UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report Nos.: 50-335/87-26 and 50-389/87-25

Licensee: Florida Power and Light Company
9250 West Flagler Street
Miami, FL 33102

Docket Nos.: 50-335 and 50-389 License Nos.: DPR-67 and NPF-16

Facility Name: St. Lucie 1 and 2

Inspection Conducted: October 26-30, 1987

Inspector: Rich C. Chou 12-29-87
R. C. Chou Date Signed

Approved by: for J. Economos 12/29/87
J. J. Blake, Chief Date Signed
Materials and Processes Section
Division of Reactor Safety

SUMMARY

Scope: This routine, announced inspection was in the areas of safety-related pipe supports and pipe support base plate design using concrete expansion anchor bolt (IEB 79-02).

Results: No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*J. H. Barrow, Operations Superintendent
W. R. Bloor, Supervisor, Civil and Structural Engineering, JPE
*G. J. Boissy, Plant Manager
W. Brannin, Manager, Civil and Structural Engineering, JPE
*K. N. Harris, Vice President, St. Lucie Nuclear Plant
M. Hoskins, QC Inspector
*K. P. Hughes, Site Lead Civil Engineer
*J. Krumins, Site Engineering Supervisor
*L. McLaughlin, Technical Staff Engineer
*B. Parks, QA
*N. G. Roos, QC Supervisor
*M. J. Snyder, Technical Staff Engineer
*D. H. West, Technical Staff Supervisor

Other licensee employees contacted included engineers, technicians, mechanics, and office personnel.

Other Organization

*R. Russo, Principal Structural Engineer, Ebasco Services Inc.

NRC Resident Inspector

*R. V. Crlenjak, Senior Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on October 30, 1987, with those persons indicated in paragraph 1 above. The inspector described the areas inspected and discussed in detail the inspection findings. No dissenting comments were received from the licensee. The following new items were identified during this inspection:

Unresolved Items (UNR) 50-335/87-26-01 and 50-389/87-25-01, Pipe Support Discrepancies between Field Conditions and Drawings

UNR 50-335/87-26-02 and 50-389/87-25-02, Base Plate and Anchor Bolt Deficiencies

UNR 50-389/87-25-03, Base Plate and Anchor Bolt Calculation Problems

UNR 50-389/87-25-04, Support Not Found in Field

UNR 50-335/87-26-03 and 50-389/87-25-05, Installation and Inspection Records for Pipe Supports

Inspector Followup Item (IFI) 50-335/87-26-04 and 50-389/87-25-06, Structural Members, Connections and Pipe Support Maintenance

The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspector during this inspection.

3. Licensee Action on Previous Enforcement Matters

This subject was not addressed in the inspection.

4. Unresolved Items

Unresolved items are matters about which more information is required to determine whether they are acceptable or may involve violations or deviations. Five unresolved items identified during this inspection are discussed in paragraph 5.

5. (Open) Pipe Support Base Plate Design Using Concrete Expansion Anchor Bolt (IEB 79-02) - Units 1 and 2

a. Briefing

This inspection was conducted to verify licensee compliance with IE Bulletin 79-02 requirements and licensee commitments.

During 1977, an extensive inspection similar to the requirements of IEB 79-02 was performed on all Unit 1 Seismic Category 1 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, based on the as-built information, were reanalyzed to demonstrate the ability to withstand design loads. Prying forces were not considered in qualification of anchor bolts and base plates. There were 13 cases where structural shapes were attached directly to concrete in Unit 1 and they were not reported to NRC, Region II. These cases had been reviewed and the designs were found to be adequate by the licensee.

The licensee's response on Unit 2 for IEB 79-02, dated July 2, 1979 (L-79-180), stated that prying forces would be calculated and accounted for in the design. The design criteria for expansion anchor applications would use safety factors of four for static loading, five for impactive loading and 15 for vibratory and seismic loading. Subsequently after a meeting between the NRC, FPL, and Ebasco, the licensee submitted a response concerning Base Plate

Flexibility Action Items to NRC, dated September 21, 1982 (L-82-408), and stated that the use of a safety factor of 15 for all types of loading precludes the necessity of a prying calculation or, if the use of a safety factor of 15 is impractical and the presence of large loads results in a significant prying effect, base plates would be analyzed using the ANSYS finite element computer program.

b. Walkdown Check

The inspector reviewed previous inspection reports and found that only a few pipe supports were walked down previously for IEB 79-02. Therefore, the inspector decided to walkdown pipe supports particularly for IEB 79-02. The inspector randomly selected the following 13 supports, in the area of dynamic pipe supports and component support structures, which included anchor bolts and baseplates, that had been QC final inspected, to see if they complied with IEB 79-02 requirements. The supports were reinspected with the assistance of the licensee's QC inspector and engineer. Table 1 is the list of supports reinspected.

TABLE 1

FIELD WALKDOWN SUPPORTS AND COMMENTS

1. Mark No. BF-2-9, Rev. 3, Feed Water System, Unit 1

   a. A 5" x 2" x 3/8" plate between the bracing and base plate was not shown on the drawing.

   b. 2-3/8" edge distance for anchor bolt at south side of the base plate for bracing was different from the drawing which showed an 1-1/2" edge distance.

   c. 1-1/4" edge distances for three anchor bolts in the base plate for the vertical post (3"d standard pipe) was different from the 1" shown on drawing.

   d. 1'-1-1/2" x 0'-10-1/2" base plate for bracing was different from 10-1/2" x 10-1/2" shown on drawing.

2. Mark No. CW-64-51, Rev. 0, ICW Lube Water System, Unit 1 (Gange Support CW-63-52)

   1-3/4" edge distances for three anchor bolts were different from the 1-1/2" shown on the drawing.

3. Mark No. CW-58-62, Rev. 1, ICW Lube Water System, Unit 1 (Gang Support CW-59-61)

   a. Base plate bent and 1/4" max gap between base plate and concrete

b. Lower bolt on south side bent at an angle of 12°

4. Mark No. CW-53-72, Rev. 1, ICW Lube Water System, Unit 1 (Gang Support CW-54-71)

   Base plate bent and 1/4" max gap between base plate and concrete

5. Mark No. CC-2074-44, Rev. 4, Component Cooling System, Unit 2

   a. 1-3/8" to 2-3/4" edge distances for anchor bolts instead of the 3/4" shown on drawing.

   b. 1/4" Gap between top of pipe and 3" x "3" tube steel exceeded the 1/16" CLR. shown on drawing.

6. Mark No. FS-2138-17, Rev. 8, Fuel Pool System, Unit 2

   2-1/4" edge distance for anchor bolt at North-East corner exceeded the 2" shown on drawing

7. Mark No. FS-2137-143, Rev. 2, Fuel Pool System, Unit 2

   3-1/4" edge distance for anchor bolt exceeded the 3" shown on drawing

8. Mark No. CW-3000B-187, Rev. 8, Circulating Water System, Unit 2

   Support could not be located in field.

9. Mark No. CS-2012-8015, Rev. 5, Fuel Pool System, Unit 2

   a. 1-3/4" to 4-1/2" edge distances for anchor bolts were different from 3" (TYP.) shown on drawing

   b. Center lines of Item No. 6 (2" d pipe) were 6" from left edge and 7-3/4" from top edge of base plate which were different from 9" (TYP.) as shown in Section A-A of drawing.

10. Mark No. BF-4001-190, Rev. 9, Feed Water System, Unit 2

    Weld around in field between Item No. 11 (TS 4" x 4") and base plate was not shown on drawing.

The above supports were partially reinspected against their detail drawings particularly for anchor bolts and base plates with a few exceptions on configuration, identification, dimensions, bolt edge distances, base plate thicknesses, bolt size, installation, rust, maintenance, and damage/protection.

c. Calculations Review

Design calculations were partially reviewed and evaluated for thoroughness, clarity, consistency and accuracy for anchor bolts and base plates. The prying forces, safety factors and allowables were reviewed particularly to see if they meet the requirements of IEB 79-02 and the licensee commitment. Table 2 showed the 32 support calculations reviewed, with comments.

d. Other Documents Reviewed

The following documents were reviewed for the support walkdown reinspection and calculation review.

(i) Expansion Anchors, Construction Quality Control Technical Sheet, TS 10.13, Rev. 1, FPL

- For expansion anchor inspection.

(ii) Drilled-In Expansion Type Anchors in Concrete, FLO-2998.469, Rev. 3, Ebasco

- For procurement, installation and testing requirement of anchoring devices.

(iii) Control of Nondestructive Examination, Appendix C, Non-Destructive Examination Manual, QI9-PR/PSL-2, Rev. 12, FPL

- For visual inspection on welds, castings, wrought and forged components, hangers, supports, pumps, valves, and other piping and structured components.

(iv) Concrete Expansion Anchor Design, Final Safety Analysis Report (FSAR), Unit 2

- For design criteria for expansion anchor bolts.

e. Documentation Availability

The following documents were requested by the inspector for references or review during the inspection, but they were not available. The licensee stated that they had completed IEB 79-02 a long time ago and it was not easy to collect all the information/documents requested in such a short period of time.

(i) A set of pipe support drawings made from final control drawing for supports shown on Table 2.

(ii) Installation and inspection records including anchor bolts and base plates for supports shown on Table 1.

(iii) Copies of pipe support installation, inspection, evaluation and design procedures or criteria.

(iv) Copy of walkdown, inspection, evaluation, and design criteria or procedures for IEB 79-14 with the cover titles which related to IEB 79-02.

f. Findings and Conclusions

During the calculation review of Unit 2, Support No. CC-2074-44, which was performed by Bergen-Paterson appeared to have a safety factor below two for anchor bolts due to the safety factor of 1.33 being used with the final interaction ratio of 0.75. Also, the prying forces were not considered in the above calculation. Therefore, the inspector requested that the licensee to evaluate the anchor bolts for the system operability. If the safety factor of anchor bolt is below two, the system should be declared inoperable. If the safety factor is between two and four, the support meets the interim operability requirement, but it requires modification to meet the long term requirements. The licensee engineers, after searching documents, replied that this support was one of the worst examples in Question No. 210A.61, SL2-FSAR, and in separate correspondence to Base Plate Flexibility Action Items to NRC, dated September 21, 1982, (L-82-408) was approved by NRC without question. The inspector reviewed the submitted FSAR and correspondence (they are identical). It appeared that the input loads were not the worst case for the analysis.

Therefore, during the exit meeting, the inspector requested that the licensee perform the evaluation of two supports for the system operability; Support no. CV-58-62 in Unit 1, with the warped baseplate, plus one bolt bent 12°, and the support listed above, using computer analysis, with current loads and field as-built conditions, due to the field conditions differing from the detail drawing. The licensee agreed, and called the Region II office to state that both of the two supports met the system operability. The input loads on FSAR and response for support no. CC-2074-44 were different from the calculation reviewed by the inspector. It appeared that this support has double calculations existing since the Bergen-Paterson calculation was revised on August 3, 1983, after the response sent to NRC on September 21, 1982.

The inspector held discussions with the licensee engineers and QC inspector about the discrepancies found in Table 1. QC Inspector stated that the supports should be inspected per the detail drawings without any tolerances except those stated in the detail drawings. Any dimensions or items which deviated from the detail drawings should be recorded and sent to the engineering department for evaluation. The licensee engineers did not know processes and location of document for evaluation after the QC inspector wrote the deviation reports. The licensee engineers also did not know the procedure for correcting the detail drawings after the deviated items were identified. The A/E, Ebasco, was not available at the time.

Table 2 shows the summary of the calculations reviewed. The safety factor for anchor bolts ranged from 1.33 to 15; Ebasco used safety factors of 4, 5, and 15. and Bergen-Paterson used 1.33, 2, and 4. The safety factor for anchor bolts should be more than four for wedge and sleeve type anchor bolts and five for shell type anchor bolts after considering base plate flexibility or prying forces. Prying forces were not considered in most calculations. The allowables for anchor bolts were also different even with the same size of bolt and the same safety factor. Per the licensee FSAR and response to NRC as stated above, the licensee committed to use a safety factor of 15 for anchor bolts in all load cases without considering the prying forces or base plate flexibility.

Based on all the findings in field walkdown, calculation review, and document request, the inspector summarized the results as follows:

- UNR 50-335/87-26-01 and 50-389/87-25-01, Pipe Support Discrepancies between Field Conditions and the Drawings
  - Examples such as Items 1(a), 1(d), 5(b), 9(b), and 10 on Table 1.
- UNR 50-335/87-26-02 and 50-389/87-25-02, Base plate and Anchor bolt Deficiencies
  - Examples such as Items 1(b), 1(c), 2, 3(a), 3(b), 4, 5(a), 6, 7 and 9(a) on Table 1
- UNR 50-389/87-25-03, Base plate and Anchor Bolt Calculation Problems
  - Examples such as the generic problems for the different safety factor and allowables used on Table 2. Particularly, the safety factor of 1.33 and 2 used by Bergen-Paterson
  - Support No. CC-2074-44, Unit 2 appeared to have double calculations existing
  - All the notes on Table 2
- UNR 50-389/87-25-04, Support not Found in Field
  - Support No. CW-3000B-187 could not be found in field as shown on Item 8 of Table 1
- UNR 50-335/87-26-03 and 50-389/87-25-05, Installation and Inspection Records Request for Pipe Supports
  - The document listed in paragraph 5(e) were requested for review or references

- IFI 50-335/87-26-04 and 50-389/87-25-06, Structural Members, Connections and Pipe Supports Maintenance

  - During the field walkdown in the intake structure area on Units 1 and 2, the inspector observed heavy rust on the structural beams, connections, anchor bolts, baseplate etc., due to the water leakage. The licensee should evaluate the significant of this condition.

In summary, Bergen-Paterson performed the large bore support calculations for Unit 2. Table 2, shows that five out of eight support calculations performed by Bergen-Paterson may have used a safety factor of 1.33 and 2 with no consideration of the prying forces. Therefore, before this Bulletin can be closed the licensee must evaluate all safety-related large bore support calculations performed by Bergen-Paterson.

No violations or deviations were identified.

CALCULATIONS REVIEWED FOR ANCHOR BOLTS
AND BASE PLATES WITH COMMENTS

Item No.	Mark No	Rev No.	Unit No.	Bolt Size (in)	Safety Factor Used	Allowables (lb)	Prying Forces Considered	Comments
1	BF-2-9	3	1	3/8	-	Ta=1190 Va=768	No	
				3/4	4	Ta=2900	No	
2	CS-678-157	2	1	1	4	Ta=2962	No	
				5/8	4	Ta=2500	Yes	
3	CS-2000-45	2	1	5/8				No tension on bolt
4	CS-2000-47	2	1	5/8	5	Ta=2457 Va=2713	No	
5	CSH-15	1	1	3/4				No tension on bolt
6	CW-64-51	1	1	5/8	15	Ta=361 Va=747	No	Note 1
7	CW-58-62	2	1	5/8	4	Ta=2080 Va=3054	No	
8	CW-53-72	1	1	5/8	4	Ta=2080 Va=3054	Yes	Note 2
9	CW-54-71	1	1	5/8	15	Ta=361 Va=747	No	Note 1
10	SIH-15	1	1	3/4	4	Ta=2900 Va-3700	No	
11*	BF-4001-190	2	2	5/8	2	Ta=5150 Va=4800	No	Note 3
12*	CC-2074-44	1	2	1/2	1.33	Ta=5325 Va=4500	No	Note 4
13*	CC-2074-7288	1	2	1	1.33	Ta=16350 Va=17700	No	Note 4
14*	CH-2081-14	1	2	1/2	2	Ta=3550 Va=3000	No	Note 5
15	C-1A-6-R4	3	2					Note 6

TABLE 2

CALCULATIONS REVIEWED FOR ANCHOR BOLTS
AND BASE PLATES WITH COMMENTS

Item No.	Mark No	Rev No.	Unit No.	Bolt Size (in)	Safety Factor Used	Allowables (lb)	Prying Forces Considered	Comments
16	C-1A-6-R27	2	2	3/4	15	Ta=773 Va=987	No	
17	C-RC-98-R9	2	2	3/4				Note 7
18	C-RC-98-R10	3	2	3/4	15	Ta=773 Va=987	No	
19	C-RC-99-R1	2	2	3/4				Note 7
20	C-RC-99-R9	2	2	3/4				Note 7
21	C-Rc-100-R1	2	2	3/4	15	Ta=773 Va=987	No	
22	C-RC-103-R1	3	2	1				Note 7
23	C-RC-103-R2	3	2	3/4				Note 7
24*	CS-2012-8015	2	2	1	2	Ta=18800 Va=17800	No	Note 8
25*	CW-3000B-187	3	2	3/4	4	Ta=2900 Va=3700	No	
26	C-SA-4-R1	1	2	3/4				Note 7
27	C-SA-4-R10	2	2	3/4				Note 7
28	FS-2137-143	0	2	3/4				No tension on bolt
29	FS-2138-17	7	2	3/4	15	Ta=773		
30	SI-2401-4003	2	2	3/4	4	Ta=2900 Va=3700		
31*	SPS-427	1	2	3/8	4	Ta=1150 Va=800	Yes	
32*	WM-2092-76	2	2	3/4	4	Ta=2900 Va=3700	No	

*These calculations were performed by Bergen-Paterson Pipe Support Corp.
The remaining of calculations were performed by Ebasco Sercices Inc.

Ta = Tension Allowable, Va = Shear Allowable

TABLE 2

CALCULATIONS REVIEWED FOR ANCHOR BOLTS AND BASE PLATES WITH COMMENTS

NOTES:

1. Calculation used one support load to qualify anchor bolts and base plate. Actually, two supports acted at same bolts and base plate.

2. Disposition of "use as is" for base plate warped with 1/8" to 1/4" gaps at all four anchor bolts was not adequate. Shim plates should be considered to be used.

3. a. Double anchor bolt spacing reduction factors should be used since existing spacings of 6.25" were less thatn the minimum requirement of 7.5".

$$\frac{6.25"}{7.50"} \times \frac{6.25"}{7.50"} = 0.694$$

   b. Using safety factor of two to qualify anchor bolts is not allowed. Requalification or modifications is required for anchor bolt safety factor between two and four.

4. a. This calc. was initiated on May 10, 1982 by Bergen-Paterson and the final revision was performed on August 3, 1983.

   b. Using safety factor of 1.33 to qualify anchor bolts is not allowed. For anchor bolt safety factor below 2, the immediate evaluation of the system operability is required.

5. Using safety factor of two to qualify anchor bolts is not allowed. Requalification or modification is required for anchor bolt safety factor between two and four.

6. This calculation was referred to calc. No. C-SA-4-R11 which was not attached or available for review.

7. Anchor bolts and base plate were qualified by comparison with the standard calculations for the various type of base plate and anchor bolts. The standard calculations were not available and will be reviewed later.

8. a. Same as note 3(b).

   b. Ta=18800 and Va=17800 are the ultimate allowables for 1-1/4" ϕ, not for 1" ϕ.