CENTRAL FILES

P.O. BOX 529100, MIAMI, FL 33152

FLORIDA POWER & LIGHT COMPANY

July 5, 1979
L-79-183

Mr. James P. O'Reilly, Director, Region II
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Dear Mr. O'Reilly:

Re: RII:JPO
50-335
IE Bulletin 79-02

Florida Power & Light Company has reviewed the subject Bulletin and a response is attached.

Very truly yours,

Robert E. Uhrig
Vice President
Advanced Systems & Technology

REU/MAS/cph

Attachment

cc: Harold F. Reis, Esquire

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ATTACHMENT

Re: RII:JPO
50-335/79-02

1. Question

"Verify that pipe support base plate flexibility was accounted for in the calculation of anchor bolt loads. In lieu of supporting analysis justifying the assumption of rigidity, the base plates should be considered flexible if the unstiffened distance between the member welded to the plate and the edge of the base plate is greater than twice the thickness of the plate. If the base plate is determined to be flexible, then recalculate the bolt loads using an appropriate analysis which will account for the effects of shear - tension interaction, minimum edge distance and proper bolt spacing. This is to be done prior to testing of anchor bolts. These calculated bolt loads are referred to hereafter as the bolt design loads."

Response

In the past prying forces for the type of application which is the subject of this bulletin have generally not been calculated, primarily because the loads are small and the assumption of single curvature bending of the plate results in an overestimation of the required plate thickness.

Analyses have now been performed to assess the actual influence of the prying effect on the load carried by the concrete expansion anchors. In 1977 Florida Power & Light undertook an inspection program to verify the design and installation of all seismic Category I pipe supports, the details are provided herein in the response to item 4 of the Bulletin. At that time various supports/installations were inspected and reanalyzed to account for as-built conditions. Approximately 50 percent of this group of reanalyzed supports were further analyzed to determine the influence of prying effects.

The approach used is similar to that presented by Fisher and Struik in "Guide to Design Criteria for Bolted and Riveted Joints", published by Wiley, 1974. This method employs static equilibrium considerations and assumes the anchors stressed to ultimate and the base plate forming a plastic hinge at the point of attachment. (The same concepts have been employed in the development of the AISC formula for prying action which is widely used in design. The derivation of the AISC formula is presented in "High Strength Bolts Subject to Tension and Prying", by R. S. Nair, P. C. Birkemoe and W. H. Munse, published in the ASCE Journal of the Structural Division, February 1974. However, the AISC formula cannot be applied directly in this case since it was derived semiempirically for A325 and A490 bolts.)

After analyzing 45 supports, not a single case of a positive α was found. Since the parameter α is indicative of the presence of prying force, it is concluded that the prying effect is negligible for this type of anchorage:

Shear-tension interaction has been accounted for by the use of the following equation: $\frac{\text{actual tension}}{\text{allowable tension}} + \frac{\text{actual shear}}{\text{allowable shear}} \leq 1$

2. Question

"Verify that the concrete expansion anchor bolts have the following minimum factor of safety between the bolt design load and the bolt ultimate capacity determined from static load tests (e.g. anchor bolt manufacturer's) which simulate the actual conditions of installation (i.e., type of concrete and its stength properties):

a. Four - For wedge and sleeve type anchor bolts,

b. Five - For shell type anchor bolts."

Response

For Unit 1 pipe support anchorage design, the allowable shear and tension values for expansion anchors were determined by dividing by a factor of 4 the bolt ultimate capacities as specified in the manufacturer's published data.

3. Question

"Describe the design requirements if applicable for anchor bolts to withstand cyclic loads (e.g. seismic loads and high cycle operating loads)."

Response

The cyclic loading considered for Unit 1 was seismic load; no reduction in bolt capabilities beyond the safety factor of 4 was taken.

4. Question

"Verify from existing QC documentation that design requirements have been met for each anchor bolt in the following areas:

(a) Cyclic loads have been considered (e.g. anchor bolt preload is equal to or greater than bolt design load). In the case of the shell type, assure that it is not in contact with the back of the support plate prior to preload testing.

4. Question (continued)

   (b) Specified design size and type is correctly installed (e.g. proper embedment depth).

If sufficient documentation does not exist, then initiate a testing program that will assure that minimum design requirements have been met with respect to sub-items (a) and (b) above. A sampling technique is acceptable. One acceptable technique is to randomly select and test one anchor bolt in each base plate (i.e. some supports may have more than one base plate). The test should provide verification of sub-items (a) and (b) above. If the test fails, all other bolts on the base plate should be similarly tested. In any event, the test program should assure that each Seismic Category I system will perform its intended function."

Response

During 1977 an extensive inspection was performed on all Unit 1 Seismic Category I pipe supports utilizing concrete expansion anchors. The following installation parameters were verified: bolt diameter and length, embedment depth, thread engagement length, sleeve recess in concrete and presence of the conical plug. Various supports were reanalyzed to demonstrate the as-built capability of the anchorage to withstand design loads. The results of the inspection program are given in the references listed below; these were reviewed and accepted by NRC.

References:

1. FPL letter L-77-282, dated 9/7/77
2. FPL letter L-77-312, dated 10/7/77
3. NRC Inspection Report 50-335/77-10, dated 11/21/77
4. FPL letter L-77-359, dated 11/30/77
5. FPL letter L-77-371, dated 12/8/77