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ACCESSION NBR:8009300372 DOC.DATE: 80/09/19 NOTARIZED: NO DOCKET #
FACIL:50-335 St. Lucie Plant, Unit 1, Florida Power & Light Co. 05000335

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| O'REILLY,J.P. | Region 2, Atlanta, Office of the Director |

SUBJECT: Forwards response to IE Bulletin 79-14, "Seismic Analysis for As-Built Safety-Related Piping Sys."

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FLORIDA POWER & LIGHT COMPANY

September 19, 1980
L-80-310

Mr. James P. O'Reilly, 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 79-14

In response to the subject Bulletin, we have attached our final report. Our work on modifications, required as a result of this Bulletin, is continuing.

Very truly yours,

J. A. DeMastry
for
Robert E. Uhrig
Vice President
Advanced Systems & Technology

REU/PLP/md

Attachment

cc: Harold F. Reis, Esquire

✓ DIRECTOR, DIV. OF LICENSING

A037
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8009300372

FLORIDA POWER AND LIGHT COMPANY

ST. LUCIE UNIT NO. 1

NRC BULLETIN IE 79-14

FINAL REPORT

JUNE 27, 1980

8009300372

TABLE OF CONTENTS

I. INSPECTION PROCESS

Inspections of as-built piping systems for NRC Bulletin IE 79-14 began on August 6, 1979. The inspection included the verification of the as-built configuration of all seismically designed, safety related piping over two inch diameter and all computer dynamically analyzed, safety related piping two inch in diameter and smaller.

The inspection Procedure for Compliance with NRC Bulletin 79-14, Appendix A, was used for all inspection except for the containment spray lines in the reactor containment building. A different inspection method was necessitated by the fact that these lines penetrate the containment at Elevation 145.00' and proceed upwards circling around the spherical dome of the building to Elevation 219.00' The highest floor elevation in the containment building is at elevation 62.00'. The only access to this piping is a narrow stairway that leads to the top of the dome. Direct measurements from the stairway could only be made on less than 5% of the piping, therefore in order to get accurate piping measurements and restraint locations on this inaccessible piping, a licensed land surveyor was contracted to determine the locations of critical points which were determined through triangulation. The triangulation was established from two stations located on a circumferencial platform at Elevation 112.00' and optical measurements were made of the piping configuration and all support/restraint locations. A Mechanical-Nuclear designer located piping, supports and restraints and numbered these points for the surveyors' use in accordance with the inspection procedure presented in Appendix A. The support/restraint as-built configuration verification was accomplished by two support/restraint engineers working with high power binoculars from the circumferential platform at Elevation 112.00', the polar crane platform (approximate Elevation 123.00') and the stairway leading to the top of the dome.

The inspection of all piping systems included under the 79-14 program was completed on October 6, 1979.

II. VERIFICATION PROCEDURE

All deviations outside of tolerance specified in the inspection procedure were subjected to stress analysis review for compliance with NRC Bulletin 79-14 in accordance with Stress Analysis Review Procedure, Appendix B.

III. RESULTS OF INSPECTION

A total of 2295 restraints were inspected. Measurements were taken on all of the piping included in the 79-14 inspection. No significant piping discrepancies were identified. Any restraint or other discrepancies noted are covered under "Results of Verification" (Item IV). All of the restraints were inspected after removing the insulation with the exception of ninety-two (92) restraints in the reactor building that were inspected to the extent possible without removing insulation as allowed by Supplement 2 of Bulletin 79-14. A listing of the insulated restraints is included in Appendix C.

IV. RESULTS OF VERIFICATION

A total of 2295 restraints have been reviewed.

Various types of discrepancies were found during the course of the verification process that were evaluated or dispositioned by either the Site or the NYO Stress Analysis engineer. In some cases actual valve weights were found to be heavier than the weight used in the stress analysis. In some cases restraints were mislocated by a distance greater than the allowable deviation (± two pipe diameters). In a few

cases extra restraints or field hangers were found and also a few cases were found where a restraint was either not installed or temporarily removed. In all cases a detailed description of the discrepancy was given to the Stress Analysis department for analysis and disposition.

Less than five (5) percent of the restraints inspected had discrepancies that could not be resolved in a timely manner through analysis and were deemed non-conformances. They are listed in Appendix D. Documentation of inspection and verification has been compiled and will be stored on site.

Ebasco utilized a procedure to initially define the scope of inspection which incorporated the ability to assure that a stress calculation and isometric had been prepared for all piping defined as being seismically supported. The flow diagrams and stress isometrics were used to independently check each other. Upon final comparison it was found that all piping which had stress isometrics had been inspected (thus assuring the completeness of information contained on the flow diagrams and line list). It was also found, however, that three (3) areas shown as seismic Category I on the flow diagrams did not have correlating stress isometrics. Seismic analyses were performed and seismic restraints were designed for these lines.

Additionally, during the inspection of the Condensate Storage Tank overflow line, a two-inch line was found that was not shown on any drawings. It was ascertained that this piping was installed during the construction phase of St Lucie Unit #1 as a temporary aid in adding chemicals during plant startup and was never removed. It was determined that this line is no longer used and it was removed.

The PC/M's generated to address these four (4) areas are called out by a double asterisk (**) in Appendix D. A 79-14 type inspection will be performed as part of the as-building of the installation of these PC/M's.

FLORIDA POWER AND LIGHT COMPANY
ST. LUCIE UNIT NO. 1

NRC BULLETIN IE 79-14

FINAL REPORT

JUNE 27, 1980

APPENDIX A

INSPECTION PROCEDURE FOR COMPLIANCE
WITH NRC BULLETIN IE 79-14

EBASCO SERVICES INCORPORATED

ST. LUCIE UNIT NO 1

BACKFIT PROGRAM

# PROCEDURE 128-2.800

# NRC BULLETIN IE 79-14

# RESTRAINT AND PIPING INSPECTION

# FINAL REVIEW OF PACKAGES

# BFI 128-2

PREPARED BY: W. J. Pelphrey/F. Pagan

REVIEWED BY: J. E. Holwell 10/25/79

APPROVED BY: G. H. Krauss 10/25/79

APPROVED BY: T. A. Yarte

DATE: October 25, 1979

EBASCO SERVICES INCORPORATED
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE UNIT NO. 1

NRC BULLETIN IE 79-14
FINAL REVIEW OF PACKAGES

PROCEDURE 128-2.800

C O N T E N T S

EBASCO SERVICES INCORPORATED
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT NO. 1

NRC BULLETIN IE 79-14
FINAL REVIEW OF PACKAGES
PROCEDURE 128-2.800

1.0 PURPOSE

.1 Provide a comprehensive review of all design verification information gathered during field inspections performed to "Inspection Procedure for Compliance with NRC Bulletin 79-14" - Attachment 4.1.

.2 Insure completeness of inspection packages.

.3 Verify inspection of all safety related large bore and qualifying small bore Seismic Class I piping as dictated by Stress Analysis (NYO).

.4 Assemble data into packages suitable for long term storage and easy retrievability.

.5 Provide a systematic basis for updating design drawings as required.

2.0 SCOPE

Isometric drawings, valve drawings, sketches and restraint details pertaining to all large bore and selected small bore seismic piping as defined by drawings ECS 128-2.301 through .325, R0 and memo BF 128-2.111, together with their respective checklists, orientation sheets and penetration sketches.

3.0 PROCEDURES

.1 Collate packages by isometric or sketch number.

.2 Compare with isometric list to insure that packages have been received from all inspection areas.

.3.1 Check each package for completeness. Each package should contain, as applicable, the following documents:

i. piping configuration checklist
ii. valve checklist and valve orientation sheets
iii. wall or floor penetration sheets

3.3.1 (continued)
iv. support/restraint checklists

Reference Attachment 4.4, "Procedure for Assembling Inspection Packages"

.3.2 Check all signatures and dates on checklists:

Piping checklist - Mechanical Designer + Restraint Engineer
Valve checklist - Mechanical Designer + Restraint Engineer
Restraint checklist - Restraint Designer + Restraint Engineer
Isometric drawings - Mechanical Designer

.4 Make a new copy of isometric drawing for permanent master copy, and clearly label as such (in RED).

.5.1 Highlight (YELLOW for "A" system; GREEN for "B" system) on master copy, valves and restraints from original inspection copies. (Both in the tabulation and on the body of each isometric).

.5.2 Highlight (YELLOW for "A" system; GREEN for "B" system) extent of each package (each area) on master copy. Mark on the master copy (in BLACK) each inspection area limits (as outlined in Attachment 4.2). Also mark (in RED) any discrepancies found during the inspection.

.6 Fold all drawings to 8 1/2" X 11" to fit into a folder marked for that isometric.

.7 Fill out master copy checklist (Attachment 4.5). One checklist shall be prepared for each master isometric.

.8 Itemize discrepancies as noted on checklists. For each isometric use a separate Discrepancy List - Attachment 4.3.

.9 After package is complete and master copy checklist is filled in, sign and date checklist.

.10 Attach master copy of isometric or sketch and list of discrepancies to checklist.

.11 File master documents and original inspection packages by isometric number for permanent retention.

4.0 ATTACHMENTS

.1 Inspection Procedure for Compliance with NRC Bulletin 79-14

.2 Inspection Areas (4 sheets)

.3 Discrepancy List

.4 Procedure for Assembling Inspection Packages

.5 Master Copy Checklist

.6 Signature List

ATTACHMENT 4.1

EBASCO SERVICES INCORPORATED

ST. LUCIE UNIT NO. 1

BACKFIT PROGRAM

PROCEDURE 128-2.800

NRC BULLETIN IE 79-14

RESTRAINT AND PIPING INSPECTION

FINAL REVIEW OF PACKAGES

INSPECTION PROCEDURE
FOR
COMPLIANCE WITH NRC BULLETIN 79-14

EBASCO SERVICES INCORPORATED
ST. LUCIE UNIT NO. 1

INSPECTION PROCEDURE FOR COMPLIANCE
WITH NRC BULLETIN 79-14

## 1.0 SCOPE

The intent of this procedure is as follows:

.1 Provide a procedural approach to be used to verify that the seismic analysis of record applies to the actual configuration of safety related piping systems.

.2 To meet the requirements as outlined in the NRC Bulletin 79-14 with regard to field inspection (subject to change pending subsequent NRC amendments)

.3 To provide sufficient details and instruction to allow qualified Mechanical Nuclear and Stress Analysis Engineers/Designers to perform inspection and field evaluation of 1) pipe run geometry and clearances; 2) support and restraint design, locations, functions, clearances and embedments; and 3) valve and valve operator locations and weights.

.4 For purposes of this inspection, the only deviations from original design which will be considered non-conforming items are those generally covered in Plant Procedure AP-0010721 and NU Reg 0161 and requiring a Licensee Event Report.

## 2.0 REFERENCES

.1 NRC Bulletin 79-14 dated July 2, 1979

## 3.0 ATTACHMENTS

.1 Piping Configuration Checklist
.2 Support/Restraint Checklist
.3 Valve Checklist
.4 Pipe Clearance Recording Form
.5 Valve Orientation Form

## 4.0 PREREQUISITES

.1 Field inspection is to be accomplished on a system basis by working from anchor point to anchor point. Therefore, segregrate the support/restraint drawings for each system into inspection packages to accompany the piping isometric drawings which show inspection end points; e.g., from pump discharge to heat exchanger inlet. All drawings comprising the inspection package will be verified as the latest applicable drawing, revision and date.

4.2 Organize the inspection personnel into two-man teams with the teams reporting to a central co-ordinator who in turn will provide support services as required, such as Health Physics, scaffolding, ladders, etc. The inspection teams will report inspection results via the central co-ordinator to the Site Restraint/Stress Analysis Engineer for use in documenting the result of the inspections in co-ordination with the New York office.

.3 A site Stress Analysis Engineer will be available for coverage to address questions/problems which arise during the inspection and provide follow-up action with the New York office.

.4 Provide the inspection teams with adequate supplies of the following items:

1. Measuring tapes, i.e., 8 to 12 foot and 50 foot lengths. Also folding carpenter rules.
2. Clipboards
3. Flashlights
4. Safety Belt Harnesses
5. Plumb bobs
6. Angle measuring devices (e.g., protractors)
7. Portable work tables, such as card tables for reporting data in work areas.
8. Radio communications or clear channel on PA system.
9. Gloves
10. Reduced size General Arrangement and P&ID drawings for each team.
11. Tool storage boxes (as required).
12. Weld gages
13. Approved markers for Class I & Class II systems

## 5.0 PRECAUTIONS

.1 Personnel safety consideration shall be observed at all times. Inspection teams shall be cognizant of the plant operating status; i.e., operating temperatures of lines being inspected and area radiation levels. Also, since considerable climbing is involved, proper judgement of safe conditions is essential.

.2 Since during part of the inspection the plant will be in Mode 1,2 or 3, care should be exercised to avoid inadvertant tripping of the unit by upsetting instruments, equipment or piping systems.

.3 Health Physics shall advise the co-ordinators of daily radiation exposure of all inspection teams. If required, personnel will be rotated to levelize exposures. Under no circumstances are the FPL exposure limits to be exceeded.

## 6.0 FIELD INSPECTION PROCEDURE

.1 General

The inspection process includes: 1) verification of pipe run geometry and clearances; and 2) verification of support and restraint design, location, functions, clearances and embedments; and 3) valve and valve operator locations and weights. These drawings are to be turned over to the Site Restraint/Stress Analysis Engineer for further evaluation. Any discrepencies will be reported by the Site Restraint/Stress Analysis Engineer. The method of recording field measurements and notes will be marking-up, in red ink, the copies of piping isometrics and support detail drawings in the inspection package. Mark-ups will be initialled and dated by the inspector.

The measurement inaccuracy of dimensional values will vary due to line sizes, accessibility, thermal insulation, curvatures of lines and resolution of the measuring device. The inspection teams will include with dimensional data their best estimate of possible measurement inaccuracy (e.g., 50'-6 ± 4"). All measurements will be ± 1/2" unless noted. R1

.2 Pipe Run Geometry

The purpose of verifying the pipe run geometry is to ensure that the installed pipe and support/restraint location and pipe clearances are in compliance with stress analyses. Measurements of piping configuration will be made as follows:

a) Measurements will start at equipment anchor points; e.g., nozzle welds, penetrations, etc.

6.2 b) Measurements along pipe will be between elbow welds, centerline of tees, centerline of supports, centerline of valve, termination weld points, etc.

c) Inspectors will record the operating condition of each line, i.e., hot or cold (information supplied by FPL operating staff through coordinator) for all lines where clearances are in question. R

d) Measurements will be recorded accurately and clearly on the inspection package piping isometric, including estimated measurement inaccuracies.

Measurements of piping clearances will be made as follows:

a) Measure and record clearance on all four sides of pipe at floor/ wall penetrations. See pipe clearance recording form.

.3 Seismic Supports and Restraints Evaluation

The seismic support and restraint evaluation will verify that the installed support/restraint devices are in the design configuration, correct locations and the function agrees with the stress analysis. The support/restraint detailed engineering evaluation will be implemented as follows:

a) Verify the design general configuration by visual comparison of applicable detailed drawings vs as-built installation. Embedments included in Bulletin IE 79-02 will not be included in this inspection.

b) Verify all clearances are in conformance with the detailed drawing by physical measurement noting measurement inaccuracy.

c) Verify clearance from foreign interference in the "FREE" direction of pipe movement, considering thermal expansion, by visual inspection.

d) Verify function is in conformance with the design drawing by visual inspection. Insulation will be removed on three-way restraints as necessary for verification. Nameplate data of snubbers will be recorded when inspected.

e) Measurement of support/restraint locations will be made with respect to pipe run geometry. Location will be verified by the site Restraint/Stress Analysis Engineer by comparison of the stress isometric with field measurement data.

6.3 f) Any deviation from the detailed design drawing will be recorded accurately on the drawing and initialled and dated by the inspector(s). Deviations will then be evaluated by the Restraint/Stress Analysis Engineer to determine support/restraint adequacy.

g) Each support/restraint device will be physically marked with its identification number when it is inspected.

.4 Valve and Valve Operator Weights and Location

The weight for each valve and valve operator will be extracted from the respective vendor supplied information. Thus, the field inspection effort will be one of recording each valve and valve operator nameplate data and recording the physical orientation of the valve and operator with respect to the pipe centerline axis. Record this orientation data on the piping isometrics used for piping geometry unless clarity is compromised.

Valve location measurements are made with respect to pipe run geometry. Location shall be verified by the Site Restraint/Stress Analysis Engineer by comparison of the stress isometric with field measurement data.

.5 Recording/Reporting Inspection Results

After concluding the field inspection of each piping package, the cognizant inspection team will verify that a support/restraint inspection form is completed for each device. The inspection team will also verify that at least one set of initials and date of inspection appear on each document comprising the inspection package, including the inspection forms and additional notes.

The inspection package will be forwarded via the central co-ordinator to the Site Restraint/Stress Analysis Engineer for use in documenting the results of the inspection in a coordinated effort with the New York Restraint/Stress Analysis office. All reportable non-conforming items will be from the New York Stress Analysis engineers in conjunctior with the central co-ordinator to the Plant Manager and/or his designee.

The inspection data will be analyzed and the final report issued by the New York Restraint/Stress Analysis office to Florida Power and Light Company.

# EBASCO SERVICES INCORPORATED

NEW YORK

BY______ DATE______ SHEET 1 OF 2

CHKD. BY______ DATE______ OFS NO.______ DEPT. NO.______

CLIENT FLORIDA POWER & LIGHT COMPANY

PROJECT ST. LUCIE PLANT - UNIT #1

SUBJECT NRC BULLETIN 79-14 CHECKLIST

## PIPING CONFIGURATION

Isometric Drawing No. ______ REv. No. ______

Area Number ______

A. FIELD INSPECTION

1. Does the general piping configuration match the drawings:
   a) Pipe dimensions?
   b) Restraint location?
   c) Valve location?
   d) Valve orientation? (Note on dwg)

REMARKS:

2. If the piping does not meet the drawing dimensions have the drawings been properly marked to show the differences?

REMARKS:

B. STRESS-RESTRAINT ENGINEER EVALUATION

1. If differences between the piping configuration and drawings exist, does the magnitude of these differences affect the seismic analysis? (Greater than 6" or 2 pipe diameters).

REMARKS:

FORM 541 REV 7-71

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SUBJECT NRC BULLETIN 79-14 CHECKLIST

PIPING CONFIGURATION

B. 2. Will physical support/restraint changes be required?

REMARKS:

FORM 881 REV 7-71

EBASCO SERVICES INCORPORATED

NEW YORK

BY________ DATE________ SHEET 1 OF 2

CHKD. BY________ DATE________ OFS NO.________ DEPT. NO.________

CLIENT FLORIDA POWER & LIGHT COMPANY

PROJECT ST. LUCIE PLANT - UNIT #1

SUBJECT NRC BULLETIN 79-14 CHECKLIST

## SUPPORTS/RESTRAINTS

Isometric Drawing No.________ Rev. No.________

Area Number________

Support/Restraint Number________

Support/Restraint Drawing No.________ Rev. No.________

A. FIELD INSPECTION:

1. Does the installed support/restraint match the restraint drawing? For spring cans; is the indicator on scale? Are the pins pulled?

   REMARKS:

2. Is the support/restraint number correct or has the correct number been marked on the support/restraint?

   REMARKS:

3. If the support/restraint does not match the support/restraint drawing has the drawing been marked to show the differences?

   REMARKS:

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PROJECT ________

SUBJECT NRC BULLETIN 79-14 CHECKLIST

## SUPPORTS/RESTRAINTS

B. STRESS-RESTRAINT ENGINEER EVALUATION

1. If differences between the support/restraint and the support/restraint drawing exist does the magnitude of these difference affect the seismic analysis?

REMARKS:

2. Will physical support/restraint changes be required?

REMARKS:

FORM 981 REV 7-71

EBASCO SERVICES INCORPORATED

NEW YORK

BY ________ DATE ________ SHEET 1 OF 2

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CLIENT FLORIDA POWER & LIGHT COMPANY

PROJECT ST. LUCIE PLANT - UNIT #1

SUBJECT NRC BULLETIN 79-14 CHECKLIST

VALVES

Isometric Drawing No. ________ Rev. No. ________

Area Number ________

Valve Number ________

Emdrac Drawing No. ________ Rev. No. ________

A. FIELD INSPECTION

1. Does the installed valve match the valve drawing?

REMARKS:

2. Is the valve number correct, or has the correct number been physically marked on the valve?

REMARKS:

3. Has valve operator and orientation been noted?

REMARKS:

B. STRESS-RESTRAINT ENGINEER EVALUATION

1. If the valve location is not correct have the drawings been properly marked to show the new location?

REMARKS:

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NEW YORK

BY________ DATE________ SHEET 2 OF 2

CHKD. BY________ DATE________ OFS NO.________ DEPT. NO.________

CLIENT________

PROJECT________

SUBJECT NRC BULLETIN 79-14 CHECKLIST

## VALVES

B. 2. Is the difference in location large enough to affect the seismic analysis?

REMARKS:

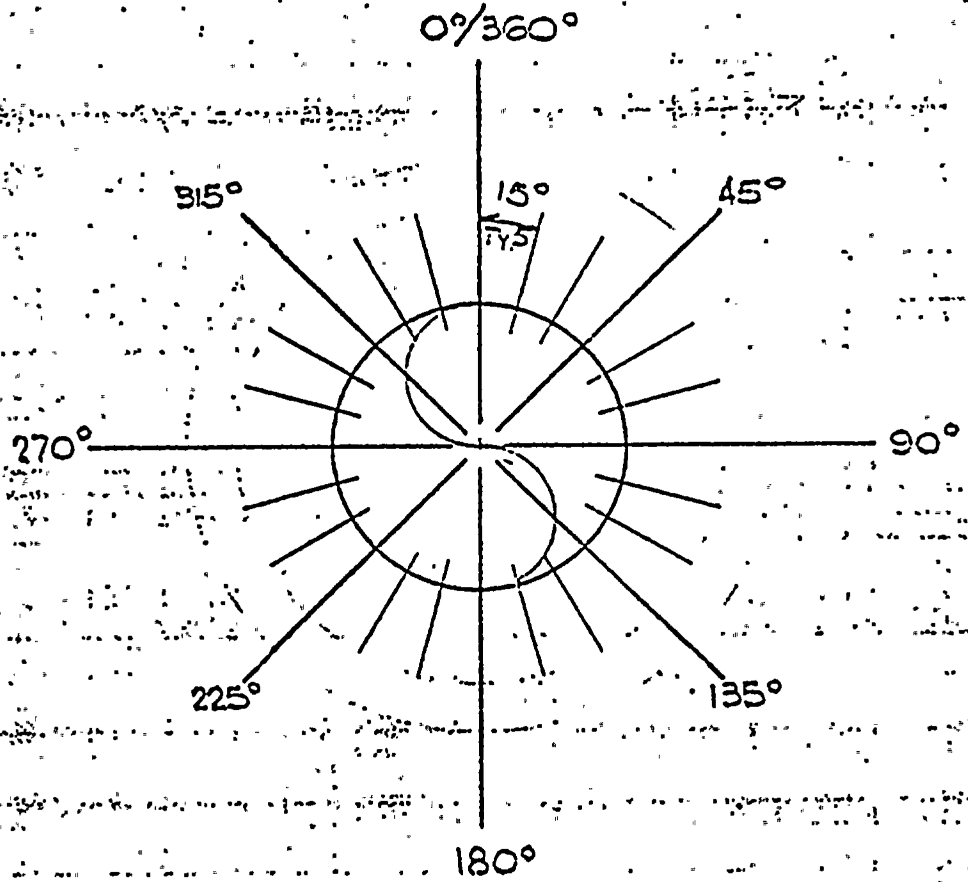
3. Will physical valve relocation be required?

REMARKS:

FORM 561 REV 7-71

SYSTEM ______________
LINE Nº ______________
VALVE Nº ______________

N
(FOR PLAN VIEWS ONLY)




VALVE ORIENTATION
VIEW LOOKING ______________

VALVE ORIENTATION FORM

## INSTRUCTIONS & GUIDELINES
## FOR
## GENERAL INSPECTION TEAM

ASSIGNMENT:

In the RAB the coordinator will assign teams to specific areas to measure all piping in that area. In general, the assigned team will have total responsibility for that area, i.e., day shift teams will not work in night shift teams areas.

In the RCB teams will be assigned by lines and will walk their assigned lines to completion.

MEASUREMENT:

For accuracy all measurements should be made from weld to weld and noted as such on the drawings. On insulated lines the center line dimensions must be used. Estimated measurement inaccuracies will differ in each case. There are three types of "elbows" used; short radius (CL to weld 1XØ), long radius elbows (CL to weld 1.5 X Ø) and bends or sweeps (CL to weld magnitude 4-6Ø). Elbow types must be kept in mind when converting "weld" dimensions to centerline dimensions.

Complete daily measurements to an anchor point or to finish the teams portion of an isometric to aid stress analysis in completing their segment of the work.

Where measurement is done area by area system priorities will be given to insure the timely completion of entire systems to aid stress analysis.

WHIP RESTRAINTS:

Whip restraints are not shown on the piping isometrics used in the inspections. In general, whip restraints are heavy structures completely encircling the pipe with a band of steel. Whip restraints do not touch the pipe in any way. In some cases seismic restraints may be installed inside a whip restraint and should be treated as seismic restraints only.

For whip restraints the only verification required is that the restraint does not contact the pipe (visual inspection only).

SPRING SUPPORTS:

Verification of spring supports will include location, size (from nameplate), a visual inspection as to orientation, damage and a check to see that the indicator is on scale and that the temporary installation pins have been removed.

VALVES:

Valve inspection will include the comparison of the physical valve with the drawings in the inspection package and the following specific checks:

Valve number
Weight (if on nameplate)/Nameplate Data
Orientation
Operator Type and Location
Mark the valve number on the valve

SEISMIC SUPPORTS/RESTRAINTS:

Seismic support/restraint inspection will include the comparison of the installed support/restraint with the drawings in the inspection package. Mark the support/restraint number on the restraint.

INSPECTION PACKAGES:

All inspection packages (whether sorted by area or line) will contain all of the drawings, checklists and forms necessary to complete the inspection.

Care should be taken to try to avoid contaminating any of the documents in the package. Radioactively contaminated documents will have to be copied on a "clean" original in an area specified by Health Physics.

DESIGN DISCREPANCIES:

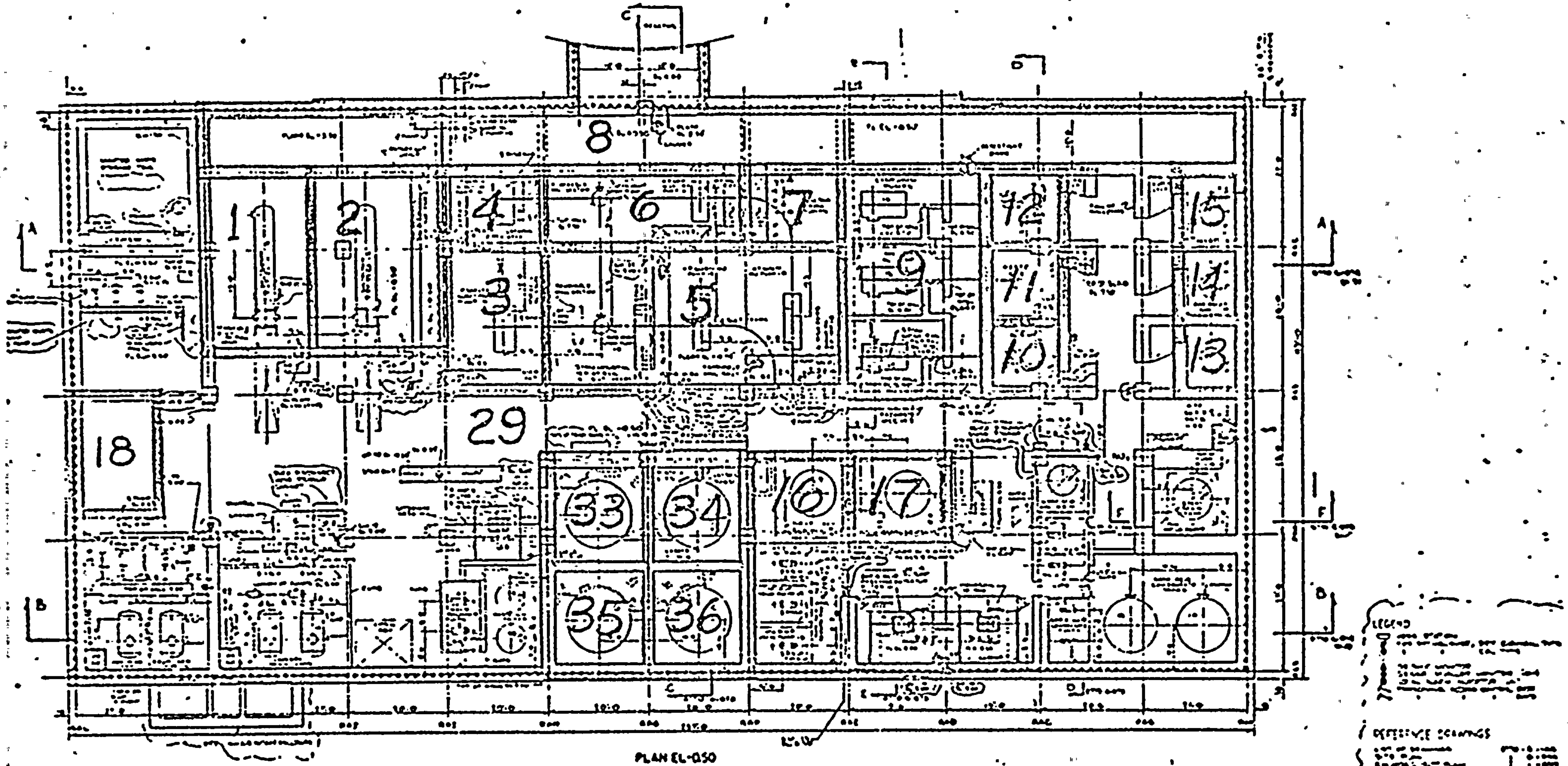
The final determination of any design discrepancies will be made by the restraint/stress analysis engineer after calculations are made or reviewed to identify any discrepancies. Any request for a team to re-enter a completed area for additional verification/inspection will be made through the coordinator.

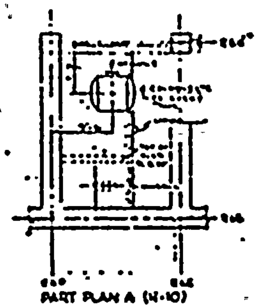
ATTACHMENT 4.2

EBASCO SERVICES INCORPORATED
ST. LUCIE UNIT NO. 1
BACKFIT PROGRAM

PROCEDURE 128-2.800
NRC BULLETIN IE 79-14
RESTRAINT AND PIPING INSPECTION
FINAL REVIEW OF PACKAGES

INSPECTION AREAS




OTHER AREAS

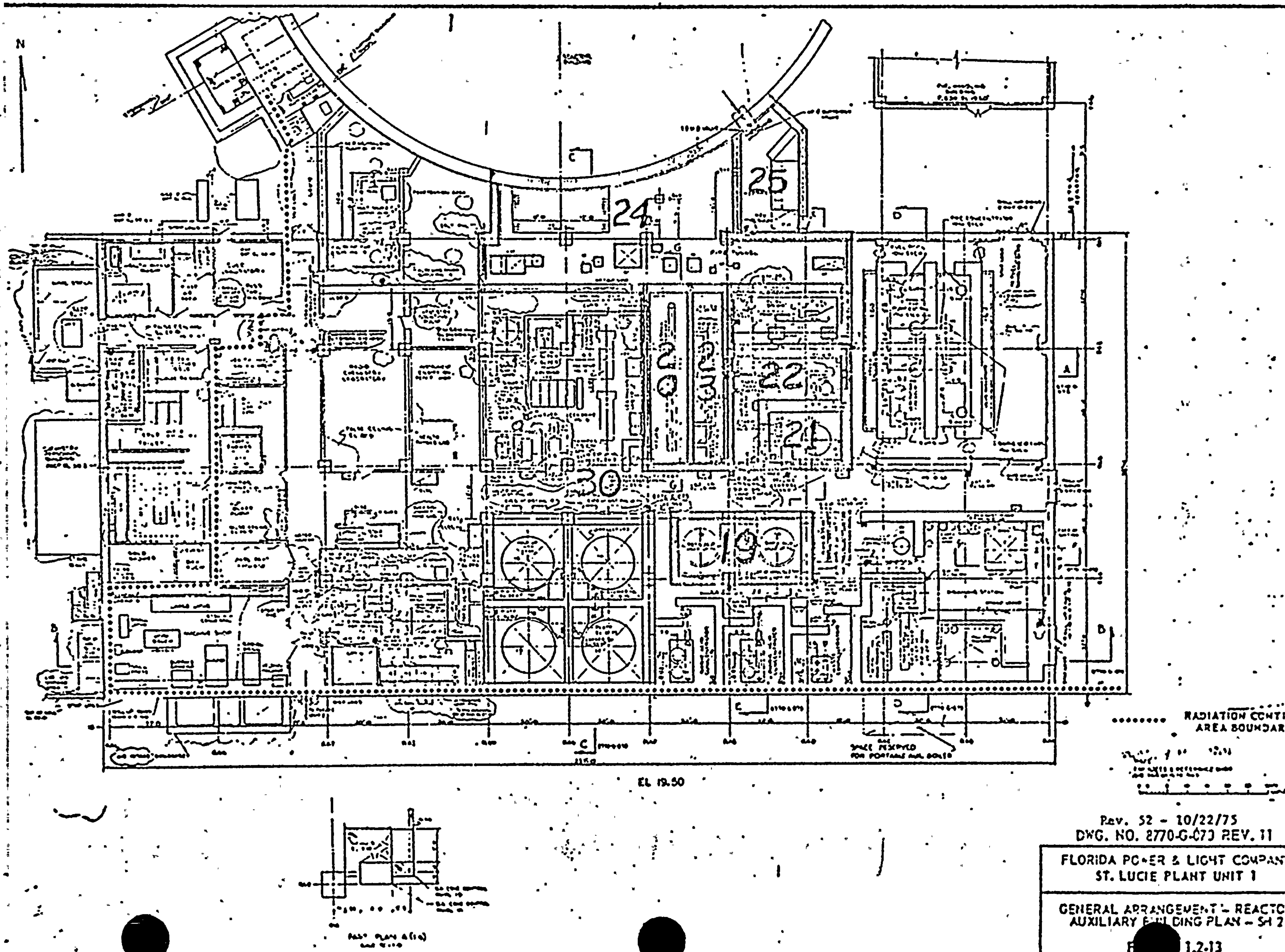
ANN - ANNULUS
CCA - COMPONENT COOL AREA
CST - CNDS STG TANK
DGB - DIESEL GEN BLDG & TANK
IS - INTAKE STRUCTURE
MST - STM TRESTLE
RAB - REACTOR AUX BLDG
RCB - REACTOR BLDG
RWT - REFUELING WTR TK
TGB - TURBINE GENERATOR BLDG

•••••••• RADIATION CONTROL AREA BOUNDARY

Rev. 52 - 10/22/75
DWG. NO. 8770-G-069 REV. 10

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1

GENERAL ARRANGEMENT - REACTOR AUXILIARY BUILDING PLAN - SH. 2
FIG ... 2-12




Rev. 52 - 10/22/75
DWG. NO. 2770-G-073 REV. 11

FLORIDA POWER & LIGHT COMPAN
ST. LUCIE PLANT UNIT 1

GENERAL ARRANGEMENT - REACTO
AUXILIARY BUILDING PLAN - SH 2

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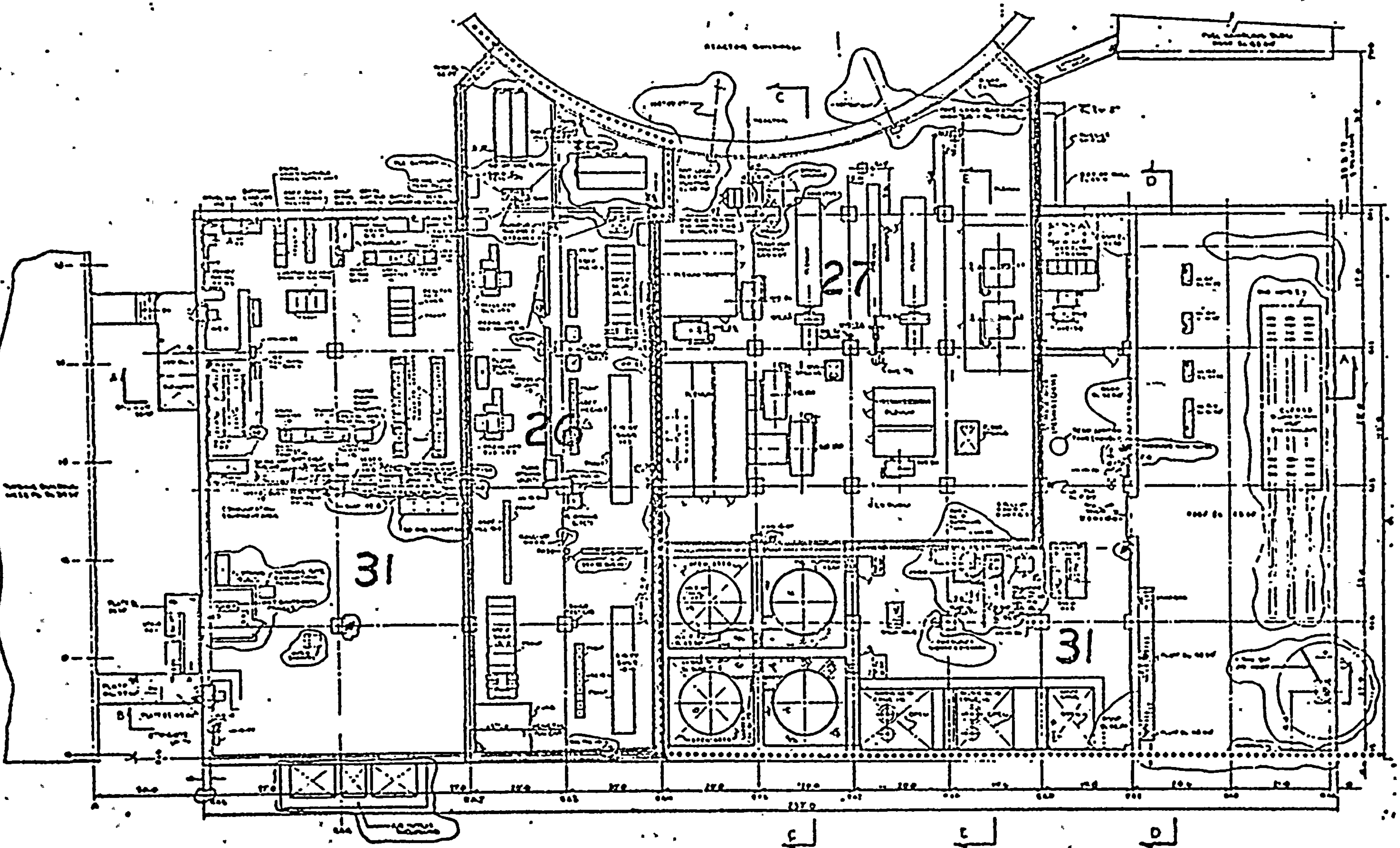



PLAN EL 43.00'

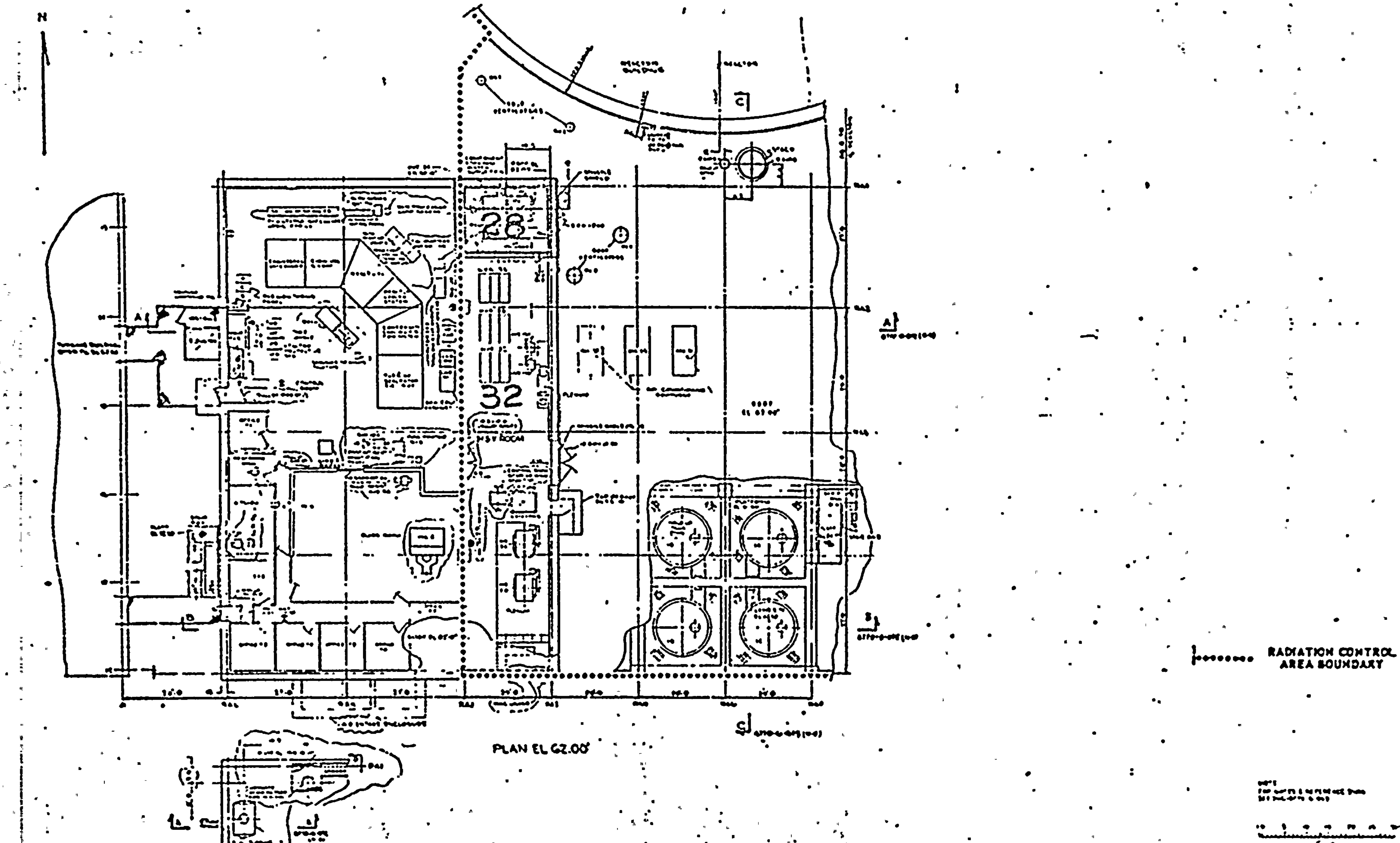
•••••••• RADIATION CONTROL AREA BOUNDARY

Rev. 52 - 10/22/75

DWG. NO. 8770-G-071 REV. 7

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1

GENERAL ARRANGEMENT
REACTOR AU[illegible]ARY BUILDING
PLA[illegible]EET 3
FI[illegible].2-14




Rev. 52 - 10/22/75

DWG. NO. 8770-G-076 REV. 6

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1

GENERAL ARRANGEMENT
REACTOR AUXILIARY BUILDING
MISCELLANEOUS [illegible] AND SECTIONS

FIG[illegible]2-17

EBASCO SERVICES INCORPORATED
ST. LUCIE UNIT NO. 1
BACKFIT PROGRAM

PROCEDURE 128-2.800
NRC BULLETIN IE 79-14
RESTRAINT AND PIPING INSPECTION
FINAL REVIEW OF PACKAGES

# DISCREPANCY LIST

# DESCREPANCIES

BF SHAW 150 ______________ REV. ______

| PROBLEM | RESOLUTION |
|---|---|
| | |

ATTACHMENT 4.4

EBASCO SERVICES INCORPORATED
ST. LUCIE UNIT NO. 1
BACKFIT PROGRAM

PROCEDURE 128-2.800
NRC BULLETIN IE 79-14
RESTRAINT AND PIPING INSPECTION
FINAL REVIEW OF PACKAGES

# PROCEDURE FOR ASSEMBLING INSPECTION PACKAGES

# PROCEDURE FOR ASSEMBLING INSPECTION PACKAGES

1. Get one copy of each isometric for each train and each area affected by that isometric.

2. At right margin, note whether isometric is for "A" train or "B" train and which area, e.g. RAB-1, "A".

3. Highlight only that piping that passes through the affected area. Use yellow for "A" and green for "B".

4. Show dimension lines in red as common to all piping isometrics. Locate all hangers, restraints, small and large bore taps, etc. Do not include temperature test points. Dimension to centerline of valves.

5. Highlight valve numbers and restraint numbers in tabulation.

6. Obtain valve operational numbers from P & ID and show at each valve on isometric.

7. Order copies of restraint drawings as required. Write the isometric number in the right hand margin of the print.

8. Obtain copies of all valve drawings, one copy for each valve. Write the valve operational number and the isometric number on each copy.

9. Attach valve and restraint drawings to their respective isometric.

10. Isometrics, with restraint and valve drawings attached, will then be grouped by area into inspection packages. Packages will include all isometrics from all systems passing through that area.

ATTACHMENT 4.5

EBASCO SERVICES INCORPORATED
ST. LUCIE UNIT NO. 1
BACKFIT PROGRAM

PROCEDURE 128-2.800
NRC BULLETIN IE 79-14
RESTRAINT AND PIPING INSPECTION
FINAL REVIEW OF PACKAGES

MASTER COPY CHECKLIST

# EBASCO SERVICES INCORPORATED

NEW YORK

BY________ DATE ________ SHEET ____ OF ____

CHKD. BY________ DATE ________ OFS NO. 5822.205 DEPT. NO. 530

CLIENT Florida Power and Light

PROJECT St Lucie - Unit No. 1

SUBJECT BFI 128-2: Restraint Inspection Program - NRC Bulletin 79-14

ATTACHED IS THE FOLLOWING PACKAGE:

BF SHAW ISOMETRIC: _____ REV _____

AREAS: ________________

INCLUDED ARE THE FOLLOWING ____ RESTRAINT DETAILS:

| DWG # | REV | DWG # | REV | DWG # | REV | DWG # | REV |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

ALSO INCLUDED ARE THE FOLLOWING ____ VALVE DETAILS:

| | | | | |
|---|---|---|---|---|
| | | | | |

REVIEW BY STRESS ANALYSIS HAS BEEN COMPETED WITH ____ COMMENTS

ATTACHMENT 4.6

EBASCO SERVICES INCORPORATED
ST. LUCIE UNIT NO. 1
BACKFIT PROGRAM

PROCEDURE 128-2.800
NRC BULLETIN IE 79-14
RESTRAINT AND PIPING INSPECTION
FINAL REVIEW OF PACKAGES

SIGNATURE LIST

SIGNATURE LIST

| NAME | SIGNATURE | INITIALS |
|---|---|---|
| J. E. Holwell | John E Holwell | JEH |
| M. Dries | Michael J. Dries | M.J.D. |
| F. Pagan | Frank Pagan | F.P. |
| H. Schelmety | Harry Schelmety | H |
| J. Karlik | Joseph Karlik | [illegible] |
| M. Correia | Malcolm Correia | MC |
| W. Campbell | W.H. Campbell | WC |
| P. Kazawic | Peter Kazawic | [illegible] |
| E. Johnson | Eugene W Johnson | EJ |
| E. Hafkin | Emmanuel Hafkin | EH |
| R. Martin | R Martin | [illegible] |
| R. Christiansen | R Christiansen | RC |
| S. Dixon | Steven A. Dixon | SD |
| N. Shabaan | [illegible] | [illegible] |
| S. Lal | Shiv Lal | SL |
| F. Arizzi | F. ARIZZI | F.A. |
| G. Krishnan | G Krishnan | GK. (GK) |
| R. Maxwell | Robert J Maxwell | RJM |
| J. W. Moreland | J W Moreland | JM |
| G. H. Krauss | George H. Krauss | [illegible] |
| L. Ladoski | Larry Ladoski | LL |
| R. Barr | Ronald Barr R. Barr | RLB RB |
| T. Curcio | Tom Curcio | CURCIO Cu |
| G. Reddish | George H. Reddish | GHR. |
| J. Somerszaul | John Somerszaul | [illegible] |
| A. Watlet | A Watlet | AW |
| R. Walter | Robert J Walter | RJW |
| W. J. Pelphrey | William J Pelphrey | WJP |

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE UNIT NO. 1

NRC BULLETIN IE 79-14

FINAL REPORT

June 27, 1980

APPENDIX B

STRESS ANALYSIS REVIEW PROCEDURE FOR
COMPLIANCE WITH NRC BULLETIN IE 79-14

EBASCO SERVICES INCORPORATED

FP&L ST. LUCIE PLANT - UNIT #1

STRESS ANALYSIS REVIEW PROCEDURE

FOR COMPLIANCE WITH NRC

BULLETIN 79-14

Prepared By W. FAN / G. Eng Dated 10/26/79

Approved By [signature] Dated 10/26/79

# STRESS ANALYSIS REVIEW PROCEDURE FOR COMPLIANCE WITH NRC BULLETIN 79-14

## 1.0 PURPOSE AND SCOPE

The intent of this procedure is as follows:

.1 Provide a procedural approach to be used to verify that the seismic analysis input information conforms to the actual configuration of safety-related piping systems in accordance with the requirements of IE Bulletin 79-14.

.2 To evaluate any deviation which are found between design and installation.

## 2.0 REVIEW PROCEDURE

### .1 General

The stress analysis review process includes:

1) Assembly of all the related design documents.
2) Examination of analysis and design records and preparation of an input information list.
3) Evaluation of deviations or discrepancies between design and installation.
4) Reanalysis and redesign of those piping support systems with any significant non-conforming findings. This information is to be compiled and recorded in a final list of design documents for submittance to NRC.

### .2 Documentation Assembly

All the stress analysis related documents are to be assembled and properly filed for ready reference. An index of current stress analysis isometric drawings and calculations is to be prepared. Preparation of the required document list will be carried out as follows:

(1) The list of current stress analysis isometric drawings and calculations shall include revision number, date and system identification. A sample of the list is attached as Form A-1. All the data shall be compiled from the Stress Analysis isometric drawings and the corresponding computer printout sheets.

.2 Documentation Assembly (cont'd)

(2) The seismic Category I systems are to be identified on the isometric drawings according to Regulatory Guide 1.29 "Seismic Design Classification" Revision 1 dated August 1, 1973 or as designated in the applicable FSAR.

(3) A preliminary list of Design Documents will be prepared for Stress Analysis which includes title, identification number, revision, date and seismic analysis information which is contained in each document (a sample form is attached as Form A-2). This list may include but will not be limited to the following documents.

a) Line List
b) Piping layout drawings
c) Valve list
d) Valve drawings (or manufacturer category)
e) As-built piping isometrics
f) As-built support/restraint detail drawings

.3 Examination of Analysis and Design Record

All information used in the latest seismic analyses of piping systems will be examined and checked as follows:

(1) Examine whether the calculation input information is consistent with stress isometric drawings.

(2) Investigate whether the latest revision of design documents such as line lists, backfit or revision programs, will have any effect on the concerned system.

(3) Prepare and complete a checklist which contain the essential items related to the seismic analysis of piping system. The list will be used to satisfy Item 1 of NRC IE Bulletin 79-14.

.4 Evaluation of Deviation in Designed Installation

The field inspection results are to be recorded on the As-built piping isometric drawing by the field team and then evaluated by the responsible stress analysis engineer. The evaluation process to be followed are as follows:

(1) The As-built piping isometric drawings may be in the form of sketches, marked-up stress isometrics or piping isometrics. The identification, location of restraints/supports and valves as well as the direction of restraints shall be clearly indicated. All the piping dimensions shown on these drawings unless they are specifically marked-up otherwise will be considered to have been verified during inspection.

.4 Evaluation of Deviation in Designed Installation (cont'd)

(2) All the piping isometric drawings which are adopted in the inspection package shall be marked for the use of this program. The markings on these piping isometric drawings are to be endorsed by a responsible site engineer. The marked-up piping isometric are considered to be the As-built isometrics.

(3) The As-built isometrics are converted from piping isometrics instead of stress analysis isometrics. Therefore a comparison of stress analysis and As-built isometrics is conducted at the job site by Pipe Support and Stress Analysis engineers..

(4) All discrepancies discovered in the above comparison effort are compiled in the stress analysis field review list (Form A-3) along with those found and reported by the inspection team. Recommendation on the disposition of each discrepancy will be made by the Stress Analysis engineer at the site. Any unresolvable discrepancies shall be channeled to Stress Analysis Group at New York Office for further evaluation.

.5 Revision of Stress Analysis

(1) If the discrepancy found in the evaluation process is considered to be significant by the sound judgement of a responsible stress analyst in concurrence with project lead stress analysis engineer, the related stress analysis will be reanalyzed. Upon the completion of the reanalysis, a Stress Analysis Revision Check list (Form A-6) which records the changes made to the previous analysis is to be completed.

(2) Unless they are specifically verified by a responsible discipline engineer to be different, all the stress and design criteria on which the previous analyses were based will be adopted for the revision of the related stress analyses.

(3) The result of stress evaluation by New York stress group are to be compiled and recorded on the Stress Analysis Review List (Form A-7). This list which contains the recommendations and dispositions of each discrepancy will be issued to site stress analysis engineer to be implemented at the site.

(4) If restraint modifications are required, a visual check of the restraints/support location by the field team will be requested before the analysis is finalized. A Restraint Verification List (Form A-8) is to be prepared by Stress Analysis Group and issued to the Support and Restraint Group for items relating to the validity of restraint design in concern.

(5) All the discrepancies will be considered to have been resolved when either positive verifications or necessary design modifications are completed by the Support/Restraint Group.

BY ______ DATE ______ NEW YORK SHEET ____ OF ____

CHKD. BY ______ DATE ______ FORM A-1 OFS NO. ______ DEPT. NO. 600

CLIENT ______

PROJECT ______

SUBJECT LIST OF ISSUED STRESS ANALYSIS ISOMETRICS & CALCULATIONS

| CALC | REV | SYS | STRESS ISO | REV | REMARKS | | CALC | REV | SYS | STRESS ISO | REV | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |

FORM 581 REV 7-71

FORM 861 REV 7-71

SUBJECT: LIST OF DESIGN DOCUMENTS FOR STRESS ANALYSIS

PROJECT ______

CLIENT ______

CHKD. BY ______ DATE ______

OFS NO. ______ NO. ______

SYSTEM ______ CALC# ______ SA ISO# ______ DATE ______

SAFETY CLASS ______ REV ______ REV ______

DATED ______

| DESIGN DOCUMENTS | | | | SEISMIC ANALYSIS INPUT INFORMATION | REMARKS |
|---|---|---|---|---|---|
| TITLE | ID. NO. | REV | DATE | | |
| | | | | | |

ST. LUC[illegible] UNIT #1

NRC BULLETIN 79-14: A[illegible]ILT CHECK WITH STRESS ISO

BY: ____________________ (FORM A-3)

| BF-SHAW | | AREA | INSPECT | STRESS | | STRESS | | POINT | | | NC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ISO # | REV | NO. | DATE | ISO NO. | REV | CALC NO | DATE | NO | DISCREPANCY | DISPOSITION | D |
| | | | | | | | | | | | |

CHKD. BY ________ DATE ________ OFS NO. ________ DEPT. NO. ____

CLIENT FLORIDA POWER & LIGHT COMPANY

PROJECT NRC BULLETIN 79-14 CHECKLIST

SUBJECT ________

STRESS ISOMETRIC VERIFICATION

As-Built Iso # ________ Rev # ____ Insp. Date ________

Stress Iso. # ________ Rev # ____ Date ________

A. Does stress isometric conform to piping isometric, restraint locations and functions? ________

If not, specify discrepancy (s) and indicate whether or not discrepancy is within tolerance.

B. Specify action to be taken to resolve discrepancy (s) that are out of tolerance.

Field inspection report sent to NYO Stress Department by transmittal # ________

FORM 281 REV 7-71

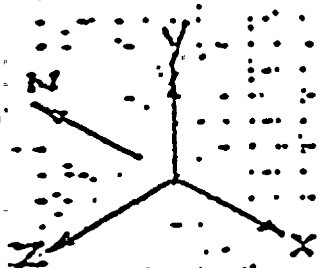
BY ______ DATE ______ SHEET ______ OF ______

CHKD. BY ______ DATE ______ TRANSMITTAL # ______ DATE ______

CLIENT FLORIDA POWER & LIGHT AS-BUILT ISO # ______ REV. ______

PROJECT ST. LUCIE UNIT I STRESS ISO # ______ REV. ______ CALC. # ______

SUBJECT NRC BULLETIN 79-14 INSPECTION DATE ______




AS-BUILT CONDITION

BY. ________ DATE ________ SHEET ____ OF ____

CHKD. BY ________ DATE ________ (FORM A-6) OFS NO. 5822.205 DEPT. NO. 66

CLIENT FLORIDA POWER & LIGHT COMPANY

PROJECT ST. LUCIE UNIT #1

SUBJECT SEISMIC ANALYSIS REVISION CHECK LIST

(NRC I&E BULLETINS 79-14 REVIEW)

CALCULATION NO. ________ REV. ________ DATE ________

SA ISO NO. ________ REV. ________ DATE ________

________ REV. ________ DATE ________

________ REV. ________ DATE ________

________ REV. ________ DATE ________

| ITEM # | CHANGES TO PREVIOUS REVISION | ID NO. OF SOURCE DOCUMENT | REV. | FILE LOCATION | REMARKS |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
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| | | | | | |
| | | | | | |
| | | | | | |

DATA CHECK

1 ☐ Input Data excluding the changes are identical to previous calculation dated ________

2 ☐ Changes made according to the source document

3 ☐ Revised isometric drawings consistent with new calculation

4 ☐ Restraint verification is required and prepared.

5 ☐ Stresses within code allowable limit.

FORM 691 REV 7-71

BY ______ DATE ______

CLIENT FLORIDA POWER & LIGHT COMPANY

PROJECT ST. LUCIE #1 NRC BULLETIN 79-14 CHECK

SUBJECT STRESS ANALYSIS REVIEW

(FORM A-7)

OPS NO. FLO 5822 196 DEPT. NO. EC

# STRESS ANALYSIS REVIEW LIST

By NY Office

| Field transm. No. | ITEM | STRESS ISO NO. REV PT. CALC | DATE No. | RESTRAINT B/P SKETCH No. | Rev. | DISCREPANCY | DISPOSITION | REF. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

BY ______ DATE ______
CHKD. BY ______ DATE ______
CLIENT FLORIDA POWER & LIGHT COMPANY (FORM A-8) OFS NO. ______ DEPT. NO. ______
PROJECT ST. LUCIE #1 NRC BULLETIN 79-14 CHECK
SUBJECT RESTRAINT DESIGN REVIEW

## RESTRAINT VERIFICATION LIST

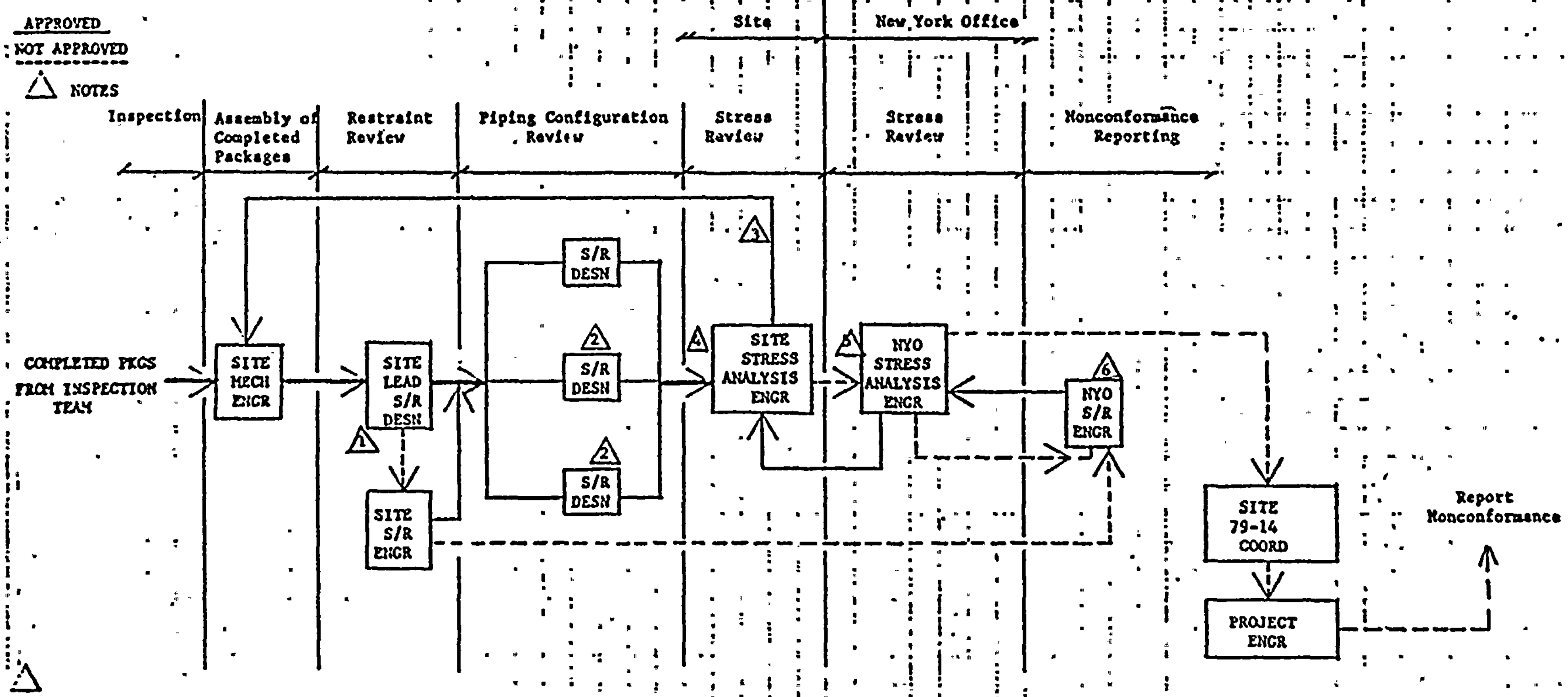
| ITEM NO | STRESS | | RESTRAINT | | TO BE VERIFIED | VERIFIED OR ADVISED BY SUPPORTING ENGINEER SIGN & DATE | REF. |
|---|---|---|---|---|---|---|---|
| | ISO NO. REV. (CALC. DATE | PT. NO. | B/P NO. | SKETCH REV. | | | |
| | | | | | | | |

EBASCO SERVICES INCORPORATED

SHEET ____ OF ____

CLIENT FLORIDA POWER & LIGHT COMPANY
PROJECT BACKFIT ENGINEERING
SUBJECT PIPING / RESTRAINTS VERIFICATION

OFS NO. ____ DEPT. NO. ____
BY TEP DATE 10/3/79
CHECKED BY MJC DATE 10/5/79




1 S/R DISCREPANCY
2 NON DISCREPANT ITEMS
3 PACKAGES FOR FILING
4 FOR REVIEW/APPROVAL OF MINOR DISCREPANCY
5 FOR DETAILED STRESS ANALYSIS
6 S/R DISCREPANCY

FLORIDA POWER & LIGHT COMPANY
ST LUCIE UNIT NO. 1
NRC BULLETIN IE 79-14

FINAL REPORT

# APPENDIX C

## CRITERIA AND PROCEDURES FOR THE EVALUATION OF SUPPORT/RESTRAINTS TO SATISFY NRC BULLETIN IE 79-14

EBASCO SERVICES INCORPORATED

ST LUCIE UNIT NO 1

# CRITERIA AND PROCEDURES FOR THE EVALUATION

# OF

# SUPPORT/RESTRAINTS

# TO SATISFY

# NCR BULLETIN I.E. 79-14

APPLIED MECHANICS

SUPPORT/RESTRAINT

EBASCO SERVICES INCORPORATED

ST LUCIE UNIT NO 1

CRITERIA AND PROCEDURES FOR THE EVALUATION

OF

SUPPORT/RESTRAINTS

TO SATISFY

NCR BULLETIN I.E. 79-14

Prepared by BKurkaiyan / J Prumerman Dated July 16, 1980

Reviewed and Approved by [signature] Dated July 16, 1980

APPLIED MECHANICS

SUPPORT/RESTRAINT

## TABLE OF CONTENTS

## 1.0 SCOPE

This specification covers the criteria and procedures used for the engineering evaluation of "as-built" safety related piping supports in order to satisfy the requirements of the Nuclear Regulatory Commission (NRC) Bulletin I.E. 79-14. It is not the intent to specify completely all the details of the Engineering evaluation.

## 2.0 CODES AND STANDARDS

ANSI - American National Standards Institute B31.1 - Code for Pressure Piping (1969)

AISC - American Institute of Steel Construction, Steel Construction Manual, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 7th Edition (1970)

MSS - Manufacturers Standardization Society SP-58-Pipe Hangers and Supports-Materials and Design (1967)

ACI - American Concrete Institute 318-63 Part IV B

## 3.0 REFERENCES


| | |
|---|---|
| Formulas for Stress and Strain | Roark & Young<br>5th Edition (1975) |
| Structural Engineering Handbook | Gaylord & Gaylord (1968) |
| Rigid Frame Formulas | Kleinlogel (1978) |
| Theory of Elasticity | Timoshenko & Goodier<br>2nd Edition (1951) |
| Design of Welded Structures | Blodgett (1976) |
| WRC Bulletin 107 & 198 | Welding Research<br>Council (1965/1974) |
| Pipe Supports Catalog No. 66 & 66R | Bergen-Paterson<br>Pipesupport Corp. |
| Load Capacity Data Sheets | Bergen-Paterson<br>Pipesupport Corp<br>& ITT Grinnell Corp |
| Modern Formulas for Statics and Dynamics | Pikley & Chang (1978) |

## 4.0 NOMENCLATURE

| | | |
|---|---|---|
| f | = | Coefficient of friction |
| DW | = | Dead weight load (lbs) |
| TH | = | Thermal load (lbs) |
| OBE | = | Operating basis earthquate (lbs) |
| DBE | = | Design basis earthquate (lbs) |
| Tu | = | Ultimate tensile force of concrete anchors (lbs) |
| Su | = | Ultimate shear force of concrete anchors (lbs) |
| P | = | Axial force (lbs) |
| A | = | Area of section ($in^2$) |
| My | = | Moment about y axis (lb-in) |
| Mx | = | Moment about x axis (lb-in) |
| Ix | = | Moment of inertia about x axis ($in^4$) |
| Iy | = | Moment of inertia about y axis ($in^4$) |
| x | = | Distance from neutral (x'-x) axis to point analyzed (in) |
| y | = | Distance from neutral (y'-y) axis to point analyzed (in) |
| S | = | Elastic section modulus ($in^3$) |
| E | = | Modulus of Elasticity (psi) |
| SAM | = | Seismic anchor movement (lbs) |

## 5.0 DEFINITIONS

5.1 As-Built: Actual physical description of a piping support at the time of inspection, indicating plan location, bill of materials, member sizes, physical clearances, and all other pertinent information.

5.2 As-Designed: The drawing of the original pipesupport design which includes the location, bill of materials, postulated loads for which the piping support was originally analyzed, member sizes, and clearances.

5.3 Existing Structure: The building structure to which the piping support is attached.

5.4 Integral Attachment - A piping support component connected to a pressure retaining component by means of a weld.

## 6.0 EVALUATION PROCEDURE

An engineering evaluation will be performed for each piping support identified on the "Stress Analysis Restraint Verification List."

The "as-built" piping support loads and functions will be compared to the "as-designed" Bergen-Paterson piping support loads and functions shown on the support detail.

If the "as-built" loads and functions are equal (or smaller) than the loads and functions shown on the Bergen-Paterson support detail, the piping support shall be considered to require no further analysis and labeled "Ok As-Built".

If there are significant variations between "as-built" and "as-designed" piping support and/or if the "as-built" loads are greater than the "as-designed" loads a complete engineering evaluation shall be performed per the criteria of this procedure.

All items on the "Stress Analysis Restraint Verification List" will be preliminarily dispositioned by the Support/Restraint Group as "Ok As-Built" or "Field Modification Required" and transmitted to Stress Analysis (see Attachment A) for final review and disposition.

7.0 GENERAL CRITERIA

7.1 Support Steel

7.1.1 Engineering evaluation and design of existing piping support structural steel shall be in accordance with the AISC Specification "Steel Construction Manual", 7th Edition 1970.

7.1.2 Piping Support Structural Steel shall be considered to be ASTM A-36 unless noted.

7.2 The permissible weld stress shall be in accordance with the applicable AISC specification.

7.3 Coefficient of Friction

7.3.1 The coefficient of friction shall be f = 0.3 for steel on steel.

7.3.2 Where the thermal movement of the pipe relative to the piping support exceeds 1/16", the friction effect shall be considered.

7.3.3 Frictional Force

Frictional Force = f • (DW + TH)

or Frictional Force = f • DW

(Whichever is greater)

7.3.4 The frictional force is to be assumed acting with all concurrent loads.

7.3.5 Lines with temperature of 120°F shall be considered cold, with no friction.

7.4 Support Hardware

7.4.1 Component Standard Support Hardware shall be Bergen-Paterson Pipesupport Corporation or equivalent unless noted.

7.4.2 U-Bolts (see Attachment C).

7.0 GENERAL CRITERIA (cont'd)

7.5 Existing Structure

7.5.1 The effect of the piping support loading on the existing structure is outside the scope of this specification.

7.5.2 All final piping support drawings reviewed by Applied Mechanics, S/R will be transmitted to Civil for review.

7.6 Integral Support Components

7.6.1 Integral Support Components shall be evaluated using WRC Bulletin Nos 107 and 198 as required.

7.6.2 Integral Support Components Material shall be equal to or compatible with the pipe material.

7.7 Base Plates With Concrete Anchors

7.7.1 Base plate analysis is not required for piping supports with "as-designed" piping support loads greater than the loads resulting from the "as-built" piping stress analysis.

In the case where the "as-built" piping loads are greater than the "as-designed" loads shown on the B-P drawing, base plates shall be evaluated to comply with the criteria of NRC Bulletin IE 79-02 and Attachment B.

7.7.2 Existing concrete expansion anchors shall be Phillips Redhead self drilling shell type anchors. Design shall consider a linear shear/tension interaction as follows:

$$\frac{B}{B_a} + \frac{V}{V_a} \leq 1$$

## 8.0 LOAD COMBINATIONS

8.1 The following load combinations for safety related piping supports shall be used as applicable:

Normal/Upset

1.0S = DW + Th + OBE (Inertia + SAM)

1.0S = DW + Th - OBE (Inertia + SAM)

1.0S = DW + OBE (Inertia + SAM)

1.0S = DW - OBE (Inertia + SAM)

Emergency

1.33S = DW + Th + DBE (Inertia + SAM)

1.33S = DW + Th - DBE (Inertia + SAM)

1.33S = DW - DBE (Inertia + SAM)

8.2 Deadweight and thermal are added algebraically.

8.3 In the absence of DBE loads, DBE shall be two (2) times OBE

ATTACHMENT A

RESTRAINT VERIFICATION TRANSMITTAL

<u>ATTACHMENT A</u>

<u>RESTRAINT VERIFICATION TRANSMITTAL</u>

To: (Stress Analysis)

From: (Support/Restraints)

Subject: ST LUCIE UNIT NO 1
RESTRAINT VERIFICATION
NRC BULLETIN I.E 79-14

Listed below is a summary of the Applied Mechanics Support Restraint Division's preliminary findings for your review.

SUMMARY OF S/A ITEM NOS

OK AS BUILT

| S/A Memo Dated | New Loads Greater Than B-P Loads | New Loads Less Than B-P Loads | Field Modification Required |
|---|---|---|---|
| (Memo Date) | (S/A Item No.) | (S/A Item No.) | (S/A Item No.) |

Items with (Rev ) indicate new loads given by S/A for which S/R was reverified.

(additional concerns or comments)

Also attached, for your convenience, is a mark-up of each of your memos plus a mark-up of the S/R details to be revised with the suggested modifications.

# ATTACHMENT B

## BASE PLATES WITH DRILLED-IN CONCRETE EXPANSION TYPE ANCHORS

DESIGN CRITERIA

AND

ALLOWABLE LOADS

EBASCO SPECIFICATION

FLO 9110-AS-13

# DRILLED-IN EXPANSION TYPE ANCHORS IN CONCRETE

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT
UNIT #1 - BACKFIT PROGRAM

| Rev. No. | Date | Prepared by | Approved by | Pages Affected |
|---|---|---|---|---|
| Original | 4/21/80 | G. H. Krauss | T. A. Tarte | All |

EBASCO SPECIFICATION

FLO 9110-AS-13

# DRILLED IN EXPANSION TYPE ANCHORS IN CONCRETE

## CONTENTS

PURCHASER'S IDENTIFICATION
NO. FLO 9110-AS-13

DRILLED IN EXPANSION TYPE ANCHORS

## 1. SCOPE

This specification covers procurement, installation and testing requirements of anchoring devices which will be used to attach Seismic Category I and Non-seismic permanent equipment and fixtures to existing hardened concrete. The anchoring devices covered by this specification shall be externally threaded wedge expansion bolt anchors (split ring).

## 2. SPECIFICATIONS AND STANDARDS

The applicable standards shall include, but not necessarily be limited to, the latest revision in effect on the date of purchase of the following specifications:

10 CFR 50, App. B - "Quality Assurance Criteria for Nuclear Power Plants"

ANSI N45-2 - "Quality Assurance Program Requirements for Nuclear Power Plants"

ANSI B94-12-1977 - "Carbide Tipped Masonry Drills and Blanks for Carbide Type Masonry Drills"

Federal Specification FF-S-325 - "Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices Anchoring, Masonry)" - including Amendment 3, July 16, 1965. QQZ-325 "Zinc Coating, Electrodeposited Requirements For"

ASTM - E-488 - "Standard Test Method for Strength of Anchors in Concrete and Masonry Elements"

ACI-503 - "Guide for Use of Epoxy Compounds with Concrete"

Ebasco Concrete Specification FLO 8770.473

Any conflict between this specification and/or the referenced codes and standards shall be immediately brought to the Engineer's attention for written resolution.

## 3. DEFINITIONS

.1 Engineer - In this specification the work "Engineer" shall mean Ebasco Services Incorporated, New York or its authorized representative, successors or assigns.

3. DEFINITIONS (continued).

.2 Owner - In this specification the work "Owner" shall mean Florida Power & Light Company or its authorized representative, successors or assigns.

.3 Manufacturer - In this specification the work "Manufacturer" shall mean ITT Phillips Drill Division or its authorized representative, successors or assigns.

4. MANUFACTURER'S DESIGN AND RELATED DATA

.1 Embedded drilled-in anchors shall be designed for direct tension applied statically so that the failure mode at the ultimate strength of the embedded anchor shall either be:

a. Bolt Failure Mode - installed bolt fails at an ultimate tensile strength equal to or exceeding 105 ksi.

b. Anchor Pullout - installed anchor pulls out of the drilled hole or bolt shaft pulls through the wedges.

.2 Embedded drilled-in anchors shall be designed for static tension so that the failure mode at the ultimate strength of the embedded anchor is not a concrete shear cone failure mode.

.3 All anchors shall conform to the requirements of Table 4.03 below.

TABLE 4.03 (1)

| NOMINAL BOLT DIAMETER INCHES | STATIC TENSILE ULTIMATE LOAD LB | STATIC SHEAR ULTIMATE LOAD LB | STATIC TENSILE TEST LOAD (TENSIONER TESTING) Lb (2) | INSTALLATION TORQUE FT.LB | NUMBER OF TURNS (MIN) | TEST TORQUE FT.LB. (2) | MINIMUM EMBEDMENT INCHES (3) |
|---|---|---|---|---|---|---|---|
| 1/4 | 890 | 800 | 330 | 10.5 | 2-1/2 | 6.6 | 1-1/2 |
| 3/8 | 4600 | 3200 | 1700 | 30 | 3-1/2 | 15 | 3-1/2 |
| 1/2 | 7100 | 6000 | 2650 | 75 | 5-1/2 | 40 | 5 |
| 5/8 | 10300 | 9600 | 3850 | 170 | 5 | 85 | 6 |
| 3/4 | 11600 | 14800 | 4330 | 200 | 5-1/2 | 135 | 6-1/2 |
| 1 | 21800 | 23600 | 8070 | 350 | 4 | 225 | 6-1/2 |
| 1-1/4 | 37600 | 35600 | 14000 | 600 | 4 | 500 | 9 |

(1) The ultimate static tensile and shear loads, the installation and test torque and the number of turns are based on the results of the on-site tests performed by the Manufacturer for St. Lucie Unit #2.

4. MANUFACTURER'S DESIGN AND RELATED DATA (continued)

.3 continued

(2) Acceptance criteria at static tensile test load and test torque is defined in Paragraph 8.02.

(3) Installed embedment is defined as the depth from the top of the concrete to the bottom of the bolt.

.4 All anchors shall have a unique length code stamped on the head of the anchor,

The minimum center-to-center anchor spacing distance for 100 percent anchor capacity shall be no more than 12 anchor diameters. The minimum center-to-center anchor spacing distance for 50 percent anchor capacity shall be no more than 6 anchor diameters. The minimum edge distance shall be no more than the minimum embedment requirement (Table 4.03) for 100 percent anchor capacity.

5. <u>MATERIAL</u>

.1 <u>Expansion Bolt Anchor Type</u>

Expansion bolt anchors shall be externally threaded expansion bolt anchors with split ring. These anchors shall conform to Federal Specification FF-S-325, Group II, Type 4, Class 1 and the requirements of this technical specification.

.2 <u>Anchor Components</u>

The Manufacturer shall submit certified material test reports or certificates of compliance as delineated in "a" through "c" below for all anchor components (nuts, bolts, washers, etc). Test reports or certificates of compliance shall state the material specification to which each component was manufactured. Test reports shall include actual results of chemical and mechanical tests per the requirements of the applicable specification. Certificates of compliance shall state typical values or range of values for the chemical and mechanical properties set forth in the applicable material specification.

Manufacturers shall submit the following material documentation:

a) Washers (all sizes) - certificate of compliance

b) Bolts, nuts and wedges - 1" nominal diameter and smaller certificate of compliance

c) Bolts, nuts and wedges - larger than 1" nominal diameter test reports

5. MATERIALS (continued)

.2 Anchor Components (continued)

All anchor components shall be zinc-plated according to Federal Specification QQZ-325, Type 1, Class 3.

6. INSTALLATION

.1 Anchors shall be installed in strict accordance with the recommended installation instructions of the Manufacturer and by qualified personnel with appropriate training in installation techniques. Initial training shall be by an anchor Manufacturer's representative with continuing training and inspection by construction supervisory personnel. The Manufacturer's installation procedure shall include a tolerance on the angularity of installed anchors and drill bit diameters. The installation procedure to be used shall be submitted to the Owner for approval prior to use of bolts.

.2 Expansion anchors shall not be installed in concrete until it has reached the specified twenty-eight (28) day design strength.

.3 Holes for expansion bolts shall be drilled in strict accordance with Manufacturer's installation recommendations. A rotary/percussion- type drill and solid core carbide bits shall be used to drill all holes, unless otherwise directed by the Owner. Drill bit diameter tolerances shall be as specified by the anchor Manufacturer. The drill bit tip point shall be in accordance with the ANSI B94.12-1977.

.4 Reinforcing steel placement drawings and Pachometer (or acceptable alternate rebar locator) shall be used to minimize anchor interference with reinforcing steel. If reinforcing steel is encountered during anchor installation, the anchor shall be relocated so as not to interfere with reinforcing steel. In no case shall concrete reinforcing steel be cut unless prior approval is given by the Engineer.

Any holes not used shall be filled with dry pack grout meeting the requirements of Article 10.

.5 All anchors shall have the nut turned the minimum number of turns, specified in Table 4.03, past the "fingertight" position and shall not be turned more than one turn past this minimum.

.6 All anchors shall then be set at the torque specified in Table 4.03. A manually operated, calibrated torque wrench shall be used to measure the torque. Torque wrenches shall be calibrated at least once a month or more frequently at the Owner's request.

6. INSTALLATION (continued)

.7 The wedge of expansion bolts (with the exception of the 1/4 bolts) shall be embedded behind the near side reinforcing steel.

.8 There shall be no welding on expansion anchors nor use of them as welding grounds.

.9 Expansion anchors shall not be cut, ground or altered in any manner.

.10 Expansion anchors shall not be installed in patched sections of concrete unless approved by the Engineer.

## 7. INSPECTION

.1 A daily check by the Owner shall be made to ensure that proper installation equipment, including type and condition of drill bits, as recommended by the anchor manufacturer is being used and records of this check shall be maintained.

.2 The condition of the threads of all anchors shall be inspected by the craftsmen performing the work before anchor installation. Anchors with damaged or imperfect threads shall be disposed of and not used.

.3 All installed expansion anchors shall be visually inspected for proper length and number of threads extending above the top of the nut.

.4 All anchors shall be inspected by torque testing and one out of each 50 anchors installed shall be tested by tensioner testing (see Paragraph 8.1). The tension test sample shall be representative of the group in which it is located.

## 8. TESTING IN PLACE

.1 Testing Methods

a) Torque Testing

Installed anchors shall be tested with a calibrated manually operated torque wrench. The test torque values, as specified in Table 4.03, shall be met. Torque wrenches used for testing installed anchors shall be calibrated monthly, or more frequently if determined necessary by the Owner.

8. TESTING IN PLACE (continued)

.1 b) Tensioner Testing

i - Installed anchors shall be tested with a tensioner to the static tensile test loads of Table 4.03.

ii - The tensioner shall be a hydraulic pulling device bearing on the concrete outside of the theoretical concrete shear cone area. This area is defined as being circular with a diameter equal to twice the embedment of the anchor and centered on the anchor.

.2 Acceptance Criteria

Anchors shall be accepted if at the test torque value and the static tensile test load of Table 4.03, no concrete failure occurs; the anchor does not rupture, distort or deform; the anchor does not slip excessively or become loose; and the anchor does not pull out.

a) Tensioner Testing

The term "slip excessively" shall mean that the washer can be turned by hand while the bolt is under the test load. If the test anchor representing a group of 50 anchors satisfies the acceptance criteria, all anchors in the group shall be considered acceptable.

b) Torque Testing

When the prescribed test torque of Table 4.03 is reached, no rotation of the nut shall occur. If rotation of the nut occurs the anchor shall be tensioner tested.

.3 Retest (Tensioner Testing)

If the test anchor does not meet the acceptance criterion above, three (3) additional anchors from the same group shall be tested. If all three additional test anchors satisfy the acceptance criterion above, all remaining in that group shall be deemed acceptable. If any of these three anchors fails the second test all anchors in that group shall be tested.

Failed test anchors shall be repaired in accordance with Paragraph 9. All repaired anchors shall be tensioner tested and if failure of any repaired anchor occurs, the Engineer is to be contacted for directions on replacement or relocation of the anchor or anchorage group.

9. REPAIR OF TEST ANCHOR FAILURES

All test anchors that fail shall be repaired as follows according to the failure mode and retested.

.1 Concrete Shear Cone Failure

The expansion anchor shall be replaced with an anchor that has an increased embedment depth of at least 4 bolt diameters, if the same hole location is used, unless otherwise directed by the Owner. The damaged concrete shall be repaired in accordance with Paragraph 10 and then a new hole drilled and the new anchor installed. As an alternate, the bolt may be relocated at least 5 anchor diameters away from the outer edge of the shear cone failure.

.2 Anchor Failure (Rupture, Distortion or Deformation)

The expansion anchor shall be removed and replaced with either another anchor of the same size or a larger sized anchor (after hole is redrilled) if the surrounding concrete has not been damaged.

.3 Anchor Slippage, Loosening, Pullout

For anchors that slip, loosen or pull out, the bolt shall be removed and replaced with a bolt that has an increased embedment depth of at least 4 bolt diameters, unless otherwise directed by the Owner. As an alternate, the anchor shall be replaced with a larger sized anchor (after the hole is redrilled).

10. REPAIR OF DAMAGED CONCRETE

.1 Use of Epoxy

Epoxy shall be used for bonding fresh concrete used for repairs. Epoxies shall be applied in strict accordance with the instructions of the Manufacturer and ACI 503.

.2 Method of Repair

"Dry-pack" grout shall be used.

.3 Curing of Patched Work

The patched areas shall be cured as required in Section II, Paragraph 5 of Ebasco Specification FLO 8770.473.

10. REPAIR OF DAMAGED CONCRETE (continued)

.4 Inspection and Approval

All materials, procedures and operations used in the repair of concrete and also the finished work shall be subject to the inspection and approval of the Owner. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage, cracks or drummy areas after the fillings have been cured and dried.

11. QUALITY ASSURANCE

.1 Documentation Requirements During Fabrication

Manufacturer shall submit test reports or certificates of compliance as specified in Paragraph 5.2. Submittal of these documentations shall be to the Site on or before delivery.

.2 Quality Assurance Requirements for Installation

a) Prior to installation, Manufacturer shall submit to the Owner for review and comment all applicable installation procedures.

b) Documentation:

The following documentation for installation shall be maintained and submitted to the Owner for review and comments.

i. Test inspection records that shall include, as a minimum, the location of anchor (and the group represented for tensioner test), the method of test, test results, inspector's name and date of test.

ii. Failed anchor reports that shall give the exact location of the failed anchor, the mode of failure, type of anchor, pertinent information on installation procedures, inspector's name and date of test. The corrective action taken shall also be reported.

EBASCO SPECIFICATION

FLO 9110-AS-14

# CONCRETE EXPANSION TYPE ANCHORS

## DESIGN CRITERIA

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT
UNIT #1 - BACKFIT PROGRAM

EBASCO SPECIFICATION

FLO 9110-AS-14

# CONCRETE EXPANSION TYPE ANCHORS

# DESIGN CRITERIA

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT
UNIT #1 - BACKFIT PROGRAM

| REV. NO. | DATE | PREPARED BY | APPROVED BY | PAGES AFFECTED |
|---|---|---|---|---|
| Original | 4/21/80 | G. H. Krauss | T. A. Tarte | All |

EBASCO SPECIFICATION

FLO 9110-AS-14

# CONCRETE EXPANSION TYPE ANCHORS
# DESIGN CRITERIA

CONTENTS

PURCHASER'S IDENTIFICATION
FLO 9110-AS-14

CONCRETE EXPANSION TYPE ANCHORS

## 1. SCOPE

This document defines the criteria to be used in the design of concrete expansion type anchors, meeting the requirements of Ebasco Specification FLO 9110-AS-13, "Drilled-in Expansion Type Anchors in Concrete", for use is Seismic Category I and Non-seismic pipe support structures. The loads, load combinations and allowable stresses are defined, and procedures are set forth to account for base plate prying action and shear-tension interaction on the anchors.

## 2. LOADS

The following loads are considered applicable to the design of concrete expansion anchors:

2.1 D = Dead loads, including the weight of stationary structures, piping and equipment.

2.2 L = Live loads, including any movable equipment loads and loads due to the operation of equipment.

2.3 W = Hurricane load.

2.4 $F_{eqo}$ = ~~Design~~ Operating Basis Earthquake ~~(DBE)~~ OBE, including effects of differential movement of supports.

2.5 $F_{eqs}$ = Design Basis Earthquake (DBE), including effects of differential movement of supports.

2.6 $R_o$ = Pipe reaction loads during normal operating or shutdown conditions.

2.7 $R_a$ = Pipe reaction loads under thermal conditions generated by a postulated pipe break, including $R_o$.

2.8 $T_o$ = Thermal effects and loads during normal operating or shutdown conditions.

2.9 $T_a$ = Thermal effects under conditions generated by a postulated pipe break, including $T_o$.

2.10 $Y_r$ = Reaction loads generated by a postulated pipe break, including an appropriate factor to account for the dynamic nature of the load.

## 3. LOAD COMBINATIONS

The following load combinations shall be used to compute the factored tensions, moments and shears for use in the design of concrete expansion anchors. The combinations represent those used in the design of concrete structures, with additional load factors added which, in combination with the appropriate capacity reduction factors, result in material factors of safety of 4 for static loads, 5 for impactive loads, and 15 for vibrating loads.

3.1 $1.4D + 1.3R_o + 1.3T_o + 1.7L$

3.2 $1.4D + 1.3R_o + 1.3T_o + 1.7L + 1.7W$

3.3 $1.2D + 1.7W$

3.4 $1.4D + 1.3R_o + 1.3T_o + 1.7L + 7.1F_{eqo}$

3.5 $1.2D + 7.1F_{eqo}$

3.6 $1.0D + 1.0R_o + 1.0T_o + 3.8F_{eqs}$

3.7 $1.0D + 1.0L + 1.0R_a + 1.0T_a + 1.25Y_r + 4.7F_{eqo}$

3.8 $1.0D + 1.0L + 1.0R_a + 1.0T_a + 1.25Y_r + 3.8F_{eqs}$

## 4. ALLOWABLE STRESSES

The ultimate loads carried by concrete expansion anchors shall be obtained from Specification FLO 9110-AS-13, Table 4.03, under the columns headed "Static Tensile Ultimate Load" and "Static Shear Ultimate Load," modified by a capacity reduction factor Ø of 0.25. If the center-to-center anchor spacing is less than 12 anchor diameters, the ultimate capacity shall be reduced linearly to 50 percent capacity at the minimum center-to-center anchor spacing of 6 anchor diameters.

## 5. DETERMINATION OF PRYING FORCES

The presence or absence of prying forces acting on the anchors due to a direct tension force is determined by the following formula:

$$\alpha = \frac{1}{\delta}\left(\frac{4\ Tb}{wt^2 \sigma_y} - 1\right)$$

5. Determination of Prying Forces (continued)

where
- T = factored direct tensile load per anchor
- b = distance from the face of the attachment where the load is applies to the centerline of the bolt, minus one-half bolt diameter
- w = width of the base plate contributing to each bolt
- t = thickness of base plate
- $\sigma_y$ = yield stress of base plate
- $\delta$ = ratio of the net area to the gross area of the base plate cross section at the bolt line
- $\alpha$ = ratio of the moment in the base plate at the bolt line to the moment in the base plate at the face of the attachment

The presence or absence of prying forces acting on the anchors due to an applied moment is determined by the following formula:

$$\alpha = \frac{1}{\delta}\left(\frac{4M_o b}{wt^2 \sigma_y d} - \frac{2b}{d} - 1\right)$$

where
- $M_o$ = factored applied moment per anchor in tension
- d = dimension of attachment in the direction of the moment
- b, w, t, $\sigma_y$, $\delta$, and $\alpha$ = as defined above

In the case of combined tension and bending, $\sigma_y$ in each of the above two equations shall be reduced so that the same $\alpha$ is computed from each equation, and the sum of the $\sigma_y$'s used is less than or equal to the actual yield stress of the base plate.

If $\alpha$ is found to be zero or less, there is no prying force present. If $\alpha$ is found to be greater than one, a value of one is to be used.

The bolt force due to a direct tensile force is calculated by the formula:

$$Q = \frac{\alpha\delta}{a} \cdot \frac{Tb}{(1+\alpha\delta)}$$

where
- Q = prying force
- a = distance from the edge of the base plate to the center line of the bolt, plus one-half bolt diamter, but not more than 1.25b
- $\alpha$, $\delta$, T, and b = as defined above

If $\alpha$ is zero or less, Q = 0

5. Determination of Prying Forces (continued)

The bolt force due to an applied moment is calculated by the formula:

$$Q = M_o \frac{\alpha \delta}{(1+\alpha \delta) \quad d+2b} \left(\frac{b}{a}\right)$$

where all terms are as defined above.

If $\alpha$ is zero or less, $Q = 0$.

Prying forces shall be computed assuming one-way bending in the base plate in each direction. If the base plate is provided with stiffeners between the attachment and the bolt line, the prying force in the direction of the stiffeners may be assumed equal to zero. The total prying force shall be computed as the square root of the sum of the squares of the prying forces in each direction.

6. <u>DETERMINATION OF ANCHOR SIZES</u>

Concrete expansion anchors shall be selected such that:

$$\frac{B}{Ba} + \frac{V}{Va} \leq 1$$

where
- B = total factored tensile load per anchor, including prying forces, if any
- $B_a$ = allowable anchor tensile capacity, including capacity reduction factor and effects of close spacing
- V = total factored shear load per anchor
- $V_a$ = allowable anchor shear capacity, including capacity reduction factor and effects of close spacing

TABLE NO. 1

PHILLIPS RED HEAD SELF-DRILLING SNAPP OFF ANCHORS

LOAD CAPACITY OF ANCHORS

| | | ULTIMATE LOAD CAPACITY* | | SAFE WORKING LOAD** | |
|---|---|---|---|---|---|
| CAT. NO. | BOLT SIZE (INCHES) | TENSION (LBS) | SHEAR (LBS) | TENSION (LBS.) | SHEAR (LBS.) |
| S-14 | 1/4 | 3,853 | 1,522 | 770 | 305 |
| S-16 | 5/16 | 4,263 | 2,314 | 853 | 463 |
| S-38 | 3/8 | 5,953 | 3,842 | 1,190 | 768 |
| S-12 | 1/2 | 8,925 | 7,661 | 1,785 | 1,532 |
| S-58 | 5/8 | 12,285 | 13,566 | 2,457 | 2,713 |
| S-34 | 3/4 | 17,010 | 18,468 | 3,402 | 3,694 |
| S-78 | 7/8 | 18.742 | 21.033 | 3.748 | 4.207 |

* Based on Phillips data contained in Catalog F-1000 reduced for 3000 psi concrete and adjusted for age of concrete using Red Head Engineering Bulletin No. 102, Pages 1 and 2, dated May 1, 1973:

Ultimate Anchor Capacity (Tension) in 3000 psi concrete = 0.875 x Ultimate Anchor Capacity (Tension) in 3500 psi Concrete x 1.2 (Effect of Concrete Age)

Ultimate Anchor Capacity (Shear) in 3000 psi concrete = 0.95 x Ultimate Anchor Capacity (Shear) in 3500 psi Concrete x 1.2 (Effect of Concrete Age)

** Based on a factor of safety of five (5).

TABLE NO. 2

PHILLIPS WEDGE ANCHORS

LOAD CAPACITY OF ANCHORS

| ANCHOR BOLT SIZE (INCHES) | FINAL MIN. EMBEDMENT (AFTER TORQUING) | ULTIMATE LOAD CAPACITY* | | SAFE WORKING LOAD** | |
|---|---|---|---|---|---|
| | | TENSION (LBS) | SHEAR (LBS) | TENSION (LBS) | SHEAR (LBS) |
| 1/4 | 1-3/8 | 2,520 | 2,650 | 630 | 662 |
| 3/8 | 1-3/4 | 4,305 | 5,700 | 1,076 | 1,425 |
| 1/2 | 2-1/8 | 6,195 | 9,576 | 1,549 | 2,394 |
| 5/8 | 2-5/8 | 8,216 | 13,680 | 2,054 | 3,420 |
| 3/4 | 3-1/4 | 12,075 | 19,380 | 3,019 | 4,845 |
| 7/8 | 3-3/4 | 12,442 | 28,386 | 3,110 | 7,096 |
| 1 | 4-1/2 | 17,115 | 40,356 | 4,279 | 10,089 |

*Based on Phillips data contained in Catalog F-1000 reduced for 3000 psi concrete and adjusted for age of concrete using Red Head Engineering Bulletin No. 102, Pages 1 and 2, dated May 1, 1973:

Ultimate Anchor Capacity (Tension) in 3000 psi concrete = 0.875 x Ultimate Anchor Capacity (Tension) in 3500 psi Concrete x 1.2 (Effect of Concrete Age)

Ultimate Anchor Capacity (Shear) in 3000 psi concrete = 0.95 x Ultimate Anchor Capacity (Shear) in 3500 psi Concrete x 1.2 (Effect of Concrete Age)

**Based on a factor of safety of four (4)

## TABLE NO. 3

## HILTI KWIK-BOLT WEDGE ANCHORS

| ANCHOR SIZE (DIAMETER) | FINAL MIN. EMBEDMENT (AFTER TORQUING) | ULTIMATE LOAD CAPACITY* | | SAFE WORKING LOAD** | |
|---|---|---|---|---|---|
| | | TENSION (LBS) | SHEAR (LBS) | TENSION (LBS) | SHEAR (LBS) |
| 1/2 | 2-1/4 | 5,027 | 7,880 | 1,257 | 1,970 |
| 5/8 | 2-3/4 | 6,005 | 11,380 | 1,501 | 2,845 |
| 3/4 | 3-1/4 | 9,152 | 15,195 | 2,288 | 3,798 |
| 1 | 4-1/2 | 15,000 | 27,117 | 3,750 | 6,779 |
| 1-1/4 | 5-1/2 | 21,000 | 36,215 | 5,250 | 9,054 |

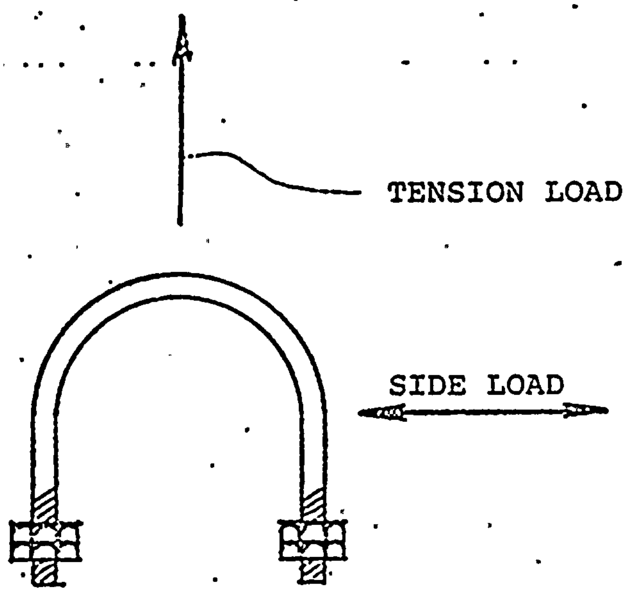
* Based on Hilti data contained in Kwik-Bolt Technical Information Report No. 8733R for 2000psi and 4000psi concrete and reduced to 3000psi concrete using straight line interpolation between 2000 and 4000psi.

** Based on a factor of safety of four (4).

NEW BASE PLATES

The design of new base plates shall comply with the specifications and codes of the A.I.S.C. Manual of Steel Construction. The DBE allowable stress increase of 4/3 is allowed for base plate bending strength analysis. The minimum thickness of new base plates will be 1/8" greater than the concrete expansion anchor diameter where possible.

New base plates shall be designed to make bolt prying forces equal to zero (0) where possible.




LONG TANGENT

U-BOLT

## U-BOLT ALLOWABLE LOADS AND INTERACTION FORMULA

| PIPE SIZE | ROD DIAM | ALLOWABLE TENSION LOAD (LBS) @ 650°F | | ALLOWABLE SIDE LOAD (LBS) @ 650°F | |
|---|---|---|---|---|---|
| | | NORMAL/UPSET | EMERGENCY | NORMAL/UPSET | EMERGENCY |
| 2½" | 1/2" | 2260 | 3010 | 184 | 240 |
| 3" | 1/2" | 2260 | 3010 | 184 | 240 |
| 3½" | 1/2" | 2260 | 3010 | 184 | 240 |
| 4" | 1/2" | 2260 | 3010 | 184 | 240 |
| 5" | 1/2" | 2260 | 3010 | 184 | 240 |
| 6" | 5/8" | 3620 | 4810 | 277 | 370 |
| 8" | 5/8" | 3620 | 4810 | 277 | 370 |
| 10" | 3/4" | 5420 | 7210 | 400 | 530 |
| 12" | 7/8" | 7540 | 10030 | 422 | 560 |
| 14" | 7/8" | 7540 | 10030 | 422 | 560 |
| 16" | 7/8" | 7540 | 10030 | 422 | 560 |
| 18" | 1" | 9920 | 13200 | | |
| 20" | 1" | 9920 | 13200 | | |
| 24" | 1" | 9920 | 13200 | | |
| 30" | 1" | 9920 | 13200 | | |

## LONG-TANGENT U-BOLT

When the combination of a normal (tension) load and side load occurs, a straight line interaction formula may be used to determine if the U-Bolt is still within the allowable stress range.

$$\frac{Pt}{Pta} + \frac{Ps}{Psa} \leq 1$$

Where:

Pt = The actual applied tensile load.

Pta= The allowable tensile load.

Ps = The actual applied side load.

Psa= The allowable side load

**NOTE:**

The allowable U-Bolt load may be upgraded where the actual operating temperature is less than the temperature for which loads are tabulated as shown below. (Refer to ASME, Section III, Table 1-13.1)

$$\text{Allowable Load} = \frac{\text{U-Bolt Material Y S. @ Design Temp.}}{\text{SA-36 Y.S. @ 650°F}} \times \text{Tabulated Loads}$$

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE UNIT NO. 1

NRC BULLETIN IE 79-14

FINAL REPORT

June 27, 1980

APPENDIX D

INSULATED RESTRAINT LISTING

# INSULATED RESTRAINT LISTING

RC BULLETIN IE 79-14

INSULATED RESTRAINTS - Inspected only for location & exposed members during 9/79 & 10/79 outage:

ISO S1-N-10:

| | | |
|---|---|---|
| Line 6"-SI-112 | Restraint | SIH-193 |
| | | SIH-194 |
| | | SIH-195 |
| | | SIH-196 |
| | | SIH-197 |
| | | SIH-198 |
| | | SIH-199 |
| | | SIH-200 |
| | | SIH-201 |
| | | SI-969-1192 |
| | | SI-969-1193 |
| | | SI-969-1195 |
| | | SI-969-1198 |
| | | SI-969-1201 |
| | | SI-969-6192 |
| | | SI-969-6193 |
| | | SI-969-6194 |
| | | SI-969-6195 |
| | | SI-969-6196 |
| | | SI-969-6197 |
| | | SI-969-6198 |
| | | SI-969-6199 |
| | | SI-969-6200 |
| | | SI-969-6201 |
| Line 6"-SI-113 | | SI-968-6204 |
| | | SI-968-6205 |
| | | SI-968-6206 |

ISO SI-N-11:

| | | |
|---|---|---|
| Line 10"-SI-420 | | SI-973-15 |

ISO SI-N-13:

| | | |
|---|---|---|
| Line 12"-RC-147 | Restraint | SIH-247 |
| Line 10"-SI-422 | | SI-970-210 |
| | | SI-970-1210 |
| | | SI-970-1248 |
| | | SI-970-6210 |
| | | SI-970-6248 |
| | | SI-970-6250 |

INSULATED RESTRAINT LISTING
Page 2

ISO RC-AB-1:

| | | |
|---|---|---|
| Line 2 1/2"-RC-156 | Restraint | RC-005-86 |
| | | RC-005=88A |
| | | RC-005-88B |
| | | RC-005-89 |
| | | RC-005-90 |
| Line 2 1/2"-RC-157 | | RC-005-51A |
| | | RC-005-53A |
| | | RC-005-55A |
| | | RC-005-55B |
| Line 4"-RC-825 | | RC-005-96 |
| | | RC-005-97 |
| | | RC-005-98 |
| | | RC-005-100 |
| | | RC-005-101 |
| Line 4"-RC-826 | | RC-005-62 |
| | | RC-005-62A |
| | | RC-005-63 |
| | | RC-005-65 |
| | | RC-005-66 |

PRESSURIZER SURGE
DRAWING 8770-40:

| | | |
|---|---|---|
| Line 12"-RC-108 | Restraint | H1-B |
| | | H2-B |
| | | H3-B |

PRESSURIZER SPRAY:

| | | |
|---|---|---|
| Line 4"-RC-103 | Restraint | SPH-768 |
| | | SPS-777 |
| | | SPS-787 |
| | | SPS-797 |
| | | SPH-808 |
| Line 3"-RC-141 | | SPS-27 |
| | | SPH-37 |
| | | SPS-48 |
| | | SPS-67 |
| | | SPH-58 |
| | | SPS-77 |
| | | SPS-78 |
| | | SPH-88 |
| | | SPS-97 |
| | | SPS-107 |
| | | SPS-117 |
| | | SPS-128 |
| | | SPS-148 |
| | | SPS-237 |

PRESSURIZER SPRAY: (continued)

| | | |
|---|---|---|
| Line 3"-RC-109 | Restraint | SPH-327 |
| | | SPS-338 |
| | | SPS-347 |
| | | SPS-367 |
| | | SPH-378 |
| | | SPS-417 |
| | | SPS-407 |
| | | SPS-427 |
| | | SPS-448 |
| | | SPS-467 |
| | | SPS-478 |
| | | SPS-497 |
| | | SPS-508 |
| | | SPS-524 |
| | | SPS-617 |
| | | SPH-628 |

FLORIDA POWER AND LIGHT COMPANY

ST. LUCIE UNIT NO. 1

NRC BULLETIN IE 79-14

FINAL REPORT

JUNE 27, 1980

# APPENDIX E

# PIPE RESTRAINT

# NON-CONFORMANCES

LISTING OF FIELD MODIFICATIONS BY RESTRAINTS

| [redacted]AINT NUMBER | S/R NO. | STRESS ISO | LINE NUMBER | PIPING ISO | PC/M |
|---|---|---|---|---|---|
| CS-678-815 | 11 | CS-220-3 | 12-S1-412 | CS-K-2 | 23-80 |
| S1-676-429 | 12 | S1-199-2D | 4-S1-416 | S1-N-9 | 596-79 |
| S1-676-245 | 14 | S1-199-18 | 10-S1-420 | S1-N-1 | 619-79 |
| S1H-91 | 17 | S1-199-19 | 6-S1-105 | S1-N-7 | 612-79 |
| S1H-88 | 18 | S1-199-19 | 6-S1-105 | S1-N-7 | 612-79 |
| (S1-868-6099) | | | | | |
| S1H-99 ) | 19 | S1-199-11C | 6-S1-464 | S1-N-5 | 596-79 |
| S1-868-122 | 20 | S1-199-11D | 6-S1-112 | S1-N-6 | 613-79 |
| CS-678-202 | 21 | S1-220-1 | 12-S1-406 | CS-K-2 | 613-79 |
| CSH-29 | 22 | S1-220-1 | 12-S1-406 | CS-K-2 | 613-79 |
| CSH-33 | 26 | S1-220-1 | 12-S1-406 | CS-K-2 | 613-79 |
| CSH-31 | 27 | S1-220-1 | 12-S1-406 | CS-K-2 | 613-79 |
| CHVH-19 | 37 | R-CH-195-1 | 4-CH-967 | CH-G-2 | 619-79 |
| CS-220-19-1 | 100 | CS-220-19-A | 3-CS-52 | | 617-79 |
| CS-220-19-1A | 102 | CS-220-19-A | 3-CS-52 | | 617-79 |
| CS-220-19-2 | 104 | CS-220-19-B | 3-CS-56 | | 617-79 |
| CS-220 | 106 | CS-222-20 | 3-CS-45 | | 614-79 |
| YPH-72A | 107 | Calc 1000 | | | |
| | | 11-3-79 | 3-CS-46 | CS-K-3 | 614-79 |
| S1H-248 | 113 | | 12-S1-149 | | Removed during inspection |
| [redacted]71-391 | 122 | | 4-S1-210 | S1-N-7 | 619-79 |
| [redacted]204-55A | 123 | | 3-WM-635 | | 619-79 |
| YPH-71 | 112 | Calc 1000 | | | |
| | | 11-3-79 | 3-CH-938 | CS-K-3 | 23-80 |
| CCH-111 | 51 | C-153-6 | 8-C-68 | C-E-5 | 32-80 |
| CC-22-2A | 138 | CC-180-22 | 14-CC-22 | CC-H-5 | 32-80 |
| CC-28-5 | 62 | CC-180-90 | 20-CC-26 | CC-H-13 | 40-80 |
| CH-122 | 57 | C-153-8 | 8-C-56 | C-E-5 | 43-80 |
| CC-16-2A | 74 | C-180-16 | 14-CC-23 | CC-H-7 | 43-80 |
| CC-23-2 | 77 | C-180-23 | 8-CC-43 | CC-H-7 | 43-80 |
| S1-676-3155 | 126 | S1-199-17 | 4-S1-415 | S1-N-3 | 43-80 |
| S1-676-320 | 127 | S1-199-17 | 4-S1-415 | S1-N-3 | 43-80 |
| S1-676-321 | 128 | S1-199-17 | 4-S1-415 | S1-N-3 | 43-80 |
| S1-676-3245 | 129 | S1-199-17 | 4-S1-415 | S1-N-3 | 43-80 |
| S1-676-3265 | 130 | S1-199-17 | 4-S1-415 | S1-N-3 | 43-80 |
| S1-676-334 | 131 | S1-199-17 | 4-S1-415 | S1-N-3 | 43-80 |
| Temp Restraint | 68 | CC-179-47 | 8-CC-41 | CC-H-18 | (RAC Memo 3/17/80) |
| CS-832-116 | 98 | CS-220-6 | 12-CS-18 | CS-K-7 | 54-80 |
| MPR-201-10 | 91A | MIS-200-1 | 3-CS-55 | MP-AD-2 | 54-80 |
| MPRH-24 | 92 | MIS-200-1 | 3-CS-55 | MP-AD-2 | 54-80 |
| MPRH-30 | 149 | MIS-200-1 | 3-CS-55 | MP-AD-2 | 54-80 |
| CC-26-1 | 38 | CC-180-26A | 16-CC-106 | CC-H-12 | 59-80 |
| CC-28-13 | 145 | CC-180-28 | 20-CC-27 | CC-H-12 | 59-80 |
| YPH-29 | 164 | Calc 2063 | 20-CC-27 | CC-H-12 | 59-80 |
| BF-4-11 | 146 | BF-149-7 | 4-BF-36 | BF-M-7 | 59-80 |
| [redacted]676-2415 | 150 | S1-199-1 | 10-S1-422 | S1-N-2 | (RAC Memo 4/9/80) |
| [redacted]-13 | 143 | R-CH-195-36 | 3-CH-939 | CH-C-1 | Removed as part of PCM 466-78 |

## LISTING OF FIELD MODIFICATIONS BY RESTRAINTS

| RESTRAINT NUMBER | S/R NO. | STRESS ISO | LINE NUMBER | PIPING ISO | PC/M |
|---|---|---|---|---|---|
| CCH-234 | 63 | CC-179-40 | 8-CC-41 | CC-H-18 | 73-80 |
| CC-1868-36 | 64 | CC-179-40 | 8-CC-41 | CC-H-18 | 73-80 |
| CC-1868-6243 | 66 | CC-179-40 | 8-CC-41 | CC-H-18 | 73-80 |
| CC-1899-2200 | 70 | CC-179-49 | 8-CC-44 | | 73-80 |
| CCH-169 | 73 | CC-179-49 | 8-CC-44 | | 73-80 |
| WM-8-2 | 124 | MIS-204-2 | 4-WM-602 | MP-AD-2 | 73-80 |
| MPR-204-129 | 125 | MIS-204-2 | 3-WM-343 | MP-AD-2 | 73-80 |
| BF-549-11 | 133 | BF-147-1 | 29-BF-14 | BF-M-6 | 73-80 |
| CS-832-385 | 167 | CS-220-16 | 4-CS-30 | CS-K-6 | 73-80 |
| CHVH-31 | 85 | R-CH-195-3 | 3-CH-939 | CH-G-1 | 80-80 |
| YPH-167A | 109 | Calc 1000 | 3-CS-72 | CS-K-3 | 80-80 |
| S1H-254 | 114 | S1-119-19 | 3-S1-211 | S1-N-7 | 80-80 |
| S1-871-742 | 115A | S1-119-19 | 3-S1-211 | S1-N-7 | 80-80 |
| S1H-109 | 117 | S1-119-19 | 6-S1-713 | S1-N-7 | 80-80 |
| S1H-161 | 118 | S1-119-19 | 3-S1-211 | S1-N-7 | 80-80 |
| S1H-160 | 119 | S1-119-19 | 3-S1-211 | S1-N-7 | 80-80 |
| S1H-159 | 120 | S1-119-19 | 4-S1-210 | S1-N-7 | 80-80 |
| S1-871-85 | 121 | S1-119-19 | 6-S1-213 | S1-N-7 | 80-80 |
| CH-3-108 | 162 | R-CH-195-3 | 3-CH-939 | CH-G-1 | 80-80 |
| CH-1-4 | 36 | R-CH-195-1 | 4-CH-967 | CH-G-2 | 138-76 |
| CS-678-160 | 88 | S1-220-2,5 | 12-CS-16 | CS-K-1 | 85-80 |
| CS-678-157 | 89 | S1-220-2,5 | 12-CS-16 | CS-K-1 | 85-80 |
| CS-678-158 | 90 | S1-220-2,5 | 12-CS-16 | CS-K-1 | 85-80 |
| CH-3-10A | 163 | R-CH-195-3 | 3-CH-904 | CH-G-10 | 85-80 |
| CC-28-8B | 168 | R-C-180-28 | 24-CC-30 | CC-H | 85-80 |
| CS-832-2981 | 166 | CS-220-16 | 3-CS-34 | CS-K-6 | Field adjusted for clearance |

## LISTING OF FIELD MODIFICATIONS MADE BY PC/M'S

| 79-14 | PC/M Transmittal | | | Restraint/Verification Items Fixed | | |
|---|---|---|---|---|---|---|
| Mod # | PC/M Number | Xmtl Letter | Date | Added | Deleted | Modification |
| 1 | 596-79 | 79-290 | 9-19-79 | 19 | | 12 |
| 2 | 599-79 | 79-298 | 9-28-79 | | | 3 Restraints |
| 3 | 612-79 | 79-319 | 10-26-79 | | 18 | 17 |
| 4 | 613-79 | 79-325 | 10-30-79 | | | 20,21,22,26,27 |
| 5 | 614-79 | 79-332 | 11-8-79 | 106,107 | | |
| 6 | 617-79 | 79-333 | 11-9-79 | 100,102,104 | | |
| 7 | 619-79 | 79-335 | 11-15-79 | | 122 | 14,37,123 |
| 8 | 23-80 | 80-010 | 1-15-80 | | | 11,112 |
| 9 | 32-80 | 80-021 | 1-25-80 | | 51,138 | |
| 10 | 40-80 | 80-055 | 2-22-80 | | | 62 |
| 11 | 43-80 | 80-065 | 3-3-80 | | 57,74,77, 127 | 126,128,129,130, 131 |
| 12 | 54-80 | 80-125 | 4-5-80 | | | 98,914,92,149 |
| 13 | 59-80 | 80-125 | 4-5-80 | | | 28,145,146,164 |
| 14 | **72-80 | 80-153 | 4-15-80 | | | 1 Restraint |
| 15 | 73-80 | 80-154 | 4-15-80 | | 63,64 | 66,70,73,124,125, 133,167 |
| 16 | **74-80 | 80-162 | 4-21-80 | 33 Restraints | 25 hangers | 120,12 |
| 17 | 80-80 | 80-156 | 4-16-80 | 115A,162 | 117 | 85,109,114,118,11 |
| 18 | 85-80 | 80-171 | 4-24-80 | 163 | | 88,89,90,168 |
| 19 | **86-80 | 80-179 | 4-28-80 | | 1 Restraint | 7 Restraints |
| [illegible] | **87-80 | 80-177 | 4-28-80 | 2 Restraints | | |
| Other* | | | | | 3 Restraints | 3 Restraints |

| Final Status of the 142 total needing work | Added | Deleted | Modified |
|---|---|---|---|
| | 44 | 40 | 58 |

* For explanation of other modifications, see Sheet 2

** Original Stress Analysis Required

## 79-14 RESTRAINT MODIFICATIONS

Other Restraint Modifications
(No PC/M Required that was 79-14 generated)

| | | | |
|---|---|---|---|
| R/V | Item 36 | Modified per PC/M 138-76 |
| | 68 | Removed per memo 3-17-80 |
| | 113 | Removed during inspection phase |
| | 143 | Removed as part of PC/M 466-78 |
| | 150 | Field adjusted |
| | 166 | Field adjusted |

Breakdown of items listed on sheet 1

** Original Stress Analysis required items

| | | | |
|---|---|---|---|
| PC/M 72-80 | issued to resolve | FT 38 "CST overflow/drain" |
| 74-80 | " | FT 36&57 "Fuel Pool Emerg.Makeup from ICW |
| 86-80 | " | FT 26&40 "RCB Sump Pump Discharge Line |
| 87-80 | " | FT 52 "Flash Tank Pump Discharge Line |

PC/M 599-79 Modified following 3 restraints

S1H -212
RC-005-61
RC-005-96

[illegible]