CGNTRAL FILES

CP&L

Carolina Power & Light Company

USNRC REG. UNIT

July 9, 1979

79 JUL 12 A10 : 43

FILE: NG-3513 (R) SERIAL: GD-79-1719

Mr. James P. O'Reilly
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261
LICENSE NO. DPR-23
RESPONSE TO IE BULLETIN 79-02

Dear Mr. O'Reilly:

In accordance with the requirements of IE Bulletins 79-02 dated March 8, 1979, and 79-02 (Revision No. 1) dated June 21, 1979, a verification, inspection, and testing program for pipe support base plates using concrete expansion anchor bolts has been initiated and completed. The results of the program verify that the expansion anchor bolts used for Seismic Category I piping system supports at H. B. Robinson Unit No. 2 will not cause a loss of function of any of the supports.

The verification, inspection, and testing program as outlined in Attachment I was performed by Ebasco Services, Incorporated, from April 4, 1979, through June 8, 1979. The program covered the investigation of design concepts and calculations, and the inspection and testing of existing concrete expansion anchor bolts on Seismic Category I pipe support base plates.

In summary, a total of 18 piping systems were investigated with a total number of 717 supports inspected and tested. The test program utilized a sampling method very similar to that described in IE Bulletin 79-02, Revision No. 1, Appendix A, (a), i.e., test one bolt per support. If the bolt failed, all other bolts on that support were tested, when accessible. The inspection program to verify proper installation determined the following:

1. Embedment depth

2. Bolt thread engagement

3. Concrete edge distance and center-to-center distance between adjacent expansion anchor bolts

7908160356

A002 CCP

411 Fayetteville Street • P. O. Box 1551 • Raleigh, N C 27602

790265

4. Expansion anchor sleeve fully expanded

5. Angularity of the bolt

6. Diameter of the bolt

7. Specified type of anchor

Expressing the results of the inspection and test program in terms of anchor bolts, the program identified 2108 anchor bolts. Using the sampling technique described, 1088 anchor bolts were inspected and tested. Of this total, 302 anchor bolts required modification, representing 14.3 percent of all anchor bolts. Inaccessible anchor bolts totaled approximately 24 or 1.1 percent of all anchor bolts. Of the 717 supports inspected and tested, 29 percent required modification due to unacceptable installation of the expansion anchors or the potential for overstressed conditions when adding considerations for flexibility to that of rigid loadings on the base plates. All support and anchor bolt modifications were completed by June 8, 1979, prior to heatup following refueling outage.

Specific detailed responses to each of the IE Bulletin 79-02 action items 1 through 4 are contained in Ebasco's final report of program results and are briefly summarized as follows:

AI-1. The original design by Grinnell, Inc., of the Seismic Category I pipe support base plates did not consider plate flexibility in the calculation of expansion anchor bolt loads for H. B. Robinson Unit No. 2. Therefore, this program was initiated to conduct the analysis and testing necessary to verify operability of Seismic Category I piping systems in the event of a seismic event. The additional tension bolt load due to considering supports flexible with a resultant prying action on the bolt was determined in accordance with the procedure outlined in the American Institute of Steel Construction (ASIC) Manual, "Specification for the Design, Fabrication and Erection of Structural Steel for Building," Seventh Edition, Pages 4-80 and 4-81, Attachment II of this response. Shear-tension interaction was reviewed using the following formula:

$$\frac{\text{Total Bolt Tension Load}}{\text{Allowable Bolt Tension Load}} + \frac{\text{Max. Bolt Shear Load}}{\text{Allowable Bolt Shear Load}} \leq 1$$

AI-2. Factors of safety used in the program were as indicated in IE Bulletin 79-02, i.e.,

Four - for wedge and sleeve type anchor bolts
Five - for shell type (self-drilling) anchor bolts

The ultimate load capacity of the concrete expansion anchor bolts specified by ITT Phillips Drill Division was modified

to account for the strength and age of concrete, based on data contained in their design handbook and specifiers guide.

AI-3. The cyclic loading considered in the detailed analysis performed in the program was due to a seismic event. During direct pull testing, the bolts were verified as being capable of carrying a proof load equal to the allowable bolt value based on ultimate capacity divided by the safety factor, as stated in (2) above.

AI-4. The direct pull test outlined in (3) above meets the requirements stated in action item 4. Piping systems investigated in this program were 1 1/4-inch or larger.

The inspection program as formulated and performed did not include verification or documentation of the bolt hole size in the base plate, as requested in Revision I of IE Bulletin 79-02. However, the inspection team leader, during the inspection phase, inspected each bolt and anchor and, if the base plate hole was enlarged or elongated, a washer was installed to ensure the proper bearing surface for the bolt head.

Further details of the program are contained in the Ebasco Final Report on file at H. B. Robinson Plant. If you have any questions, please contact me.

Yours very truly,

E. E. Utley
Executive Vice President
Power Supply & Customer Services

FB/CSB:men*

Attachments

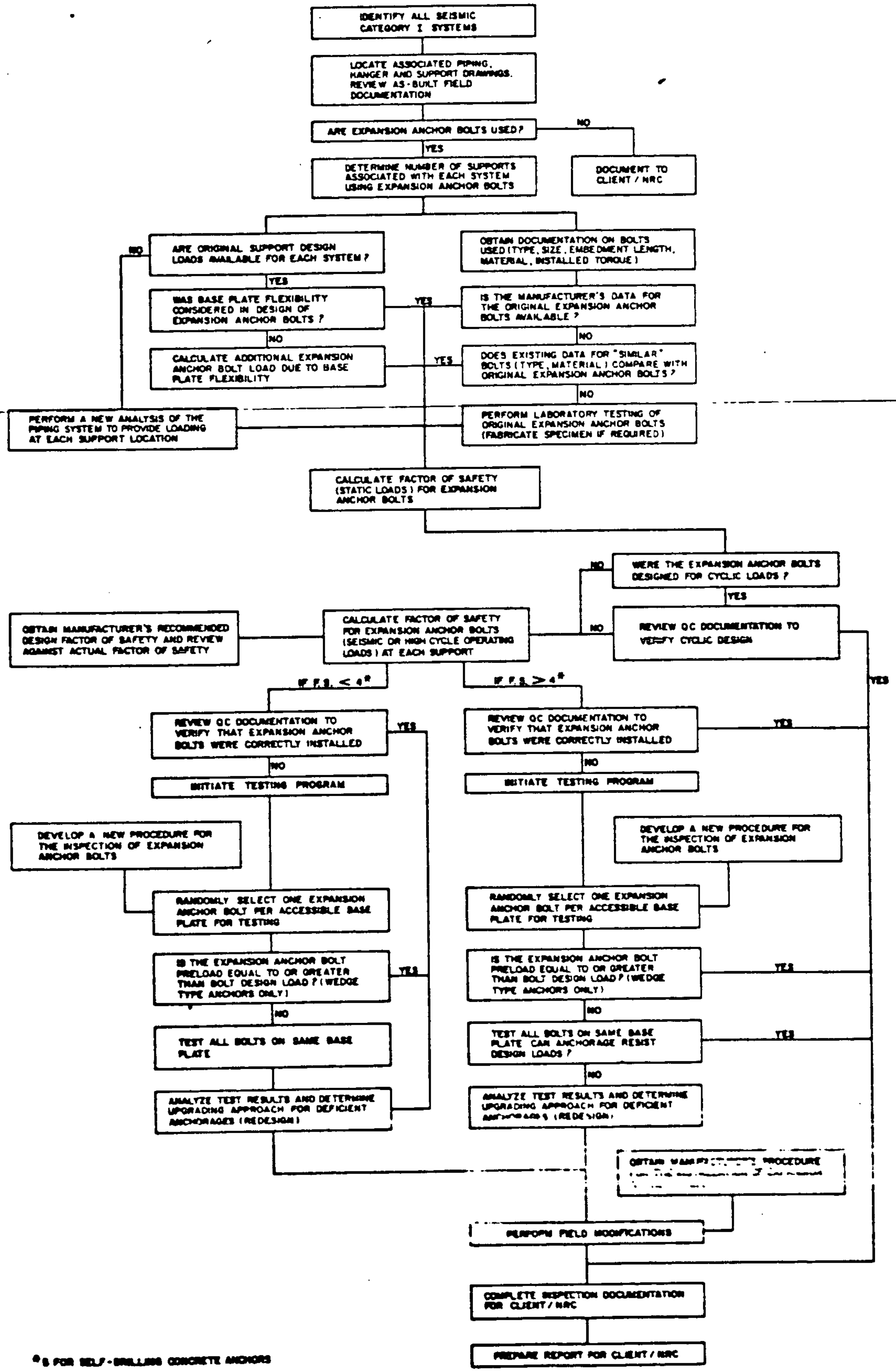
cc: Mr. R. A. Hartfield
Mr. V. Stello

EBASCO SERVICES INCORPORATED

VERIFICATION PROGRAM FOR PIPE SUPPORT BASE PLATES USING CONCRETE EXPANSION ANCHOR BOLTS

CAROLINA POWER AND LIGHT COMPANY

H.B. ROBINSON - UNIT NO. 2



*5 FOR SELF-DRILLING CONCRETE ANCHORS

JUNE, 1979

HANGER TYPE CONNECTIONS

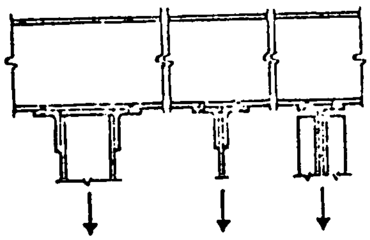
Fasteners loaded in tension

In the design of hanger type connections, prying action must be considered. It will usually increase the tension in the fasteners transmitting tension force through the flange of a tee or the outstanding leg of angles and it will introduce additional bending stresses in the steel fitting.

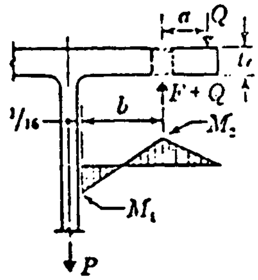
The following table is useful for making a rapid selection of a trial fitting using $F_y = 36$ ksi. The fitting must then be checked for bending stresses due to prying force Q and possible increase in size.

STRUCTURAL TEE OR DOUBLE ANGLE HANGERS

Loads in kips per linear inch for trial section



HANGERS



b in.	Thickness of angle or flange of tee, t_f, inches															
	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	1 1/16	1⅛	1 3/16	1¼
1	1.76	2.53	3.45	4.50	5.70	7.03	8.51	10.13	11.83	13.72	15.32	19.00	20.32	22.73	25.35	28.13
1¼	1.41	2.03	2.76	3.60	4.56	5.63	6.81	8.10	9.51	11.03	12.66	14.40	16.26	18.23	20.31	22.50
1½	1.17	1.69	2.30	3.00	3.80	4.69	5.67	6.75	7.92	9.19	10.55	12.00	13.55	15.19	16.92	18.75
1¾	1.00	1.45	1.97	2.57	3.25	4.02	4.86	5.79	6.79	7.88	9.04	10.29	11.61	13.02	14.50	15.07
2	0.83	1.27	1.72	2.25	2.85	3.52	4.25	5.05	5.94	6.89	7.91	9.00	10.15	11.39	12.69	14.06
2¼	0.78	1.13	1.53	2.00	2.53	3.13	3.78	4.50	5.28	6.13	7.03	8.00	9.03	10.13	11.28	12.50
2½	0.70	1.01	1.38	1.80	2.28	2.81	3.40	4.05	4.75	5.51	6.33	7.20	8.13	9.11	10.15	11.25
2¾	0.64	0.92	1.25	1.64	2.07	2.55	3.09	3.68	4.32	5.01	5.75	6.55	7.39	8.23	9.23	10.23
3	0.59	0.84	1.15	1.50	1.90	2.34	2.84	3.38	3.96	4.59	5.27	6.00	6.77	7.59	8.46	9.33
3¼	0.54	0.78	1.06	1.38	1.75	2.16	2.62	3.12	3.66	4.24	4.87	5.54	6.25	7.01	7.81	8.65

For the above table, the points of critical moment are assumed at the fastener line and at a point one-sixteenth of an inch from the near face of the outstanding leg of the angle or tee.

$$M = \frac{P}{2} \times \frac{b}{2} = \frac{27t_f^2}{6}; \quad P = \frac{18t_f^2}{b}$$

where

P = Allowable load on two angles or structural tee, in kips per linear inch, using maximum allowable bending stress of 27.0 ksi

b = Distance from fastener line to near face of outstanding leg of angle or structural tee less 1/16″ ($b/2$ is the lever arm used to determine the assumed moment)

t_f = Thickness of angle or flange of tee

HANGER TYPE CONNECTIONS

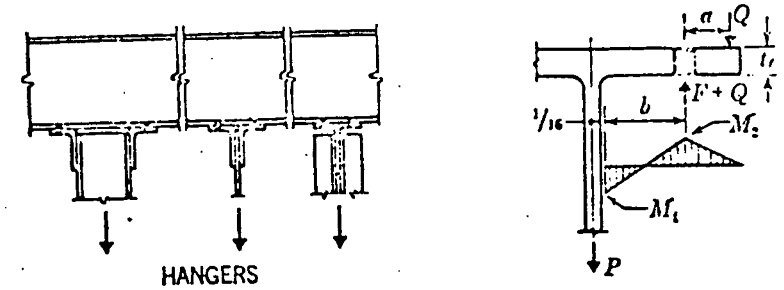
Fasteners loaded in tension

In the design of hanger type connections, prying action must be considered. It will usually increase the tension in the fasteners transmitting tension force through the flange of a tee or the outstanding leg of angles and it will introduce additional bending stresses in the steel fitting.

The following table is useful for making a rapid selection of a trial fitting using F_y = 36 ksi. The fitting must then be checked for bending stresses due to prying force Q and possible increase in size.

STRUCTURAL TEE OR DOUBLE ANGLE HANGERS

Loads in kips per linear inch for trial section



b in.	Thickness of angle or flange of tee, t_f, inches															
	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4
1	1.76	2.53	3.45	4.50	5.70	7.03	8.51	10.13	11.83	13.78	15.32	18.00	20.32	22.78	25.33	28.13
1 1/4	1.41	2.03	2.76	3.60	4.56	5.63	6.81	8.10	9.51	11.03	12.66	14.40	16.26	18.23	20.31	22.50
1 1/2	1.17	1.69	2.30	3.00	3.80	4.69	5.67	6.75	7.92	9.19	10.55	12.00	13.55	15.19	16.92	18.75
1 3/4	1.00	1.45	1.97	2.57	3.25	4.02	4.86	5.79	6.79	7.88	9.04	10.29	11.61	13.02	14.50	16.07
2	0.88	1.27	1.72	2.25	2.85	3.52	4.25	5.06	5.94	6.89	7.91	9.00	10.16	11.39	12.69	14.06
2 1/4	0.78	1.13	1.53	2.00	2.53	3.13	3.78	4.50	5.28	6.13	7.03	8.00	9.03	10.13	11.28	12.50
2 1/2	0.70	1.01	1.38	1.80	2.28	2.81	3.40	4.05	4.75	5.51	6.33	7.20	8.13	9.11	10.15	11.25
2 3/4	0.64	0.92	1.25	1.64	2.07	2.56	3.09	3.68	4.32	5.01	5.75	6.55	7.39	8.28	9.23	10.23
3	0.59	0.84	1.15	1.50	1.90	2.34	2.84	3.38	3.96	4.59	5.27	6.00	6.77	7.59	8.46	9.38
3 1/4	0.54	0.78	1.06	1.38	1.75	2.16	2.62	3.12	3.66	4.24	4.87	5.54	6.25	7.01	7.81	8.65

For the above table, the points of critical moment are assumed at the fastener line and at a point one-sixteenth of an inch from the near face of the outstanding leg of the angle or tee.

$$M = \frac{P}{2} \times \frac{b}{2} = \frac{27 t_f^2}{6}; \quad P = \frac{18 t_f^2}{b}$$

where

P = Allowable load on two angles or structural tee, in kips per linear inch, using maximum allowable bending stress of 27.0 ksi

b = Distance from fastener line to near face of outstanding leg of angle or structural tee less 1/16" ($b/2$ is the lever arm used to determine the assumed moment)

t_f = Thickness of angle or flange of tee