November 14, 1980 GAI Report No. 2226

PROJECT PROCEDURE
FOR
THE DESIGN OF ELECTRICAL AND INSTRUMENTATION EQUIPMENT
BASIS AND ATTACHMENTS

VIRGIL C. SUMMER NUCLEAR STATION
UNIT 1

PREPARED FOR
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
COLUMBIA, SOUTH CAROLINA

BY

GILBERT/COMMONWEALTH, INC.
READING, PENNSYLVANIA 19603

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BASIS AND ATTACHMENTS

1. Definitions:

   a. Base: The intermediate framework between the electrical equipment and the building structure.

   b. Attachment: The method of attaching the electrical equipment to the base.

2. For each piece of safety related equipment the Electrical, or Instrumentation and Control Department provides the following information to the Structural Department:

   a. Test or analysis data, where available, including the following:

      1. Details of anchorage used for attachment during testing or loads calculated by analysis, including bolt size and strength, if applicable.

      2. Natural frequency

      3. Equipment damping

   b. Equipment data as follows:

      1. Weight

      2. Center of gravity if documented, or suggested assumption for center of gravity

      3. Vendor drawings numbers

   c. A conceptual base and attachment design, including the following:

      1. Exact location, including building and elevation

      2. Conceptual base detail

      3. Conceptual attachment detail

3. The Structural Department performs the following tasks:

   a. Finalizes the design of the base in accordance with established criteria (see attached).

   b. Finalizes the design of the attachment in accordance with established criteria (see attached).

   c. Transmits the details of the final design to the Drafting Section of the Electrical Department.

4. The Drafting Section of the Electrical Department performs the following:

   a. Incorporates the detailed designs onto the applicable construction drawings.

   b. Checks the drawings for dimensional adequacy and functional concept.

   c. Signs out the drawing.

5. The Engineering Section of the Electrical Department, or the Instrumentation Department, performs the following:

   a. Reviews the drawing for concept and compatibility with equipment.

   b. Signs out the drawing.

6. The Structural Engineering Department performs the following:

   a. Checks the drawings for correct interpretation of the design.

   b. Signs out the drawing as an interfacing department.

   c. Performs an independent verification of the design.

NOTE: If for any reason any of the interface sign-off steps have been omitted, the reviewer in step 6c, will ensure that all final details are compatible with the design requirements.

V. C. SUMMER NUCLEAR STATION

PROJECT CRITERIA
FOR
DESIGN OF ELECTRICAL AND INSTRUMENTATION EQUIPMENT
BASES AND ATTACHMENTS

DEFINITIONS

1. Base: The intermediate framework between the Electrical Equipment and the building structure.
2. Attachment: The method of attaching the Electrical Equipment to the base.

SAFETY RELATED EQUIPMENT

Criteria for the design of equipment bases:

1. The base shall have adequate strength in accordance with applicable structural codes and standards.

2. The base shall be rigid with respect to the natural resonant frequency of the building.

Criteria for the design of equipment attachments:

1. Equipment qualified by test:
   a. The attachment shall be of the same type, size and strength as used during qualification testing.
   b. Alternatively, the attachments shall be in the same place and shall have equivalent or greater rigidity and strength as the attachment used during qualification testing.
   c. Alternately, the attachment shall be as close as possible to the location of the attachments used during test and shall have an equivalent or greater rigidity and strength as the attachment used during the qualification testing. The equipment base shall be checked to ensure that with the revised attachment location that the effective stiffness has not been decreased.

d. If the type of attachment used during testing is not fully known and documented, the attachment should be designed to have adequate strength in accordance with applicable structural standards for the seismic loading, and will be provided with a positive type connective such as: bolts, Threaded Nelson Studs, plug welds or fillet welds or a combination of these methods.

2. Equipment qualified by analysis: The attachment design shall be consistent with the qualification analysis and shall have a strength equivalent to or greater than that determined as required during the qualification analysis.

Assumptions for the design of equipment bases and attachments:

1. The equipment shall be assumed resonant with the building natural frequency.

2. The equipment damping factor shall be taken as 5 percent maximum.

GILBERT ASSOCIATES, INC. ENGINEERS AND CONSULTANTS READING, PA.	DEPARTMENT NAME: Structural Engineering	DEPT. NO.: 0414	FILING CODE: 0.11.3 - 1
	PROJECT NAME: SCE & G. V.C. Summer #1	W.O. NUMBER: 01-4361-060	PAGE: 1 of 5

SUBJECT: Elec. Equip. Support & Anchorage - Battery Charger 300 Amp.

ORIGINATOR: L.C. Eurman

DATE: 10-31-80

VERIFIER: D.T. DeHaas

DATE: 11/4/80

XBC1A, XBC1B, XBC1A-1B Int. Bldg. Fl. El. 412'-0"

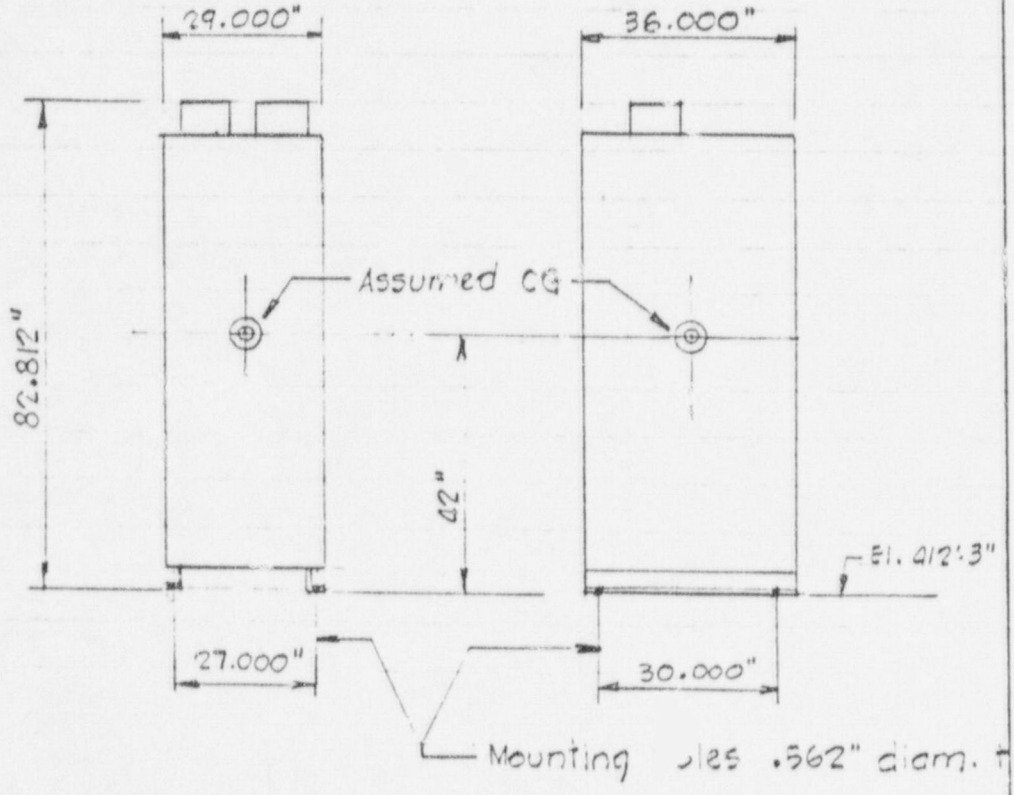
Reference Details:

Vendor Dwg.	IMS-37-027-4
Elec. Plan Dwg.	E-201-194
Elec. Det. Dwg.	E-201-185 Sh. 1 Det. "G"
Struct. Det. Dwg.	E-513-121

Unit Wt. : 1650 # Approx. (From Vendor Dwg.)

Test Data Connection: Grade 2 bolts (Information Incomplete)
(Seismic evaluation of equipment - test report)

Physical Dimensions of Cabinet: (From Vendor Dwg.)



FILING CODE 0.11.3-1

SUBJECT: Elec. Equip. Support & Anchorage-Battery Charger 300 Amp.

ORIGINATOR: L.C. Bierman
DATE: 10-31-80
VERIFIER: E.T. DeVivo
DATE: 11/4/80

XBC1A, XBC1B, XBC1A-1B Int. Bldg. Fl. El. 412'-0"

Testing data of cabinet base connection is not sufficiently clear to assume strength of bolts used in test. Therefore a strength analysis shall determine capacity of attachment required. Cabinet is inplaced using plug welds in holes provided thru base of unit and stitch welds along base edge.

Seismic Investigation:

Anchorage criteria assumes equipment resonance tuned with that of building and a 5% critical equipment damping factor at peak response. From the response spectrum envelope for OBE, Intermediate Building at el. 412'-0", the following accelerations are read from figures 61.

X-quake : 0.54g (east-west)
Y-quake : 2.20g (north-south)
V-quake : 0.83g (at 1.0 gamma scaling factor)

The above seismic data is taken from Specification "Seismic Analysis, Testing and Documentation - V.C. Summer Nuclear Station - Unit 1 - SP-702-4461-00 May 17, 1972". Figures 61 refer to Response Spectrum envelope for OBE, Intermediate Building Elevation 412'-0".

Design of Cabinent Base Connection

Design detail "G" on Dwg. E-201-185 indicates cab. base is connected to intermediate support member thru holes in base by plug welds and by stitch fillet welds along base edge. To prove connection capacity, however, only plug welds are computed on the following page.

FILING CODE 0.11.3-1

GILBERT ASSOCIATES, INC. ENGINEERS AND CONSULTANTS READING, PA.	DEPARTMENT NAME Structural Engineering	DEPT. NO. 0414	FILING CODE 0.11.3-1
	PROJECT NAME SCE&G V.C. Summer #1	W.O. NUMBER 04-4461-060	PAGE 3 of 5

SUBJECT: Elec. Equip. Support & Anchorage - Battery Charger 300Amp

ORIGINATOR: A.C. Eamon

DATE: 10-31-80

VERIFIER: H.T. Dillon

DATE: 11/2/80

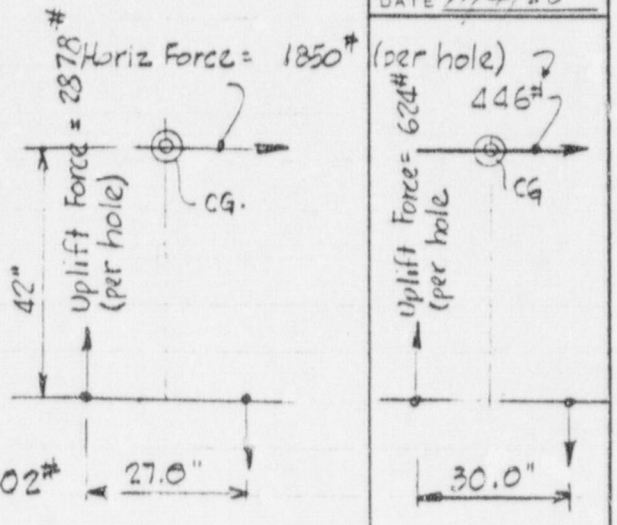
XBC1A, XBC1B, XBC1A-1B Int. Bldg. Fl. El. 412'-0"

Design of Cab. Base Connection

Because of orientation of cabs. assume max. horiz. accel in 27" bolt spacing direction:

Horiz. Force/hole (27" spac. direct) = $\frac{1650^{\#} \times 2.2g}{2 \text{ holes acting per side}} = {}^{\#}1850$

Horiz. Force/hole (30" spac. direct) = $\frac{1650^{\#} \times 0.54g}{2 \text{ holes acting per side}} = 446^{\#}$



Max Uplift Force (per hole) = $\frac{1850 \times 42}{27} + \frac{446 \times 42}{30} = 3502^{\#}$

Max. shear horiz. acceleration (per hole) = $\frac{1650^{\#} \times 2.2g + 1650^{\#} \times 0.54g}{4 \text{ holes acting}} = 1130^{\#}$

Least down loading vert. up acceleration. (per hole) = $\frac{1650^{\#} - (1650 \times 0.88g)}{4 \text{ holes acting}} = 50^{\#}$ down

Conservatively assume N-S and E-W Max. accelerations occur simultaneously:

Max. combined force (per hole) = 3502# (uplift) + 1130# (shear) - 50# (down) = 4582# ok less than capacity of weld

Conservatively assume only plug weld effective:

Capacity of Plug Weld Per Hole Hole D = 0.562"

Area of Weld = $D^2 \times 0.7854 = 0.562^2 \times 0.7854 = 0.2481$

Allowable stress class E 70 electrodes = 21000 psi (AISC 1969 Sec. 1.5.2.1 Table 1.5.2.1)

Strength of weld per hole = $21,000 \times 0.2481 = 5210$ #

Conclusion: The cabinet connection is satisfactory as constructed

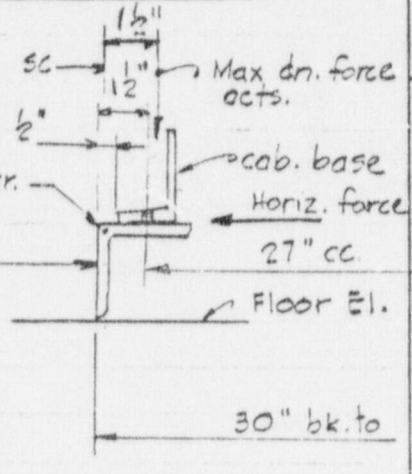
FILING CODE 0.11.3-1

SUBJECT: Elec. Equip. Support & Anchorage - Battery Cramer 300 Amp.

ORIGINATOR: [illegible]
DATE 10-31-80
VERIFIER: [illegible]
DATE 11/4/80

XBC1A, XBC1B, XBC1A-1B Int. Bldg. Fl. El. 412'-0"

Design of Intermediate Support



- Note: Non-supporting ∠'s of frame welded to embedded pls. (See next page) ∠ 3 x 3 x ½" spans to framing ∠'s
- Assume ends of ∠ 3 x 3 x ½ restrained against rotation
- Down Force and Directional Horiz. Shear Force combine to produce max. twisting mom. in supporting ∠. However, shear force action is so near the shear center of the angle that only bending stress will be examined in the horizontal direction

Twisting Mom (Max Dn Force): $\left[\frac{1650^{\#} \times 2.20g \times 42"}{27"} + \left(\frac{1650 + 1650 \times .38g}{2}\right)\right] \times 1.5" = 12035^{"\#}$
(5647# ; 1650 + 726)

$J_{\angle 3\times3\times\frac{1}{2}} = \frac{2.75\,(0.5^3)}{3} \times 2 = 0.23\ in^4$

Torsional Shear (St. Venant) = $\frac{Tt}{J} = \frac{12035^{"\#} \times 0.50}{0.23 \times 2} = 13082$ psi at each end
(2 for each end.)

End Shear Stress (from horiz. force) = $\frac{1650^{\#} \times 2.20g}{4 \times \underbrace{3 \times 0.5}_{\text{area of one leg of } \angle}} = 605$ psi

Combined shear = 13687 psi (ok) less than 14500 psi (0.40 f_y)

Horiz bending stress = $\frac{1650^{\#} \times 2.20g}{2} \times \frac{36"}{8} \times \frac{1}{1.07_{\text{SM of } \angle}} = 7633$ psi < less than 22000 psi (0.60 f_Y)

- Bending stress occurs at center span
- combined shear stress occurs at end of member
- Combined shear stress = 13082 + 605 = 13687 psi < 14500 psi (0.40 f_y)
- Conclusion: The int. support is satisfactory as constructed

1 - Conservative value

FILING CODE 0.11.3-1

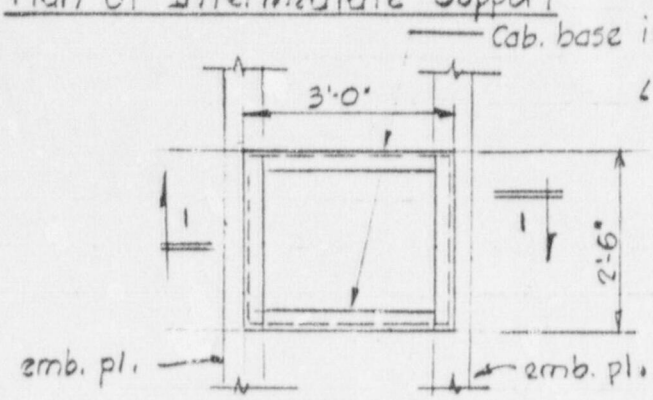
SUBJECT: Elec. Equip Support Anchorage - Battery Charger 300 Amp

ORIGINATOR: RC Berman
DATE: 11-6-80

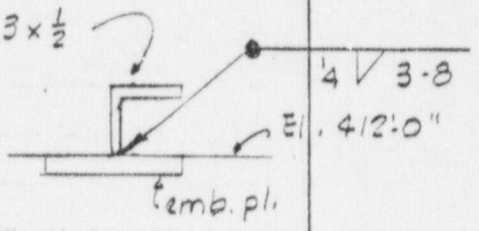
VERIFIER: D. F. DeTilla
DATE: 11/4/80

XBC1A, XBC1B, XBC1A-1B Int. Bldg. Fl. El. 412'-0"

Plan of Intermediate Support



Plan Typ. Int. Support
All frame L's 3 x 3 x ½"



Sec. 1-1
Showing min. weld condition for any frame.

Checking Weld Capacity:

- Assume only welds to embedded pl. at end of frame active against uplift.
- Although all welds resist shear, assume end welds (only) active against shear
- Max. combined net uplift and shear on one ¼" x 3" long fillet weld = 4582 # (refer to calc. fg. 3) (ok) less than

Allowable working strength of ¼" x 3" long fillet weld ;
(Class E70 electrodes @ 21000 psi - AISC Table 1.5.2.1 - 1969)

.25 x .707 x 21000 psi x 3" long = 11135 # capacity of weld

Therefore, frame attachment to plate embedment is satisfactory as constructed.

FILING CODE 0.11.3-1

ATTACHMENT #5

TAG #	MODEL # (*)	REPORT NO.	LOCATION
PT402	Barton Lot #2	1	Reactor Bldg. Floor EL 412'-0"
PT403	" "	1	Reactor Bldg. Floor EL-412'-0"
PT455	" "	1	Reactor Bldg. Floor EL-436'-0"
PT456	" "	1	Reactor Bldg. Floor EL-436'-0"
PT457	" "	1	Reactor Bldg. Floor EL-436'-0"
PT446	Barton Lot #3	2	Turbine Bldg. Floor EL-436'-0"
PT4465	" "	2	
PT447	" "	2	Turbine Bldg. Floor EL-436'-0"
LT459	Barton Lot #2	1	Reactor Bldg. Floor EL-436'-0"
LT460	" "	1	Reactor Bldg. Floor EL-436'-0"
LT461	" "	1	Reactor Bldg. Floor EL-436'-0"
FT474	" "	1	Reactor Bldg. Floor EL-463'-0"
LT474	" "	1	Reactor Bldg. Floor EL-463'-0"
FT475	" "	1	Reactor Bldg. Floor EL-463'-0"
LT475	" "	1	Reactor Bldg. Floor EL-463'-0"
LT476	" "	1	Reactor Bldg. Floor EL-463'-0"
LT477	" "	1	Reactor Bldg. Floor EL-436'-0"
FT484	" "	1	Reactor Bldg. Floor EL-463'-0"
LT484	" "	1	Reactor Bldg. Floor EL-463'-0"
FT485	" "	1	Reactor Bldg. Floor EL-463'-0"
LT485	" "	1	Reactor Bldg. Floor EL-463'-0"
LT486	" "	1	Reactor Bldg. Floor EL-463'-0"
LT487	" "	1	Reactor Bldg. Floor EL-436'-0"
FT494	" "	1	Reactor Bldg. Floor EL-463'-0"
LT494	" "	1	Reactor Bldg. Floor EL-463'-0"
FT495	" "	1	Reactor Bldg. Floor EL-463'-0"
LT495	" "	1	Reactor Bldg. Floor EL-463'-0"
LT496	" "	1	Reactor Bldg. Floor EL-463'-0"
LT497	" "	1	Reactor Bldg. Floor EL-436'-0"
FT414	Barton Lot#3	2	Reactor Bldg. Floor EL-412'-0"
FT4143	" "	2	
FT415	" "	2	Reactor Bldg. Floor EL-412'-0"
FT416	" "	2	Reactor Bldg. Floor EL-412'-0"
FT424	" "	2	Reactor Bldg. Floor EL-412'-0"
FT425	" "	2	Reactor Bldg. Floor EL-412'-0"
FT426	" "	2	Reactor Bldg. Floor EL-412'-0"
FT434	" "	2	Reactor Bldg. Floor EL-412'-0"
FT435	" "	2	Reactor Bldg. Floor EL-412'-0"
FT436	" "	2	Reactor Bldg. Floor EL-412'-0"
FT476	" "	2	Auxiliary Bldg. Floor EL-436'-0"
FT4765	" "	2	
FT477	" "	2	Auxiliary Bldg. Floor EL-436'-0"
FT486	" "	2	Intermediate Bldg. Floor EL-436'-0"
FT487	" "	2	Intermediate Bldg. Floor EL-436'-0"
FT496	" "	2	Intermediate Bldg. Floor EL-436'-0"
FT497	" "	2	Intermediate Bldg. Floor EL-436'-0"
PT950	" "	2	Auxiliary Bldg. Floor EL-463'-0"

TAG #	MODEL # (*)	REPORT NO.	LOCATION
PT9505	Barton Lot #3	2	
PT951	" "	2	Fuel Handling Bldg. Floor EL-463'-0"
PT952	" "	2	Fuel Handling Bldg. Floor EL-436'-0"
PT953	" "	2	Intermediate Bldg. Floor EL-436'-0"
LT1310	" "	2	Fuel Handling Bldg. Floor EL-412'-0"
LT1311	" "	2	Fuel Handling Bldg. Floor EL-412'-0"
LT1320	" "	2	Diesel Gen. Bldg. Floor EL-427'-0"
LT1321	" "	2	Diesel Gen. Bldg. Floor EL-427'-0"
LT1322	" "	2	Diesel Gen. Bldg. Floor EL-427'-0"

*Westinghouse Proprietary Information

REPORTS

1. NS-TMA-2184
2. WCAP-8687