE (Ref. 2) / F.S. for anchor bolt pullout allowable, A-46 per GIP (Ref. 1)

∴ HCLPF > 0.3g

(* Note that this IR is still conservative since peak spectral accelerations were used)

5.10.5 HCLPF Calculation for 2-PNLA-009-0081 (SSEL 9066)

(Ref. SEWS in Attachment M)

This panel is located in Aux. Instr. Room in CB @ EL. 593' of RB.

The maximum IR for anchor bolts on this panel was conservatively calculated in the SEWS for this panel with the A-46 level seismic input as IR = 0.98. The acceleration used to obtain this IR was the peak of the spectra. As the frequency of this panel was shown to be 14.1 Hz per testing, the accel. @ f=14.1 Hz could be used.

The equivalent interaction ratio for the IPEEE evaluation is:

$$a_h^{used} = 1.34g \times 1.25 = 1.675\,g$$

$$a_{h\,@\,f=14.1\,Hz} = 0.52g \qquad (RB, DBE, 5\%, EL.\ 593' - Ref.5)$$

$$a_{IPEEE} = 0.52g \times 1.88 = 0.98\,g$$

(1.88: IPEEE scale factor (Ref. calc. CD-Q0000-940339))

Conservatively;

$$IR_{IPEEE} = IR_{A\text{-}46} \times \frac{0.98g}{1.675g} \times \frac{2.4}{3.0}$$

(2.4: IPEEE, F.S. for Anch. pull out (Ref. EPRI NP-6041-SL); 3.0: A-46, F.S. for Anch. pull out)

$$= 0.98 \times 0.59 \times 0.8 = 0.46 < 1.0 \quad ok$$

$\therefore$ HCLPF > 0.3 g

Note: Anchorages of U2/3 MCR's panels have been upgraded and modified per Calculation CD-Q0009-871685, Rev.5. A representative bounding evaluation of the typical MCR panel anchorage configuration is performed on SEWS for panel 3-9-54 (SSEL# 39133). The F.S. for this bounding configuration is shown to be greater than 2.0. ok

6.0 CONCLUSIONS

ALL electrical equipment that are on the BFNP Electrical SSEL (Ref. 3) have been shown to have HCLPF values in excess of 0.3g, with the exception of equipment that were determined to be outliers in the A-46 program with respect to their anchorage configuration and the following equipment. [It is noted that the equipment with anchorage outliers will have HCLPF values greater than 0.30g after the suggested modifications, as documented on the respective outlier sheets (OSVS), are implemented.]

- Transformer O-OXF-219-TDA (SSEL # 9004, @ EL. 583', DGB1/2)
- Transformer O-OXF-219-TDB (SSEL # 9005, @ EL. 583', DGB1/2)

The HCLPF value for the above transformers was calculated to be 0.26g. (see section 5.4.1)

⚠ Note: The above conclusions are also applicable to the equipment that were added to the SSEL since the issuance of the Rev.0 of this Calculation. (see also Note on page 6).

FB 6-21-96

JD 7/15/96

(11 pages)

ATTACHMENT A

SEWS for 3-BDBB-268-0003D (SSEL# 39016)

SSEL Line No. 39016 Status Y (N) U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 3/10

Equip. ID No. 3-BDBB-268-0003D Equip. Class 01 - Motor Control Centers

Equipment Description 480V RMOV BOARD 3D

Location: Bldg. U3-RB. Floor El. 593 Room, Row/Col U,R17

Manufacturer, Model, Etc. (optional but recommended) International Switchboard Corp.

SEISMIC CAPACITY VS DEMAND

1	Elevation where equipment receives seismic input		593'
2.	Elevation of seismic input below about 40' from grade		(Y) N U. (grade @ 563')
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (1)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	(BS)
		1.5 x Bounding Spectrum	ABS
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	(GRS)
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	RRS

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U (Ref. Calc. CD-Q0000-940339)

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	600 V rating or less	(Y) N U N/A
3.	Adjacent cabinets which are close enough to impact, or sections of multi-bay cabinets, are bolted together if they contain essential relays	(Y) N U N/A (4)
4.	Attached weight (except conduit) less than about 100 lbs per cabinet assembly	(Y) N U N/A
5.	Externally attached items rigidly anchored	(Y) N U N/A
6.	General configuration similar to NEMA Standards	(Y) N U N/A
7.	Cutouts in lower half less than 6 in. wide and 12 in. high	(Y) N U N/A
8.	All doors secured by latch or fastener	(Y) N U N/A
9.	Natural frequency relative to 8 Hz limit considered	(Y) N U N/A (9)
10.	Anchorage adequate (See checklist below for details)	(Y) N U N/A (3), (10)
11.	Relays mounted on equipment evaluated AF = 3.0	(Y) N U N/A
12.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

SSEL Line No. 39016

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 10

Equip. ID No. 3-BDBB-268-0003D Equip. Class 01 - Motor Control Centers

Equipment Description 480V RMOV BOARD 3D

CAVEATS - GERS (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in generic seismic testing equipment class	Y N U (N/A)
2.	Meets all Bounding Spectrum caveats	Y N U (N/A)
3.	Floor mounted cabinet	Y N U (N/A)
4.	Maximum weight per section less than 800 pounds	Y N U (N/A)
5.	Base anchorage utilizing MCC base channels	Y N U (N/A)
6.	Adequate strength and stiffness in load transfer path from anchorage to base frame (only for "function after" GERS)	Y N U (N/A)
7.	Essential relays have GERS > 4.5g (only for "function during" GERS)	Y N U (N/A)
8.	Able to reset starters (only for "function after" GERS)	Y N U (N/A)
9.	All adjacent cabinets or sections of multi-bay assemblies bolted together	Y N U (N/A)

Is the intent of all the caveats met for GERS? Y N U (N/A)

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A (6,7)
2.	Type of anchorage covered by GIP	(Y) N U N/A
3.	Sizes and locations of anchors determined	(Y) N U N/A
4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	(Y) N U N/A
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A

Are anchorage requirements met? (Y) N U (3),(10)

SSEL Line No. 39016

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 3 of 3/10

Equip. ID No. 3-BDBB-268-0003D Equip. Class 01 - Motor Control Centers

Equipment Description 480V RMOV BOARD 3D

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	Y (N) U N/A (8)
3.	Attached lines have adequate flexibility	(Y) N U N/A
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is equipment free of interaction effects? Y (N) U (8)

IS EQUIPMENT SEISMICALLY ADEQUATE? Y (N) U (8)

COMMENTS

1) See note 1 on SEWS for 2-BDBB-268-0002E (SSEL 9028). → f 7.8Hz

2) note no. not used.

3) The weak links in the load path to the anchor point are judged to be the 3/8"ϕ bolts connecting the MCC to the sill channel & the 3/4"ϕ Red head anchor bolts @ sill. The welds @ sill to 3/4" ℄ are less critical. See Note 10 for anchorage evaluation.

– See pages 4-6 for notes 4-10.

Evaluated by: Fazzi Baig Date: 10-10-95

John O. Bizon 10/10/95

SSEL 39016

3-BDBB-268-0003D 480V RMOV BD 3D

(DWG. 3-45N389 and 48N1125-1)

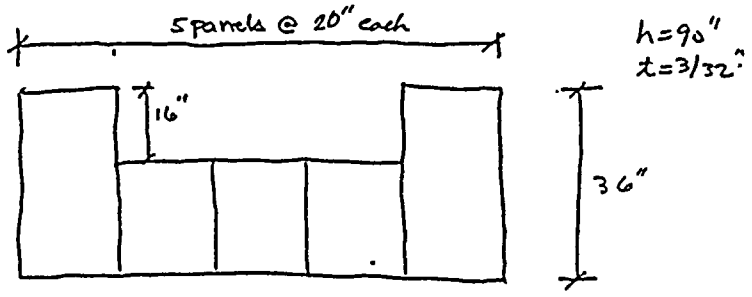
(International Switchboard corporation)

4) 5 bays all bolted together.

5) Top restraint not provided by the top entry conduit (3-2½"φ, 8-3"φ) Conduit span to the first support ~ 12'

6) Each bay is bolted to the sill channel by 4-3/8" φ bolts. The sill channel is welded to embeded plate which is on a 1½" tapered grout pad.

7) The base of each unit consists of L1½ x 1½ x ¼ angles and the internal framing consists of L1½ x 1½ x 3/32 to ⅛ angles and the side panels are continuous (no cutout in the sheet metal between the adjacent bays)



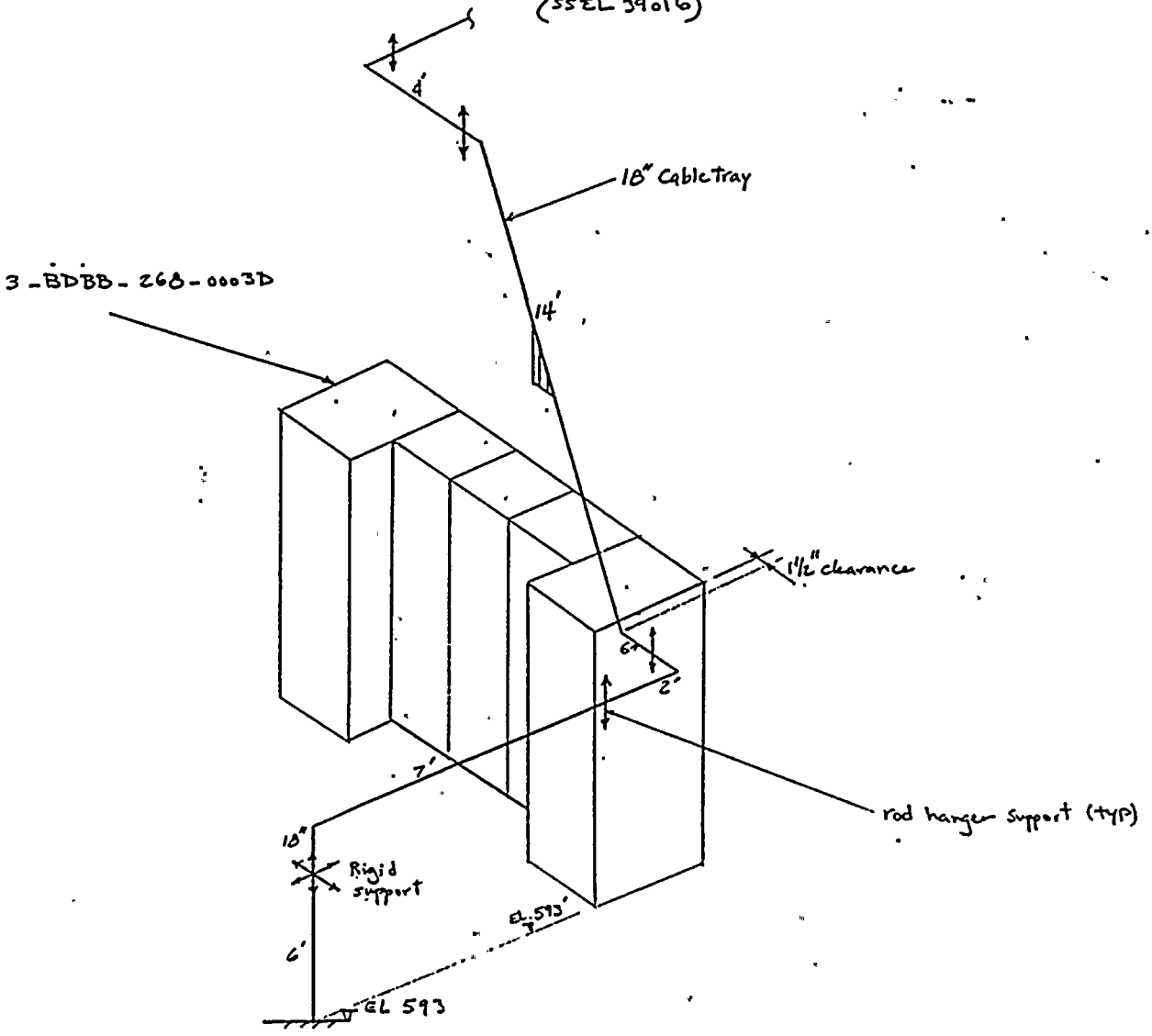
Plan
(Base Config.)

8) Long cable tray vertical riser has about 1½" clearance to this equipment. the cable tray is supported by rod hangers (~ 20' rods) and will swing and impact this equipment. → outlier OSVS-39016
(See sketch on the next pg.)

9) Breakers in compartments 1D and 5D are type K-600S (GOULD Manuf.). These breakers are about 12" above the base of the equipment and are mounted on rails which are connected to a rigid "platform" plate 3/32" thic The primary and secondary contacts are in the "BD" configuration but there is a grounding bar @ about the C.G. of the breaker which will restrain the breaker from side to side movement.

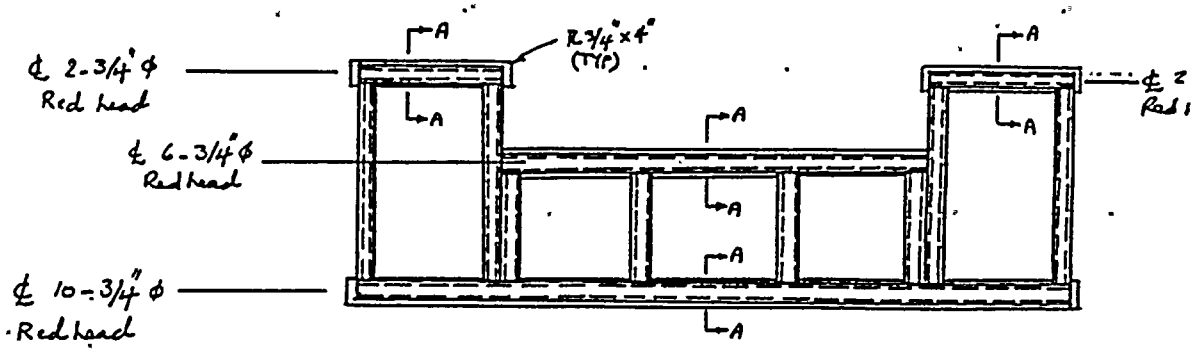
JOB NO. 50147 JOB TVA / BENP A-46 / IPEEE BY ZBeig DATE 10-10-9

CALC. NO. N/A SUBJECT SEWS for 3-BDBB-268-0003D (SSEL 39016) CHK'D [illegible] DATE 10/10/9

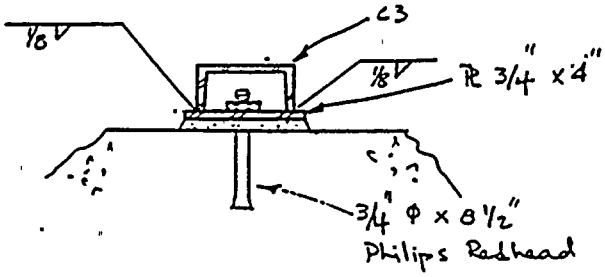


Configuration of the Interaction of the 18" Cable Tray with MCC
(Interaction Documented in Outlier OSVS_39016)

10) Anchorage Evaluation:



SILL PLAN
(DWG. 48N1125-1)



A-A

- Each bay is bolted to the sill channel by 4-3/8" ϕ bolts:

$T_{all_1} = 2.0 \times 1.7 \times 0.11\ (in^2) = 3.74^K$

$V_{all_1} = 10 \times 1.7 \times 0.11\ (in^2) = 1.870^K$

- Sill channel is anchored by 3/4" ϕ Red heads to the concrete floor:

$$T_{all_2} = 4.69^K \times \frac{3600}{4000\ f'_c} \times 0.75 \quad (\text{reduction for presence of relays}) = 3.166^K < T_{all_1} = 3.74^K$$

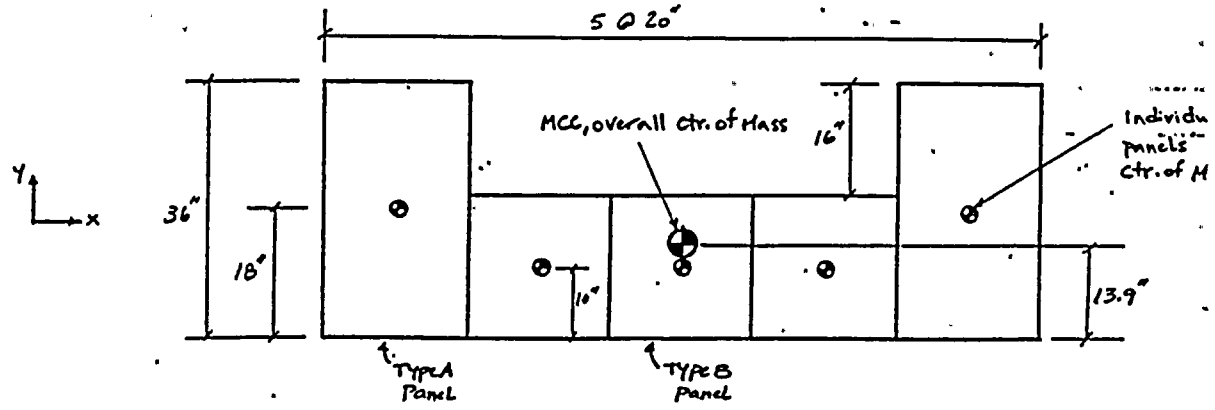
$V_{all_2} = 5.48^K \times 0.75 = 4.11^K > V_{all_1} = 1.87^K$

=> Check both 3/8" ϕ M.bolts and 3/4" ϕ anchor bolts.

JOB NO. 50147 JOB TVA/BFNP A-46/IPEEE BY FBeig DATE 10-10-9

CALC. NO. A1/A SUBJECT SEWS for 3-BDBB-268-0003D (SSEL 39016) CHK'D J.D.Stevenson DATE 10/10/95

Note 16 (cont'd)



Dead wt. of type A panel per App. C of GIP:

$$D.wt._A = 3.0 \times \frac{490}{12^3} \times \frac{3}{32} \times 2\left[(20\times90)+(36\times90)+(36\times20)\right] = 919.\#$$

Dead wt. of type B panel:

$$D.wt._B = 3.0 \times \frac{490}{12^3} \times \frac{3}{32} \times 2\left[(20\times20)+(20\times90)+(20\times90)\right] = 638.\#$$

$$Y_{c.g.} = \frac{(2\times919\times18)+(3\times638\times10)}{(2\times919)+(3\times638)} = 13.9"$$

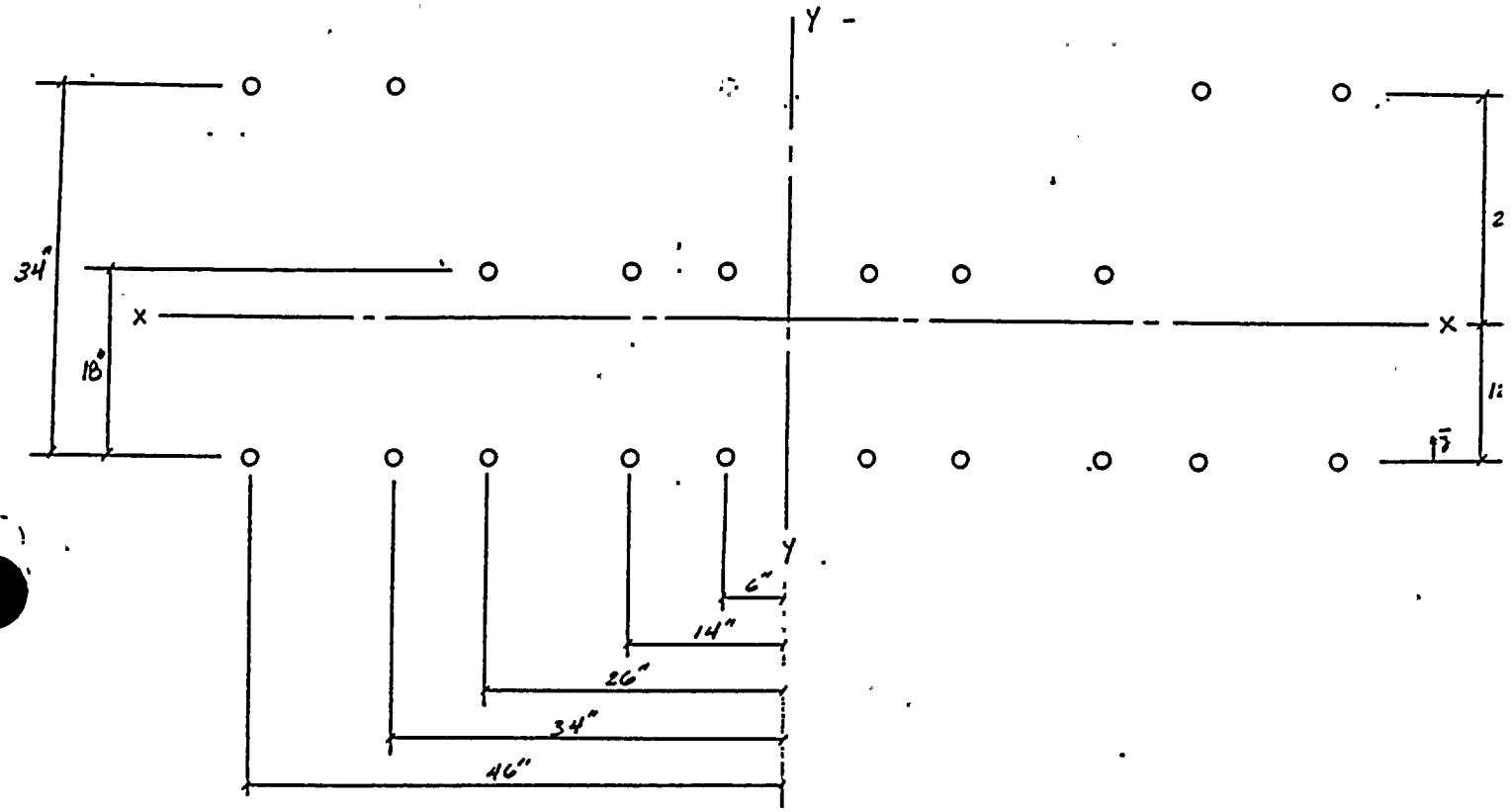
Overall center of mass @ $(x=50, y=13.9)$

Overall center of rigidity @ $(x=46"+4"=50",\ y=12.2"+1"=13.2")$

Eccentricity $= 13.9 - 13.2 = 0.7"$ → too small, can be neglected

Note 10 (cont'd)

- Determination of section modulus of bolt group:



$$\bar{y} = \frac{(6 \times 18") + (4 \times 34)}{20} = 12.2"$$

$$I_{xx} = 4(21.8)^2 + 4(12.2)^2 + 6(18-12.2)^2 + 6(12.2)^2 = 3591. \ in^2$$

$$S_{xx} = \frac{3591}{21.8} = 165. \ in \quad \text{(for moments acting out of plane of the bolt group}$$

$$I_{yy} = 4(6^2 + 14^2 + 26^2 + 34^2 + 46^2) = 16720. \ in^2$$

$$S_{yy} = \frac{16720}{46} = 363. \ in \quad \text{(for moments acting out of plane of the bolt grou}$$

$$I_p = I_{xx} + I_{yy} = 3591 + 16720 = 20,311. \ in^2$$

$$S_p = \frac{20,311}{[(21.8)^2 + (46)^2]^{1/2}} = 399. \ in$$

Note 10 (Cont'd)

-Determine Loads

- Conservatively consider 2-3"ϕ and 1-2½"ϕ rigid conduit, with 6' tributary span @ top of each bay:

$Wt._{cond.} = 5\ bays \times (2 \times 12.8\#/' + 1 \times 8.9\#/') \times 6' = 1035.\#$ (@ 90" above base)

- $Wt._{cable\ tray\ (18")} = 25 \times 1.5 \times (1.5' + 7' + 2' + .5' + 14') \times 2/3 \times 2.0 = 1250.\#$ (@ 90" above base and only in x-direction)

(2.0 ← Impact factor; 2/3 ← conservative estimate of cable fill)

- $Wt._{MCC} = 2 \times 919\# + 3 \times 638\# = 3752\#$ (@ 45" above base)

-Accelerations: (conservatively used for Bounding purposes)

$a_h = 1.0g$ (@ f=8 HZ, RB, EL. 621', DBE, 5%)

$a_v = 0.16g$ (ZPA)

Acceleration to use, including 1.25 increase factor for Med. Centered spectra:

→ $a_h = 1.0g \times 1.25 = 1.25g$

→ $a_v = 0.16g \times 1.25 = 0.20g$

- Seismic loads:

$F_x = 1250\# + (1035\# \times 1.25g) + (3752\# \times 1.25g) = 7234.\#$

$F_y = (1035\# \times 1.25g) + (3752\# \times 1.25g) = 5984.\#$

$F_z = (1035 + 3752) \times 0.2g = 957.\#$

$M_x = (1035\# \times 1.25g \times 90") + (3752\# \times 1.25g \times 45") = 327,488.\#"$

$M_y = (1250\# \times 90") + (1035\# \times 1.25g \times 90") + (3752\# \times 1.25g \times 45") = 439,988.\#"$

$M_z \approx 0$

Note 10 (cont'd)

- Shear per 3/8" ϕ bolt:

$$V = \left[\left(\frac{7234}{5\times4}\right)^2 + \left(\frac{5984}{5\times4}\right)^2\right]^{1/2} = 469^{\#}$$

$$f_V = \frac{469^{\#}}{0.11\ in^2} = 4.3\ Ksi$$

shear - tension interaction:

$$26(1.7) - 1.8(4.3) = 36.5^{Ksi} \quad > F_t = 1.7\times20^{Ksi} = 34^{Ksi}$$

$\rightarrow$ use $F_t = 34.\ Ksi$

- Tension per 3/8" ϕ bolt:

$$T = \sqrt{\left(\frac{327,488^{\#"}}{165"}\right)^2 + \left(\frac{439,988^{\#"}}{363}\right)^2 + \left(\frac{957}{5\times4}\right)^2} - \frac{1035^{\#} + 3752^{\#}}{5\times4} = 2087.^{\#}$$

$$f_t = \frac{2087^{\#}}{0.11\ in^2} = 19.\ Ksi \qquad < F_t = 34\ Ksi \qquad ok$$

$$\frac{f_t}{F_t} = 0.56 \quad < 1.0 \qquad ok$$

- Check 3/4" ϕ Anchor bolts:

Conservatively, use the same S_{xx} & S_{yy} as for 3/8" ϕ bolts.

Therefore: $V = 469^{\#} < V_{all_2} = 4.11^{K}$, $\frac{V}{V_{all}} = 0.11 < 0.3$ ok

$T = 2087^{\#} < T_{all_2} = 3.166^{K}$, $\frac{T}{T_{all}} = 0.66 < 1.0$ ok

∴ Anchorage config. Adequate

(7 pages)

ATTACHMENT B

SEWS for 0-BDBB-219-0000A (SSEL# 9031)

SSEL Line No. 9031 Status Y (N) U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 36

Equip. ID No. 0-BDBB-219-0000A Equip. Class 01 - Motor Control Centers

Equipment Description 480V DSL AUX BD A

Location: Bldg. U1/2 DGB Floor El. 583 Room, Row/Col - -

Manufacturer, Model, Etc. (optional but recommended) GE 7700

SEISMIC CAPACITY VS DEMAND

1	Elevation where equipment receives seismic input		583'-6"
2.	Elevation of seismic input below about 40' from grade		(Y) N U grade el. 573'
3.	Equipment has fundamental frequency above about 8 Hz		Y (N) U N/A (9)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	BS
		1.5 x Bounding Spectrum	(ABS)
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	GRS
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	(RRS)

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) Y (N) U (10)

(outlier OSVS-9031)

CAVEATS.- BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	600 V rating or less	(Y) N U N/A
3.	Adjacent cabinets which are close enough to impact, or sections of multi-bay cabinets, are bolted together if they contain essential relays	(Y) N U N/A (3)
4.	Attached weight (except conduit) less than about 100 lbs per cabinet assembly	(Y) N U N/A
5.	Externally attached items rigidly anchored	(Y) N U N/A
6.	General configuration similar to NEMA Standards	(Y) N U N/A
7.	Cutouts in lower half less than 6 in. wide and 12 in. high	(Y) N U N/A
8.	All doors secured by latch or fastener	(Y) N U N/A
9.	Natural frequency relative to 8 Hz limit considered	(Y) N U N/A
10.	Anchorage adequate (See checklist below for details)	(Y) N U N/A (8)
11.	Relays mounted on equipment evaluated AF = 3.0	(Y) N U N/A (11)
12.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

SSEL Line No. 9031

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 36

Equip. ID No. 0-BDBB-219-0000A Equip. Class 01 - Motor Control Centers

Equipment Description 480V DSL AUX BD A

CAVEATS - GERS (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in generic seismic testing equipment class	Y N U (N/A)
2.	Meets all Bounding Spectrum caveats	Y N U (N/A)
3.	Floor mounted cabinet	Y N U (N/A)
4.	Maximum weight per section less than 800 pounds	Y N U (N/A)
5.	Base anchorage utilizing MCC base channels	Y N U (N/A)
6.	Adequate strength and stiffness in load transfer path from anchorage to base frame (only for "function after" GERS)	Y N U (N/A)
7.	Essential relays have GERS > 4.5g (only for "function during" GERS)	Y N U (N/A)
8.	Able to reset starters (only for "function after" GERS)	Y N U (N/A)
9.	All adjacent cabinets or sections of multi-bay assemblies bolted together	Y N U (N/A)

Is the intent of all the caveats met for GERS? Y N U (N/A)

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A (1)
2.	Type of anchorage covered by GIP	(Y) N U N/A (6)
3.	Sizes and locations of anchors determined	(Y) N U N/A (2,6)
4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	(Y) N U N/A
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A

Are anchorage requirements met? (Y) N U (8)

SSEL Line No. 9031

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 3 of 36

Equip. ID No. 0-BDBB-219-0000A Equip. Class 01 - Motor Control Centers

Equipment Description 480V DSL AUX BD A

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A (7)
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	(Y) N U N/A
3.	Attached lines have adequate flexibility	(Y) N U N/A (4)
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A (5)
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is equipment free of interaction effects? (Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? Y (N) U (10)

COMMENTS

For notes 1 thru 8 See. page pp. 4 to 6.

9) Per EPRI Report. TR-102180 the lower tested frequency of typical "thin" Motor control Centers is in the range of 3-7 HZ. Since the anchorage condition of this MCC is judged to be flexible (4-1/4" ϕ Drilled and Tapped bolts per section), the overall lower bound frequency of this MCC is in order of 3-5 HZ.

10) per Figures B.1.1 & B.3A.1 (Rf. calc. CD-Q0000-94-0339), both the Instructure response Spectra and 1.5 x In-structure spectra exceed the 1.5 x Bounding Spectrum and GERS (for this equipment class), respectively, at and above frequency of 8.25 HZ. Therefore the intent of the seismic capacity Vs. Demand is not met. → Outlier (OSVs-9031)

11) see note 13 on SEWS for 3-BDBB-281-0003A (SSEL 39030) → AF=3.0

Evaluated by: Farzi Beji Date: 8-16-95

John O. Dizon 8/23/95

JOB NO. 5014705 JOB TVA/BFN A-46/IPEEE BY FBeig DATE 7-27-9

CALC. NO. N/A SUBJECT Attach. to SEWS for O-BDBB-219-0000A CHK'D JDS DATE 8/23/9

(SSEL No. 9031)

SSEL#: 9031, 9032, 9033

I.D.: O-BDBB-219-0000A, 0000B, 3EB

Notes.

(1) 12 bays. each bay is 20"x20"x90". Tot. wt. = 5610 #. (DWG. O-45N328)

(2) each bay @ base is connected to the sill channel by 4-1/4"ϕ screws @ 4-corners (drill and tap) (E-F of the rows is 3/8")

(3) All adjacent bays are bolted together w/ 1/4" ϕ bolts. There are 4-bolts along each corner of the panels (i.e., total of 16 bolts @ each bay). Additionally an L 2x3 x 1/4" is seated at top of the panels connects all bays together with 2-5/8"ϕ bolts @ top of each bay.

(4) Flex conduits have adequate flexibility.

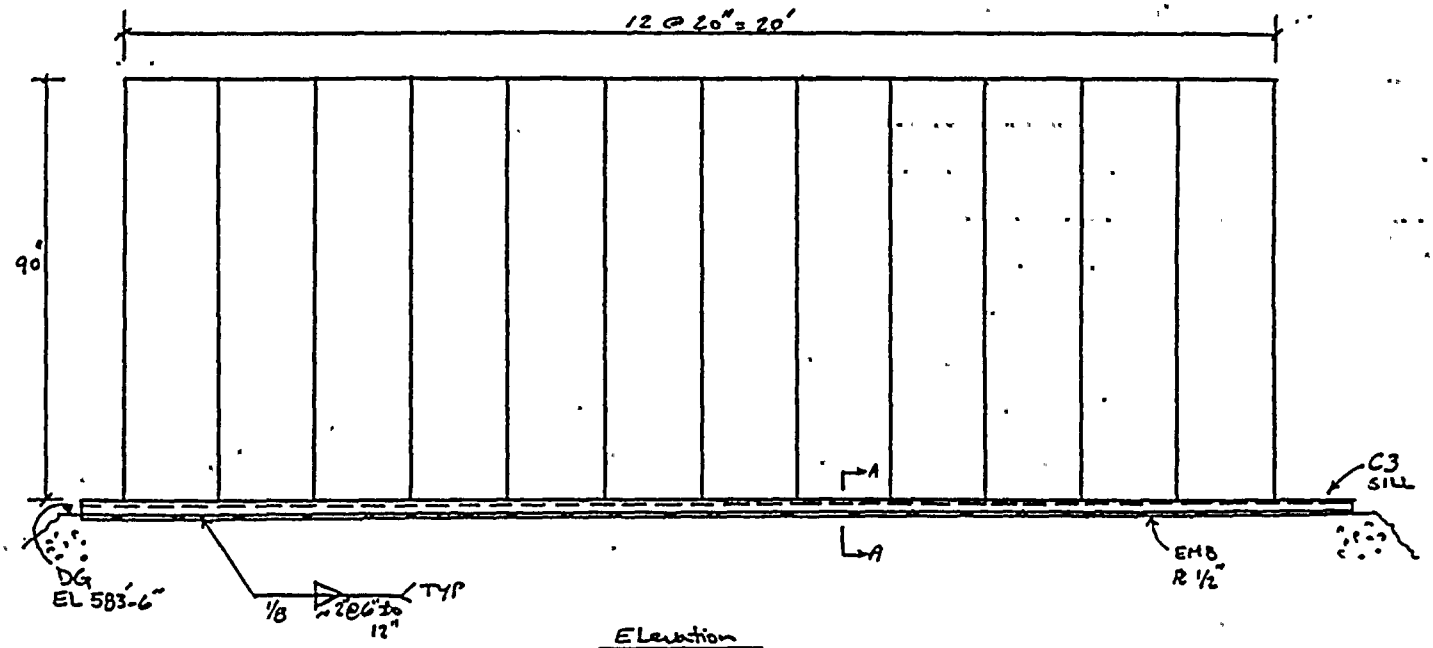
Most top entry conduit are 1"ϕ rigid conduit; which connect to a header 2 1/2"ϕ rod hung conduit → No top restraint can be assumed to be provided by top entry conduit. The effective conduit load on anchorage evaluations is insignificant.

(5) Fluorescent lights that are near this equipment have compression fittings for the tubes and as such judged not to be a falling hazard.

(6) The sill channel is welded to embedded plates with 1/8" welds, 2" length @ ≈ 12" c.c. spacing.

(7) Fire protection piping behind the Board is rigidly supported. ok

8) Anchorage Evaluation. (Ref. DWG. 0-45N328 & 48N888)

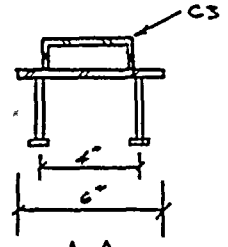


Elevation
(Looking East)

Total Equip. wt. = 5600 #

wt. per panel = $\frac{5600}{12}$ = 467 # (c.g. @ center)

Anchorage of each of the panels to the sill channels is obtained by 4 - 1/4" ø screws (drill and tap) @ the 4 corners of the panel.



A-A
(Ref. Dwg. 48N888 R7, Sect. D-D)

consider no overturning due to N/S loads due to high aspect ratio.

For anchorage evaluation, consider the upper bound (conservative) frequency of 7 hz (Note 9 Due to its configuration, this will be the dominating mode (E-W flexure). However, conservatively apply the multi-mode factor of 1.5; a^{horiz} = 1.05g @ 7hz (Ref. MARS Report, DGB, EL-583', SSE, 5% damping)

a^{vert} = 0.18 g (use ZPA acceleration)

T = tensile load per 1/4" ø screw = $\left[\left(\frac{467 \times 1.05 \times 1.5 \times 1.25 \times 90/2}{18" \times 2}\right)^2 + \left(\frac{467 \times 0.18 \times 1.25}{4}\right)^2\right]^{1/2} - \frac{467}{4}$

1.25 factor to account for median-centered in-structure spectra use

T = 1033 #

Allowable stress, F_t (see next page)

T_{all} = 0.049 in² x 32.3 = 1.583 K > T = 1033 # OK

(nominal area for 1/4" ø screw (AISC 8th ed.))

JOB NO. 50147.05 JOB TVA / BFN A-46 / IPEEE BY JReiss DATE 8-15-95

CALC. NO. N/A SUBJECT Attachment to SEWS for 0-BDBB-219-0000A CHK'D J.O'Sullivan DATE 8/23/95
(SSEL No. 9031)

$$V = \left[\left(\frac{467 \times 1.05 \times 1.5 \times 1.25}{4}\right)^2 + \left(\frac{467 \times 1.05 \times 1.5 \times 1.25}{4}\right)^2\right]^{1/2} = 325^{\#}$$

$$V_{all} = \frac{\pi (0.25)^2}{4} \times 10 \times 1.7 = .834^{K} > V = 325^{\#} \quad \text{ok}$$

Shear-Tension interaction:

$$F_t = 26 \times 1.7 - 1.8 f_v \leq 20 \times 1.7$$

$$= 26 \times 1.7 - 1.8 \left(\frac{.325}{\frac{\pi}{4}(.25)^2}\right) = 32.3 \text{ ksi} < 20 \times 1.7 = 34 \text{ ksi}$$

Use $F_t = 32.3$ ksi (This is what was used on previous pa

The weak link in the anchorage load path is the 1/4" ϕ screws, which have been shown to be adequate for SSE loading. Other elements in the load path (eg., Weld @ sill channel to embed plate or the embed plate headed studs) are less critical and therefore judged ok by comparison.

EQE INTERNATIONAL

SHEET NO. C1 of 4

JOB NO. 50147 JOB TVA/BENP A46/IPEEE BY ZBeig DATE 12-19-9

CALC. NO. C-011 SUBJECT HCLPF for Elect. Equip. CHK'D J.D.Stevenson DATE 12/29/9

(4 Pages)

ATTACHMENT C

SEWS for 2-BDBB-231-0002A (SSEL # 9020)

SSEL Line No. 9020 Status Y (N) U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 3

Equip. ID No. 2-BDBB-231-0002A Equip. Class 02 - Low Voltage Switchgear

Equipment Description 480V SHDN BD 2A

Location: Bldg. RB Floor El. 621'-3" Room, Row/Col S-R13

Manufacturer, Model, Etc. (optional but recommended) - GE TYPE AKD-5
- Breaker types AK-2A-25-1, AK-6A-25, AK-2A-50S-2

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		621'-3"
2.	Elevation of seismic input below about 40' from grade		Y (N) U
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (4)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	BS
		1.5 x Bounding Spectrum	(ABS)
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	GRS
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	(RRS)

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U (5)*

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A (1)
2.	600 V rating or less	(Y) N U N/A
3.	Side-to-side restraint of draw-out circuit breakers is provided	(Y) N U N/A (2, 3, 4)
4.	Adjacent cabinets which are close enough to impact, or sections of multi-bay cabinets, are bolted together if they contain essential relays	(Y) N U N/A (9)
5.	Attached weight (except conduit) less than about 100 lbs per cabinet assembly	(Y) N U N/A (8)
6.	Externally attached items rigidly anchored	(Y) N U N/A
7.	General configuration similar to ANSI C37.20 Standards	(Y) N U N/A
8.	Cutouts in lower half of cabinet side sheathing less than 30% of width of side panel wide and less than 60% of width of side panel high excluding bus transfer compartment	(Y) N U N/A
9.	All doors secured by latch or fastener	(Y) N U N/A
10.	Anchorage adequate (See checklist below for details)	(Y) N U N/A (6)
11.	Relays mounted on equipment evaluated AF = 4.5	(Y) N U N/A (12)
12.	Have you looked for and found no other adverse concerns?	Y (N) U N/A (8)

Is the intent of all the caveats met for Bounding Spectrum? Y (N) U N/A (8)

(See outlier OSVS-9020)

SSEL Line No. 9020

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 3

Equip. ID No. 2-BDBB-231-0002A Equip. Class 02 - Low Voltage Switchgear

Equipment Description 480V SHDN BD 2A

CAVEATS - GERS (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in generic seismic testing equipment class	Y N U (N/A)
2.	Meets all Bounding Spectrum caveats	Y N U (N/A)
3.	Floor-mounted enclosure	Y N U (N/A)
4.	Manufactured by major vendor (ITE/Brown Boveri, Westinghouse, or GE)	Y N U (N/A)
5.	Maximum weight per section less than 1600 lbs	Y N U (N/A)
6.	Base anchorage adequate (See checklist below for details)	Y N U (N/A)
7.	Relays used for breaker function are not on "Low Ruggedness Relays" list	Y N U (N/A)
8.	Relay evaluation completed for all relays that are essential to other equipment or cause unacceptable lockout	Y N U (N/A)
9.	For 2.5 g level GERS, vertical restraint prevents breaker uplift	Y N U (N/A)
10.	For 2.5 g level GERS, outside corners of end units are reinforced, if needed	Y N U (N/A)
11.	All adjacent cabinets or sections of multi-bay assemblies bolted together	Y N U (N/A)

Is the intent of all the caveats met for GERS? Y N U (N/A)

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A
2.	Type of anchorage covered by GIP	(Y) N U N/A (6)
3.	Sizes and locations of anchors determined	(Y) N U N/A
4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	Y N U (N/A)
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	(Y) N U N/A
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A

Are anchorage requirements met? (Y) N U (6)

SSEL Line No. 9020

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 3 of 3

Equip. ID No. 2-BDBB-231-0002A Equip. Class 02 - Low Voltage Switchgear

Equipment Description 480V SHDN BD 2A

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	Y (N) U N/A (8)
3.	Attached lines have adequate flexibility	(Y) N U N/A (11)
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A (10)
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A (7)

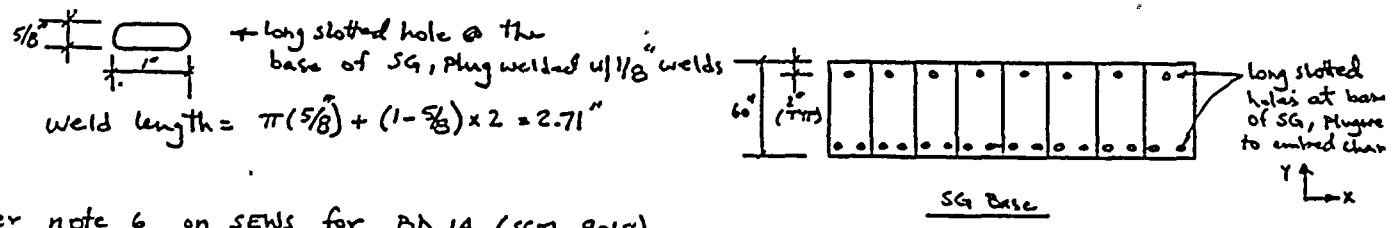
Is equipment free of interaction effects? Y (N) U (8)

IS EQUIPMENT SEISMICALLY ADEQUATE? Y (N) U (9)

COMMENTS

- For Notes 1 thru 5 and 8 thru 12, see SEWS for 1-BDBB-231-0001A (SSEL No. 9018).

6) Switchgear is attached to the embeded sill channel by plug welds, as shown below.



Weld length = $\pi(5/8") + (1-5/8)\times 2 = 2.71"$

Per note 6 on SEWS for BD 1A (SSEL 9018), the resultant pull out load per plug weld is $f_{N_{Tension}} = 1.12^{K}$

The shear load per weld is:

$V_x = \frac{14000^{\#}}{24} = 583^{\#} = V_y$ (D.L. = 14K, Ref. SEWS for SSEL # 9018)

$\Rightarrow f_{w_{Shear}} = \left[583^2 + 583^2\right]^{1/2} = 824^{\#}$

$F_{W_{tensile}} = \frac{0.707 \times 1/8" \times 2.71"}{4} \times 30.6^{ksi} = 1.832^{K}$ ← Knock down factor for tensile loads

$F_{W_{shear}} = 1.832 \times 4 = 7.329^{K}$ ← No knock down factor for shear loads (Ref. EPRI NP-5228-SL, Vol

Shear-Tension interaction:

$\left(\frac{1.12}{1.832}\right)^2 + \left(\frac{.824}{7.329}\right)^2 = 0.39 < 1.0$ OK

Evaluated by: Fanzi Beij Date: 9-5-95

John O. Dizon 9/15/95

Note 7) - Blockwalls in the area are qualified per IEB 80-11 program. (Ref. DWG. 41N1202-1, R3; Walls 63 & 64)

(10 pages)

ATTACHMENT D

SEWS for 0-BDAA-211-0000A (SSEL # 9012)

SSEL Line No. 9012 Status Y (N) U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 3/9

Equip. ID No. 0-BDAA-211-0000A Equip. Class 03 - Medium Voltage Switchgear

Equipment Description 4KV SHDN BD A

Location: Bldg. RB Floor El. 621'-3" Room, Row/Col R-R2

Manufacturer, Model, Etc. (optional but recommended): GE, Circuit Breaker Type Magne-Blast MAH-4.76-250-D

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		621'-3"
2.	Elevation of seismic input below about 40' from grade		Y (N) U grade @ 561'
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (1)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	BS
		1.5 x Bounding Spectrum	(ABS)
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	GRS
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	(RRS)

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U (2) *

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A (4)
2.	2.4 KV to 4.16 KV rating	(Y) N U N/A
3.	Internally mounted potential and/or control power transformers are restrained to prevent damage to or disconnection of contacts	(Y) N U N/A
4.	Adjacent cabinets which are close enough to impact, or sections of multi-bay cabinets, are bolted together if they contain essential relays	(Y) N U N/A (5)
5.	Attached weight (excluding conduit) less than about 100 lbs per cabinet bay	(Y) N U N/A (14), (11)
6.	Externally attached items rigidly anchored	(Y) N U N/A (14), (11)
7.	General configuration similar to ANSI C37.20 Standards	(Y) N U N/A
8.	Cutouts in lower half of cabinet sheathing less than 30% of width of side panel wide and less than 60% of width of side panel high excluding bus transfer compartment	(Y) N U N/A
9.	All doors secured by latch or fastener	(Y) N U N/A
10.	Anchorage adequate (See checklist below for details)	(Y) N U N/A (3)
11.	Relays mounted on equipment evaluated AF= 7.0	(Y) N U N/A (15)
12.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

SSEL Line No. 9012

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 8 9

Equip. ID No. 0-BDAA-211-0000A Equip. Class 03 - Medium Voltage Switchgear

Equipment Description 4KV SHDN BD A

CAVEATS - GERS (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in generic seismic testing equipment class	Y	N	U	N/A
2.	Meets all Bounding Spectrum caveats	Y	N	U	N/A
3.	Floor-mounted enclosure	Y	N	U	N/A
4.	The switchgear is not a specially-designed type	Y	N	U	N/A
5.	Circuit breakers are truck-mounted type, not jack-up or vertical-lift	Y	N	U	N/A
6.	Maximum weight per vertical section less than 5000 lbs	Y	N	U	N/A
7.	Base anchorage adequate (See checklist below for details)	Y	N	U	N/A
8.	Relays used for breaker function are not on "Low Ruggedness Relays" list	Y	N	U	N/A
9.	Relay evaluations completed for all relays that are essential to other equipment or cause unacceptable lockout	Y	N	U	N/A
10.	For 2.5g level GERS, vertical restraint prevents circuit breaker uplift	Y	N	U	N/A
11.	For 2.5g level GERS, circuit break arc chutes are restrained horizontally	Y	N	U	N/A
12.	For 2.5g level GERS, a Beaver Type Z relay is not used in Westinghouse MV switchgear for the "Y" anti-pump relay	Y	N	U	N/A
13.	Separate evaluation of breaker racking mechanism completed; seismic positioner or sufficient side-to-side restraints used	Y	N	U	N/A
14.	All adjacent cabinets or sections of multi-bay assemblies bolted together	Y	N	U	N/A

Is the intent of all the caveats met for GERS? Y N U (N/A)

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y)	N	U	N/A (8, 3)
2.	Type of anchorage covered by GIP (Plug & Fillet welds)	(Y)	N	U	N/A
3.	Sizes and locations of anchors determined	(Y)	N	U	N/A (8)
4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y)	N	U	N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition; and concrete cracking	Y	N	U	(N/A)
6.	For bolted anchorages, gap under base less than 1/4-inch	Y	N	U	(N/A)

SSEL Line No. 9012

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 3 of 9

Equip. ID No. 0-BDAA-211-0000A Equip. Class 03 - Medium Voltage Switchgear

Equipment Description 4KV SHDN BD A

ANCHORAGE (Cont'd)

7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	(Y) N U N/A
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A

Are anchorage requirements met? (Y) N U (3)

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A (12)
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	(Y) N U N/A (7)
3.	Attached lines have adequate flexibility	(Y) N U N/A (9)
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A
5.	Have you looked for and found no other adverse concerns?	Y (N) U N/A (13)

Is equipment free of interaction effects? Y (N) U (13)

IS EQUIPMENT SEISMICALLY ADEQUATE? Y (N) U (13)

COMMENTS

1) The heavy circuit breakers in this med. voltage switchgear are horizontally racked and their weight rests on the floor. Mechanical jack screws secure the breakers to the rear of the enclosure. The lowest frequency associated with the rigidity of the breakers in racked-in position is estimated to be 22.9 HZ based on a conservative calculation (Ref. Calc. CD-Q0211-890151). Test results of a 2.3 unit sections of switchgear showed that the side-to-side response is often less than 8 HZ, while the front-to-back response is greater than 8 HZ (Ref. EPRI Report TR-102180, March 1993). However, since all individual sections of this switchgear are bolted together, the side-to-side frequency would at least match that of the front-to-back. Therefore, it is concluded that the switchgear lowest fundamental frequency is greater than 8 HZ.

Evaluated by: Fang Li Beij Date: 9-12-95

John O. Dizon 9/18/95

2) Per Calc. CD-Q0000-940339, FIG. B.1, the 1.5 x Bounding spectrum is exceeded by the In-structure spectra at EL. 621' of RB in the frequency range of 5.0 HZ to 7. HZ. Since, the lowest natural frequency of this Switchgear is greater than .7 HZ, the intent of GIP seismic capacity vs. Demand Criteria is met.

3) Anchorage Evaluation:

Wt. = 60^K (Ref. DWG. 45N326)

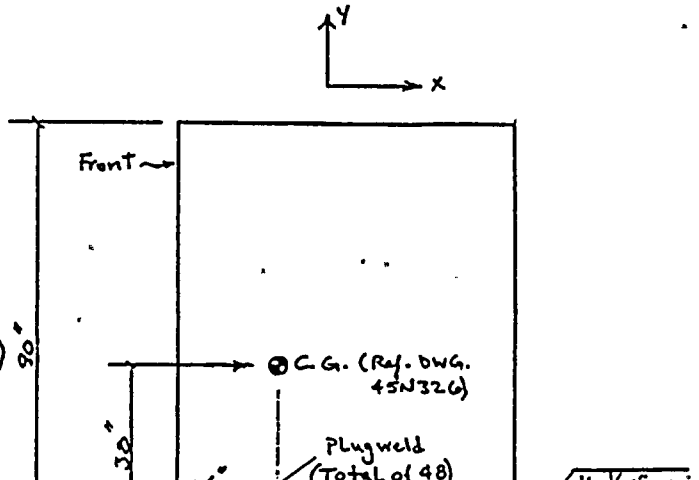
DBE Horiz. Accel. @ f = 8 HZ

a_h = 1.0 g (RB, EL. 621', 5% Damping, DBE)

a_v = 0.16g (ZPA)

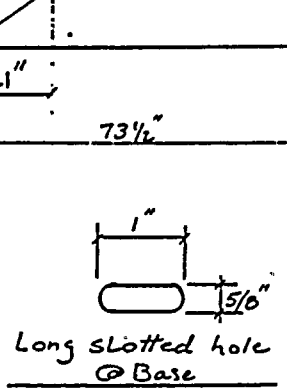
$F_h = 60 \times 1.25 \times 1.0g = 75^K$ ← Factor to account for Med. ctr. spectra

$F_V = 60 \times 1.25 \times 0.16g = 12^K$



- Weld properties

Perimeter of Hole = $\pi(5/8) + (1-5/8) \times 2 = 2.71"$



Long slotted hole @ Base

Equivalent weld length (for shear) @ front = $2.71" \times 48 = 130"$

Equivalent weld length (for tension) @ front = $\frac{130"}{4.} = 32.5"$
Knock down factor for poor workmanship, per GIP, App. C

Equivalent weld length @ back = $24 \times 2 \times 4" = 192"$ (does not govern)
(# of Bays; # of 4" welds per Bay)

JOB NO. 50147 JOB TVA / BFNP A-46 / IPEEE BY FBeiji DATE 9-12-9

CALC. NO. N/A SUBJECT Attach. to SEWS for O-BDAA-211-000A (SSEL 9012) CHK'D J.O.Bi DATE 9/18/95

Note 3 (cont'd)

- Weld allowables:

$F_{W_S} = 30.6^{ksi} \times \frac{1}{8}'' \times 0.707 \times 130'' = 352.6^{k}$ (Total allowable weld shear stress for plug welds @ front of S.G.)

$F_{W_T} = 30.6^{ksi} \times \frac{1}{8}'' \times 0.707 \times 32.5'' = 87.9^{k}$ (Total allowable weld Tensile stress for plug welds @ front of S.G.)

- Weld seismic forces (Moment about A)

$OTM = (75^{k} \times 38'') + (12^{k} \times (73\frac{1}{2} - 17)) - (60 \times (73\frac{1}{2} - 17)) = 138^{k\text{-in}}$ (Resisting Moment due to D.L.)

$F_Y = \frac{138^{k''}}{73.5'' - 4''} + \frac{12^{k}}{2} = 8.0^{k}$

$F_X = \frac{75^{k}}{2} = 37.5^{k}$

$F_{Z_1} = F_X = 37.5^{k}$

$F_{Z_2} = \frac{75^{k}(73.5'' - .21'')}{73.5'' - 4''} = 56.7^{k}$

$\Rightarrow F_Z = 37.5 + 56.7 = 94.2^{k}$

- Shear - Tension Interaction:

$$\left(\frac{F_Y}{F_{W_T}}\right)^2 + \left(\frac{[F_X^2 + F_Z^2]^{1/2}}{F_{W_S}}\right)^2 \leq 1.0$$

$$\left(\frac{8^{k}}{87.9^{k}}\right)^2 + \left(\frac{101^{k}}{352.6^{k}}\right)^2 = 0.09 \ll 1.0 \quad \text{ok}$$

∴ Anchorage Adequate

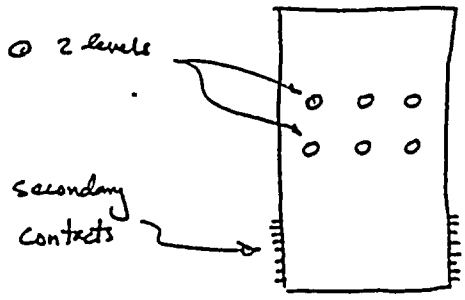
SSEL: 9012

ID: 0-BDAA-211-000A

(4 KV shutdown Board)

Breaker Type: GE Magne-blast circuit breaker
Type MAH-476-250-1D

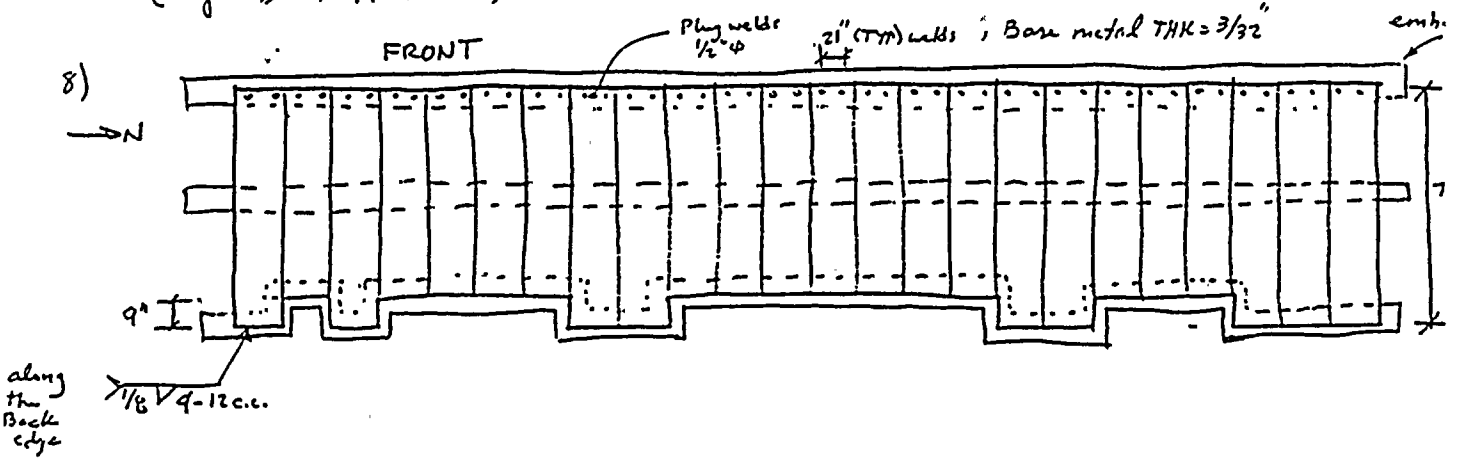
- 4) primary contact: 3 in series (round cross-section) @ 2 levels



- 5) 24 panels, all bolted together, with 5 rows of 1/4" to 1/2" ϕ along the length of each panel (~15" spacing). Also each adjacent panel is bolted to each other @ top by 2" x 3/16" metal strip that are bolted heavily to the panels.
- 6) Size: 73 1/2 (D) x 26 (W) x 90 (H) ← @ 9 panels
  64 1/2 (D) x 26 (W) x 90 (H) ← @ 15 panels

- 7) Blockwalls in the vicinity of Board qualified per IEB 80-11 program (Ref. DWG. 41N1201-1, wall Nos. 28 and 35)

8)



9012 (cont'd)

9) Top entry conduit are rod hung → adequate flexibility

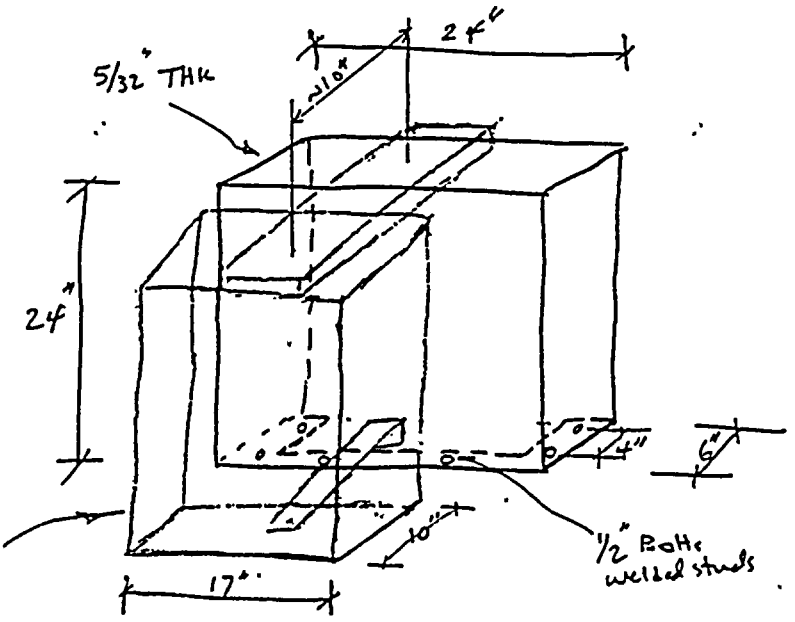
10) Consider 2-3"ϕ, 1-2"ϕ, 1-1½"ϕ, 1-¾"ϕ conduit w/ 4' span @ top of each bay.
$[2 \times 12.8 + 1 \times 5.1 + 1 \times 3.6 + 1 \times 1.4] \times 4' = 143.^{\#}$ ⇒ small enough to ignore in Anchorage Calc

11) There is a synchronizing panel (24"x17"x10") @ top of bay No. 12. See note 14 for its estimated weight and frequency calculation load path from the C.G. of this panel to the S.G. is rugged (6-½" ϕ bo The frequency estimation in Note 14 is based on the determination that the lowest frequency of this panel is attributed to its base flexibility.

12) Fluorescent lights overhead are far enough not to cause seismic interaction. Additionally, the fixtures use compression fittings for the light tubes ok (For SSEL 9013 and 9015, there are 2 Fluorescent fixtures without compress. Fitting → ok since they are fa and are located behind Boards.

13) There is a racking wrench attached to bay No. 2 which would impact the front of the panel in a seismic event. The upper compartment in this bay has relays and the impact of this wrench to the bottom compartment would potentially chatter these relays. → Outlier (OSVS-901

14) Synchronizing panel details:



Synchronizing Panel
3/32" thick housing
17 x 24 x 10

weight of housing = $\frac{490}{12^3} \times \frac{3}{32} \times 2\left[(17\times10)+(17\times24)+(10\times24)\right] = 43.5^{\#}$

There are total of 5 components (meters) mounted inside the box. wt. of each component is estimated to be less than 10 #.

Total wt. of the box = $43.5 + 5(10^{\#}) = 93.5^{\#}$

wt. of the support panel = $\frac{490}{12^3} \times \frac{5}{32} \times \left[(24\times6)+2(6\times24)+(24\times24)\right]$

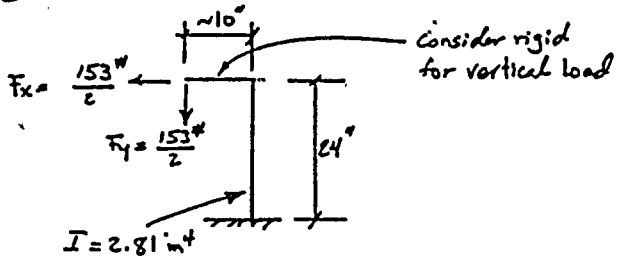
$= 45^{\#}$

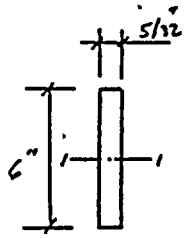
wt. of connecting arms ($\sim 18" \times 6" \times 2"$) $\approx \frac{490}{12^3} \times \frac{5}{32} \times 2\left[(18\times2)+(18\times6)+(6\times2)\right] = 14^{\#}$

Total wt. of synchronizing panel = $93.5 + 45 + 14 = 153.^{\#}$
(This wt. could be ignored in anchorage calc. since it is very small as compared to the overall S.G. wt. ($153/60000 = 0.3\%$).)

Note 14 (cont'd)

Consider the following model and Calculate the frequency of the synch. panel:



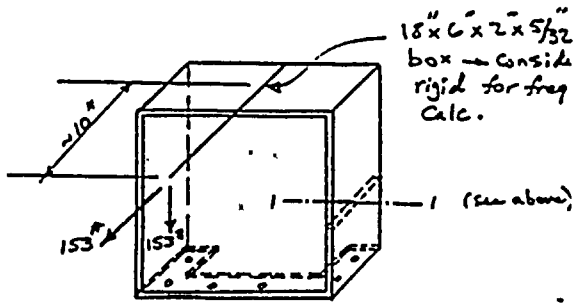


$I_{1-1} = \frac{5/32\,(6)^3}{12} = 2.81$"

δ_{x_1} (due to F_x) $= \frac{(153\#/2)(24)^3}{3 \times 29E6 \times 2.81} = 0.0043$"

δ_{x_2} (due to F_y) $= \frac{(153/2 \times 10")(24)^2}{2 \times 29E6 \times 2.81} = 0.0027$"

$\delta_x = \delta_{x_1} + \delta_{x_2} = 0.0043 + 0.0027 = 0.007$"



$$f = \frac{1}{2\pi}\sqrt{\frac{g}{\delta_x}}$$

$$= \frac{1}{2\pi}\sqrt{\frac{386.4}{.007}} = 37.4 \text{ HZ} \quad (\therefore \text{Rigid})$$

Note: F_x and F_y above are conservative since the restraint provided by the lower member connecting the box to the supporting panel. is ignored in the frequency calculation.

15) The long heavy loaded panel doors are consistently reinforced with stiffenening angles. A similar panel door for low voltage switchgear with no reinforcement was shown to have an estimated fundamental frequency of 9.5 HZ (see SEWS for SSEL No. 9018). By comparison, the fundamental frequency of the panel doors on this equipment where relays are attached to is greater than 9.5 HZ (due to additional stiffeners). A conservative amplification factor of 7.0 is assigned to this switchgear, consistent with that suggested in EPRI Report NP-7148-SL for typical switchgear enclosures.

(6 pages)

ATTACHMENT E

SEWS for 2-XFA-253-0002A1 (SSEL # 9006)

SSEL Line No. 9006 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of ~~35~~

Equip. ID No. 2-XFA-253-0002A1 Equip. Class 04 - Transformers

Equipment Description 480V-120/208V XFMR FOR I&C BUS 2A

Location: Bldg. RB Floor El. 621'-3" Room, Row/CoT P-R13

Manufacturer, Model, Etc. (optional but recommended) SQUARE D, . . 75 KVA, 3 phase

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		621'-3"
2.	Elevation of seismic input below about 40' from grade		Y (N) U (1)
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (2)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	BS
		1.5 x Bounding Spectrum	ABS
		GERS	(GERS)
5.	Demand based on:	Ground Response Spectrum	GRS
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	(RRS)

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) * (Y) N U (3, 10)

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	4.16 KV rating or less	(Y) N U N/A
3.	For floor-mounted dry- and oil-type unit, transformer coils are positively restrained within cabinet	(Y) N U N/A
4.	For 750 kVA or larger units, coils are top braced or adequacy shown by evaluation	Y N U (N/A)
5.	For 750 kVA or larger units, 2-inch clearance is provided between energized component and cabinet	Y N U (N/A)
6.	For 750 kVA or larger units, the slack in the connection between the high-voltage leads and the first anchor accomodates 3-inch relative displacement	Y N U (N/A)
7.	For wall-mounted units, transformer coils anchored to enclosure near enclosure support surface	Y N U (N/A)
8.	For floor-mounted units, anchorage does not rely on weak-way bending of cabinet structures under lateral forces	(Y) N U N/A (9)
9.	Adjacent cabinets which are close enough to impact are bolted together if they contain essential relays	Y N U (N/A)
10.	All doors secured by latch or fastener	(Y) N U N/A
11.	Anchorage adequate (See checklist below for details)	(Y) N U N/A (8)
12.	Relays mounted on equipment evaluated only alarm relays (non-essential)	Y N U (N/A)
13.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

SSEL Line No. 9006

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of ~~35~~

Equip. ID No. 2-XFA-253-0002A1 Equip. Class 04 - Transformers

Equipment Description 480V-120/208V XFMR FOR I&C BUS 2A

CAVEATS - GERS

1.	Equipment is included in generic seismic testing equipment class	(Y) N U N/A
2.	Meets all Bounding Spectrum caveats	(Y) N U N/A
3.	Dry-type unit (not oil-filled)	(Y) N U N/A
4.	Wall or floor-mounted NEMA-type enclosure	(Y) N U N/A
5.	120 to 480 VAC rating	(Y) N U N/A
6.	7.5 to 225 KVA rating	(Y) N U N/A
7.	180 to 2000 pound weight	(Y) N U N/A
8.	Internal supports provide positive attachment of transformer components	(Y) N U N/A
9.	There is a minimum clearance of 3/8 inches between bare conductors and enclosure	(Y) N U N/A
10.	All adjacent cabinets or sections of multi-bay assemblies bolted together	Y N U (N/A)

Is the intent of all the caveats met for GERS? (Y) N U N/A

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A (4,5)
2.	Type of anchorage covered by GIP (Exp. Anch.)	(Y) N U N/A (4,5)
3.	Sizes and locations of anchors determined	(Y) N U N/A
4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	Y N U (N/A)
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A (9)
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A (9)
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	Y N U (N/A)

Are anchorage requirements met? (Y) N U (8)

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A (6)
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	Y N U (N/A)
3.	Attached lines have adequate flexibility	(Y) N U N/A
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A (7)

SSEL Line No. 9006

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 3 of ~~35~~

Equip. ID No. 2-XFA-253-0002A1 Equip. Class 04 - Transformers

Equipment Description 480V-120/208V XFMR FOR I&C BUS 2A

INTERACTION EFFECTS (Cont'd)

5. Have you looked for and found no other adverse concerns? (Y) N U N/A
Is equipment free of interaction effects? (Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

1) Effective grade for RB-2 is @ EL. 550' (Rg. Calc. CD-Q0000-940339)

2) The fundamental frequency of this transformer is judged to be greater than 8 HZ due to rigid mounting configuration of its coil, small mass and reinforced base channel. Additionally, per EPRI Report TR-102180 the fundamental frequency of Transformers <750 KVA is greater than 8HZ (See also Note 10)

3) Per Calc. CD-Q0000-940339, Rev. 0, Figure 8-3A, the 1.5x Instructure SSE Response spectra (i.e., Realistic Median Centered Instructure Response spectrum) @ RBEL 621' exceeds the GERS for Transformers in the frequency range of about 5.5 HZ to 6.2 HZ. Since the lowest frequency of this transformer is estimated to be greater than 8 HZ (see note 2) the intent of the Capacity Vs. Demand criteria is met. OK

— Notes 4 thru 9 continued on sheets 4 & 5.

10) Furthermore, the above transformer (75 KVA) is also seismically qualified [*] by comparison to similar transformer (45 KVA) that was tested per IEEE 344-75 requirements. The 75KVA transformer base mounting bracket and base mounting dimension were increased to lower the resulting stresses and increase the natural frequency (>8Hz) based on comparable test results from the 45 kva transformer. (Wyle Test Report # 44509-1, 5/14/80) JDD 9/21/95 FB 9/21/95

Evaluated by: Fozzi Beiji Date: 7-21-95

John O. Dizon 7/25/95

[*] Seismic qualification documented in a letter from B.R. Rich (Square D Co.) to Anita Helton (TVA) dated 1/21/81.

EQE INTERNATIONAL

SHEET NO. 4 of 5

JOB NO. 50147.05 JOB TVA/BFN A-46/IPEEE BY TBeij DATE 7-21-9

CALC. NO. NA SUBJECT 2-XFA-253-0002A1 (SSEL #9006) CHK'D JoDizon DATE 7/25/9

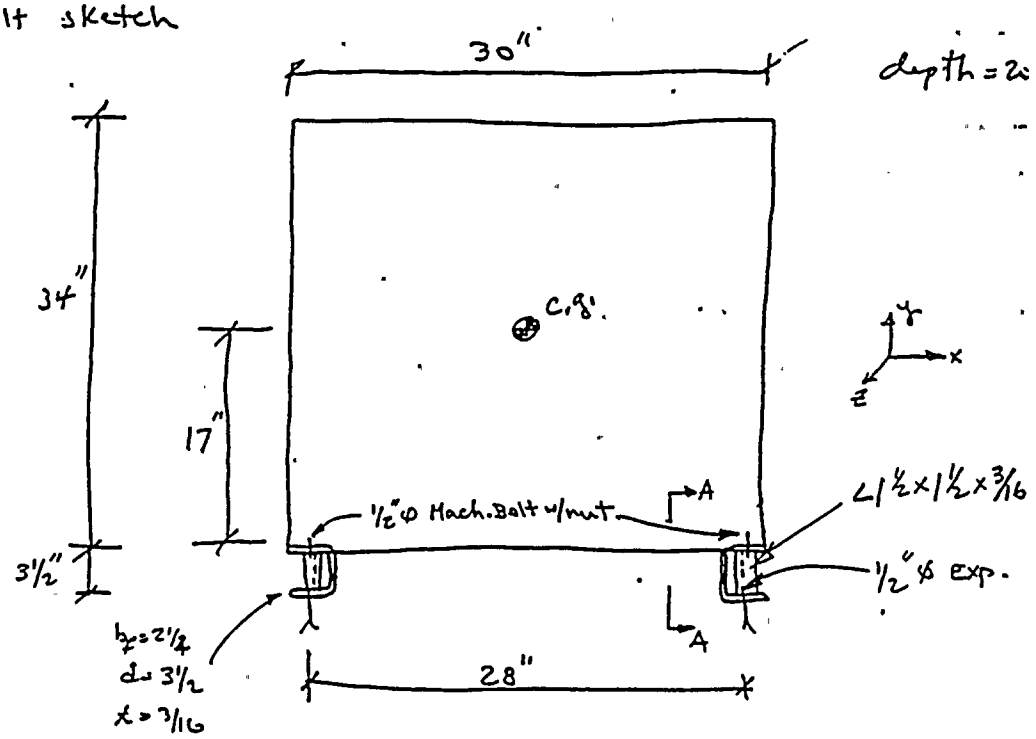
SSEL No. 9006, 9008 (photos; R1, F 9 & 10)

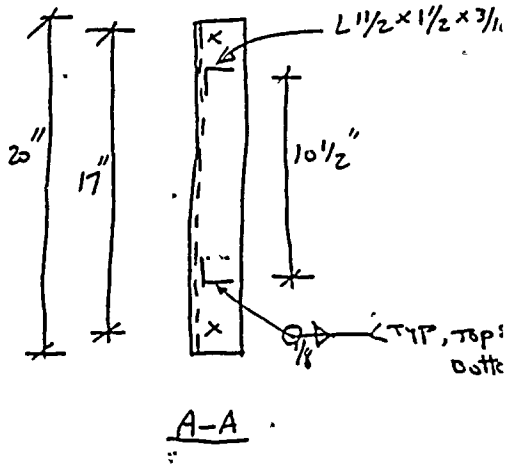
Comp-ID. 2-XFA-253-0002A1, 2B1

Manufacturer: SQUARED company

75KVA, 3 phase

Note 4) - as-built sketch





A-A

5) - C.G. @ center of the Transformer (Conservative)

6) - Fire Extinguisher near by not supported positively may fall & impact the Transformer. Judged ok since Transf. is enclosed by 3/32" thick steel & does not have any soft targets or relays.

7) - Fluorescent lights above this comp. are potential interaction hazard. but it is insignificant (See above note)

SSEL No. 9006

Equip. ID. 2-XFA-253-0002A1

8) Anchorage Evaluation:

WT ≃ 385# (similar to the transformer analyzed in Calc. CD-Q30T3-930999 Rev. 1)

conservatively use peak accelerations @ RB, EL 621'-3", 5% Damping, SSE

$a_h^{Peak} = 2.15\ g$

$a_V^{Peak} = 0.66\ g$ (Ref: CEB-88-05-C, Rev. 1)

T = Resultant pullout load per 1/2" ϕ Exp. Anchor

$$= \left[\left(\frac{385^{\#} \times 2.15g \times 20.5"}{28" \times 2}\right)^2 + \left(\frac{385^{\#} \times 2.15g \times 20.5"}{17" \times 2}\right)^2 + \left(\frac{385^{\#} \times 0.66g}{4}\right)^2\right]^{1/2} \times 1.25$$

(for median-centered spectra)

$$- \frac{385^{\#}}{4} = 638^{\#} < T_{all} = 2.29^{k} \times \frac{3600}{4000} = 2.06^{k}$$

(Ref. GIP, App. C)

(f'_c Red. Factor)

V = Resultant Shear load per 1/2" ϕ Anchor

$$= \sqrt{2}\,(385^{\#} \times 2.15g \times 1.25)/4 = 366^{\#} < V_{all} = 2.38^{k}; \quad \frac{V}{V_{all}} < 0.3$$

$$IR = \frac{638}{2060} = \underline{0.31} < 1.0 \quad \underline{OK}$$

9) - Base channel

The stress in the base channel is very small by inspection and due to the fact that the channel flanges are reinforced @ the anchor points by L 1 1/2 x 1 1/2 x 3/16 members.

(6 pages)

ATTACHMENT F

SEWS for 0-0XF-219-TDA (SSEL # 9004)

SSEL Line No. 9004 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 25

Equip. ID No. 0-0XF-219-TDA Equip. Class 04 - Transformers

Equipment Description 4KV/480V XFMR TDA

Location: Bldg. U1/2 DGB Floor El. 583 Room, Row/Col South end of Hallway West of T and R1

Manufacturer, Model, Etc. (optional but recommended) GE, 300 KVA - 3 Phase, 60 cycles

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input	583'	
2.	Elevation of seismic input below about 40' from grade	(Y) N U	
3.	Equipment has fundamental frequency above about 8 Hz	(Y) N U N/A	(1)
4.	Capacity based on: Existing Documentation	DOC	
	Bounding Spectrum	(BS)	
	1.5 x Bounding Spectrum	ABS	
	GERS	GERS	
5.	Demand based on: Ground Response Spectrum	(GRS)	
	1.5 x Ground Response Spectrum	AGS	
	Conserv. Des. In-Str. Resp. Spec.	CRS	
	Realistic M-Ctr. In-Str. Resp. Spec.	RRS	

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A	(2)
2.	4.16 KV rating or less	(Y) N U N/A	
3.	For floor-mounted dry- and oil-type unit, transformer coils are positively restrained within cabinet	(Y) N U N/A	(2)
4.	For 750 kVA or larger units, coils are top braced or adequacy shown by evaluation	Y N U (N/A)	
5.	For 750 kVA or larger units, 2-inch clearance is provided between energized component and cabinet	Y N U (N/A)	
6.	For 750 kVA or larger units, the slack in the connection between the high-voltage leads and the first anchor accomodates 3-inch relative displacement	Y N U (N/A)	
7.	For wall-mounted units, transformer coils anchored to enclosure near enclosure support surface	Y N U (N/A)	
8.	For floor-mounted units, anchorage does not rely on weak-way bending of cabinet structures under lateral forces	(Y) N U N/A	
9.	Adjacent cabinets which are close enough to impact are bolted together if they contain essential relays	Y N U (N/A)	
10.	All doors secured by latch or fastener	(Y) N U N/A	
11.	Anchorage adequate (See checklist below for details)	(Y) N U N/A	(3)
12.	Relays mounted on equipment evaluated	Y N U (N/A)	
13.	Have you looked for and found no other adverse concerns?	(Y) N U N/A	

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

SSEL Line No. 9004

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 25

Equip. ID No. 0-OXF-219-TDA Equip. Class 04 - Transformers

Equipment Description 4KV/480V XFMR TDA

CAVEATS - GERS

1.	Equipment is included in generic seismic testing equipment class	Y	N	U	(N/A)
2.	Meets all Bounding Spectrum caveats	Y	N	U	(N/A)
3.	Dry-type unit (not oil-filled)	Y	N	U	(N/A)
4.	Wall or floor-mounted NEMA-type enclosure	Y	N	U	(N/A)
5.	120 to 480 VAC rating	Y	N	U	(N/A)
6.	7.5 to 225 KVA rating	Y	N	U	(N/A)
7.	180 to 2000 pound weight	Y	N	U	(N/A)
8.	Internal supports provide positive attachment of transformer components	Y	N	U	(N/A)
9.	There is a minimum clearance of 3/8 inches between bare conductors and enclosure	Y	N	U	(N/A)
10.	All adjacent cabinets or sections of multi-bay assemblies bolted together	Y	N	U	(N/A)

Is the intent of all the caveats met for GERS? Y N U (N/A)

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y)	N	U	N/A	
2.	Type of anchorage covered by GIP	(Y)	N	U	N/A	
3.	Sizes and locations of anchors determined	(Y)	N	U	N/A	
4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y)	N	U	N/A	
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y)	N	U	N/A	
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y)	N	U	N/A	
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	Y	N	U	(N/A)	
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y)	N	U	N/A	(4)
9.	Strength of equipment base and load path to CG adequate	(Y)	N	U	N/A	(4)
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	Y	N	U	(N/A)	

Are anchorage requirements met? (Y) N U

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y)	N	U	N/A	
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	Y	N	U	(N/A)	
3.	Attached lines have adequate flexibility	(Y)	N	U	N/A	(5)
4.	Overhead equipment or distribution systems are not likely to collapse	(Y)	N	U	N/A	

SSEL Line No. 9004

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 3 of 25

Equip. ID No. 0-OXF-219-TDA Equip. Class 04 - Transformers

Equipment Description 4KV/480V XFMR TDA

INTERACTION EFFECTS (Cont'd)

5. Have you looked for and found no other adverse concerns? (Y) N U N/A
Is equipment free of interaction effects? (Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

(1) The transformer is rigidly mounted to the floor framing which in turn is anchored to the concrete floor. Electrical boxes on the sides of the transformers are also rigidly attached to the XFMR frame and have rigid conduit (3"ϕ + 4"ϕ) to floor penetrations and ceiling mounted supports. Test results indicate natural frequency of typical transformers (<750KVA) to be greater than 8 hz. (Refer to EPRI TR-102/80)

(2) The transformer (floor-mounted oil-type unit) is well represented in the experience data base. This type of transformers typically are factory-sealed, thus, internal inspection of the coil restraints is not necessary. There are no instances of failure in the data base due to rocking motion or sliding between the coil and the enclosure.

(3) Base frame anchorage as well as the connection bolts between the XMFR framing and base are found to be seismically adequate per attached anchorage calc. (page 5)

(4) Base frame consists of WF6 section with stiffener plates near the C-I-P concrete anchors. XMFR housing and framing are of 3/16" thick plate and are further stiffened by the L2x2x½ cross-ties at the bottom. Base has adequate stiffness to transfer loads to the base anchors.

(5) Overall, the transformer is rigid. Displacement at the top of the XMFR should be minimal, thus, short rod-hung conduit supports (ceiling-mounted) are not a concern.

Evaluated by: Hem O. Dizon Date: 7/22/95

Farzi Beigi 7/25/95

EQE INTERNATIONAL

SHEET NO. 4 OF

JOB NO. 50147.05 JOB TVA/BFN A-46/IPEEE BY FBaiji DATE 7/2:

CALC. NO. N/A SUBJECT Additional Notes for SEWS 0-OXF-219-TDA CHK'D [illegible] DATE 7/22

(Photo R1, F20, 21)

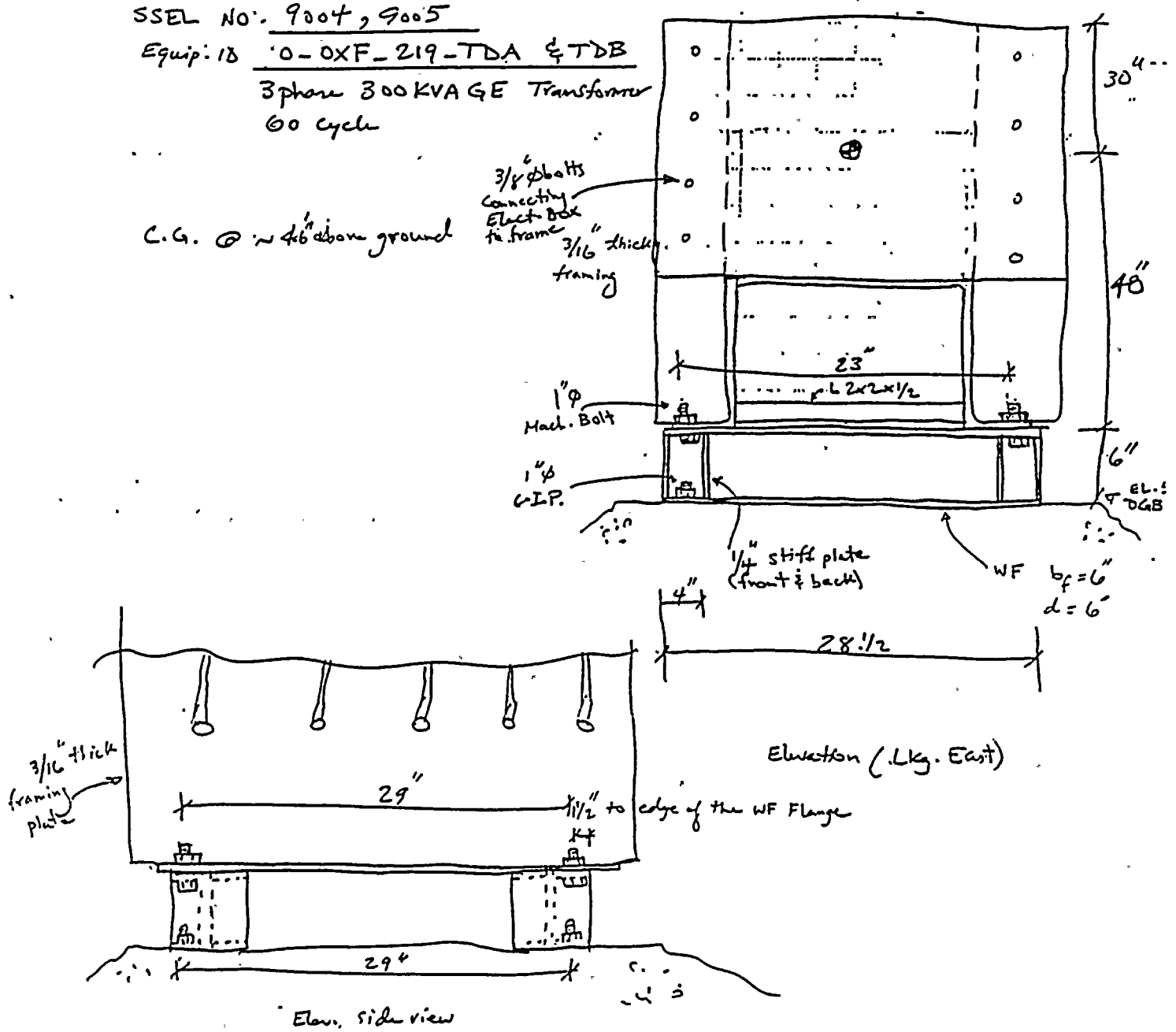
SSEL NO: 9004, 9005

Equip: ID 0-OXF-219-TDA & TDB

3phase 300KVA GE Transformer

60 cycle

C.G. @ ~46" above ground



Elevation (Lkg. East)

Elev. side view (Looking South)

(Sketches apply to TDA, TDB is similar)

EQE INTERNATIONAL

JOB NO. 50147.05 JOB TVA/BFN A-46/IPEEE BY JDJ DATE 7/22/95 SHEET NO. 5 OF 5

CALC. NO. N/A SUBJECT Anchorage Evaluation, XMFR TDA, TDB CHK'D JB DATE 7/25/95

SSEL Line no: 9004, 9005

Equip. ID: 0-0XF-219-TDA & -TDB

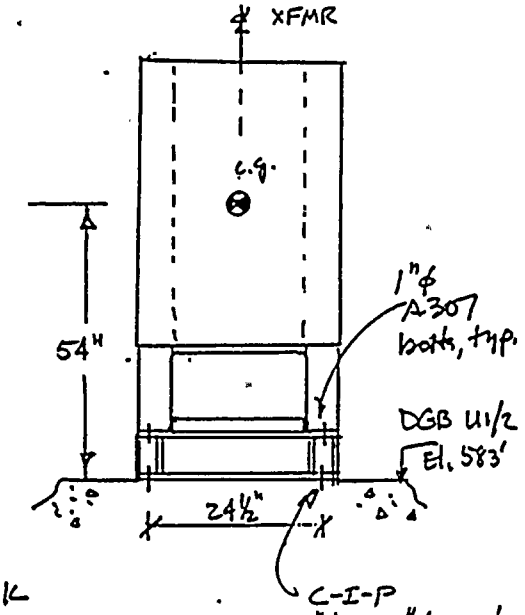
Evaluate Existing anchorage:

For horiz. direction, use peak $S_a = 1.067 \times 2 = 2.134$ g.
Vert. direction, use ZPA $= 0.091 \times 2 = 0.182$ g.
} DBE, 5% damping, El. 583' (Ref. - MARS report CEB-88-05-C Rev. 1)

Total Wt = 3950 lbs. (Ref- TVA Dwg. 0-45N328, R2)

$F_h = 3950 \times 2.134g \times 1.25 = 10.54^k$

$F_V = 3950 \times 0.182g \times 1.25 = 0.90^k$



Calculate anchor loads,

$P_{NS} = P_{EW} = \frac{10.54 \times 54"}{2 \times 24.5} = 11.62^k$

$P_V = \frac{0.90}{4} = 0.23^k$

$V_{NS} = V_{EW} = \frac{10.54}{4} = 2.64^k$

Max. pullout load, $P = \left(11.62^2 + 11.62^2 + 0.23^2\right)^{1/2} - \frac{3.95}{4}$ (conservative)
$= 15.44^k$

Max. shear load, $V = 2.64\sqrt{2} = 3.73^k$

For 1"ϕ C-I-P, $P_{nom} = 26.69^k$, $V_{nom} = 13.35^k$
$L = 12" > L_{min} = 10"$, $s >> s_{min}$
No capacity reduction factor reqd. $P_{nom} = P_{all}$, $V_{nom} = V_{all}$

$\frac{V}{V_{all}} = \frac{3.73}{13.35} = 0.28 < 0.30$.

$\therefore \frac{P}{P_{all}} = \frac{15.44}{26.69} = \underline{0.58} < 1.0$ ok

Check connection bolts, 1"ϕ A307 type, nom. Area, $A_n = \frac{\pi D^2}{4} = \frac{\pi}{4} = 0.785 in^2$.

$f_t = \frac{P}{A_n} = \frac{15.44}{0.785} = 19.67$ ksi $\quad C/D = \frac{19.67^4}{34} = 0.58 < 1.0$ ok

$f_V = \frac{V}{A_n} = \frac{3.73}{0.785} = 4.75$ ksi $< F_V = 1.7 \times 10 = 17$ ksi,

$F_t = 26(1.7) - 1.8(4.75) = 35.7$ ksi $\Rightarrow$ use $F_t = 1.7 \times 20 = 34$ ksi $> f_t = 19.67$ ksi ok.

$\therefore$ Anchorage of Transformers TDA and TDB is adequate.

(4 pages)

ATTACHMENT G

SEWS for 2_MGEN_268_0002EN (SSEL# 9141)

SSEL Line No. 9141 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 23

Equip. ID No. 2-MGEN-268-0002EN Equip. Class 13 - Motor-Generators

Equipment Description LPCI M-G SET 2EN

Location: Bldg. RB Floor El. 639 Room, Row/Col U-R14

Manufacturer, Model, Etc. (optional but recommended) Motor: Pacemaker, model: 1270330044 TYPE CJ GS

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		639'
2.	Elevation of seismic input below about 40' from grade		Y (N) U grade @ El. 550
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (1)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	BS
		1.5 x Bounding Spectrum	(1.5BS)
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	GRS
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	(RRS)

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U (2)*

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	Main driver and driven equipment connected by a rigid support or skid	(Y) N U N/A (1)
3.	Base vibration isolators adequate for seismic loads	Y N U (N/A)
4.	Attached lines have adequate flexibility	(Y) N U N/A
5.	Anchorage adequate (See checklist below for details)	(Y) N U N/A (3)
6.	Relays mounted on equipment evaluated	Y N U (N/A)
7.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A
2.	Type of anchorage covered by GIP	(Y) N U N/A
3.	Sizes and locations of anchors determined	(Y) N U N/A
4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A

SSEL Line No. 9141

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 2/3

Equip. ID No. 2-MGEN-268-0002EN Equip. Class 13 - Motor-Generators

Equipment Description LPCI M-G SET 2EN

ANCHORAGE (Cont'd)

6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	Y N U (N/A)
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A

Are anchorage requirements met? (Y) N U (3)

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	Y N U (N/A)
3.	Attached lines have adequate flexibility	(Y) N U N/A
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is equipment free of interaction effects? (Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

1) The motor and generator, and flywheel assembly are located in a common skid, and are rigidly bolted to 1" thk stiffened steel skid plate which is bolted by 12-1"ϕ bolts to the CG sill Channel. The sill Channel is welded (3/16" Fillet @ both flanges with 4" @ 12" c.c. weld) to 1/2" thk Base plate which is anchored to the concrete floor by 24-1"ϕ wedge anchors (48N Dwg. 1244-1) The assembly as a whole is judged to have lowest frequency of much greater than 8 HZ.

*2) Per Calc. CDQ0000-940339, the 1.5 x B.S. exceeds the instructure spectra in the frequency range of 4.8 to 7.3 HZ @ EL. 639' of RB. Since the lowest frequency of this unit is much greater than 7.3 HZ (see note 1) the unit meets the intent of the GIP seismic capacity vs. Demand criteria.

Evaluated by: J Beij Date: 8-22-95

John O. Dizon 8/25/95

3) Considering that the horiz. spectral acceleration @ EL. 639' of RB (DBE, 5%) corresponding to f ≈ 10 HZ (conservative) is about 0.75g and the fact that there are 24-1"ϕ Wedge anchor anchoring the unit to the floor ($T_{all} = 6.15 \times \frac{3600}{4000} = 6.25^K$, $V_{all} = 9.53^K$) and 12-1"ϕ bolts connecting the unit to the 1" Thk steel skid, it is judged that the anchorage is adequate for seismic loading (effects due to high frequency (1800rpm) vibrating equip. are negligible)

EQE INTERNATIONAL

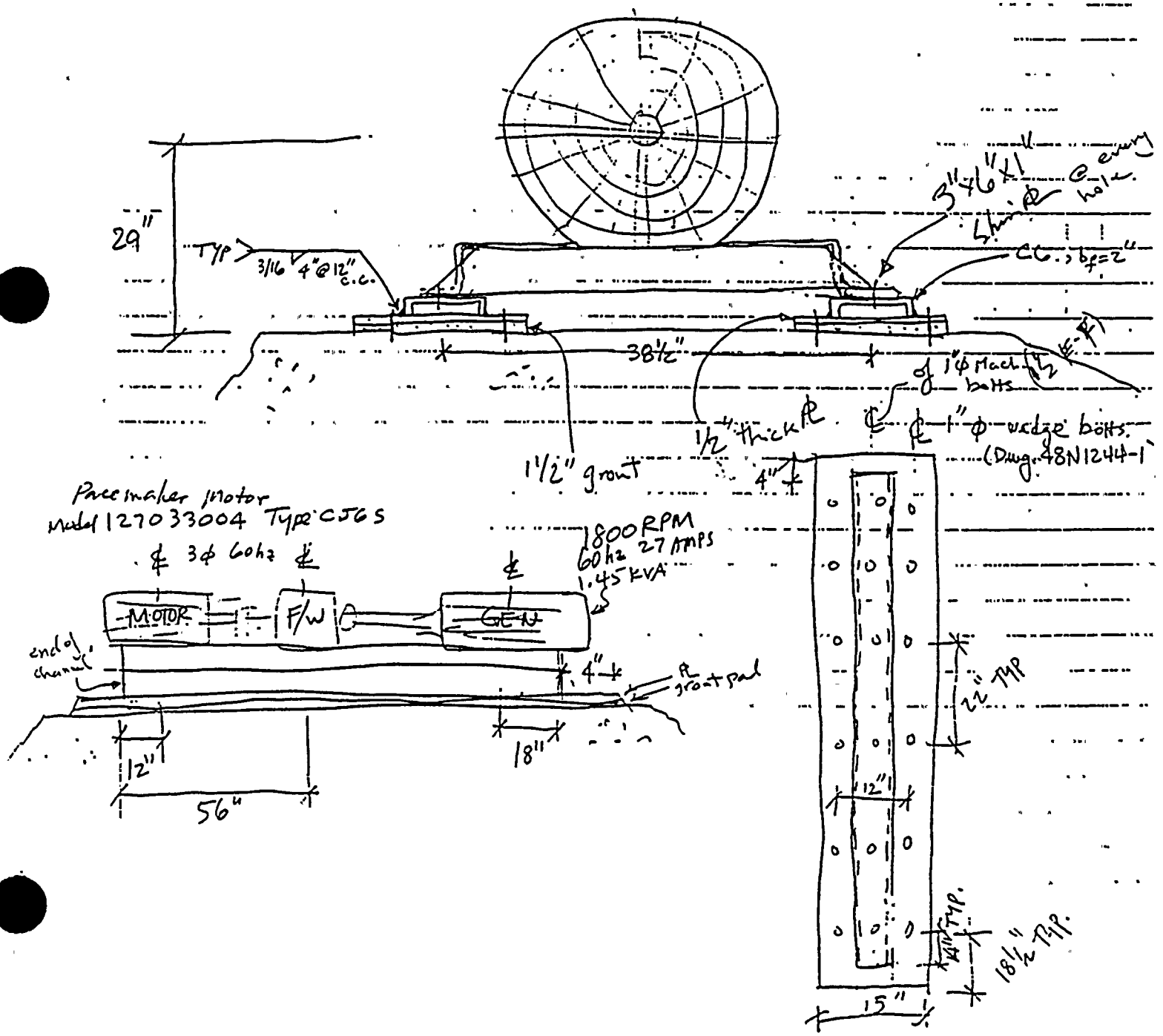
SHEET NO. 3 of 3

JOB NO. 50147.05 JOB TVA / BFNP A-46 / 10CFR BY ZBeji DATE 7-24-9

CALC. NO. N/A SUBJECT Attachment to SEWS for 2-MGEN-268-0002EN CHK'D J.D.Stevenson DATE 8/25/9
(SSEL No. 9141)

SSEL No. : 9141 , 9140

I.D. : 2-MGEN-268-0002EN & 0002DN



(6 pages)

ATTACHMENT H

SEWS for 3_INVT_256_0002 (SSEL# 39075)

SSEL Line No. 39075 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 35

Equip. ID No. 3-INVT-256-0002 Equip. Class 16 - Battery Chargers & Inverters

Equipment Description DIV II ECCS ATU INVERTER

Location: Bldg. RB Floor El. 621'-3" Room, Row/Col SD-BD RM E

Manufacturer, Model, Etc. (optional but recommended) _____

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		621'-3"
2.	Elevation of seismic input below about 40' from grade		Y (N) U (grade @ 563')
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (1),(8)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	BS
		1.5 x Bounding Spectrum	(ABS)
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	GRS
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	(RRS)

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U (2)*

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	Solid state type	(Y) N U N/A
3.	For floor-mounted, transformer positively anchored and mounted near base, or load path is evaluated	(Y) N U N/A (7)
4.	Base assembly of floor-mounted unit properly braced or stiffened for lateral forces	(Y) N U N/A (5),(7)
5.	For wall-mounted units, transformer supports and bracing provide adequate load path to the rear cabinet wall	Y N U (N/A)
6.	All latches and fasteners in doors secured	(Y) N U N/A
7.	Anchorage adequate (See checklist below for details)	(Y) N U N/A (4,7)
8.	Relays mounted on equipment evaluated AF=3.0	(Y) N U N/A (3)
9.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

CAVEATS - GERS (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in generic seismic testing equipment class	Y N U (N/A)
2.	Meets all Bounding Spectrum caveats	Y N U (N/A)

SSEL Line No. 39075

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 35

Equip. ID No. 3-INVT-256-0002 Equip. Class 16 - Battery Chargers & Inverters

Equipment Description DIV II ECCS ATU INVERTER

CAVEATS - GERS (Cont'd)

3.	Silicon-Controlled Rectifier (SCR) power controls; wall- or floor-mounted NEMA-type enclosure	Y N U (N/A)
4.	Within range of battery charger ratings:	
	24-250 VDC	Y N U (N/A)
	120-480 VAC	Y N U (N/A)
	25-600 amps	Y N U (N/A)
	150-2850 pounds (floor-mounted)	Y N U (N/A)
	150-600 pounds (wall-mounted)	Y N U (N/A)
5.	Within range of inverter ratings:	
	120 VDC only	Y N U (N/A)
	120-480 VAC	Y N U (N/A)
	0.5-15 KVA	Y N U (N/A)
	300-2000 pounds	Y N U (N/A)
6.	Heavy components are located in lower half of cabinet and are supported from base or rear panel with no panel cutouts adjacent to attachment	Y N U (N/A)

Is the intent of all the caveats met for GERS? Y N U (N/A)

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A (5, 6)
2.	Type of anchorage covered by GIP	(Y) N U N/A (5)
3.	Sizes and locations of anchors determined	(Y) N U N/A (5)
4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	(Y) N U N/A
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A

Are anchorage requirements met? (Y) N U (4, 7)

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	(Y) N U N/A

SSEL Line No. 39075

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 3 of 35

Equip. ID No. 3-INVT-256-0002 Equip. Class 16 - Battery Chargers & Inverters

Equipment Description DIV II ECCS ATU INVERTER

INTERACTION EFFECTS (Cont'd)

3.	Attached lines have adequate flexibility	(Y) N U N/A
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is equipment free of interaction effects? (Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

1) The frequency of this type of inverters (small size) has been shown, by shake table testing, to be greater than 8 HZ. (Ref. EPRI Report TR-102180). Additionally, the frequency calculation performed on page 5, based on the base flexibility, demonstrates f > 8 HZ. (see also note 1 on SEWS for 2-INV-256-0001

2) Per Calc. CD-Q0000-940339, the 1.5 xBS is exceeded by the Realistic Med Centered in-structure spectra, @ EL 621' of RB, in the frequency range of about 5.0 HZ to 6.8 HZ. since the lowest frequency of this inverter is greater than 8 HZ and there are no exceedances above 8 HZ, the intent of the GIP seismic Capacity vs. demand criteria is met.

3) See note 4 on SEWS for 2-INV-256-0001 (SSEL 9114) → AF=3.0

4) Anchorage adequacy is demonstrated in calc. CD-Q3057-923665, Rev. 1 and note 7.

- See sheets 4 & 5 for additional notes.

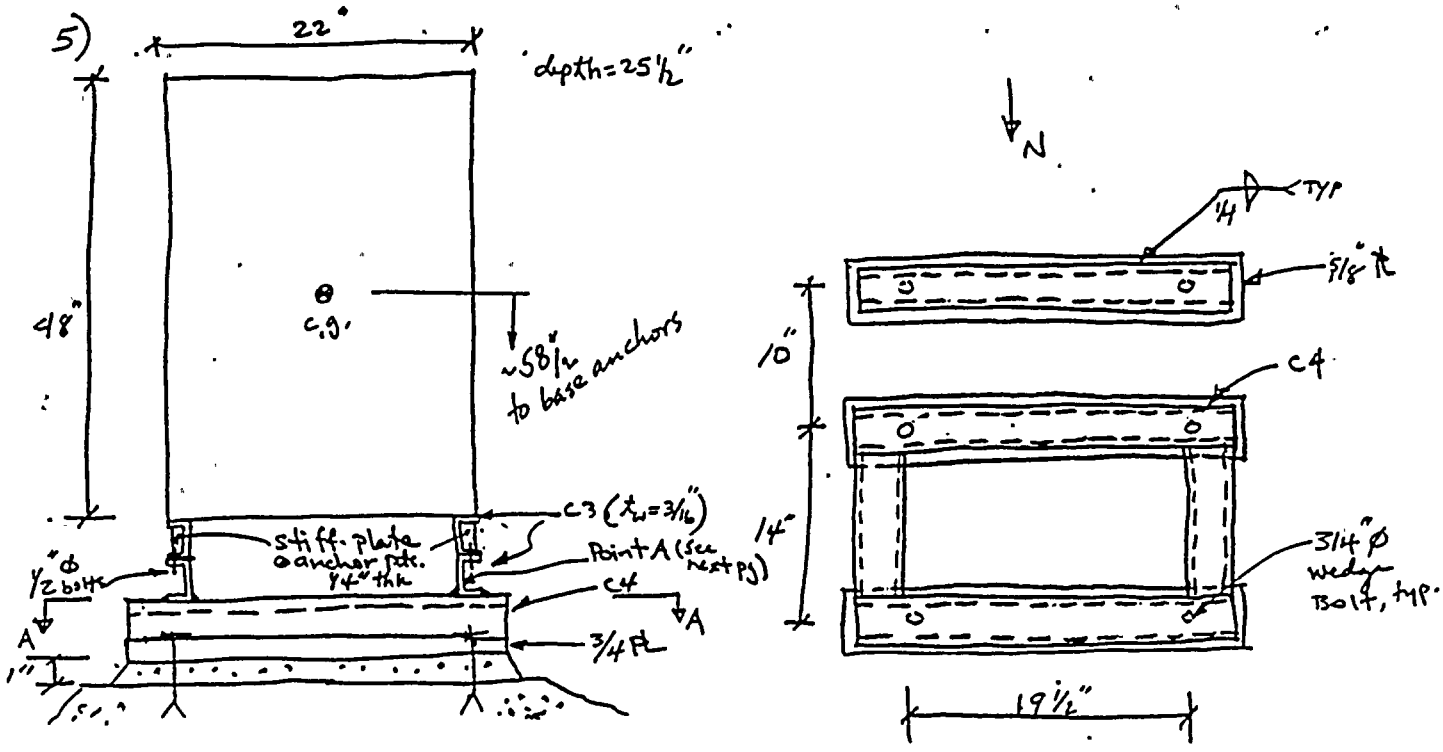
Evaluated by: Farzi Beji Date: 9-17-95

John O. Dizon 9/25/95

SSEL: 39075

I.D: 3-INVT-256-0002 (HDR power systems)

5)



A-A

6) C.G. @ geometric center of Enclosure.

7) Anchorage Evaluation: conservatively, consider only 4 - ¾"ϕ WB @ each corner,

- wt = 45 #/ft³ [22" x 48" x 25.5"] $\frac{1}{12^3}$ = 701 # (Per GIP, App C, Table C.1-1)
- @ f = 8 Hz (DBE accel., 5% damping, RB, EL 621'-3")

a_h = 1.0 g → F_h = 701 x 1.0g x 1.25 = 877 #

ZPA: a_v = 0.16 g → F_v = 701 x .16g x 1.25 = 140 # ← to account for Med. ctr spectra

- $T = \left[\left(\frac{877 \times 58"/2}{19.5 \times 2}\right)^2 + \left(\frac{877 \times 58/2}{24 \times 2}\right)^2 + \left(\frac{140}{4}\right)^2\right]^{1/2} - \frac{701}{4} = 666$ #

$V = \left[\left(\frac{877}{4}\right)^2 + \left(\frac{877}{4}\right)^2\right]^{1/2} = 310.$ #

← relay red. Factor

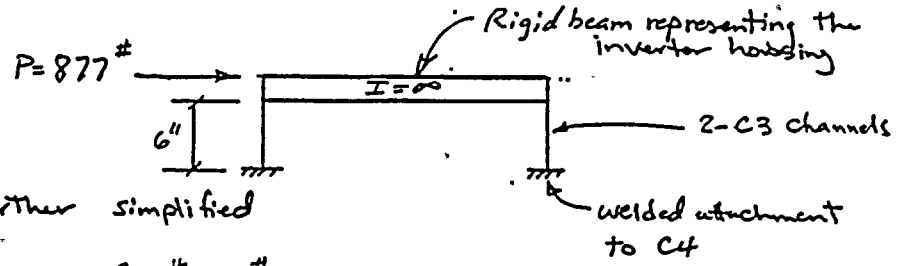
- V_{all} = 5480 x 0.75 = 4110 # → $\frac{V}{V_{all}}$ = 0.08 ≪ 0.3 ok

T_{all} = 4690 x .75 x $\frac{3600}{4000}$ = 3166 # → $\frac{T}{T_{all}}$ = 0.21 < 1.0 ok

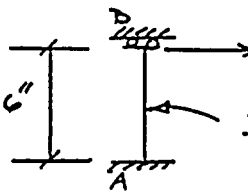
Note 7 (cont'd)

Check base channel bending (Stress in the web of C3):

Consider the simplified model below:



This model can be further simplified to:



$I = \frac{24(3/16)^3}{12} = 0.0132\ in^4$

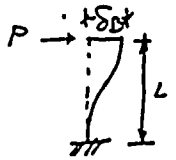
$S = \frac{I}{C} = \frac{.0132 \times 2}{3/16} = 0.141\ in^3$

$M_A = \frac{439^{\#} \times 6"}{2} = 1317\ \#"$

$f_{b_A} = \frac{1317}{0.141} = 9.34\ ksi \quad < \quad F_b = 0.75\ F_y\ (1.7) = 45.9\ ksi$ ok

(effect of Tensile stress on the section is negligible and therefore ignored)

8) Estimate the lower bound frequency of the inverter corresponding to its base flexibility:



$\delta_B = \frac{PL^3}{12EI}$

$= \frac{701/2 \times 6^3}{12 \times 29E6 \times .0132} = 0.0165"$

$f = \frac{1}{2\pi}\sqrt{\frac{g}{\delta_B}}$

$= \frac{1}{2\pi}\sqrt{\frac{386.4}{.0165}} = 24.4\ Hz \quad >> 8\ hz.$

EQE INTERNATIONAL

SHEET NO. I1 of 5

JOB NO. 50147 JOB TVA/BFNP · A46 /IPEEE BY JBeig DATE 12-19-9

CALC. NO. C-011 SUBJECT HCLPF for Elect. Equip. CHK'D D.D.Dizon DATE 12/29/9

(5 pages)

ATTACHMENT I

SEWS for 2_LPNL_925_0032 (SSEL #9075)

SSEL Line No. 9075 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 24

Equip. ID No. 2-LPNL-925-0032 Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 25-32

Location: Bldg. RB Floor El. 621'-3" Room, Row/Col Q-R13

Manufacturer, Model, Etc. (optional but recommended) GE

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		621'-3" Eff.
2.	Elevation of seismic input below about 40' from grade		Y (N) U (Grade @ EL. 550')
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (1)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	BS
		1.5 x Bounding Spectrum	(ABS)
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	GRS
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	(RRS)

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U (6)*

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	No computers or programmable controllers	(Y) N U N/A
3.	No strip chart recorders	(Y) N U N/A
4.	Steel frame and sheet metal structurally adequate	(Y) N U N/A
5.	Adjacent cabinets or panels which are close enough to impact, or sections of multi-bay cabinets or panels, are bolted together if they contain essential relays	(Y) N U N/A (2)
6.	Drawers and equipment on slides restrained from falling out	Y N U (N/A)
7.	All doors secured by latch or fastener	(Y) N U N/A
8.	Attached lines have adequate flexibility	(Y) N U N/A(5)
9.	Anchorage adequate (See checklist below for details)	(Y) N U N/A(8)
10.	Relays mounted on equipment evaluated AF=4.5	(Y) N U N/A(7)
11.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A (2, 3)
2.	Type of anchorage covered by GIP Weld	(Y) N U N/A (2, 4)
3.	Sizes and locations of anchors determined	(Y) N U N/A (2)

SSEL Line No. 9075

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 24

Equip. ID No. 2-LPNL-925-0032 Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 25-32

ANCHORAGE (Cont'd)

4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A(2)
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	Y N U (N/A)
6.	For bolted anchorages, gap under base less than 1/4-inch	Y N U (N/A)
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	Y N U (N/A)
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A

Are anchorage requirements met? (Y) N U(8)

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	(Y) N U N/A
3.	Attached lines have adequate flexibility	(Y) N U N/A(5)
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is equipment free of interaction effects? (Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

1) Panels are lightly loaded. The panel thickness is 5/32" - 3/16" and top restraint is provided by rigid conduit that are rigidly supported from the nearby walls. The load path of the internal components and the housing to the base anchorage is adequate and therefore the natural frequency of the panel is judged to be > 8 Hz.

(See pp. 3 & 4 for continuation of notes)

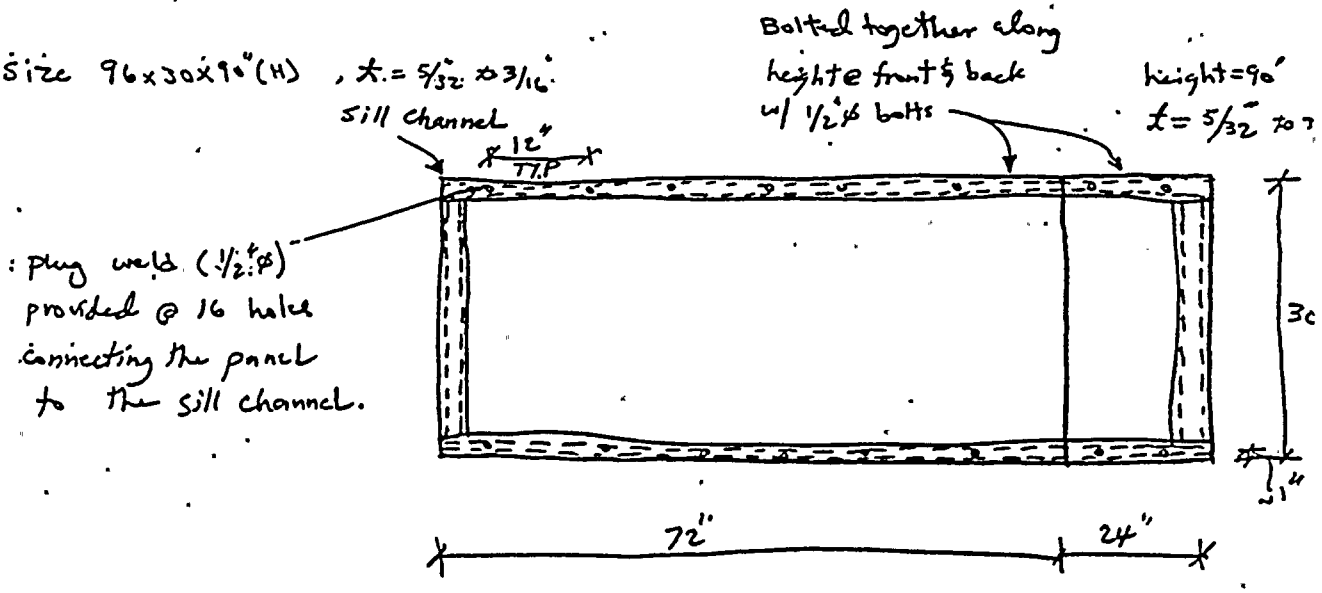
Evaluated by: Farzi Beig Date: 8-21-95

John O. DiPiero 8/23/95

SSEL No.: 9075

I.D.: panel 2-LPNL-925-0032

2) Size 96x30x90"(H), t.= 5/32" to 3/16"



3) C.G. @ 45" above sill channel @ center of the panel.

4) sill channel welded to embed plate w/ 1/8" Fillet weld (l=1½"@7") all along its perimeter

5) Top restraint provided by rigid conduit which are supported rigidly from the nearby wall. Flex conduit have adequate flexibility.

6) per Calc. CD-Q0000-940339, the 1.5 x B.S. is exceeded by the in-structure spec @ EL. 621' of RB, in the 5.0 to 6.8 Hz frequency range. Since the lowest natural frequency of this equipment is > 8 Hz (See note 1) then the intent of the GIP Seismic Capacity vs. Demand criteria is met.

7) The thickness of the panel sheet metal is 3/16" and the panel is lightly loaded. Also, the panels' faces where the relays are mounted are reinforced by welded bars/plate. Therefore, an in-cabinet amplification factor of 4.5 is conservative to use for relay evaluations.

8) Anchorage Evaluation: (Conservatively, ignore top restraint provided by conduit)

- Per GIP App-C the wt. of this type of panel can be estimated by multiplying 3.0 by the wt. of the cabinet housing. Since this panel is lightly loaded use 2.0 x Cabinet housing wt.:

$$Wt. = 2.0 \times \frac{490}{12^3} \times 3/16 \times 2 \times [(96\times90) + (96\times30) + (30\times90)] = 3024.\#$$

- The corresponding horizontal acceleration @ f = 8 Hz @ RB. EL 621', 5% DBE is

$a_h = 1.0\ g$ → $F_h = 3024 \times 1.0 \times 1.25 = 3780$ lbs.

$a_v = 0.16\ g$ (ZPA) → $F_v = 3024 \times 0.16 \times 1.25 = 605$ lbs.

- T = pullout force per plug weld location = $\left[\left(\frac{3780\times45}{(30-2)8}\right)^2 + \overbrace{\left(\frac{3780\times45}{(72+24-2)2}\right)^2}^{\text{conservative}} + \left(\frac{605}{16}\right)^2\right]^{1/2} - \frac{3024}{16} = 993\ \#$

- $V = \left[\left(\frac{3780}{16}\right)^2 + \left(\frac{3780}{16}\right)^2\right]^{1/2} = 334\ \#$

- $A_{W_T} = \frac{\pi D}{4} = \frac{\pi(1/2)}{4} = 0.393''$ (weld length to be used for Tension loads)
  ↳ knock down factor for Tensile loads per EPRI NP-5228SL, Vol.1

- $A_{W_S} = \pi D = 1.57''$ (weld length to be used for Shear loads).

- $f_{W_T} = \frac{993}{.393} = 2527$ lb/in

- $F_{W_S} = \frac{334}{1.57} = 213$ lb/in

$F_W = 30.6^{ksi} \times 0.707 \times 1/8'' = 2.7$ k/in

- $\left(\frac{2527}{2700}\right)^2 + \left(\frac{213}{2700}\right)^2 = 0.88 < 1.0$ ok

EQE INTERNATIONAL

SHEET NO. J1g 5

JOB NO. 50147 JOB TVA/BTNP A46/IPEEE BY JBeig DATE 12-19-

CALC. NO. C-011 SUBJECT HCLPF for Elect. Equip. CHK'D J.D.Dizon DATE 12/29/

(5 pages)

ATTACHMENT J

SEWS for 0-LPNL-925-0045C (SSEL # 9094)

SSEL Line No. 9094 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 24

Equip. ID No. 0-LPNL-925-0045C Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 25-45C

Location: Bldg. RB Floor El. 621 Room, Row/Col R-R13

Manufacturer, Model, Etc. (optional but recommended) _____

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		621' + 628'
2.	Elevation of seismic input below about 40' from grade		Y (N) U Eff. grade @ El. 550'
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (1)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	BS
		1.5 x Bounding Spectrum	(ABS)
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	GRS
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	(RRS)

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U (2)*

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	No computers or programmable controllers	(Y) N U N/A
3.	No strip chart recorders	(Y) N U N/A
4.	Steel frame and sheet metal structurally adequate	(Y) N U N/A
5.	Adjacent cabinets or panels which are close enough to impact, or sections of multi-bay cabinets or panels, are bolted together if they contain essential relays	Y N U (N/A)
6.	Drawers and equipment on slides restrained from falling out	Y N U (N/A)
7.	All doors secured by latch or fastener	(Y) N U N/A
8.	Attached lines have adequate flexibility	(Y) N U N/A
9.	Anchorage adequate (See checklist below for details)	(Y) N U N/A
10.	Relays mounted on equipment evaluated $AF = 4.5$	(Y) N U N/A
11.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A (3)
2.	Type of anchorage covered by GIP	(Y) N U N/A (3)
3.	Sizes and locations of anchors determined	(Y) N U N/A (3)

SSEL Line No. 9094

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 24

Equip. ID No. 0-LPNL-925-0045C Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 25-45C

ANCHORAGE (Cont'd)

4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	(Y) N U N/A
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	Y N U (N/A)

Are anchorage requirements met? (Y) N U (4)

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	(Y) N U N/A
3.	Attached lines have adequate flexibility	(Y) N U N/A
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is equipment free of interaction effects? (Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

(1) This cabinet is rigidly anchored to wall at its top and is rigidly connected to floor by 4-4"ϕ rigid conduit (12" lengths) and 5-3/8"ϕ Exp. anchors @ its bottom. The relays inside this cabinet are rigidly mounted on a 1/8" thick mounting plate. The lowest natural frequency of this cabinet is therefore judged to be much greater than 8 HZ. (see also EPRI TR-102180, App.C)

(2) Per Fig. B.1 of Calc. CD-Q0000-940339, the 1.5 x Bounding spectrum envelops the in-structure response spectrum @ and above 8 HZ. Therefore the intent of Capacity vs. Demand Criteria is met. ok

(3) See pp. 3 and 4.

Evaluated by: Fangi Beig Date: 8-15-95

John O. Dizon 8/23/95

(4) Cabinet anchorage adequate per calc. performed on pg. 4 of 4 of this SEWS.

EQE INTERNATIONAL

SHEET NO. 3 of 4

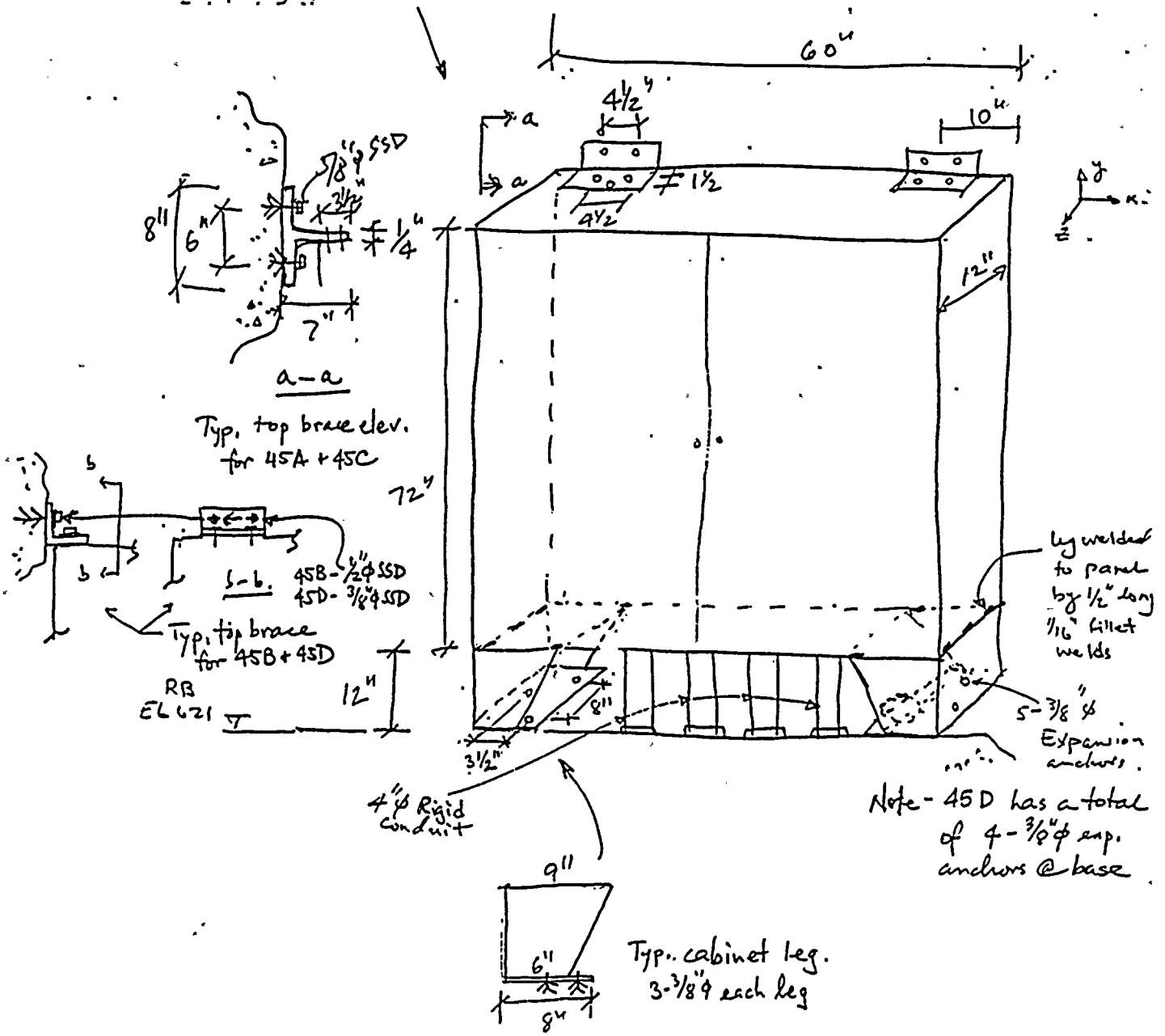
JOB NO. 50147.05 JOB TVA/BFN A-46/IPEEE BY JBeiji DATE 8-4-9

CALC. NO. N/A SUBJECT Attachment to SEWS for panel 25-45C CHK'D M.D.Dizon DATE 8/23/9

SSEL. # 9094

SSEL. No. : 9094, 9095, 9092, 9093

Equip. ID : OJLPNL-925-0045C, D, A, B



As-built above from panel 25-45C. other panels are similar.

SSEL No.: 9094

Equip. ID: 0-LPNL-925-0045C

Anchorage Evaluation: (conservatively, ignore contribution of the 4-4"ϕ Rigid conduit in resisting any loads)

Panel dead wt. $= 3.0 \times \frac{490}{12^3} \times \frac{3}{32} \times 2\left[(60\times72)+(60\times12)+(72\times12)\right]$

$= 942.\ ^{\#}$

conservatively use peak accelerations @ RB, EL. 639'; SSE 5% damping:

$a_h = 2.48\,g \rightarrow F_h = 2.48 \times 942 \times 1.25 = 2920$ lbs.

$a_v = 0.73\,g \rightarrow F_v = 0.73 \times 942 \times 1.25 = 860$ lbs.

Use the most critical anchorage configuration of Panel 25-45D, i.e., 4-3/8"ϕ exp. anchors @ top and bottom

There is no pull-out loads at these anchor bolts, due to top restraint.

$$V = \left[\left(\frac{2920}{2\times4}\right)^2 + \left(\frac{2920}{2\times4}\right)^2\right]^{1/2} = 516\ ^{\#}$$

$V_{all} = 1420^{\#} \times 0.75^{F_{RRs}} = 1065^{\#}$

$\frac{V}{V_{all}} = \frac{516}{1065} = 0.48 < 1.0$ ok

- check pull out of 3/8"ϕ Anchors @ top

$T = \frac{2920}{2\times2\times2} = 365^{\#} < T_{all} = 1460^{\#} \times \frac{3600}{4000} \times 0.75^{F_{RRp}} = 986^{\#}$ ok

half of load @ top & the other half @ bottom of the panel; 2 = no. of Anchors, 2 = no. of conc. pts.

$\frac{T}{T_{all}} = \frac{365}{986} = 0.37 < 1.0$ ok

$V = \frac{2920}{2\times2\times2} = 365^{\#} < V_{all} = 1065^{\#}$ $\frac{V}{V_{all}} = 0.34 > 0.3$, $\therefore 0.7\frac{T}{T_{all}} + \frac{V}{V_{all}} = 0.7(.37)+.3$

$= 0.60 < 1.0$

- Welds are adequate by inspection and comparison to the above small demand loads

(6 Pages)

ATTACHMENT K

SEWS for O-LPNL-925-0041A (SSEL # 9076)

SSEL Line No. 9076 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 25

Equip. ID No. 0-LPNL-925-0041A Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 25-41A Central Diesel Information Center Panels

Location: Bldg. U1/2 DGB Floor El. 583' Room, Row/Col - -

Manufacturer, Model, Etc. (optional but recommended) _____

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input	583'	
2.	Elevation of seismic input below about 40' from grade	(Y) N U	(1)
3.	Equipment has fundamental frequency above about 8 Hz	(Y) N U N/A	(2)
4.	Capacity based on: Existing Documentation	DOC	
	Bounding Spectrum	(BS)	
	1.5 x Bounding Spectrum	ABS	
	GERS	GERS	
5.	Demand based on: Ground Response Spectrum	(GRS)	
	1.5 x Ground Response Spectrum	AGS	
	Conserv. Des. In-Str. Resp. Spec.	CRS	
	Realistic M-Ctr. In-Str. Resp. Spec.	RRS	

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A	
2.	No computers or programmable controllers	(Y) N U N/A	
3.	No strip chart recorders	(Y) N U N/A	
4.	Steel frame and sheet metal structurally adequate 3/16" thick	(Y) N U N/A	
5.	Adjacent cabinets or panels which are close enough to impact, or sections of multi-bay cabinets or panels, are bolted together if they contain essential relays	(Y) N U N/A	(3)
6.	Drawers and equipment on slides restrained from falling out	Y N U (N/A)	
7.	All doors secured by latch or fastener	(Y) N U N/A	
8.	Attached lines have adequate flexibility	(Y) N U N/A	
9.	Anchorage adequate (See checklist below for details)	(Y) N U N/A	
10.	Relays mounted on equipment evaluated AF = 4.5	(Y) N U N/A	(5)
11.	Have you looked for and found no other adverse concerns?	(Y) N U N/A	

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A	
2.	Type of anchorage covered by GIP	(Y) N U N/A	
3.	Sizes and locations of anchors determined	(Y) N U N/A	

SSEL Line No. 9076

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 25

Equip. ID No. 0-LPNL-925-0041A Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 25-41A

ANCHORAGE (Cont'd)

4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A
6.	For bolted anchorages, gap under base less than 1/4-inch @ base to sill Channel	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	(Y) N U N/A
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A

Are anchorage requirements met? (Y) N U (4)

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	(Y) N U N/A
3.	Attached lines have adequate flexibility	(Y) N U N/A
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is equipment free of interaction effects? (Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

1) Per Calc. CD-Q0000-940339 the effective grade for DG 1/2 is @ EL. 573'.

2) See page 3 for frequency estimation.

3) This panel is in a row of panels (25-41A, B, C & D). All these panels are bolted together w/ 5/8" ϕ bolts (See sketch on pg. 5)

4) See page 4 for anchorage Evaluation.

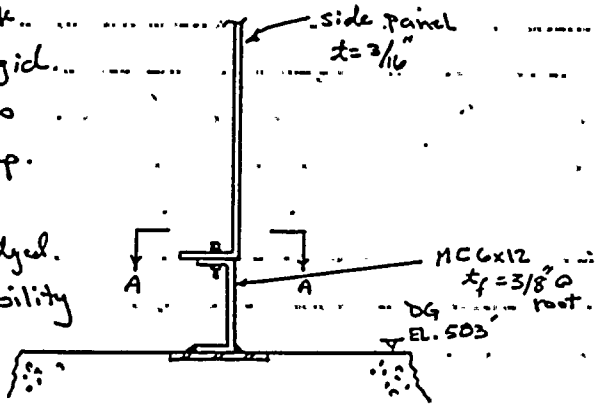
5) Since the cabinet is of thicker (3/16") material and lightly loaded, an amplification factor of 4.5 (typical for control panel of lighter gage) is conservatively assumed for this panel.

Evaluated by: Fazzi Beig Date: 7-28-95

John O. Dizon 8/3/95

Note 2 (cont'd)

The panels are constructed of 3/16" thick steel and are therefore considered very rigid. The panels are essentially empty which also forces the fundamental frequency to go up.



The lowest frequency for this panel is judged to be that corresponding to the flexibility of the bare, @ its connection points to the sill channel.

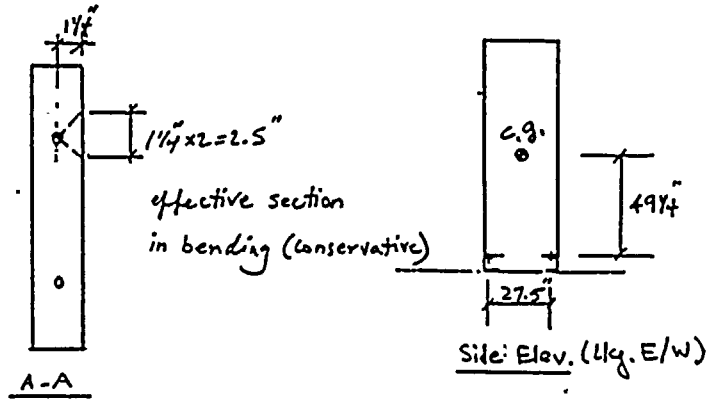
Determine the lowest frequency of the panel:

Panel size = 98 1/2 x 24 (w) x 30 (d) x 3/16

Panel wt. = $1.5 \times \frac{490}{12^3} \times \frac{3}{16} \times [(2 \times 98.5 \times 30) + (2 \times 98.5 \times 24) + (24 \times 30)]$

= 906. #

Since the panel is essentially empty, use 1.5 x Cabinet Housing wt. instead of 3.0 suggested in the GIP App. C for full panels.



P = Pullout per attachment bolt due to 1g horiz. load = $\frac{906 \times 49.25}{27.5 \times 2} = 811$ #

Thickness of the effective section = 3/16"

$I_{eff.} = \frac{2.5 \times (3/16)^3}{12} = 0.0014$ in^4

$\Delta = \frac{P l^3}{3EI} = \frac{811 \times 1.25^3}{3 \times 29E6 \times .0014} = 0.0133$ IN

$f = \frac{1}{2\pi}\sqrt{\frac{g}{\Delta}} = \frac{1}{2\pi}\sqrt{\frac{386.4}{.0133}} = 27.1$ HZ (> RIGID)

Note 4 (cont'd)

Anchorage Evaluation:

The weak link in the load path to the anchorage system for these panels is judged to be the 3/8" ϕ A-307 bolts connecting the panels to the sill channel. It is noted that only two panels have the 3/8" ϕ bolts, the other panels have combination of 1/2" ϕ and 5/8" ϕ bolts. The welds on the sill channel to embed plate are judged more than adequate for seismic loading.

Conservatively use peak spectral accelerations @ EL. 583' of DG, with 5% damping, DBE: (BFN MARS Report CEB 88-05-C, R1)
(↓ to account for medium-centered spe

$a_h = 2.13\,g \rightarrow F_h = 906^{\#} \times 2.13g \times 1.25 = 2412^{\#}$

$a_V = 0.52\,g \rightarrow F_V = 906^{\#} \times 0.52g \times 1.25 = 589^{\#}$

overturning due to E/W loads are small and insignificant and can be ignored.

T = pull out @ each 3/8" ϕ (A307) $= \sqrt{\left(\frac{2412 \times 98.5/2}{27.5 \times 2}\right)^2 + \left(\frac{589}{4}\right)^2} - \frac{906}{4} = 1938^{\#}$

Bolt area $= \frac{\pi}{4}(3/8)^2 = 0.11\ in^2$

$f_t = \frac{1938}{0.11} = 17.62\ ksi \quad < F_a = 20 \times 1.7 = 34\ ksi$ ok

$V = \left[\left(\frac{2412}{4}\right)^2 + \left(\frac{2412}{4}\right)^2\right]^{1/2} = 853^{\#}$

$f_v = \frac{853}{0.11} = 7.7\ ksi \quad < F_V = 10 \times 1.7 = 17\ ksi$ ok

Shear-Tension Interaction per AISC 8th, Table 1.6-3:
$(26 \times 1.7) - 1.8(7.7) = 30.3\ ksi < 20 \times 1.7 = 34\ ksi \rightarrow$ use $F_t = 30.3^{ksi}$ ($I_R = \frac{17.62}{30.3} = 0.58 < 1.$) $> f_t = 17.62^{ksi}$ o

EQE INTERNATIONAL

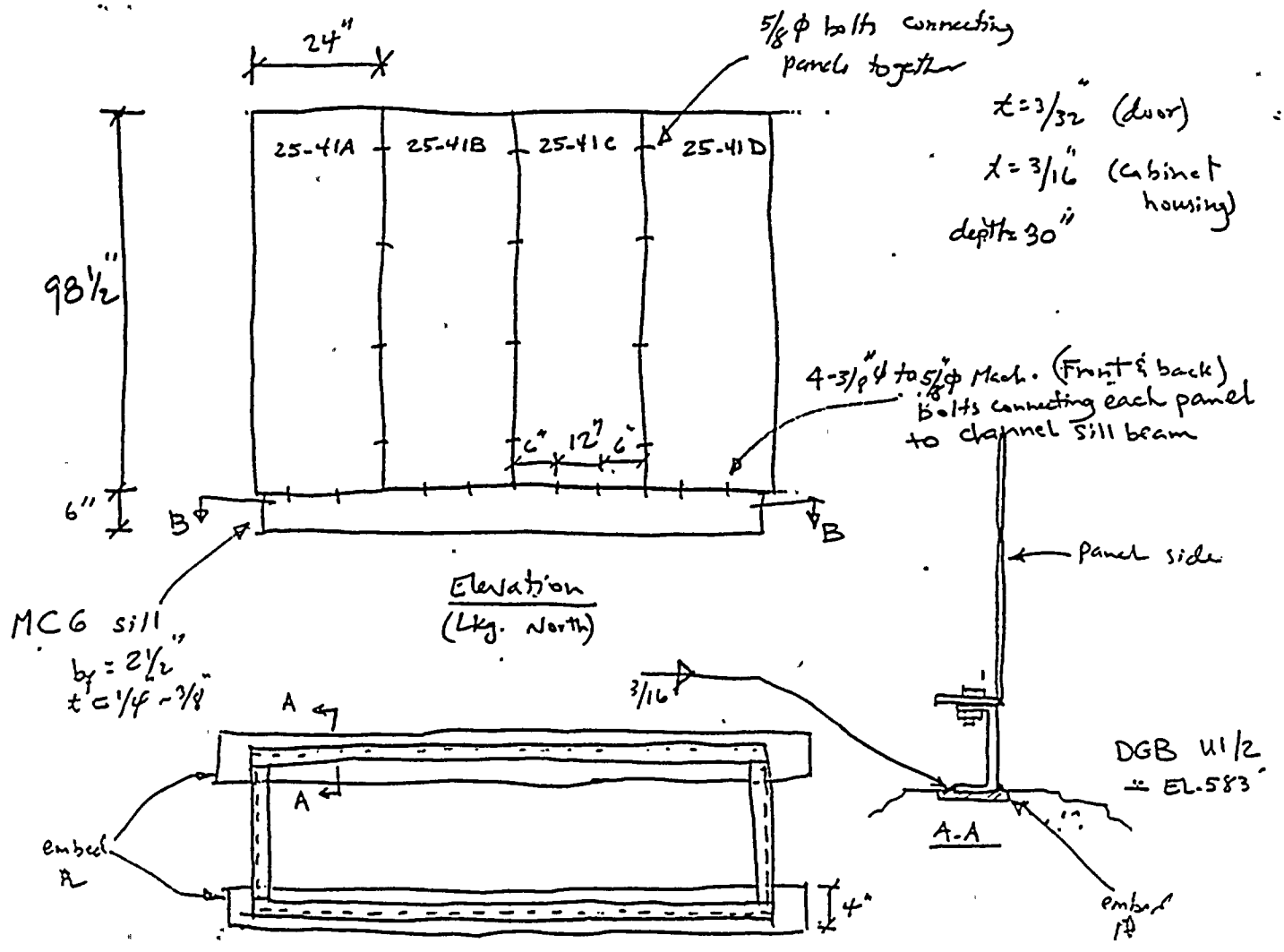
SHEET NO. 5 of 5

JOB NO. 50147-05 JOB TVA/BEN A-46/IPEEE BY JBen DATE 7-27-95

CALC. NO. N/A SUBJECT Attachment to SEWS for PNL 25-41A (SSEL # 9076) CHK'D JDO DATE 7/28/95

SSEL : 9076, 9077, 9078, 9079

Equip. ID: PNL-25-41A, B, C, D (Central Diesel Information Center Panel)



t = 3/32" (door)

t = 3/16" (cabinet housing)

depth = 30"

- rigid top entry conduit

- Panel is essentially loaded w/ very light components. → use 1.5 x Cabinet housing wt. to determine approx. dead wt.
- c.g. @ Mid height & Mid depth

(8 pages)

ATTACHMENT L

SEWS for 2-PNLA-009-0087 (SSEL # 9072)

SSEL Line No. 9072 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 27

Equip. ID No. 2-PNLA-009-0087 Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 9-87

Location: Bldg. CB Floor El. 593 Room, Row/Col AIR

Manufacturer, Model, Etc. (optional but recommended) _____

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input		593
2.	Elevation of seismic input below about 40' from grade		(Y) N U (grade @ 590')
3.	Equipment has fundamental frequency above about 8 Hz		(Y) N U N/A (1)
4.	Capacity based on:	Existing Documentation	DOC
		Bounding Spectrum	(BS)
		1.5 x Bounding Spectrum	ABS
		GERS	GERS
5.	Demand based on:	Ground Response Spectrum	(GRS)
		1.5 x Ground Response Spectrum	AGS
		Conserv. Des. In-Str. Resp. Spec.	CRS
		Realistic M-Ctr. In-Str. Resp. Spec.	RRS

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	No computers or programmable controllers	(Y) N U N/A NOTE (10)
3.	No strip chart recorders	(Y) N U N/A
4.	Steel frame and sheet metal structurally adequate	(Y) N U N/A NOTE (6)
5.	Adjacent cabinets or panels which are close enough to impact, or sections of multi-bay cabinets or panels, are bolted together if they contain essential relays	Y N U (N/A) NO RELAYS NOTE (7)
6.	Drawers and equipment on slides restrained from falling out	Y N U (N/A)
7.	All doors secured by latch or fastener	(Y) N U N/A
8.	Attached lines have adequate flexibility	(Y) N U N/A FLEX. END. OF (8)
9.	Anchorage adequate (See checklist below for details)	(Y) N U N/A
10.	Relays mounted on equipment evaluated	Y N U (N/A)
11.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A
2.	Type of anchorage covered by GIP	(Y) N U N/A
3.	Sizes and locations of anchors determined	(Y) N U N/A

SSEL Line No. 9072

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 7

Equip. ID No. 2-PNLA-009-0087 Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 9-87

ANCHORAGE (Cont'd)

4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	Y N U (N/A)
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A NOTE (3)
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	(Y) N U N/A NOTE (4)
Are anchorage requirements met?		(Y) N U (9) SEE ATTACHED CALCULATION

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	Y N U (N/A)
3.	Attached lines have adequate flexibility	(Y) N U N/A
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A (7)
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A
Is equipment free of interaction effects?		(Y) N U NOTE (5)

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

NOTE (1):

PANEL IS JUDGED TO HAVE FREQUENCY > 8 HZ DUE TO THICK SHEET METAL AND STIFF FRAMING AND ALSO DUE TO RELATIVELY LIGHT WEIGHT OF INTERNALS, ANCHORAGE IS ALSO VERY STIFF. ALSO, REFERENCE EPRI REPORT TR-102180, SECT. 3.4 STATES THAT TYP. CABINET FREQUENCY > 8 HZ IF BASE ANCHORAGE IS STIFF & CONSTRUCTION IS ROBUST

Evaluated by: [signature] Date: 8-17-95

[signature] 8-18-15

SSEL. 9072, 9073

I.D. Panel 9-87, 9-88 $t = 3/16$.

size 2X24".x.24"x 84"

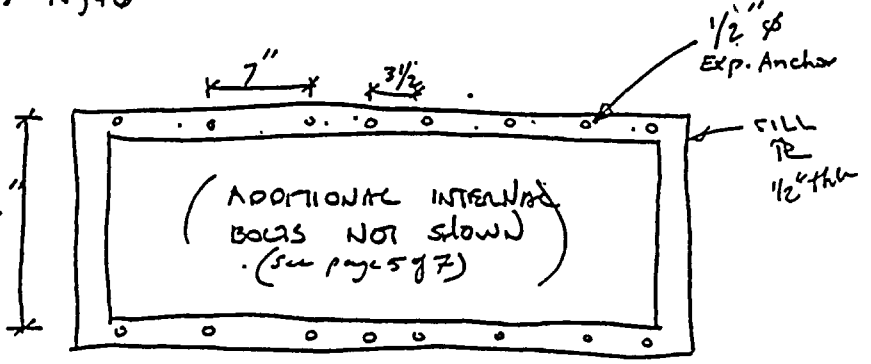
(2) Panels bolted together along the height by 3/8"ϕ bolts. (No relays present).

(3) Panels are welded to the sill by intermittent welds ok
SILL is welded to 1/2" thk base plate by stitch welds ok

(4) baseplate on 1½" grout pad ok

(5) Blockwall on the east & north end of the panel qualified per IEB 80-11 program. (DWG. 4IN1202-1 WALLS 45, 46)

(6) - panels are lightly loaded
- Panel thickness=3/16



(7) Fluorescent light tubes are positively restrained. ok

(8) Flex conduit with adequate flexibility.

(9) See pages 4-7 of this SEWS.

(10) Programmable controllers are properly mounted and are well represented in the data base

EQE INTERNATIONAL

JOB NO. 50147 JOB TVA/BFNP A&G/IPEEE SHEET NO. 4/7

CALC. NO. N/A SUBJECT 2-PNLA-009-0087 (9072) BY DCB DATE 8-17-

CHK'D JRC DATE 8-18-95

REF. DRWG. 2-47E605-30

" " 48N1244-3

⑨ ANCHORAGE EVALUATION

THIS EVALUATION ALSO QUALIFIES ADJACENT PANEL 9-88 (SSEL # 9073)

⇒ PANEL WEIGHT: (2 PANELS @ W × D × H 24 × 24 × 84)

$t \cong .19''$

PANEL AREA $A = 2\left(\underset{\text{SIDES}}{24 \times 84 \times 4} + \underset{\text{TOP}}{24 \times 24}\right) = 17280\ in^2$

VOLUME $V = At = 17280(.19) = 3283\ in^3$

WEIGHT $= V\rho_s = 3283(.283\ \#/in^3) = 929\ \#$

SINCE PANELS ARE LIGHTLY LOADED, USE 2× PANEL WEIGHT TO ACCOUNT FOR CONTENTS (CONS.)

$\therefore W = 1860\ \#$

⇒ ACCELERATIONS:

CONSERVATIVELY USE PEAK ACCELERATIONS @ 593' REACTOR BUILDING

$a_x = a_z = 1.34\ g's$

$a_y = .42\ g's$

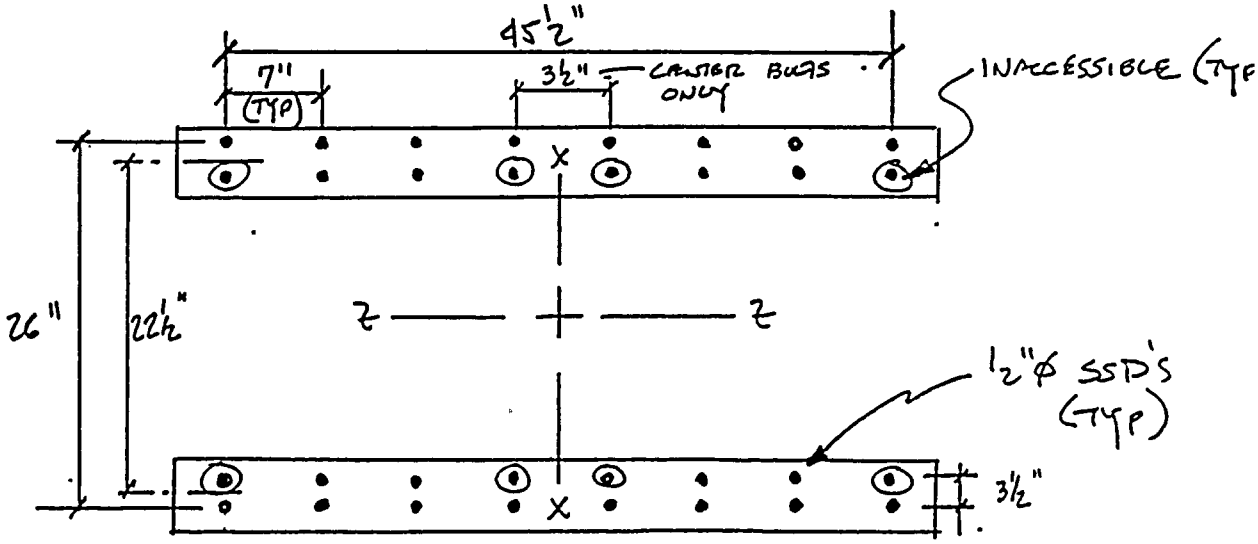
∴ SEISMIC FORCES ARE:

$F_X = F_Z = 1860(1.34) = \underline{2492\#}$

$F_Y = 1860(.42) = \underline{781\#}$

ASSUMING CG @ GEOMETRIC CENTROID, LOADS ON ANCHORAGE ARE: (X1.25 TO ACCOUNT FOR MEDIAN-CENTERED SPECTR

$F_X = 3115\#$ $M_X = 3115(42) = 131E3$ "#
$F_Y = 976\#$ $M_Y = \text{NEGL.}$
$F_Z = 3115\#$ $M_Z = 3115(42) = 131E3$ "#



FOR ANCHORAGE EVALUATION, NEGLECT INSIDE ROWS OF BOLTS.

⇒ BOLT PULLOUT: (FOR M_x ONLY USE CORNER BOLTS) ⇒ VERY CONS.

$$P = \left[\frac{M_x}{2(45.5)} + \frac{M_z}{8(26)} + \frac{F_y}{16}\right]^{SRSS} - \frac{DW}{16}$$

$$= \left(\frac{131000}{91} + \frac{131000}{8(26)} + \frac{976}{16}\right)^{SRSS} - \frac{1860}{16} = \underline{1456\ \#/bolt}$$

⇒ BOLT SHEAR:

$$V = \left(\frac{F_x^2 + F_z^2}{16}\right)^{\frac{1}{2}} = \left(\frac{311.5^2 + 311.5^2}{16}\right)^{\frac{1}{2}} = \underline{275\ \#/bolt}.$$

ALLOWABLES PER GIP (SECT. C.2.1) ($\frac{1}{2}$" ϕ EXP. ANCHORS)

$P_{nom} = 2290\ \#$ $V_{nom} = 2380\ \#$

REDUCING PULLOUT FOR CONCRETE STRENGTH (3600 psi)

$$P_{nom} = 2290\left(\frac{3600}{4000}\right) = 2061\ \#$$

NO OTHER REDUCTIONS APPLY ($3\frac{1}{2}$" SPACING AT TWO LOCATIONS ACCEPTED WITHOUT REDUCTION SINCE INNER ROW OF BOLTS CONSERVATIVELY IGNORED)

CHECK INTERACTION:

$$\frac{V}{V_{all}} = \frac{271}{2380} = .12 < .3 \quad \therefore \text{USE BILINEAR}$$

$$\frac{P}{P_{all}} = \frac{1456}{2061} = .71 < 1.0 \quad \therefore \underline{\underline{OK}}$$

(4 pages)

ATTACHMENT M

SEWS for 2_PNLA_009_0081 (SSEL # 9066)

SSEL Line No. 9066 Status (Y) N U

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 1 of 2/3

Equip. ID No. 2-PNLA-009-0081 Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 9-81

Location: Bldg. CB Floor El. 593 Room, Row/Col AIR

Manufacturer, Model, Etc. (optional but recommended) Nutherm International

SEISMIC CAPACITY VS DEMAND

1.	Elevation where equipment receives seismic input (Unit), see note 9)	593'	
2.	Elevation of seismic input below about 40' from grade	(Y) N U	grade @ EL. 561
3.	Equipment has fundamental frequency above about 8 Hz	(Y) N U N/A	(1)
4.	Capacity based on: Existing Documentation	DOC	
	Bounding Spectrum	(BS)	(Ref calc. CD-Q0000-94033)
	1.5 x Bounding Spectrum	ABS	
	GERS	GERS	
5.	Demand based on: Ground Response Spectrum	(GRS)	
	1.5 x Ground Response Spectrum	AGS	
	Conserv. Des. In-Str. Resp. Spec.	CRS	
	Realistic M-Ctr. In-Str. Resp. Spec.	RRS	

Does capacity exceed demand? (Indicate at right (*) and in COMMENTS if a special exception to enveloping of seismic demand spectrum is invoked per Section 4.2 of the GIP.) (Y) N U (2)

CAVEATS - BOUNDING SPECTRUM (Identify with an asterisk (*) those caveats which are met by intent without meeting the specific wording of the caveat rule and explain the reason for this conclusion in the COMMENTS section below)

1.	Equipment is included in earthquake experience equipment class	(Y) N U N/A
2.	No computers or programmable controllers	(Y) N U N/A
3.	No strip chart recorders	(Y) N U N/A
4.	Steel frame and sheet metal structurally adequate (3/16 min)	(Y) N U N/A
5.	Adjacent cabinets or panels which are close enough to impact, or sections of multi-bay cabinets or panels, are bolted together if they contain essential relays (stand alone cabinet w/ adequate clearance to adjacent cabinet)	Y N U (N/A)
6.	Drawers and equipment on slides restrained from falling out	Y N U (N/A)
7.	All doors secured by latch or fastener	(Y) N U N/A
8.	Attached lines have adequate flexibility	(Y) N U N/A (5)
9.	Anchorage adequate (See checklist below for details)	(Y) N U N/A (3)
10.	Relays mounted on equipment evaluated (Af = 4.5)	(Y) N U N/A
11.	Have you looked for and found no other adverse concerns?	(Y) N U N/A

Is the intent of all the caveats met for Bounding Spectrum? (Y) N U N/A

ANCHORAGE

1.	Appropriate equipment characteristics determined (mass, CG, natural freq., damping, center of rotation)	(Y) N U N/A (7, 8)
2.	Type of anchorage covered by GIP 3/4" ϕ SSD	(Y) N U N/A
3.	Sizes and locations of anchors determined	(Y) N U N/A (See page 2 of 3)

SSEL Line No. 9066

SCREENING EVALUATION WORK SHEET (SEWS) Sheet 2 of 23

Equip. ID No. 2-PNLA-009-0081 Equip. Class 20 - Instr. & Control Panels & Cabinets

Equipment Description PANEL 9-81

ANCHORAGE (Cont'd)

4.	Anchorage installation adequate, e.g., weld quality and length, nuts and washers, expansion anchor tightness	(Y) N U N/A
5.	Factors affecting anchorage capacity or margin of safety considered: embedment length, anchor spacing, free-edge distance, concrete strength/condition, and concrete cracking	(Y) N U N/A
6.	For bolted anchorages, gap under base less than 1/4-inch	(Y) N U N/A
7.	Factors affecting essential relays considered: gap under base, capacity reduction for expansion anchors	(Y) N U N/A
8.	Base has adequate stiffness and effect of prying action on anchors considered	(Y) N U N/A
9.	Strength of equipment base and load path to CG adequate	(Y) N U N/A
10.	Embedded steel, grout pad or large concrete pad adequacy evaluated	Y N U (N/A)
Are anchorage requirements met?		(Y) N U (3)

INTERACTION EFFECTS

1.	Soft targets free from impact by nearby equipment or structures	(Y) N U N/A
2.	If equipment contains sensitive relays, equipment free from all impact by nearby equipment or structures	(Y) N U N/A
3.	Attached lines have adequate flexibility	(Y) N U N/A (5)
4.	Overhead equipment or distribution systems are not likely to collapse	(Y) N U N/A (6)
5.	Have you looked for and found no other adverse concerns?	(Y) N U N/A (4)
Is equipment free of interaction effects?		(Y) N U

IS EQUIPMENT SEISMICALLY ADEQUATE? (Y) N U

COMMENTS

1) Per Test document (RIMS DES840813024), "Modal Analysis Test on Reactor Protection System Cabinet," the lowest natural frequency of this type of Cabinet is 14.1 Hz (see Table 7 of the Referenced document)

2) Per Calc. CD-Q0000-940339 the bounding spectrum envelops the ground response spectra over all frequencies.

3) See Page 3 for anchorage evaluation

Evaluated by: Fanji Deji Date: 8-21-95

8-21-95

Photo: 17 7:13

SSEL: 9067 , 9066 , 9071
ID: Panel 9-82 , 9-81 , 9-86

size: 30 x 36 x 90 (thickness = 3/16")
power supplies in these panels have proper mounting configurations. ok
(9-81 & 9-82)

4) Block wall at west & north end qualified per IEB 80-11 program (Ref. DWG. 41N201-1, R4) 41N202-1, R3

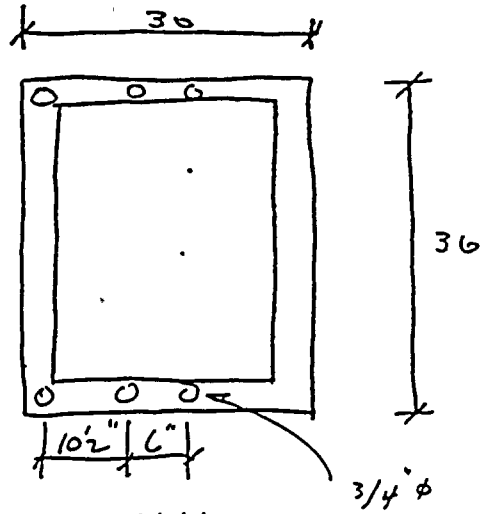
5) Flex conduit with adequate flexibility

6) Fluorescent light tubes positively restrained against falling.

7) Very lightly loaded. use 1.5 x D.L. for wt. calculation.

8) C.G. @ geometric center of the panel

9) These panels are on the Unit 1 Floor.



PLAN
(9-82)
Bare

Per App C of GIP. the fully loaded wt of a cabinet can be determined by multiplying 3 by the wt. of the cabinet housing. Per note 7 above since cabinet is not fully loaded use 1.5 x D.L.

$wt. = 1.5 \times \frac{490}{12^3} \times 3/16 \times 2 \left[(30 \times 36) + (36 \times 90) + (30 \times 90) \right] = 1120^{\#}$

$a_h = 1.34\ g \rightarrow F_h = 1120 \times 1.34 \times 1.25 = 1876^{\#}$ (use peak accelerations, conservative, @ f = 14.1 Hz $a_h = .52g$

$a_v = .42\ g \rightarrow F_v = 1120 \times .42 \times 1.25 = 588^{\#}$ $a_v = .16g$ ok

$T = \left[\left(\frac{1876 \times 90/2}{36 \times 3} \right)^2 + \left(\frac{1876 \times 99/2}{16.5 \times 2} \right)^2 + \left(\frac{588}{6} \right)^2 \right]^{1/2} - \frac{1120}{6} = 2490.^{\#}$

$V = \left[(1876/6)^2 + (1876/6)^2 \right]^{1/2} = 442^{\#} < V_{all} = 5.48^{K} \times 0.9 \times 0.75 = 3.7^{K}$, $\frac{V}{V_{all}} = 0.12 < 1$ ok

$T_{all} = 4.69 \times 0.9 \times 0.75 \times \frac{6}{10\,3/4} = 2533^{\#} > T = 2490^{\#}$ ok , $\frac{T}{T_{all}} = 0.98 < 1.0$ ok

(Concrete strength; Rebar; close spacing; conservative)