Job No. 83090
Doc. No. DC-3
Rev. 2

INDEPENDENT DESIGN REVIEW

CABLE TRAY SUPPORT DESIGN REVIEW CRITERIA

FOR

COMANCHE PEAK NUCLEAR PLANT - UNIT 1

TEXAS UTILITIES SERVICES, INC.

Prepared by J. Russ — 28 Sept. 1984 Date

Independent Review by W. Horstman — Sept 28, 1984 Date

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1.0 INTRODUCTION

This criteria document is intended to establish general guidelines to be used in the review of the cable tray supports associated with tray segments carrying the power supply cable for the RHR - Train B pump (TBX-RHAPRH-01). The review shall ensure that the cable tray and conduit supports are adequate to transmit the loads from the cable trays to supporting building structural members. This document shall be used in conjunction with Work Instruction 1, "Assessment Procedures," for details on the review methodology and documentation.

2.0 SCOPE

This structural review will consist of a design review of the supports for the following tray segments that carry the power supply cable for the RHR - Train B pump (TBX-RHAPRH-02).

T11GEAB30-0870-4915-4767
T11GEAB29-0870-4909-4767
T11GEAB30-0870-4909-4768
T11GEAB26-0870-4909-4772
T11GEAB25-0869-4909-4777
T11GEAB24-0869-4909-4786
T11GEAB23-0869-4901-4786
T11GEAB22-0869-4901-4812
T11GSAB50-0871-4909-4889
T11GSAB49-8068-4910-4889
T11GSAB48-0868-4914-4889
T11GSAB47-0868-4930-4889
T11GSAB46-0867-4930-4900
T11GSAB45-0867-4938-4900
T11GSAB44-0843-4938-4900
T11GSAB07-0820-4938-4900
T11GSAB01-0801-4938-4900
T11GSAB02-0801-4914-4900
T11GSAB03-0782-4914-4900
T11GSAB04-0782-4909-4900
T11GSAB-05-0782-4901-4899
T11GSF007-0785-4890-4875
T11GSF008-0785-4886-4875

3.0 CODES, STANDARDS AND REFERENCE DOCUMENTS

3.1 Gibbs & Hill Calculation SCS-101C, Set #5, "Cable Tray Support Design Criteria and References," Rev. 2.

3.2 U.S. Nuclear Regulatory Commission, Standard Review Plan, Section 3.8.4.

3.3 American Institute of Steel Construction, Inc., Manual of Steel Construction, 7th Edition.

3.4 American Welding Society, Structural Welding Code, AWS D.1.1., 1979,

3.5 Gibbs & Hill, Inc., Specification No. 2323-SS-30, Appendix 2, "Design Criteria for Hilti Kwik & Super Kwik Bolts".

3.6 Gibbs & Hill, Inc., Specificaton No. 2323-SS-30, Appendix 3, "Design Criteria for Screw Anchors".

3.7 Gibbs & Hill, Inc., Drawing No. 2323-S-0901, Note 13, Rev. 4.

3.8 Commanche Peak Steam Electric Station, Units 1 and 2, Final Safety Analysis Report (April 24, 1977); Sections 3.7 and 3.10.

4.0 DESIGN

4.1 Physical Requirements

As described in Reference 3.7, the design should assume that the distance between two cable tray supports is 7 feet or less with a location tolerance of plus or minus 6 inches along the tray run. This allows in an extreme case for the nominal support spacing to be increased to 8 feet.

Spacing of longitudinal supports, in general, should not exceed 40'-0" for a continuous cable tray run. Unless otherwise verified by calculation, at least one lorgitudinal support shall be placed in each straight segment of cable tray run.

The assumptions used in modelling the support shall be clearly stated and justified. The model, whether a computer finite element or a hand calculation, shall reflect the actual support geometry and load distribution. Changes to the initial geometry, or use of one geometry to qualify a different geometry, shall be justified.

4.2 Loads and Load Combinations

Loads and load combinations to be used in the design review should be determined in accordance with USNRC Standard Review Plan, Section 3.8.4. The loadings that should be taken into account in the design of the cable tray supports are as follows:

- Dead Load (DL), including any permanent loads, and their related moments and forces.

Live Load (LL), including any movable equipment loads and their related moments and forces.

Operating Basis Earthquake (OBE)

Safe Shutdown Earthquake (SSE)

The following loading conditions should be used:

1) Operating Condition: DL + LL + OBE

2) Safe Shutdown Condition: DL + LL + SSE

4.3 Allowable Stress

Structural steel sections, structural bolts and welds should be designed to meet the allowable stress requirements specified in Reference 3.8. For the operating condition, the allowables are based on the working stress design method per Reference 3.3. For the Safe Shutdown condition, the allowables may be increased in accordance with reference 3.8. No additional increase in allowables for short duration loading is allowed. Exhibit 4.3-1 provides a table summarizing typical allowable stresses.

4.4 Base Plate and Anchor Bolt Design

Anchor bolts are used to attach the cable tray support base plates or base angles to structural concrete. The two types of anchor bolts used are drilled in expansion anchors (Hilti Kwik and Super Kwik bolts) and cast in place screw anchors (Richmond Structural Inserts).

4.4.1 Base Plate Stress Analysis

Base plate stiffness and prying effect should be considered in the design of the cable tray supports. The Teledyne method, a finite element analysis or comparable method may be used to check the adequacy of the base plate and to calculate the anchor bolt loads.

4.4.2 Allowable Loads (Expansion Anchors)

Expansion anchors shall be evaluated based on the following criteria:

a. Allowable loads shown in Exhibit 4.4-1, shall apply to anchors installed in ordinary concrete with f'_c = 4000 psi only.

b. For concrete strength between 3 ksi and 5 ksi, the data in Exhibit 4.4-1 may be ratioed up or down.

c. Allowable load values given in this standard shall not be increased for short duration loading (e.g., for wind or seismic loads).

d. If the center-to-center spacing of anchors is less than 10 diameters and/or if the distance from edges of concrete to center of anchor is less than 5 diameters, the allowable loads shall be reduced in accordance with the Gibbs

& Hill, Inc., Specification No. 2323-SS-30 Appendix 2.

e. Embedded length of the anchor should be exclusive of thickness of grout pad or other overlay.

f. For anchors which will be subjected simultaneously to pullout and shear forces, the allowable load values used must satisfy the following formula:

$$\{\frac{P_C}{P_D}\} + \{\frac{S_C}{S_D}\} < 1$$

where:

P_D, S_D = allowable loads (pullout, shear), reduced for spacing or edge distance if appropriate.

P_C, S_C = design loads to be used in cases where pullout and shear loads may occur simultaneously.

4.4.3 Allowable Loads (Screw Anchors)

Screw anchors shall be evaluated based on the design criteria and allowable loads for screw anchors shown in Reference 3.6.

5.0 EXHIBITS

Exhibit 4.3-1 Allowable Stresses

Exhibit 4.4-1 Allowable Load on Expansion Anchors

EXHIBIT 4.3-1

ALLOWABLE STRESSES

Stress	Load Case: Operating* Value	Load Case: Safe Shutdown** Value
Tension	0.6 F_y	0.96 F_y
Shear	0.4 F_y	0.64 F_y
Web Crippling	0.75 F_y	1.2 F_y
Compression	F_a per AISC Section 1.5.1.3	1.6 F_a per AISC Section 1.5.1.3
Bending	F_b per AISC Section 1.5.1.4	1.6 F_b per AISC Section 1.5.1.4
Bearing	0.9 F_y	1.44 F_y
Bolts		
Tension and Shear	Per AISC Appendix Section 1.5.2 and 1.6.3	1.6 x Allowable per AISC Appendix Section 1.5.2 and 1.6.3
Welds (Fillet, Full or Partial Penetration):		
Shear	0.3 F_y (Weld Metal)	0.48 F_y (weld metal)
Tension	0.6 F_y (Base Metal)	0.96 F_y (base metal)
Combined Stress	As per AISC Section 1.6.1	As per AISC Section 1.6.1

**1.6 x Operating Allowable
* Allowable stresses per reference 3.3

EXHIBIT 4.4-1

ALLOWABLE LOAD ON EXPANSION ANCHORS
KWIK-BOLT
DESIGN ALLOWABLE TENSILE & SHEAR LOADS (lbs.)

Factor of Safety		FS = 4.0		FS = 5.0	
Diameter	Embedment	Tension	Shear	Tension	Shear
1/4"	1-1/8"	364	653	291	522
	1-1/2"	556	653	445	522
	1-3/4"	675	653	540	522
	2"	781	653	625	522
	2-1/4"	827	653	662	522
	2-1/2"	837	653	670	522
3/8"	1-5/8"	588	1276	471	1021
	2"	756	1276	605	1021
	2-1/2"	975	1276	780	1021
	3"	1075	1354	860	1083
	3-1/2"	1150	1354	920	1083
	4"	1187	1354	950	1083
	4-1/2"	1200	1354	960	1083
1/2"	2-1/4"	1377	2079	1102	1663
	2-3/4"	1800	2079	1440	1663
	3-1/2"	2362	2079	1890	1663
	4-1/2"	2806	2558	2245	2046
	5-1/2"	3012	2558	2410	2046
	6"	3075	2558	2460	2046
5/8"	2-3/4"	1650	2880	1320	2312
	3-1/2"	2275	2890	1820	2312
	4-1/2"	3000	2890	2400	2312
	5-1/2"	3575	3359	2860	3087
	6-1/2"	4000	3859	3200	3087
	7-1/2"	4250	3859	3400	3087

Note: Allowable loads per Reference 3.5

EXHIBIT 4.4-1

ALLOWABLE LOAD ON EXPANSION ANCHORS
KWIK-BOLT
DESIGN ALLOWABLE TENSILE & SHEAR LOADS (lbs.)

Factor of Safety		FS = 4.0		FS = 5.0	
Diameter	Embedment	Tension	Shear	Tension	Shear
3/4"	3-1/4"	2537	4283	2030	3426
	4"	3350	4283	2680	3426
	5"	4125	4283	3300	3426
	6"	4500	4616	3600	3693
	7"	5250	4616	4200	3693
	8"	5750	4616	4600	3693
	9"	5875	4616	4700	3693
1"	4-1/2"	4000	6719	3200	5375
	5"	4725	6719	3780	5375
	6"	5860	6719	4688	5375
	7"	5860	6719	4688	5375
	8"	5860	8622	4688	6898
	9"	5860	8622	4688	6898
	10"	5860	8622	4688	6898
1-1/4"	5-1/2"	5750	8920	4600	7136
	6-1/2"	6775	8920	5420	7136
	7-1/2"	7775	8920	6220	7136
	8-1/2"	8650	8920	6920	7136
	9-1/2"	9450	8920	7560	7136
	10-1/2"	10225	8920	8180	7136

Note: Allowable loads per reference 3.5

EXHIBIT 4.4-1

ALLOWABLE LOAD ON EXPANSION ANCHORS
SUPER KWIK-BOLT
DESIGN ALLOWABLE TENSILE & SHEAR LOADS (lbs.)

Factor of Safety		FS = 4.0		FS = 5.0	
Diameter	Embedment	Tension	Shear	Tension	Shear
1/2"	3-1/4"	2496	2860	1997	2280
	4-1/4"	3695	2860	2956	2280
	5-1/4"	3641	2860	2913	2280
	6-1/4"	3786	2860	3029	2280
1"	6-1/2"	8741	6884	6993	5507
	8-1/2"	12452	6884	9962	5507
	10-1/2"	12439	6884	9951	5507
1-1/4"	8-1/8"	10675	10369	8540	8295
	10-5/8"	13420	10369	10736	8295
	13-1/8"	16230	10369	12984	8295

Note: Allowable loads per reference 3.5.

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INDEPENDENT ASSESSMENT PROGRAM

ELECTRICAL SYSTEM REVIEW CRITERIA

FOR

COMANCHE PEAK STEAM ELECTRIC STATION

TEXAS UTILITIES SERVICES, INCORPORATED

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