UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 8, 1991

Docket No. 50-302

Mr. Percy M. Beard, Jr.
Senior Vice President,
Nuclear Operations
Florida Power Corporation
ATTN: Manager, Nuclear Operations
Licensing
P. O. Box 219-NA-21
Crystal River, Florida 32629

Dear Mr. Beard:

SUBJECT: CRYSTAL RIVER UNIT 3 - AUDITS ON NRC BULLETIN 88-11, "PRESSURIZER SURGE LINE THERMAL STRATIFICATION" (TAC NO. 72172)

In connection with our review of the response by Florida Power Corporation (FPC) to the subject Bulletin for Crystal River Unit No. 3 (CR-3), the NRC staff and our consultants conducted two audits.

The first audit was at the offices of Babcock & Wilcox at Lynchburg, Virginia on April 4, 1990, and included an update of the status of the B&W Owners Group (BWOG) program on pressurizer surge line thermal stratification. Since we had raised some concerns during our review of the BWOG interim bounding analysis of the surge line, which was used by each B&W plant as technical basis for supporting the justification for continued operation until their individual final analysis is complete, the audit also served the purpose of clarifying or resolving some of these concerns. CR-3 is a typical B&W plant relying primarily on the BWOG program to respond to the Bulletin 88-11 issues. Technical discussions and document reviews on the B&W information applicable to CR-3 were also initiated.

A trip report, which provided a detailed description of our audit efforts, is enclosed (Enclosure 1). The following are our major findings and conclusions:

1. The BWOG program appears to be progressing well. Program completion was scheduled by the end of 1990 and the final report was recently received. Efforts to refine methodology for predicting thermal stratification and thermal striping were near completion.

2. Our review of the BWOG bounding analysis and our discussion with BWOG during this audit had identified certain areas of concern, such as inadequacy of the thermal striping analytical model and lack of clarity in defining interface responsibilities between the individual licensee and the BWOG to ensure Code compliance of the surge line.

   These concerns are either s[illegible] our review of the BWOG bounding analysis or in Enclosure 1. [illegible]ndicated that all our concerns would be addressed in the forthcoming final report.

3. Generic information applicable to the CR-3 surge line was reviewed. FPC was requested to provide additional plant-specific information during our forthcoming site audit, such as surge line drawings, pipe stress report, pipe support calculations, pipe deflection analysis, plant operating procedures and operating records.

The second audit was at CR-3 on May 1-2, 1990. The purpose was to review the implementation of the licensee's program to address NRC Bulletin 88-11 regarding pressurizer surge line thermal stratification. A trip report which provides a detailed description of our audit efforts is enclosed (Enclosure 2).

We found that FPC, in conjunction with the BWOG, has defined a comprehensive program to address the requirements of the Bulletin. A visual inspection of the CR-3 surge line piping and supports was conducted and a generic bounding analysis applicable to CR-3 for justifying continued short-term operation of the plant was performed. A refined analysis utilizing surge line stratification date monitored at a similar plant is in progress to justify long-term operation, which was scheduled for completion by the end of 1990.

Items of staff concern related to this audit are delineated in Section 3.0 of Enclosure 2. FPC should resolve all the concerns in accordance with the schedule indicated in the Bulletin.

Sincerely,

(Original signed by)

Harley Silver, Project Manager
Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc w/enclosures:
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Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc w/enclosures:
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ENCLOSURE 1

AUDIT TRIP HIGHLIGHTS REPORT

PURPOSE: Audit of Crystal River Pressurizer Surge Line Program and B&W Owners Group Program Status

LOCATION: Babcock & Wilcox, Lynchburg, VA

DATE: April 4, 1990

PARTICIPANTS: NRC, Florida Power Co., and B&W Owners Group (See Attachment 1)

The purpose of this trip was to update the status of the B&W Owners Group (B&WOG) Program on Pressurizer Surge Line Thermal Stratification and to initiate the audit of the Crystal River Program. B&WOG had submitted a bounding evaluation report (BAW-2085) in May 1989, to justify continued near term operation. A long term program is under way to justify operation for the remaining life of the plants. This program is scheduled to be completed by December 1990.

Crystal River was selected for NRC audit as a typical B&W plant relying primarily on the B&WOG program to respond to the Bulletin 88-11 requirements. Technical discussions and document reviews on the B&W information applicable to this plant, were initiated. Due to time constraints, B&W was asked to provide a sample of detailed calculations for later review. The Crystal River audit will continue at the plant site next month.

A copy of the meeting presentation slides is included as Attachment 2. Highlights of the audit are presented below.

B&WOG Long Term Program

- The program will evaluate the surge line to justify long term operation, update the design documentation, and develop operating guidelines to reduce frequency and severity of thermal cycling.

- Test data on thermal striping from the German HDR Project was purchased from Battelle-Frankfurt. B&W found this data to be the most applicable to surge lines and will use it to refine their thermal striping input to the final analysis.

- A thermal stratification algorithm based on Oconee monitoring data has been developed to predict thermal hydraulic conditions in surge line using global plant input.

- A review of operating procedures and practices has been performed by B&W. Recommendations for operational changes have been developed and will be reviewed by the B&WOG Operator Support Committee.

- Development of new surge line design transients based on operating history, operating procedures, and algorithms for thermal stratification and thermal striping will provide output in a usable format for structural analysis of surge line.

Review of Calculations

Calculation methods and assumptions used in the bounding analysis were discussed. The bounding analysis relied primarily on monitoring data taken at the German Muelheim-Kaerlich (M-K) Plant to define stratification transients. A flowchart of the bounding analysis which identified the important calculations was provided. Due to the time constraints and the complexity of the subject, B&W was asked to provide the calculations for further detailed review. Highlights of the discussions are listed below:

- The analysis assumed only three cycles during heatup and one cycle during cooldown. This was based on an envelope of measurements at M-K. The enveloping of amplitudes seemed conservative but it was noted that several smaller amplitude cycles were ignored. This needs further review.

- Normal and upset transient cycles were not included in the bounding analysis. The adequacy of assuming that these cycles are not significant needs to be verified.

- A verification analysis using the Oconee heatup data (28 cycles of lower ΔT) and the same single cooldown cycle resulted in a lower fatigue usage factor.

- A 1.25 factor was applied in the verification analysis to adjust for the nonlinear temperature profile. The original analysis which used the M-K data assumed a linear temperature profile which may be unconservative.

- Thermal striping was based on a 45% ΔT at the pipe wall and 0.25 Hz frequency. This was based on a conservative interpretation of striping data from various sources.

- The thermal striping stress analysis is based on a one dimensional model (equal temperature around the circumference). The adequacy of the model was questioned. This needs further review.

- An ANSYS piping model was used in the thermal stratification analysis. It appears that local stresses at the hot to cold fluid interface were not considered. This needs further review.

Additional Discussion Items

- Pipe displacements were never checked to verify that spring hangers and snubbers do not bottom out. The Licensee stated that the inspection of the line indicated no damage but conceded that inspection is probably not sufficient to demonstrate that bottoming out did not occur. The Licensee was asked to provide displacement data from bounding analysis at the upcoming site audit.

- The effect of thermal stratification on pipe break locations and on faulted conditions was questioned. The Licensee will address this during site audit.

- The Licensee was cautioned not to mix Code versions. The Licensee will perform a Code reconciliation.

- A comparison of Crystal River to Oconee support configurations showed that Crystal River has three snubbers and three spring hangers while Oconee has only three snubbers. Since the analysis is based on Oconee, it was not clear that the supports were properly considered. The Licensee was asked to provide the stress report at the site audit.

Items to be Reviewed at Site

The Licensee was asked to provide the following items for NRC review at the site audit:

- Operating procedures and records including operating logs. An operations supervisor should be available to discuss and answer questions.

- Surge line deflections for comparison with allowables.

- Surge line pipe stress report.

- Pipe support calculations.

- Surge Line QA/QC drawings.

- Surge Line should be accessible for NRC inspection if possible.

Conclusions and Recommendations

The B&WOG long term program is well under way The thermal hydraulic work is nearly complete and the structural evaluation is starting. Program completion is scheduled for the end of this year. B&W has apparently performed a considerable amount of work to refine their methodology for predicting thermal stratification and thermal striping. B&W suggested additional meetings with NRC to discuss these topics in depth. Based on the importance of these parameters and the complexity of the subject, further meetings are advisable.

A review of the B&WOG bounding analysis identified several areas of concern. B&WOG indicated that all our concerns will be addressed in the forthcoming final report. The staff asked B&WOG to provide selected calculations for more detailed review. B&W requested that these reviews be performed in their offices. It is recommended that these review meetings be scheduled in the near future.

Additional questions regarding how to apply results of the generic bounding analysis to the Crystal River Plant were raised. The Licensee was asked to provide additional plant-specific information during the upcoming site audit. The requested information includes surge line drawings, pipe stress reports, pipe support calculations, pipe deflections, operating procedures and operating records.

ATTACHMENT 1

Audit Meeting Attendees

APRIL 4, 1990 - LYNCHBURG, VA

NRC AUDIT OF NRCB 88-11 ISSUES - CRYSTAL RIVER

BWOG STATUS REPORT - SURRY LINE

Name	Company	Phone
Bill Gray	BWNS	804-385-2783
MARK CISNEROS	APSL	(501) 377-4335
SARITA BRONER	NRC	(301) 492-3270
Tad Marsh	NRC	(301) 492-0902
Shou-nien Hou	NRC/EMEB	(301) 492-0904
Giuliano DeGrassi	NRC/BNL	(516) 282-2949
JIM TAYLOR	B&W	804-385-2817
ALI HAGHI	Duke Power	(704) 373-4060
CHRIS DOYEL	FPC	(813) 866-44-68
Charles Tally	B&W	(804) 385-2883
HARRY J. CORDLE	TOLEDO EDISON	(419) 321-7712
W. D. Maxham	B+W	804-385-2293
Ed FROATS	FPC	(813) 866-4412

ATTACHMENT 2

Meeting Presentation Slides

STATUS OF B&W OWNERS GROUP
SURGE LINE THERMAL STRATIFICATION PROGRAM
SUPPORTING DECEMBER 1990 TOPICAL REPORT SUBMITTAL

OVERVIEW OF PRESENTATION

- OBJECTIVES OF PROGRAM
- TECHNICAL APPROACH
- PROGRAM PLAN/TASK INTEGRATION
- DESCRIPTION OF KEY TASKS (EMPHASIS ON ONGOING WORK)
- SUMMARY

PRESSURIZER SURGE LINE THERMAL STRATIFICATION PROGRAM OBJECTIVES

- PERFORM ENGINEERING EVALUATIONS TO SUPPORT LONG TERM OPERATION OF THE SURGE LINE.

- ASSESS THE NEED FOR DEVELOPING OPERATOR GUIDELINES TO REDUCE THE FREQUENCY AND SEVERITY OF THERMAL CYCLING IN THE SURGE LINE; PROVIDE THOSE GUIDELINES AS NECESSARY.

- UPDATE THE SURGE LINE DESIGN DOCUMENTATION TO ACCOUNT FOR THERMAL STRATIFICATION AND THERMAL STRIPING PHENOMENA.

PRESSURIZER SURGE LINE THERMAL STRATIFICATION
TECHNICAL APPROACH

ISSUES TO BE ADDRESSED

- THERMAL CYCLING IN SURGE LINE AND ITS NOZZLES
- THERMAL STRATIFICATION
- THERMAL STRIPING IN HORIZONTAL RUNS

KEY ELEMENTS

- GENERIC APPROACH FOR 177 FA PLANTS
- OPERATIONAL EXPERIENCE OF PLANTS
- TEST DATA/MEASUREMENTS FROM OCONEE UNIT 1
- STRIPING TEST DATA FROM BATTELLE LABS
- NEW DESIGN BASES FOR SURGE LINE
- COMPLETE STRUCTURAL ANALYSES FOR SURGE LINE

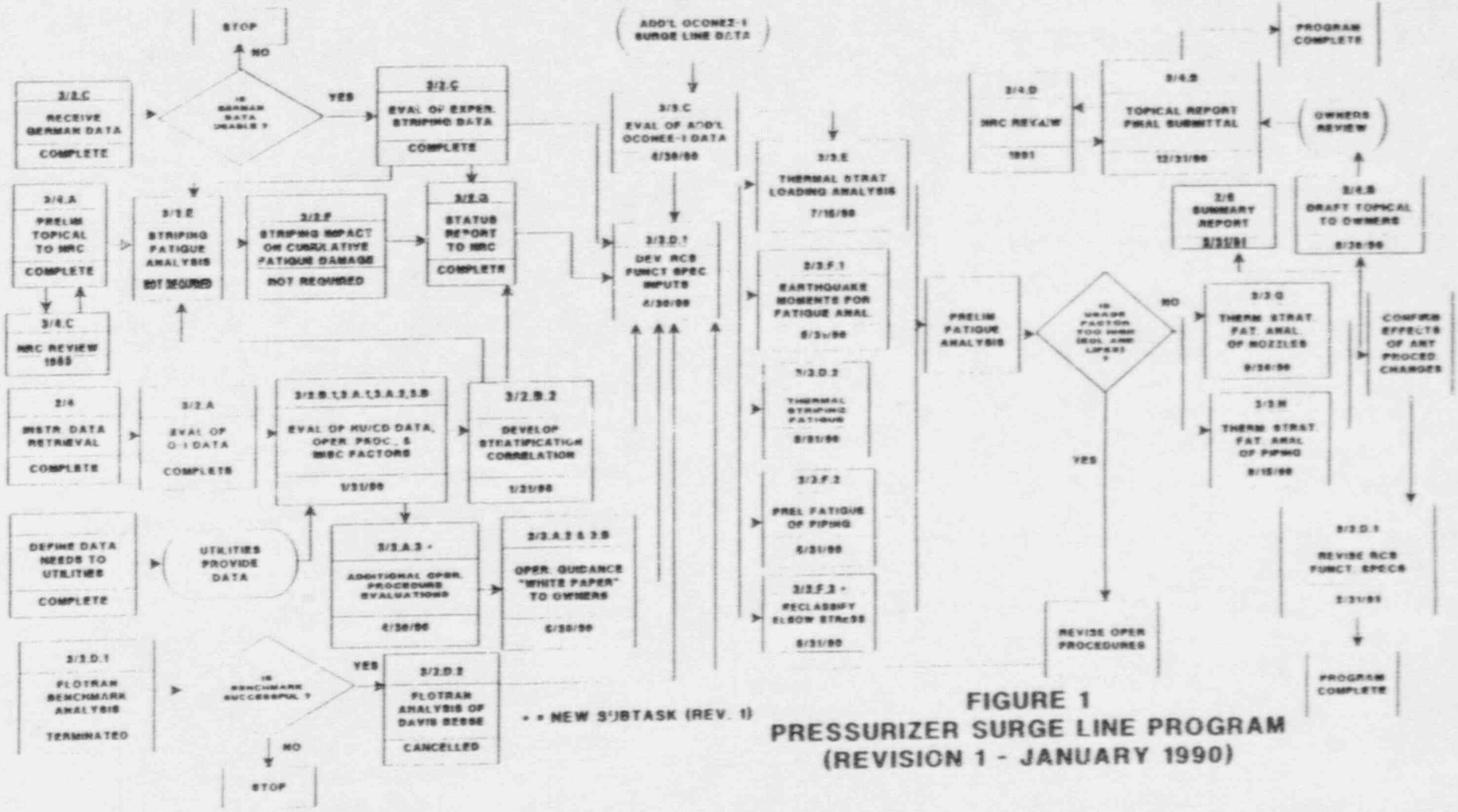


FIGURE 1
PRESSURIZER SURGE LINE PROGRAM
(REVISION 1 - JANUARY 1990)

PRESSURIZER SURGE LINE THERMAL STRATIFICATION
DESCRIPTION OF KEY TASKS

THERMAL STRIPING EVALUATION

- DETAILED LITERATURE SEARCH & EVALUATION OF AVAILABLE EXPERIMENTAL DATA
- DIRECT CONTACT WITH RESEARCHERS AT ANL & BATTELLE FRANKFURT
- PURCHASE AND EVALUATION OF BATTELLE DATA
- KEY PARAMETERS OF INTEREST, CORRELATED IN THIS WORK, ARE:
  - FREQUENCY OF HOT/COLD INTERFACE OSCILLATION
  - AMPLITUDE OF OSCILLATION RELATIVE TO THE TOP-TO-BOTTOM TEMPERATURE DIFFERENTIAL
  - LOCATION OF HOT/COLD INTERFACE (ELEVATION IN HORIZONTAL PIPE)
  - TEMPERATURE GRADIENT IN REGION OF HOT/COLD INTERFACE
  - RELATIONSHIP OF THE ABOVE PARAMETERS TO GLOBAL SURGE LINE CONDITIONS SUCH AS THE DIRECTION AND MAGNITUDE OF THE SURGE LINE FLOW RATE AND THE ENDPOINT TEMPERATURES.
- ALL STRIPING EVALUATION WORK IS COMPLETE.
- COMPARISONS WITH ASSUMPTIONS MADE IN BAW-2085 SHOW THAT THE BAW-2085 ASSUMPTIONS WERE QUITE CONSERVATIVE.
- FINAL ANALYSIS IS EXPECTED TO SHOW THAT THERMAL STRIPING HAS A MINOR IMPACT ON SURGE LINE FATIGUE.

PRESSURIZER SURGE LINE THERMAL STRATIFICATION
DESCRIPTION OF KEY TASKS

INSTRUMENTATION OF REPRESENTATIVE PLANT

- SURVEY FOR BAW-2085 SHOWED THAT ALL B&W LOWERED LOOP PLANTS ARE IDENTICAL IN SURGE LINE CONFIGURATION AND SIMILAR IN INSULATION AND SUPPORTS.

- DUKE POWER VOLUNTEERED TO HAVE OCONEE UNIT 1 INSTRUMENTED IN JANUARY 1989. INITIAL DATA COLLECTED IN FEBRUARY 1989. TO DATE, TWO HEATUPS AND ONE COOLDOWN HAVE BEEN RECORDED AND EVALUATED.

- MAJOR OBSERVATIONS FROM THE OCONEE MEASUREMENTS:

  - THERMAL STRATIFICATION IS MAXIMUM IN THE HORIZONTAL RUN JUST DOWNSTREAM OF THE PRESSURIZER.
  - THERMAL CYCLES ARE THE DIRECT RESULT OF REPETITIVE INSURGES AND OUTSURGES, MOST OF WHICH CAN BE TRACED TO OPERATOR OR CONTROL SYSTEM ACTION.
  - SURVEILLANCE TESTING OF THE HPI PUMP SUCTION LINE CHECK VALVES CAUSED THE LARGEST THERMAL CYCLES.
  - THE LARGEST THERMAL CYCLES TAKE PLACE EARLY IN PLANT HEATUP, BEFORE THE FIRST REACTOR COOLANT PUMP IS STARTED.
  - OPERATION OF FULL PRESSURIZER SPRAY FLUSHES THE ENTIRE SURGE LINE AND RESULTS IN NEGLIGIBLE STRATIFICATON ($< 20^{o}F$).
  - STRATIFICATION DURING POWER OPERATION DID NOT EXCEED $80^{o}F$ WITH THE TOP OF THE SURGE LINE REMAINING NEAR $600^{o}F$.

PRESSURIZER SURGE LINE THERMAL STRATIFICATION
DESCRIPTION OF KEY TASKS

DEVELOPMENT OF THERMAL STRATIFICATION CORRELATION

- OBJECTIVE: DEVELOP METHOD TO PREDICT THERMAL-HYDRAULIC CONDITIONS IN THE SURGE LINE IMPORTANT IN DETERMINING THE STRESS CONDITIONS, USING GLOBAL PLANT INPUT.

- REQUIRED OUTPUT:

  - SIGNIFICANT TOP-TO-BOTTOM TEMPERATURE DIFFERENCES
  - TRENDS OF SYSTEM PRESSURE
  - LOCATION AND MAGNITUDE OF TEMPERATURE GRADIENT
  - STRIPING
    - AMPLITUDE
    - NUMBER OF CYCLES/FREQUENCY
    - COICIDENCE WITH TOP-TO-BOTTOM TEMPERATURE DIFFERENCES

- ALGORITHM HAS BEEN DEVELOPED AND CHECKED AGAINST OCONEE MEASUREMENTS FOR WIDELY VARYING SURGE LINE CONDITIONS.

  - ALGORITHM OVERPREDICTS THE SEVERITY OF CONDITIONS AND IS THEREFORE PROVIDES A CONSERVATIVE ESTIMATE OF ACTUAL SURGE LINE CONDITIONS.

- WORK IS CURRENTLY BEING REVIEWED; ALL RESULTS MUST BE CONSIDERED PRELIMINARY.

PRESSURIZER SURGE LINE THERMAL STRATIFICATION
DESCRIPTION OF KEY TASKS

REVIEW OF OPERATING PROCEDURES AND OPERATOR PRACTICES

- FOCUS IS ON OPERATOR-INDUCED CAUSES OF SURGE LINE THERMAL CYCLING AND HOW TO REDUCE THEM.
- OPERATING PROCEDURES AND OPERATOR PRACTICES HAVE BEEN REVIEWED AT EACH SITE BY A SENIOR COGNIZANT ENGINEER.
- PRIMARY ATTENTION IS ON:
  - REDUCTION OF PRESSURIZER TO LOOP TEMPERATURE DIFFERENTIAL EARLY IN PLANT HEATUP, AND
  - ELIMINATION OR REDUCTION OF RCS INVENTORY UPSETS EARLY IN PLANT HEATUP.
- TASK IS IN PROGRESS:
  - RECOMMENDATIONS FOR OPERATIONAL CHANGES ARE IN DEVELOPMENT.
  - THE OWNERS GROUP'S OPERATOR SUPPORT COMMITTEE WILL REVIEW RECOMMENDATIONS PRIOR TO FORMAL RELEASE FOR UTILITY IMPLEMENTATION.
  - DESIGN BASIS TRANSIENT DESCRIPTIONS FOR FUTRE EVENTS WILL ACCOUNT FOR THESE CHANGES - ASSUMED TO BE IN PLACE IN CALENDAR 1991.

PRESSURIZER SURGE LINE THERMAL STRATIFICATION
DESCRIPTION OF KEY TASKS

DEVELOPMENT OF NEW SURGE LINE DESIGN TRANSIENTS

0 BASES:

- OPERATING HISTORY OF PLANTS
- REVIEW OF OPERATING PROCEDURES TO DETERMINE MECHANISMS OF THERMAL CYCLING
- OCONEE UNIT 1 DETAILED SURGE LINE DATA
- CORRELATION OF SURGE LINE CONDITIONS TO GLOBAL PLANT CONDITIONS
- THERMAL STRIPING ALGORITHM

0 TWO-STEP PROCESS USED

- DEFINE OVERALL PLANT CONDITIONS FOR IMPORTANT TRANSIENTS (CONVENTIONAL PRESSURE, TEMPERATURE, RC PUMP STATUS VERSUS TIME DESCRIPTIONS).
  - HEATUP
  - COOLDOWN
  - STEADY STATE AT POWER
  - OTHER EVENTS
- USE PREVIOUSLY DEVELOPED CORRELATION AND ALGORITHM TO DEVELOP DETAILED SURGE LINE FLUID CONDITIONS.
  - STRATIFICATON
  - STRIPING

0 PROVIDE OUTPUT IN USABLE FORMAT FOR STRUCTURAL ANALYSIS OF SURGE LINE AND NOZZLES.

0 TASK IS IN PROGRESS.

PRESSURIZER SURGE LINE THERMAL STRATIFICATION
SUMMARY

- O B&WOG PROGRAM COMPREHENSIVELY ADDRESSES BULLETIN 88-11 REQUIREMENT TO UPDATE SURGE LINE DESIGN BASIS.

- O PROGRAM WILL RESULT IN OPERATIONAL CHANGES AT EACH PLANT TO REDUCE THE SEVERITY OF THERMAL CYCLING.

- O AFFECTED DESIGN DOCUMENTATION WILL BE UPDATED.

- O TOPICAL REPORT TO NRC WILL BE COMPLETED IN DECEMBER OF THIS YEAR.

BEFORE APRIL 1989 (meeting with NRC)

Use M-K Stratification Data
for Top-to-Bottom Temperature Data
and Number of Cycles

Use 2*Sb, in place of 3*Sm
for Equ. 10 and 12
(Sb = 2*Sa at 10^6 Cycles)

POST-APRIL 1989 (meeting with NRC)

Release of BAW-2085 in MAY 1989

Discussion of 2*Sb added in Appendix
Striping Evaluation Added
Oconee Data evaluated for Fatigue

QUESTIONS
(relative to BAW-2085)

Phase 1: Telephone Call with NRC

Phase 2: Formal NRC-Transmittal
Responses from BWOG

Phase 3: Final Question answered:
Fatigue Analysis using Oconee Data
is bounded

CMTR 3•Sm allowable
NB-3685.1-2 stress indices
(confirmed by Finite Element Stress)

Aside: a review of available test data was made.
It showed that 2•Sb limit is reasonable.

CONCLUSION

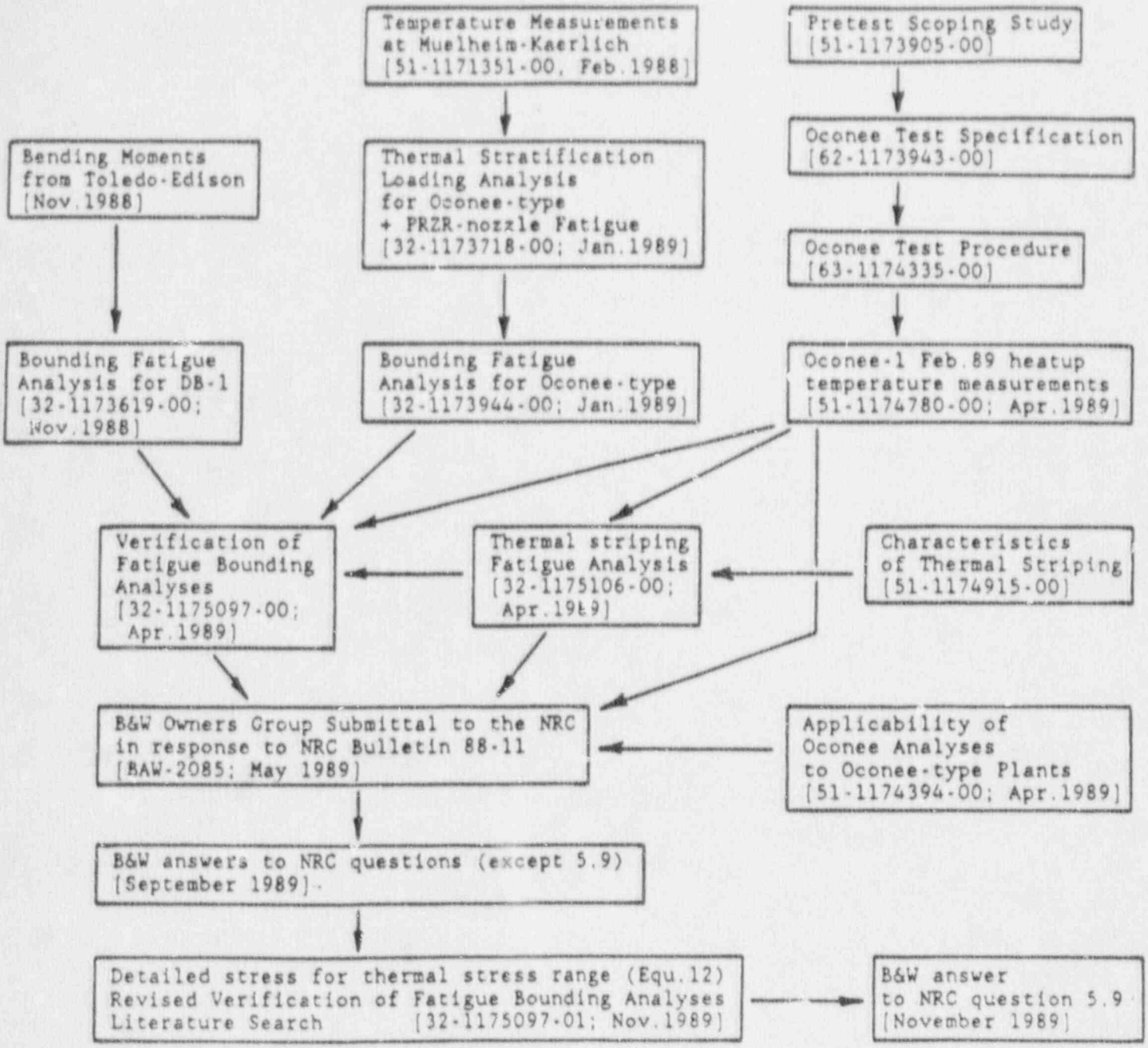
Appendices have been added

Questions have been answered

The original Fatigue Usage in BAW-2085 has been shown to be bounding

Handout

SURGE LINE THERMAL STRATIFICATION [Nov.1988 - Nov.1989]



ENCLOSURE 2

AUDIT TRIP REPORT

PURPOSE:	Audit of Crystal River Unit 3 on Bulletin 88-11 Issues (Pressurizer Surge Line Thermal Stratification).
LOCATION:	Crystal River Plant, Red Level, Florida
DATES:	May 1-2, 1990
NRC PERSONNEL:	S. N. Hou (NRC), S. Brewer (NRC), G. DeGrassi (BNL)
LICENSEE PERSONNEL:	J. S. Tunstill (FPC), E. E. Froats (FPC), C. B. Doyel (FPC), E. J. Gallion (FPC).

1.0 INTRODUCTION

The purpose of this audit was to review the implementation and results of the Licensee's program to address Bulletin 88-11 issues regarding pressurizer surge line thermal stratification. The bulletin requested all PWR Licensees to establish and implement a program to confirm pressurizer surge line integrity in view of the occurrence of thermal stratification and inform the staff of the actions taken to resolve this issue. Licensees of operating PWRs were requested to take the following actions:

1. Conduct a visual inspection of the surge line to determine any gross discernable distress or structural damage in the piping and its supports.

2. Demonstrate that the surge line meets the applicable design codes, FSAR and regulatory commitments by performing a plant specific or generic bounding analysis concerning the phenomena of thermal stratification and thermal striping.

3. If the requirements and licensing commitments are not met for the remaining life of the plant, a justification for continued operation must be submitted and plant specific data on thermal stratification, thermal striping, and line deflections must be obtained. The data may be obtained through collective efforts, such as from other plants with a similar surge line design.

4. Based on the applicable data, the stress and fatigue analyses are to be updated to ensure compliance with applicable Code requirements.

Florida Power Corporation (FPC) performed the inspection on December 31, 1988 and found no signs of distress. The bounding analysis was performed as part of the B&W Owners Group (B&WOG) Program on surge line stratification. FPC submitted the B&WOG Report, BAW-2085, to NRC on June 1, 1989. The report presented the results of the bounding analysis to justify continued operation of the plant until the final program results are available. The analysis concluded that the most limiting B&W plant can operate for at least five more years without fatiguing the surge line to the Code limit. As part of the B&WOG program, thermal stratification data is being taken at a typical B&W plant (Oconee Unit 1). The long term program which is scheduled to be completed by the end of this year will refine the analysis to demonstrate Code compliance for the remaining life of the plant.

This audit was conducted to review the Crystal River Unit 3 (CR-3) program in detail. A copy of the NRC audit agenda is included in Attachment 1. A number of generic items including the bounding analysis methods and models were discussed during a previous meeting at B&W offices on April 4, 1990. A summary of that audit was documented in a separate report. The site audit focussed on plant-specific items including operating procedures and records, surge line drawings, pipe stress reports, pipe support calculations, pipe deflections, and a surge line inspection. The audit included discussions with FPC personnel, document reviews and a walkdown of the surge line. A list of audit participants and exit meeting attendees is included in Attachment 2.

2.0 AUDIT SUMMARY

The following is a summary of the information obtained during the audit through our discussions and document reviews:

2.1 Operating Records and Procedures

Information on the temperature differential (ΔT) between the Pressurizer and the Hot Leg was needed to assure that the B&WOG bounding analysis assumptions were applicable to CR-3. The bounding analysis used a maximum ΔT of 422°F which was based on measurements taken at the German Muelheim-Kaerlich (M-K) Plant. A CR-3 Nuclear Shift Supervisor, Ernie Gallion, discussed operating procedures and surveillance procedures with the audit team. Mr. Gallion stated that Plant Technical Specifications limit the ΔT to 410°F. According to his recollection, he believed that ΔT's as high as 400°F had been observed in the past during heatups and cooldowns. However, because of administrative limits imposed a few years ago, the operators try to maintain a maximum ΔT of 250°F. The basis for the ΔT limits are to limit thermal shock to the pressurizer spray nozzle. The Licensee was asked to provide the documentation defining the administrative limit of 250°F.

Operating procedures OP-202 for Plant Heatup and OP-209 for Plant Cooldown were provided. One of the limits and precautions stated, "Unless required for plant safety, do not operate pressurizer spray valve during heatup unless ΔT is $\leq 250°F$." The audit team interpreted this statement as a limit on the use of pressurizer spray instead of a ΔT limit but the Licensee argued that the plant operators interpret this as a ΔT limit.

An additional limitation of ΔT is imposed by the maximum pressure versus temperature limit curves which are based on NDT limits. Based on current limits, the Licensee showed that the ΔT cannot exceed approximately 280°F. However, earlier curves permitted larger ΔTs. FPC is performing a calculation to define the maximum permissible ΔT based on the earlier curves. Preliminary results indicate a maximum ΔT of 399°F for heatup and 388°F for cooldown.

Mr. Gallion also discussed and provided procedures for heatup and cooldown surveillance (SP-422) and documentation of allowable operating transient cycles (SP-296). Procedure SP-422 requires recording loop and pressurizer temperatures every 30 minutes during heatups and cooldowns and provides forms to record the information. The audit team asked for sample logs of this information over different time periods to determine maximum ΔTs that had been recorded. A sample log is included in Attachment 4. A quick review did not reveal any ΔTs exceeding 300°F.

Surveillance procedure SP-296 gives procedures and forms for documenting allowable operating transient cycles. A review of the most recent logs indicated that CR-3 had experienced a total of 554 heatup/cooldown cycles as of February 1990. It was noted that this number did not agree with the number of heatup/cooldown cycles given in the B&WOG report (29 cycles). Although the number of cycles is still lower than the limiting number from the report (135), the discrepancy raises questions regarding the credibility of the information in the report. The Licensee was asked to explain the difference.

2.2 Surge Line Design and Inspection

During the April meeting at B&W, several questions were raised regarding the surge line configuration and support arrangement. The B&WOG bounding analysis was based on the Oconee design which was stated to be representative of nearly all B&W plants including CR-3. A review of the B&W information indicated that while the piping layout was similar, the pipe supports were different. Oconee has three snubbers while CR-3 has three snubbers plus three spring hangers. Furthermore, the locations of the supports could not be determined from the drawings. As a result, FPC was asked to provide the latest QA/QC surge line drawings for review at the site.

The Licensee provided two drawings of the reactor coolant system which were recently revised to indicate the location of the pressurizer surge line supports. The drawings indicated that the support locations were based on a recent walkdown. A piping isometric drawing was not available but the Licensee provided an isometric sketch which was made up recently (see Attachment 3). However, the original surge line isometric drawing was subsequently found and reviewed by the staff three months after the audit. FPC also provided pipe support drawings for the three spring hangers and three snubbers (see Attachment 3). These drawings were indicated as "as-built" drawings.

FPC provided a copy of the inspection report which was performed to satisfy the Bulletin 88-11 inspection requirement. The visual inspection was performed in accordance with ASME XI, VT-3 requirements and concluded that there are no signs of distress or structural damage. The inspection report was found to be acceptable.

The NRC audit team conducted a plant walkdown to inspect the pressurizer surge line. Due to high radiation, access to the area was limited. The team was able to view the line from a platform located about eight feet from pipe support RCH-44. From this area, the horizontal routing of the line and the supports from the pressurizer nozzle to hot leg were visible. The vertical riser and support RCH-46 were behind the hot leg and could not be seen from the observation platform. Although the audit team inspection was limited by distance and pipe insulation, the piping configuration and support arrangement were confirmed and no obvious signs of damage were seen. The audit team also noted that there was adequate vertical clearance to accommodate pipe movement due to thermal stratification. There were no pipe whip restraints or other structures which could interfere with the pipe. Since no pipe whip restraints were seen, the Licensee was asked how the plant is designed for pipe breaks. The licensee couldn't provide an explanation.

2.3 Surge Line Calculations

During the April meeting at B&W, questions were raised regarding the acceptability of stratification-induced deflections versus limits of travel and loads on spring hangers and snubbers as well as proper consideration of all loads including deadweight, seismic and normal thermal loads. FPC was asked to provide the original pipe stress report, pipe support calculations and evaluation of bounding deflections versus allowables.

The Licensee informed the audit team that pipe support calculations could not be found. Some of the support drawings indicated support load values for standard components (spring hangers). However, there was no documentation on the source of the loads or on the adequacy of the supporting steel, welds or anchor

bolts. The Licensee could not explain how the support adequacy was verified during the NRC Bulletin 79-14 program.

The Licensee provided the original pipe stress report for review. This report had been prepared by B&W in March 1974. The piping was originally analyzed for pressure, deadweight, thermal expansion and seismic loads in accordance with the USAS B31.7 (1969) Code. Computer analysis had been performed to demonstrate that the piping met Code allowables for primary stress (eq. 9), primary + secondary stress (eq. 10), and peak stress for fatigue evaluation (eq. 11). The piping model had three snubbers and no spring hangers. Since the spring hangers could be expected to reduce the deadweight stresses and not have a significant effect on thermal expansion and seismic stresses, the model appears conservative. The seismic response spectrum used in the analysis was stated to be more conservative than the CR-3 response spectrum. The fatigue usage calculation considered 1300 cycles of OBE which seemed conservative but it was not clear whether thermal transients were considered. This should be verified in the final analysis. The calculation did not provide support loads. As discussed above, the source of the support loads is unknown and remains to be resolved. It was also noted that the piping contained welded attachments for axial supports which were not evaluated in the analysis. The adequacy of the welded attachments remains to be demonstrated.

FPC provided a recent calculation to demonstrate the adequacy of the surge line deflections due to thermal stratification. This calculation was generated in response to the questions raised at the B&W meeting. The calculation compared displacements from the B&W bounding analysis with the manufacturer's specified travel range for the spring hangers and snubbers. Displacement perpendicular to the support was also checked to demonstrate that the angle does not exceed a 4° tolerance. The methodology and results were found to be acceptable. However, the source of the displacements (B&W document No. 86-1178976-00, "Thermal Stratification - Surge Line Displacements", dated 4/18/90) was not available for review. It remains to be to be verified that the displacements are indeed based on the bounding analysis conditions.

3.0 SUMMARY OF AUDIT FINDINGS AND ITEMS OF STAFF CONCERN

The following is a summary of the findings and items of staff concern from the site audit:

- Pressurizer to Hot Leg ΔT is limited to 410°F by Technical Specifications. The Licensee stated that operators try not to exceed a 250°F ΔT and a sample review of operating logs did not reveal a ΔT of greater than 300°F. The B&W bounding analysis used a maximum ΔT of 422°F which bounds the Technical Specification limits. However, B&W may need to lower the ΔT

for the long term resolution. If that occurs, the Licensee will need to ensure that CR-3 is operating within limits including a complete review of operating logs to demonstrate applicability.

- The CR-3 operating logs indicated a total of 55¼ heatup/cooldown cycles. The B&WOG bounding analysis report indicated only 29 cycles. An explanation for this discrepancy is needed.

- The Licensee was not able to provide pipe support calculations. Support loads were indicated on three of the six support drawings, but the source of the loads was not documented.

- A review of the original pipe stress report raised questions regarding proper consideration of thermal transient cycles in the fatigue analysis. In addition, the design adequacy of welded attachments for supports RCH 46 and RCH 49 was not demonstrated.

- The surge line does not have any pipe whip restraints. The Licensee was not able to explain how pipe breaks are postulated and designed for.

- The calculation which demonstrated that stratification-induced displacements do not exceed spring hanger or snubber travel limits was generally acceptable but the calculation which documented the source of the displacements was not available.

- The Licensee inspection and the staff walkdown of the surge line did not reveal any problems.

In addition to the site audit findings, there were a number of findings from the April audit at B&W which were documented in a separate report.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The Licensee in conjunction with the B&W Owners Group has defined and implemented a comprehensive program to address the requirements of NRC Bulletin 88-11. The program included a visual inspection of the piping and supports and a bounding analysis to justify continued short term operation of the plant. A refined analysis utilizing surge line stratification data monitored at a simil[illegible] plant is in progress to justify long term operation. This long term program is scheduled for completion by the end of this year.

The NRC staff audits at B&W offices on April 4, 1990, and at the CR-3 site on May 1-2, 1990, identified a number of items of staff concern which must be resolved in the long term program. Items of staff concern due to the CR-3 site audit are summarized in section 3.6 of this report.

ATTACHMENT 1

Audit Agenda

AGENDA

NRC AUDIT OF BULLETIN 88-11 ISSUES

AT CRYSTAL RIVER PLANT

I. AUDIT DISCUSSION ITEMS

A. Surge line inspection results (Site)

B. Corrective actions implemented or planned (Site)

C. Surge line monitoring program and results from Oconee and applicability to Crystal River (Site/B&W)

D. Surge line analysis methods and models (B&W)

1. Transient definition and basis

a. Stratification profiles

b. Striping

2. Piping and support structural analysis

3. Line deflection, thermal gradient and local stresses

4. Stress concentration by weld attachments

E. If Oconee analysis is used for Crystal River, show its applicability. (Site)

F. Code evaluation - Stress and fatigue (Site/B&W)

1. Load, load combination and code allowables

2. Verification of Code compliance

II. DOCUMENT REVIEW

A. Surge line inspection reports (Site)

B. Surge line drawings, including updates to reflect corrective actions (Site)

1. Detailed calculations, including design and modifications of piping and supports
2. Computer models used
3. ASME Code evaluation
4. Deflection assessments to ensure no adverse interaction with other structures and components

D. Monitoring program reports and data (Site/B&W)

E. Other relevant licensee or NSSS reports (Site/B&W)

III. WALKDOWN (Site)

ATTACHMENT 2

Audit Meeting Attendees

5/1/90 NRC BULLETIN 88-11 MEETING

Name	Department
J. W. Tunstill	FPC NUC Licensing
Giuliano DeGrassi	NRC/Brookhaven National Lab
Shou-nien Hou	NRC/NRR/MEB
Sarita Brewer	NRC/NRR/EMEB
E. J. Gallion	FPC-Nuc OPs
E. E. Froats	FPC-Supv., Nuclear Licensing
C. B. Doyel	FPC - Mgr. Mech/Struc. Eng.

5/2/90 NRC BULLETIN 88-11 EXIT MEETING

NAME	TITLE	DEPARTMENT
W. Marshall	Nuc. OPs Super	FPC
Sarah Johnson	Mgr. Site Nuclear Serv.	FPC
W. L.Rossfeld	Mgr. Nuc. Compliance	FPC
E. J. Gallion	NSS	FPC
S. B. Brewer	General Eng.	NRR/EMEB
Shou Hou	Sr. Mech. Eng.	NRR/EMEB
P. Holi s-Ray	Sr. Res. Insp.	NRC
C. B. Doyel	Mgr. Mech./Struc. Eng.	FPC
E. E. Froats	Supv., Nuclear Licensing Eng.	FPC
J. W. Tunstill	Sr. Nuclear Licensing Eng.	FPC
K. R. Wilson	Mgr. Nuclear Licensing	FPC
P. F. McKee	Dir. Nuc. PIant Ops.	FPC
G. DeGrassi	Sr. Research Eng.	NRC/BNL

ATTACHMENT 3

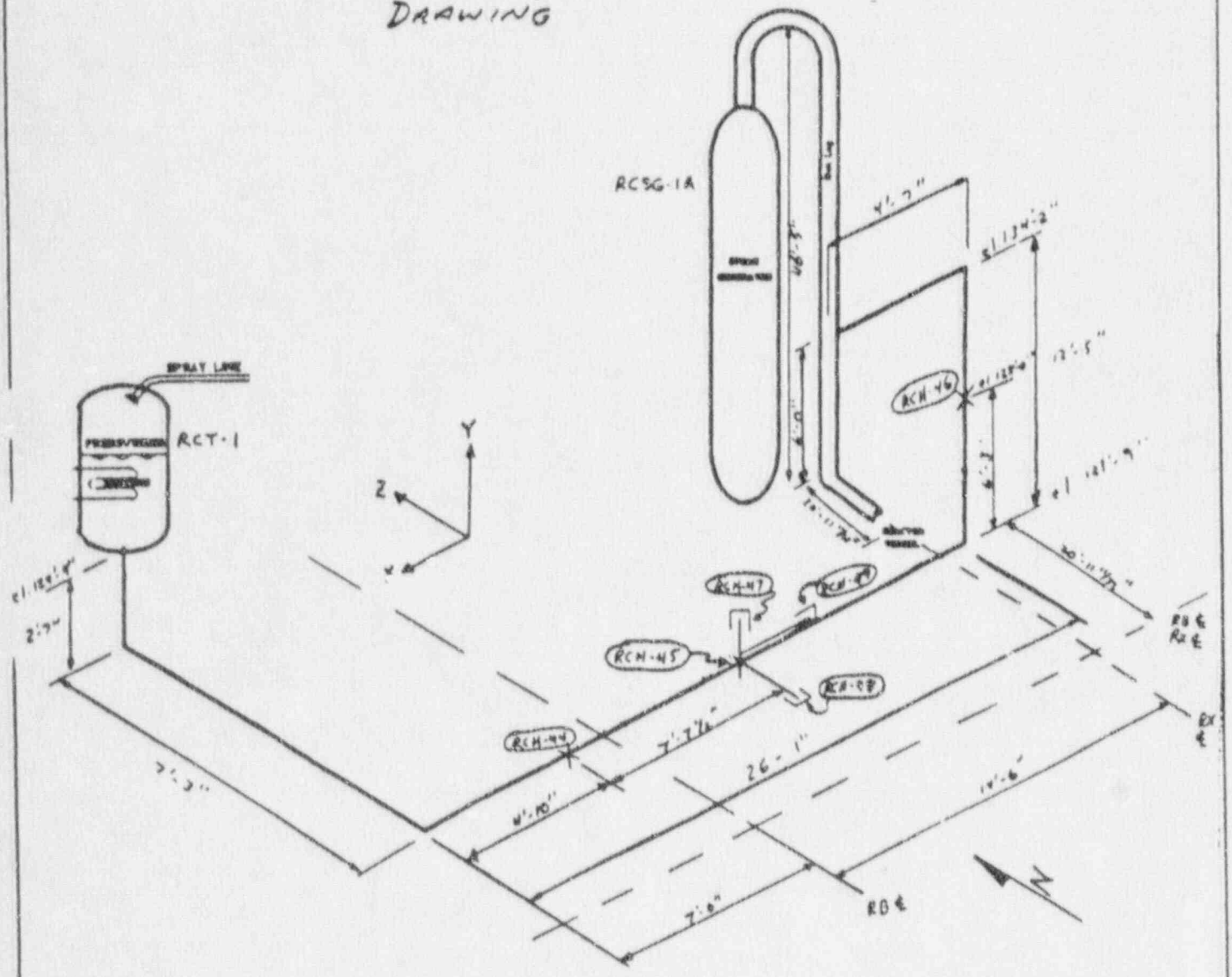
Pipe Support Drawings and

Surge Line Isometric Sketch

MENT IDENTIFICATION NUMBER	REVISION	REI/MAR/SP NUMBER/FILE
M-90-0009	0	SP 89-008

FIGURE 1

10" SURGE LINE
ISOMETRIC
DRAWING



REV-3

Power Piping — POWER PIPING COMPANY
PITTSBURGH, PA. 15233

FLORIDA POWER CORPORATION
CRYSTAL RIVER - UNIT #3
P.O. PR3-1403

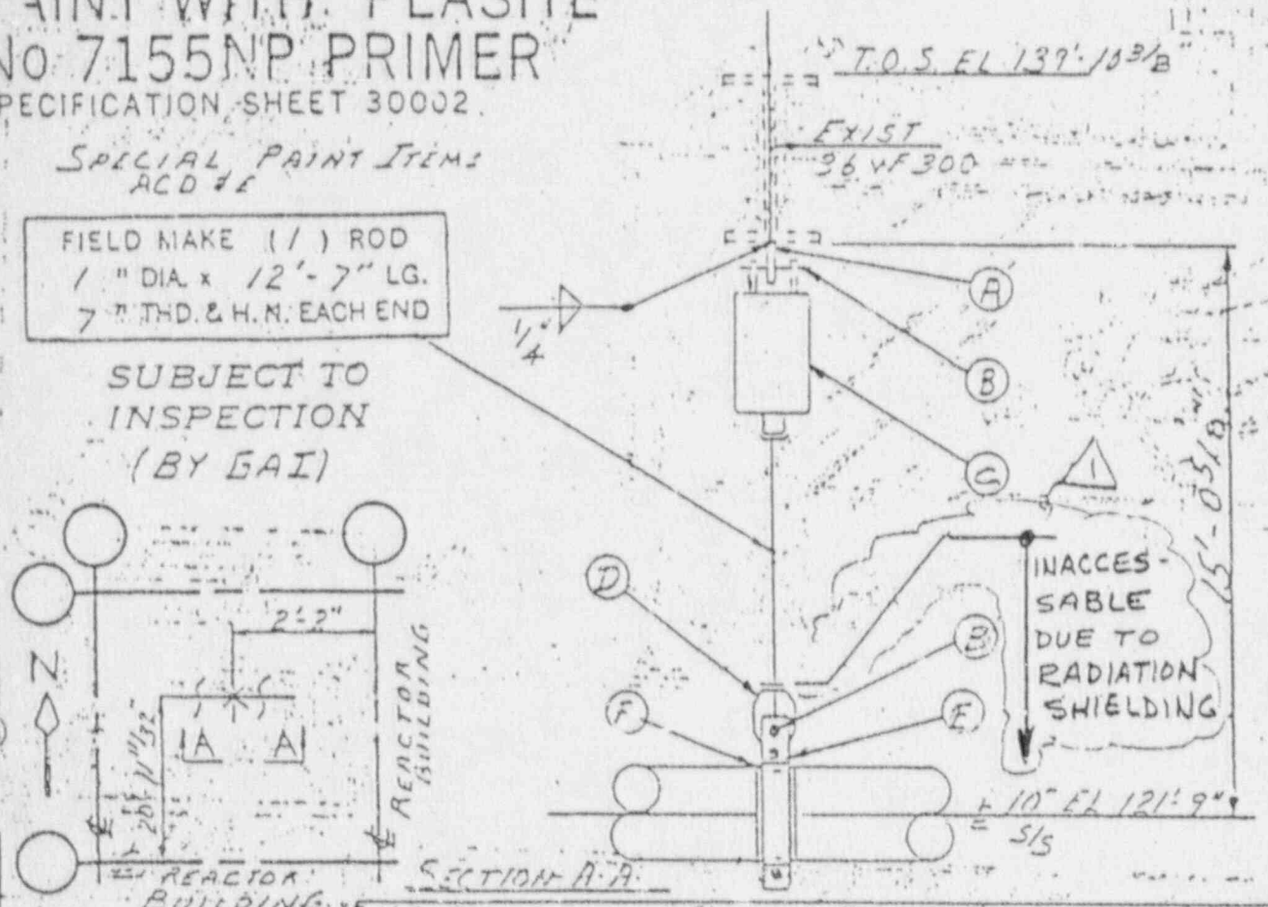
AINT WITH "PLASITE" NO 7155NP PRIMER

SPECIFICATION SHEET 30002.

SPECIAL PAINT ITEMS ACD & E

FIELD MAKE (1) ROD
1" DIA. x 12'-7" LG.
7" THD. & H.N. EACH END

SUBJECT TO INSPECTION (BY GAI)



N	PRESSURIZER SURGE PIPING INSIDE REACTOR BUILDING	1 REQ'D	MK

		ENGINEERING AND BILLING LIST	ASTM	
A	1	1"ϕ HGR ATTACH. PER FIG. 203	S25	
B	2	1"ϕ BOLT x 5" LG - HN & (2) WASHER	301	HF-200
C	1	#610 VARIABLE SUPPORT HGR TYPE "C"		
		LOAD = 2170# INVNT = 0.293 DN		
		SETCOLD = 2043# PROVIDE PRESET		
		BAR & HYDRO STOP		
D	1	1" WELDLESS EYE NUT FIG. 162		
E	1	10" SPECIAL PIPE CLAMP FIG. 222		
		(LESS TOP BOLT)		
F	1	3" x 24 GA STN STL SHEET x 2'-9 1/2" LG	A-240	HF-102
	1	ASSEMBLY		
	1	DETAILING		
		SPECIAL PAINTING - WT = 101#		

REF. DWG HD-321-402
REVISION 1, AS BUILT PER MAP 79-12-71 GEC

DRWN WARNER
CHKD
DATE

AUTH. 3725-M
SHEET 31844

ISSUE --
REV. (1)

PC

8247 62-78-703-44-0

Power Piping

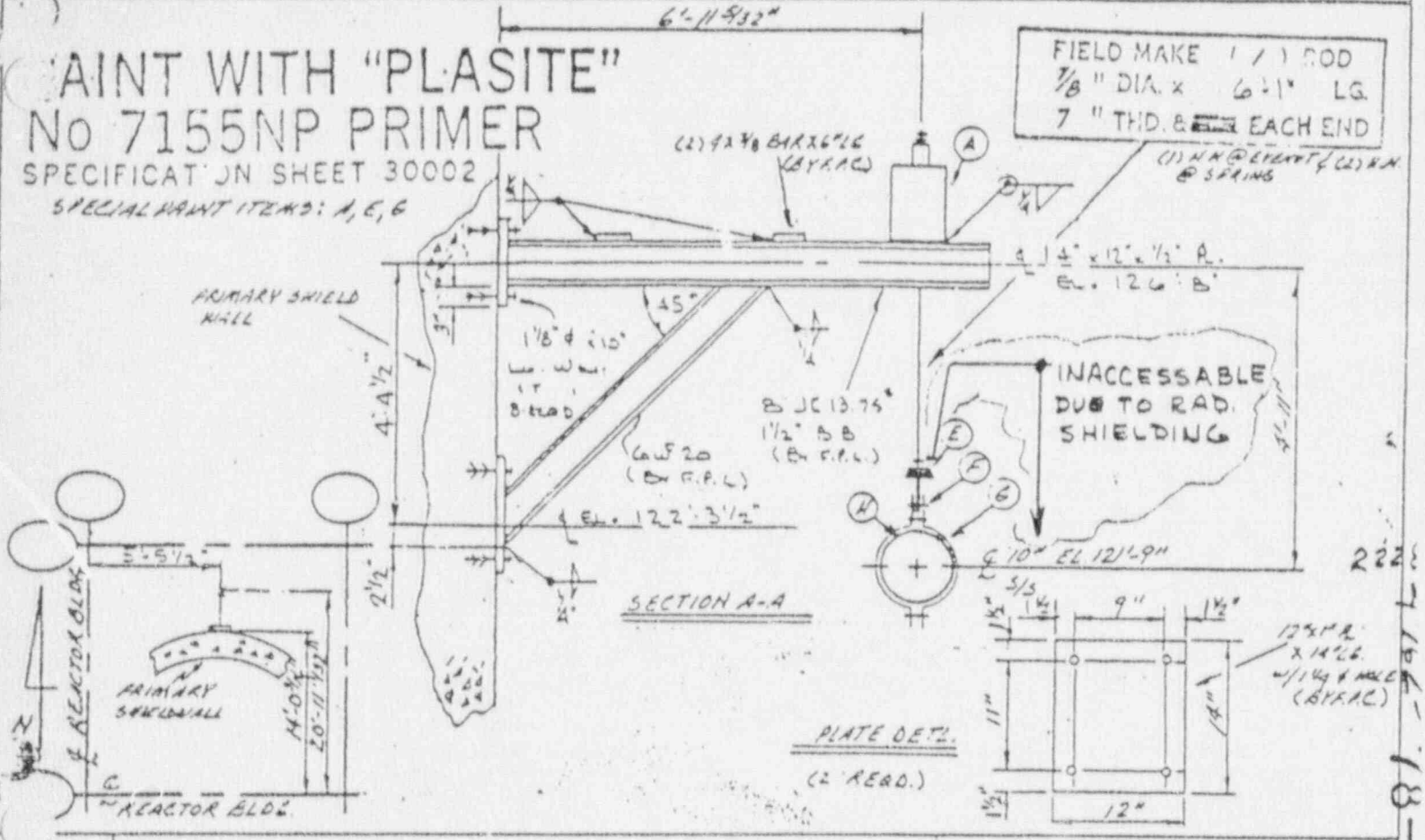
POWER PIPING COMPANY
PITTSBURGH, PA. 15233

FLORIDA POWER CORPORATION
CRYSTAL RIVER - UNIT #3
P.O. PP3-1103

PAINT WITH "PLASITE" No 7155NP PRIMER

SPECIFICATION SHEET 30002

SPECIAL PAINT ITEMS: A, E, G



CL.	N	PIPE SUPPORTS PER SURGE PIPING INSIDE REAC. BLDG.	1 REQD. MK		
○	QUAN.	[X] INSPECTION [ ] HOT & COLD IND. [X] SPECIAL PAINT "PLASITE"	MATL.	MRS	
A	1	#609 VARIABLE SUPPORT HGR. TYPE "D"			
		LOAD = 1565# INVAIT. = 0.346 UP			
		SET COLD = 1670# PROVIDE PRESET BAR & HYDROSTOP			
~~B~~	~~2~~	~~8" x 2 3/4" x 2'-3.75" x 4 1 8 3/4" LG. WT. 12.5#~~	~~A-36~~	~~HF-202~~	
~~C~~	~~8~~	~~5/8" ø x 2 1/2" LG. WT. 1#~~		~~HF-102~~	
~~D~~	~~1~~	~~6" x 6" x 1/2" W 20 x 5'-5 1/2" LG. BUTT END @ EACH END~~	~~A-36~~		
E	1	7/8" WELDLESS EYENUT FIG 162			
F	1	1" ø BOLT x 5" LG. ~ H.N. & (2) WASHERS	A-307	HF-200	
G	1	10" SPECIAL PIPE CLAMP FIG. 222			
		(LESS TOP BOLT) WT. 22#			
H	1	3" x 24 GA. STN/STL SHIELD x 2'-9 1/2" LG.	A-240	HF-102	
~~K~~	~~2~~	~~4" x 2 3/4" BAR x 1'-1" LG.~~	~~A-36~~		
	1	ASSEMBLY			
	1	DETAILING			
		SPECIAL PAINTING TOTAL WT. 351#			
		REV. 4 - AS BUILT PER MAR 7911 2.7 PPC			

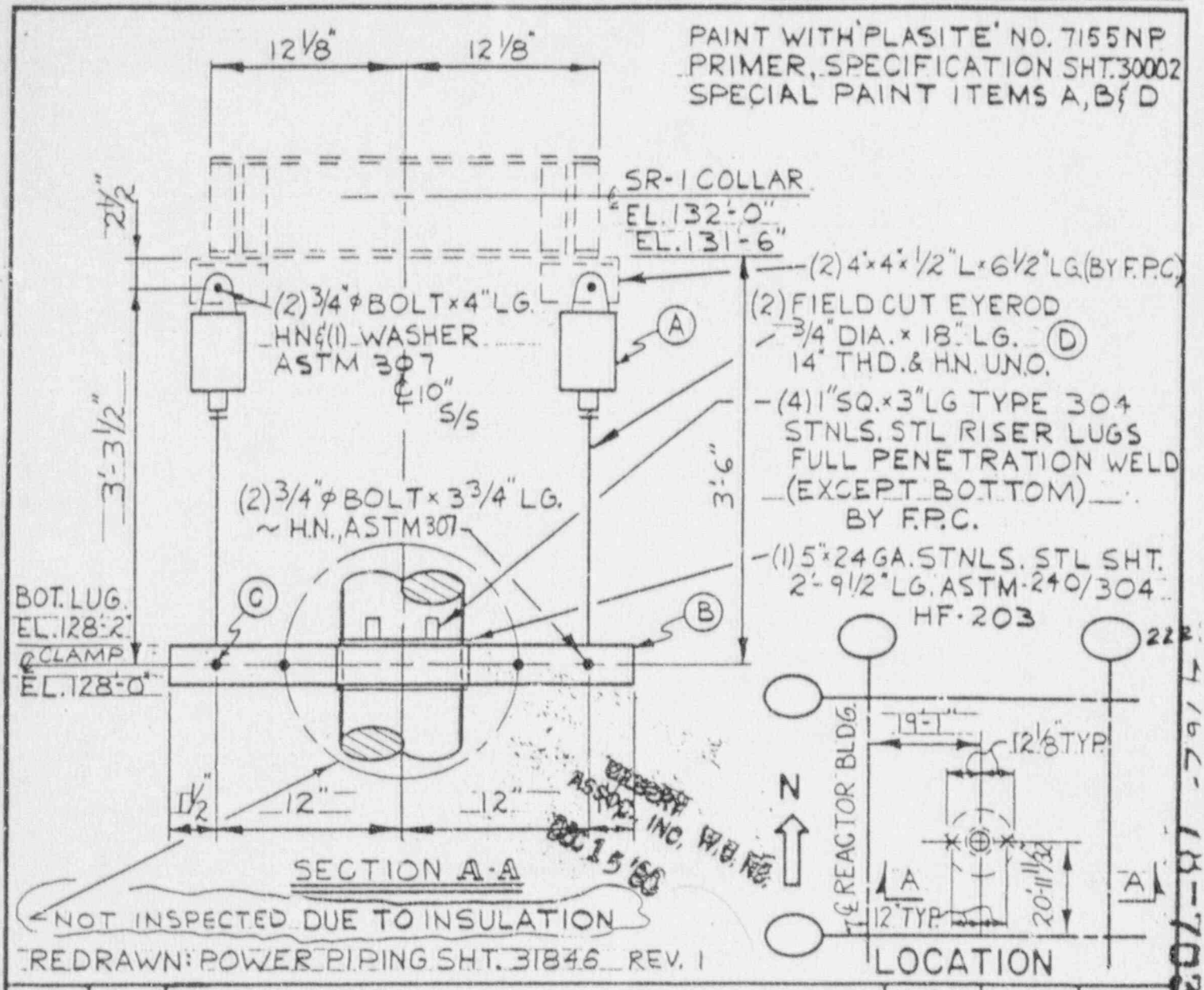
R. NO. WO. (5) 32-421-012 & (5) WO. 32-5206 HO-5-14405

REVISIONS	DSN	DWN TT	CK AL	ISSUE
	REL DATE	4-25-72	AUTH	3726-N
	PROJ ENGR		SHEET	31895
			REV	4

8-7-68 - 8-15-68

SYSTEM ENGINEERING DEPARTMENT

PAINT WITH 'PLASITE' NO. 7155NP PRIMER, SPECIFICATION SHT. 30002 SPECIAL PAINT ITEMS A, B & D



REDRAWN: POWER PIPING SHT. 31846 REV. 1

ITEM	QTY	DESCRIPTION	WGT.	ASTM	
A	2	# 708 VAR. SUPPORT HGR. TYPE "C" LOAD = 1120# EA.			
		MVMT. = 0.991 UP, SET COLD 1219# EA. PROVIDE			
		PRESET BAR & HYDRO STOP.			
B	1	10" RISER CLAMP, MAKE FROM (2) 4" x 5/8" BAR		575	
		2'-9" LG. WT. 47# DRILL (4) 7/8" ϕ HOLES & BEND			
		TO FIT 10" PIPE, 1" GAP.			
C	2	3/4" ϕ BOLT x 4 1/2" LG. ~ H.N. & (2) WASHER		307	

REVISIONS			
NO	DATE		
0	12-1-80	AS BUILT PER MAK 79127L	GEC JMD

SYSTEM PRESSURIZE SURGE

MARK CRCH546 SEIS. CL.

PROJECT CRYSTAL RIVER 3

This support designed and drawn by

GILBERT ASSOCIATES, INC.

DRAWN BY	JMD
DATE	12-1-80
CHECKED	12/2/80
APPROVED	F.J. Tomonic
SCALE	NONE

DWG. NO. HD-322-823

4197-103-703-116-0

FORM 135-A

Power Piping | POWER PIPING COMPANY
PITTSBURGH, PA. 15233

FLORIDA POWER CORPORATION
CRYSTAL RIVER - UNIT #3
P.O. PR3-1403

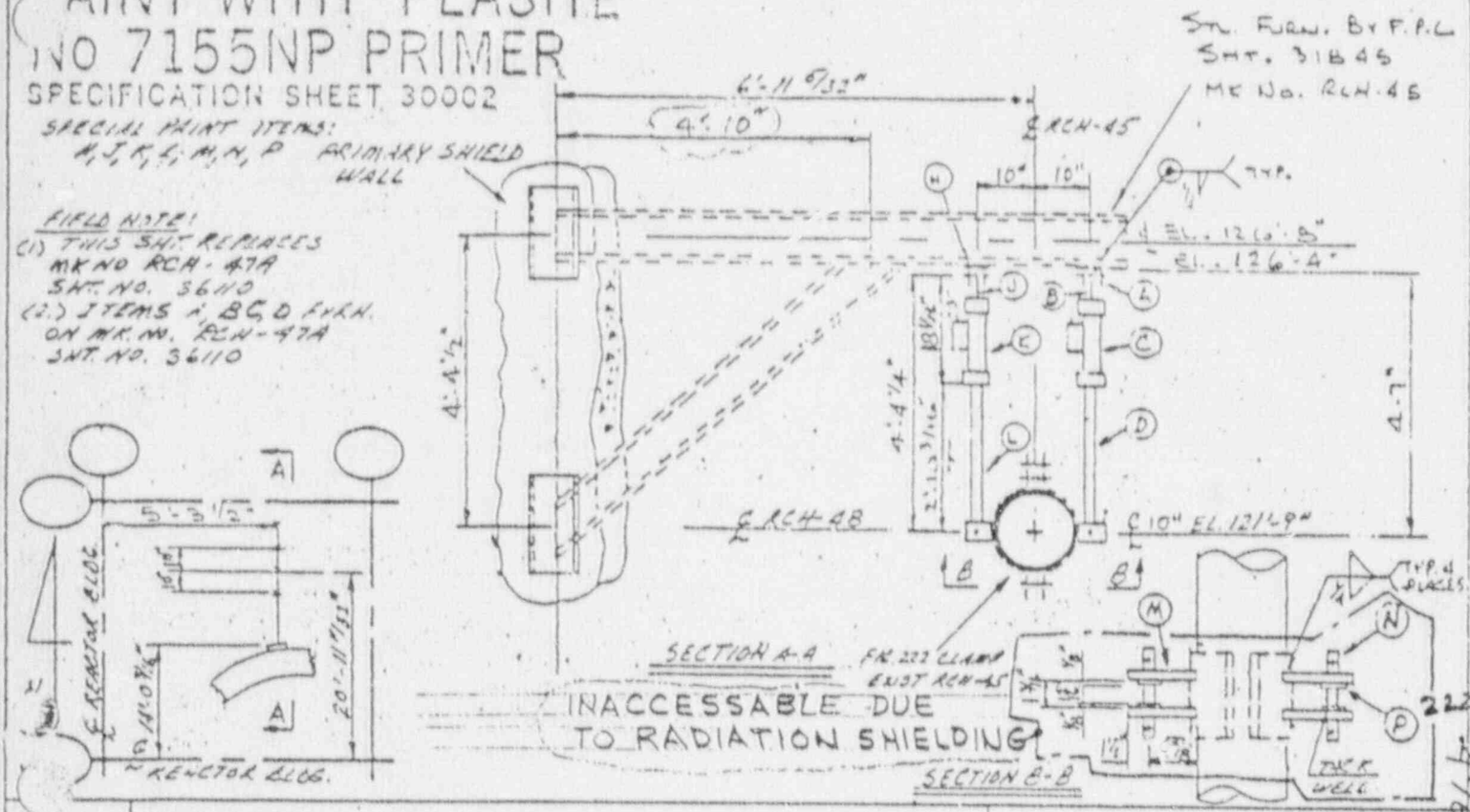
PAINT WITH "PLASITE" NO 7155NP PRIMER

SPECIFICATION SHEET 30002

SPECIAL PAINT ITEMS: H, J, K, L, M, N, P

PRIMARY SHIELD WALL

FIELD NOTE!
(1) THIS SHT REPLACES MK NO RCH-47A SHT. NO. 36110
(2.) ITEMS A, B, C, D, F, K, H. ON MK. NO. RCH-47A SHT. NO. 36110



MK NO. CL.	N	SEISMIC RESTRAINT PER 10" SURGE LINE INSIDE REACTOR BLDG	1 REQD. MK		
○	QUAN.	[X] INSPECTION [ ] HOT & COLD IND. [X] SPECIAL PAINT "PLASITE"	MATL.	MRS	
H	1.	BEAM ATTACHMENT SK. #5-142 FOR 2½" BORE SNUBBER			
J	1	PISTON ROD ATTACHMENT SK. #5-143 FOR 2½" BORE SNUBBER			
K	1	2½" BORE X 5" STROKE HYDRAULIC SNUBBER		N55	
		FE. (MOOG TYPE 6 POS) S=18 1/16" T=2'-10 3/16" USE SEALS (5) EP SEALS			
L	1	EXTENSION PIECE PER SK. #5-103 FOR A 2½" BORE			
	-	SNUBBER X = 20" 1/16			
M	4	3"x⅜" BAR 5 13/16 LG RAD CUT 5½" (1) END & DRILL (1) 1"Ø	A-575		
		ON E AS SHOWN WT 7#			
N	1	1"Ø x 4 1/8" LG. C.R. PIN W/COTTERS	A-[illegible]		
P	2	1" SCH 40 PIPE x 1/2" LG. (SNUBBER) WT 1#	A-1/36		
		SPECIAL PAINTING TOTAL WT = 9#			
	1	ASSEMBLY			
	1	ENGINEERING (SEISMIC)			

BUILDING STRUCTURE REVISIONS INTERFERENCE MOD-TRI-ACE

REVISIONS REVISED PER MK. FIELD LAN. 6-17-76

2. AS BUILT PER MAR 7912-718 9C

ISSUE

AUTH FPC 4-11

SHEET 38426 PT (2)

4962 787-03-478-0

FORM 123A

Power Piping POWER PIPING COMPANY
PITTSBURGH, PA. 15233

FLORIDA POWER CORPORATION
CRYSTAL RIVER - UNIT #3
P.O. PR3-1403

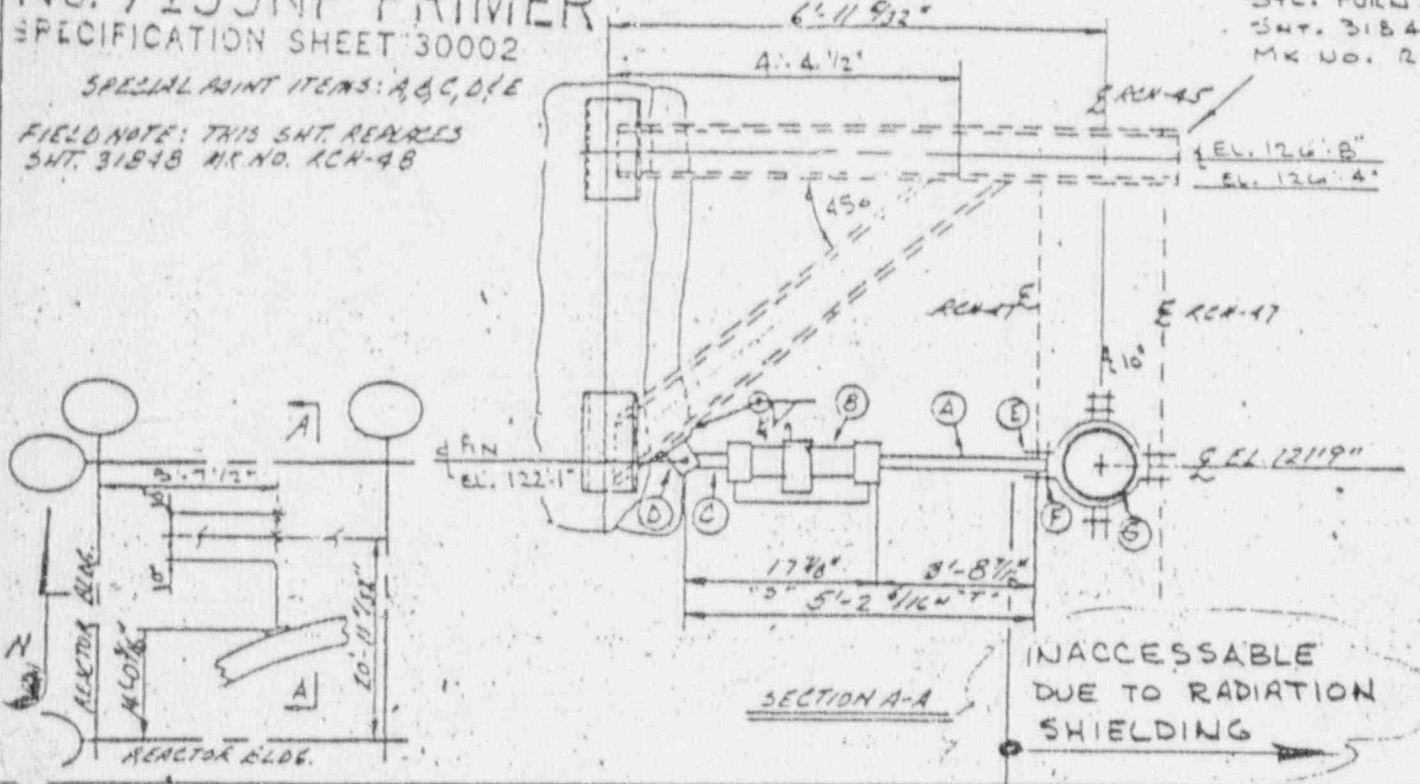
AINT WITH "PLASITE"
No. 7155NP PRIMER

SPECIFICATION SHEET 30002

SPECIAL PAINT ITEMS: A, B, C, D, E

FIELD NOTE: THIS SHT. REPLACES SHT. 31848 MK NO. RCH-48

STL. FURN. BY F.P.C. SHT. 31845 MK NO. RCH-45



NU. CL.	QUAN.		MATL.	MRS
N		SEISMIC RESTRAINT PER 10" SURGE LINE INSIDE REAC. BLDG.	1 REQD. MK	[redacted]
○	QUAN.	[X] INSPECTION [ ] HOT & COLD IND. [X] SPECIAL PAINT "PLASITE"	MATL.	MRS
A	1	EXTENSION PIECE PER SK. HS-103 FOR A 2½" BORE,		
		SNUBBER X= 2'-10 15/16".		
B	1	2½" BORE X 5" STROKE HYDRAULIC SNUBBER		NSS
		FIG. 1900N TYPE B POS. B S= 17 7/8" T= 3'-8 7/16"		
C	1	PISTON ROD ATTACHMENT SK. HS-143 FOR 2½"		
		BORE SNUBBER		
D	1	CLEVIS ATTACHMENT SK. HS-142 FOR 2½" BORE		
		SNUBBER		
E	1	18" SPECIAL PIPE CLAMP #-303 EXCEPT MAKE FROM 6"x 3/4" BAR	A-575 AT 74#	
F	2	1 1/8"ø X 4½" LG. BOLT, H.N.	A-307	
G	1	4½" x 24GA. x 2'-9½" LG. STNL'S STL. SHEET	A 240 GR. 304	NF-242
		SPECIAL PAINTING	TOTAL WT = 159#	
	1	DETAILING		
	1	ASSEMBLY		

REV. 4 - AS BUILT PER MAR 79-12-7 QFC

REV. DWG. SS-421-012 FOR UNIT 1 SIMILAR TO UNIT 2 AD-321-L0K

ID SIZE G 42 | ID IR 11 | C IX RL

REVISIONS REV 1 - NEW MK NO. PER CHANGE LETTER 11-27-74
REV 2 - NEW PER MAR 2-3 PIPE PLAN 1-31-75
REV 3 - [illegible] 12-24-75

REL. DATE 12-6-73

PROJ ENGR [illegible]

AUTH SPEC-N

SHEET 36111

ISSUE REV 4

4062-78-703-480-0

Power Piping

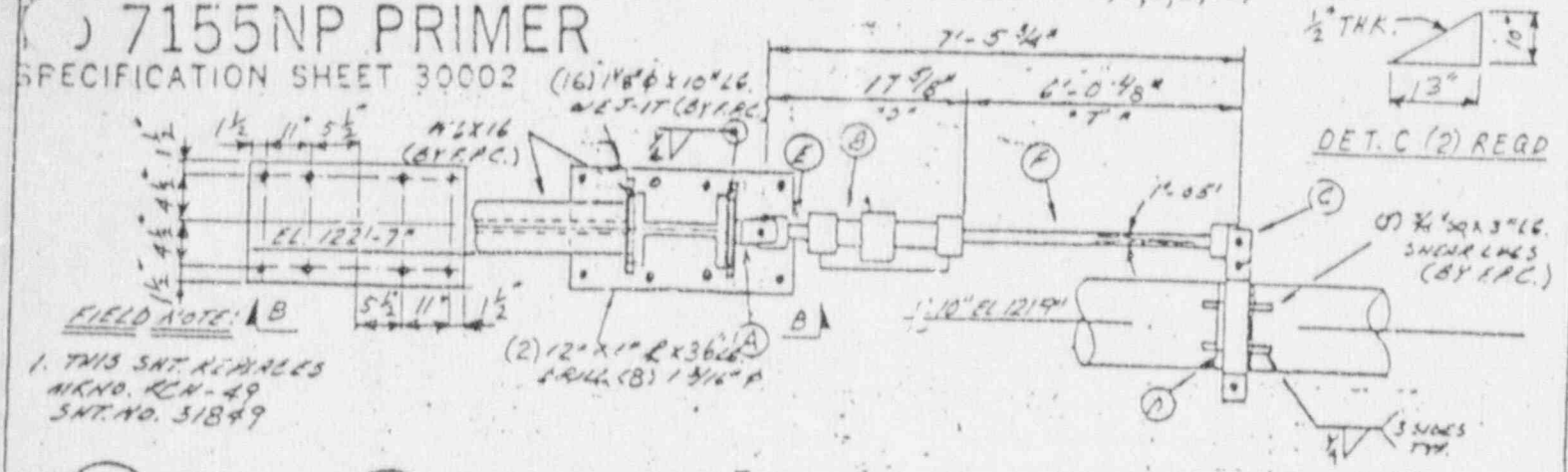
POWER PIPING COMPANY
PITTSBURGH, PA. 15233

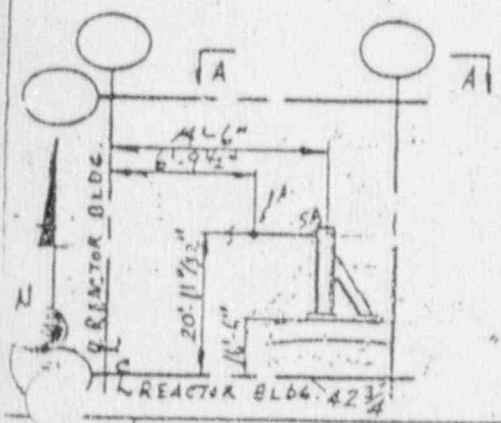
FLORIDA POWER CORPORATION
CRYSTAL RIVER - UNIT #3
P.O. PR3-1403

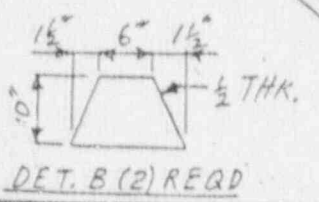
RINT WITH "PLASITE"
7155NP PRIMER

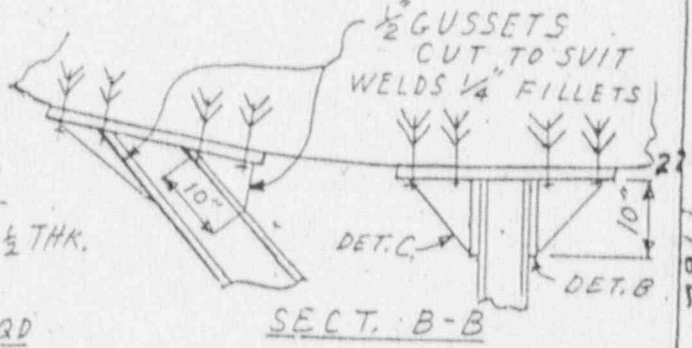
SPECIFICATION SHEET 30002

SPECIAL PAINT AREAS: A, B, C, E, & F









NO. CL.	QUAN.	[X] INSPECTION [ ] HOT & COLD IND. [X] SPECIAL PAINT "PLASITE"	MATL.	MRS
		SEISMIC RESTRAINT PER SVAGE LINE INSIDE REAC. BLDG. 1 REQD. MK		
A	1	BEAM ATTACHMENT SK. NS-142 FOR A 2 1/2" BORE SNUBBER		
B	1	2 1/2" BORE X 5" STROKE HYDRAULIC SNUBBER FIG. 1800-N TYPE "B" POS. A S = 17 9/16" T = 6'-0 4/8" (USE SF-96(50)) EA SEIS		NSS
C	1	10" SPECIAL PIPE CLAMP PER SK 503 EXCEPT MAKE FROM 6" x 1" BAR WT. 93#		
2	1	6 1/2" x 24GA. x 2'-9 1/2" STAINLESS STL. SHIELD	A 240 GR. 304	NF-345
E	1	PISTON ROD ATTACHMENT SK NS-143 FOR 2 1/2" BORE SNUBBER		
E	1	SPECIAL EXTENSION PIECE SK. NS-103 FOR A 2 1/2" BORE EXCEPT AS SHOWN PER DET. A X = 5'-0 4/8" SPECIAL PAINTING TOTAL WT. 189#		
	1	ASSEMBLY		
	1	ENGINEERING (SEISMIC)		

REF. G.E. SC-421-021 B (W DWG 1135851-1) & (1135852-6), HB-321-607

REVISIONS 1. AS BUILT PER MAR 78-12-27-1 S.C.
2 AS BUILT PER MAR 79-6-8 S.C.

D'S G.A.I. D A TT C K R L

REL. DATE 12-10-76

PROJ ENGR

AUTH 3924-N

SHEET 3.54-27

ISSUE

REV (2)

4762-78-703-49A-0

ATTACHMENT 4

Sample Surveillance Logs

for Heatup and Cooldown

ENCLOSURE 2

HEATUP AND COOLDOWN

Attach documentation of the following data:

	Initials
1. RCS T_C	HH
2. RCS Pressure	HH

Annotate all data as necessary with the following: parameter, date, time, chart speed, sensitivity (e.g., psig/div, °F/div), key transient events (Reactor trip, HPI actuation, etc).

Heatup & Plant startup following RCV-11 Closure.

1/23/90 - 1/25/90

By: Henry W. Hill / NOTA — 3/9/90 / Date

ENCLOSure

RC SYSTEM HEATUP AND COOLDOWN SURVEILLANCE LOG

TIME	LOOP "A" PRESSURE	* T_{CA}	* T_{CB}	* AVG $\frac{TC_A + TC_B}{2}$	PZR TEMP Tp	δT_{RX} (°F/hr.)	δT_p (°F/hr.)	** INSERVICE DH COOLER OUTLET TEMP	*** PZR SPRAY ΔTEMP.	INITIALS
**** 1945	426	349	349	349	455	①	①	N/A	NA	MGW
2015	601	348	348	348	489	-2	68			MGW
2045	711	346	346	346	507	-4	36			MGW
2115	675	347	347	347	503	+2	-8			LDL
2145	495	349	349	349	470	+4	-66			LDL
2215	536	350	350	350	477	+2	+14			MGW
2245	532	350	350	350	477	0	0			LDL
2315	530	350	350	350	477	0	0			LDL
2345	544	349	349	349	479	-2	+4			TB
0015	560	~~349~~ 348	349	349	482	0	+6			TB

* This column will be N/A if DHR System operating and no RCP's ru ning.
** This column will be N/A if any RCP's running.
*** This column will be N/A if Aux. Spray not in Use or if PZR < 440°F.
**** Data carried over from previous page.

COMMENTS: ① INITIAL DATA

Performed By [signature] [signature]

Date 1-23-90

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ENCLOSure

RC SYSTEM HEATUP AND COOLDOWN SURVEILLANCE LOG

TIME	LOOP "A" PRESSURE	* T_{CA}	* T_{CB}	* AVG $\frac{TC_A + TC_B}{2}$	PZR TEMP Tp	δT_{RX} (°F/hr.)	δT_p (°F/hr.)	** INSERVICE DH COOLER OUTLET TEMP	*** PZR SPRAY ΔTEMP.	INITIALS
****	560	349	349	349	~~482~~ NA	NA	NA	NA	NA	com
0045	663	349	349	349	499	Ø	+34	NA	NA	com
0115	665	348	348	348	500	-2	+2	NA	NA	com
0145	472.5	349	349	349	465	+2	-70	N/A	N/A	[illegible]
0215	622	350	350	350	492	+2	+54	NA	NA	com
0245	634	350	350	350	495	Ø	+6	NA	NA	com
0315	691	350	350	350	503	Ø	+16	N/A	N/A	[illegible]
0345	877	350	350	350	529	Ø	+52	NA	NA	com
0415	1065	353	353	353	553	+6	+48	NA	NA	com
0445	1288	357	357	357	577	+8	+48	NA	NA	com

* This column will be N/A if DHR System operating and no RCP's ru ning.
** This column will be N/A if any RCP's running.
*** This column will be N/A if Aux. Spray not in Use or if PZR < 440°F.
**** Data carried over from previous page.

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COMMENTS: _____

Performed By C Williams

Date 1-24-90

ENCLOS 1

RC SYSTEM HEATUP AND COOLDOWN SURVEILLANCE LOG

TIME	LOOP "A" PRESSURE	* T_{CA}	* T_{CB}	* AVG $\frac{TC_A + TC_B}{2}$	PZR TEMP Tp	δT_{RX} (°F/hr.)	δT_p (°F/hr.)	** INSERVICE DH COOLER OUTLET TEMP	*** PZR SPRAY ΔTEMP.	INITIALS
****	1288	357	357	357	577	NA	NA	NA	NA	cam
0515	1540	376	376	376	599	+38	+44	NA	NA	cam
0545	1761	387	387	387	617	+22	+36	NA	NA	cam
0615	1945	396	396	396	632	+18	+30	NA	NA	cam
0645	2015	420	420	420	634	48	+8	N/A	N/A	[illegible]
0715	2146	436	436	436	645	32	+18	N/A	N/A	[illegible]
0745	2167	453	453	453	647	34	+4	N/A	N/A	[illegible]
0815	2164	464	464	464	647	22	0	NA	NA	EL
0845	~~2440~~ 2160 psig	478	478	478	646	28	-2	N/A	N/A	WGL
0915	2166	490	490	490	647	24	+2	NA	NA	EL

* This column will be N/A if DHR System operating and no RCP's ru ning.
** This column will be N/A if any RCP's running.
*** This column will be N/A if Aux. Spray not in Use or if PZR < 440°F.
**** Data carried over from previous page.

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COMMENTS: _____

Performed By C Malcom Robert Case / WM Cain

Date 1-24-90

ENCLS 4

RC SYSTEM HEATUP AND COOLDOWN SURVEILLANCE LOG

TIME	LOOP "A" PRESSURE	* T_{CA}	* T_{CB}	* AVG $\frac{TC_A + TC_B}{2}$	PZR TEMP Tp	δT_{RX} (°F/hr.)	δT_p (°F/hr.)	** INSERVICE DH COOLER OUTLET TEMP	*** PZR SPRAY ΔTEMP.	INITIALS
****	2166	490	490	490	647	+24	+2	N/A	N/A	WSC
0945	2164	501	501	501	647	+22	0	N/A	N/A	WSC
1015	2160	514	514	514	647	26	0	N/A	N/A	[signature]
1045	2170	528	528	528	647	28	0	NA	NA	EC
1115	2168	533	533	533	648	10	+2	NA	NA	EC
1145	2182	536	536	536	648	6	0	N/A	N/A	[signature]
1215	2155	536	536	536	646	0	-2	NA	NA	EC
1245	2161	536	536	536	647	0	2	N/A	N/A	[signature]
1315	2167	536	536	536	647	0	0	NA	NA	EC
1345	2167	536	536	536	647	0	0	NA	NA	EC

* This column will be N/A if DHR System operating and no RCP's ru ning.
** This column will be N/A if any RCP's running.
*** This column will be N/A if Aux. Spray not in Use or if PZR < 440°F.
**** Data carried over from previous page.

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COMMENTS: _____

Performed By [signature] [signature] RSE

Date 1-24-90

S' 22 Rev. 17 Page 13

ENCLOSURE 1

RC SYSTEM HEATUP AND COOLDOWN SURVEILLANCE LOG

TIME	LOOP "A" PRESSURE	* T_{CA}	* T_{CB}	* AVG $\frac{TC_A + TC_B}{2}$	PZR TEMP Tp	δT_{RX} (°F/hr.)	δT_p (°F/hr.)	** INSERVICE DH COOLER OUTLET TEMP	*** PZR SPRAY ΔTEMP.	INITIALS
****	2167	536	536	536	647	0	0	NA	NA	EC
1415	2164	535	535	535	647	-2	0	NA	NA	EC
1445	2162	535	535	535	647	0	0	NA	NA	EC
1515	2165	535	535	535	647	0	0	NA	NA	EC
1545	2167	535	535	535	647	0	0	N/A	N/A	MW
1615	2166	535	535	535	647	0	0	N/A	N/A	LDC
1645	2166	535	535	535	647	0	0	NA	NA	MW

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** This column will be N/A if any RCP's running.
*** This column will be N/A if Aux. Spray not in Use or if PZR < 440°F.
**** Data carried over from previous page.

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COMMENTS: Secured from heatup until laboratory for criticality is complete

Performed By ESW DRSN Jr Leon A Nagel

Date 24 Jan 90

ENCLOSURE 4

RC SYSTEM HEATUP AND COOLDOWN SURVEILLANCE LOG

TIME	LOOP "A" PRESSURE	* T_{CA}	* T_{CB}	* AVG $\frac{TC_A + TC_B}{2}$	PZR TEMP Tp	δT_{RX} (°F/hr.)	δT_p (°F/hr.)	** INSERVICE DH COOLER OUTLET TEMP	*** PZR SPRAY ΔTEMP.	INITIALS
****	2163	535	535	535	647	①	①	NA	NA	LDA
2315	2164	537	538	537.5	647	+5	0	NA	NA	MW
2345	2168	542	542	542	647	+9	0	N/A	NA	MW
0015	2164	546	546	546	647	+8	Ø	NA	NA	MW
0045	2165	547	547	547	647	+2	0	N/A	N/A	JS
0115	2168	547	547	547	647	0	0	N/A	N/A	JS
0145	2168	551	551	551	647	+8	0	N/A	N/A	QH
0215	2164	556	556	556	647	+10	0	N/A	N/A	JS
0245	2168	561	561	561	647	+10	0	N/A	N/A	JS
0315	2178	564	564	564	647	+6	0	N/A	N/A	QH

* This column will be N/A if DHR System operating and no RCP's ru ning.
** This column will be N/A if any RCP's running.
*** This column will be N/A if Aux. Spray not in Use or if PZR < 440°F.
**** Data carried over from previous page.

COMMENTS: Original DATA

Performed By [signature] JE Spence 116 / Lewis Hagin / concurrent

Date 1-24-90 / 1-25-90

ENCLOSURE 4

RC SYSTEM HEATUP AND COOLDOWN SURVEILLANCE LOG

TIME	LOOP "A" PRESSURE	* T_{CA}	* T_{CB}	* AVG $\frac{TC_A + TC_B}{2}$	PZR TEMP Tp	δT_{RX} (°F/hr.)	δT_p (°F/hr.)	** INSERVICE DH COOLER OUTLET TEMP	*** PZR SPRAY ΔTEMP.	INITIALS
****	2178	564	564	564	647	+6	0	N/A	N/A	JG
0345	2170	566	566	566	647	4	0	N/A	N/A	JG
0415	2156	566	567	566.5	647	1	0	N/A	N/A	JG
0445	2167	567	567	567	647	1	0	N/A	N/A	JG
0515	2153	572	572	572	646	+10	-2	NA	NA	JG
0										

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*** This column will be N/A if Aux. Spray not in Use or if PZR < 440°F.
**** Data carried over from previous page.

COMMENTS: sec. from SP-422, Plant on line ≈ 12% PWR

Performed By JG Sparrow

Date 1-25-90

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