U. S. ATOMIC ENERGY COMMISSION
REGION II
DIVISION OF COMPLIANCE

Report of Construction Inspection

CO Report No. 50-302/71-1

Licensee: Florida Power Corporation
Crystal River Unit 3
License No. CPPR-51
Category A

Dates of Inspection: February 9-12, 1971

Dates of Previous Inspection: December 14-18, 1970

Inspected By: W. D. Kelley — 3/12/71
W. D. Kelley, Reactor Inspector (Construction) (In Charge) — Date

F. U. Bower — 3-12-71
F. U. Bower, Reactor Inspector (Construction) — Date

R F Warnick — 3-12-71
R. F. Warnick, Reactor Inspector (Operations) — Date

Reviewed By: F J Long — 3/17/71
F. J. Long, Senior Reactor Inspector — Date

Proprietary Information: None

SCOPE

A routine announced inspection was made by W. D. Kelley and R. F. Warnick on February 9-12, 1971, and F. U. Bower on February 11-12, 1971, of the Crystal River Unit 3 located ten miles northwest of Crystal River, Florida, on the Gulf of Mexico. The plant is a Babcock and Wilcox Company (B&W) pressurized water reactor designed for a maximum power level of 2560 Mwt (885 Mwe). The purpose of the inspection was to continue the audit of the records of the containment liner (Attachment C), Class I piping (Attachments F and G), and other Class I components (Attachment L) in accordance

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with PI 3800/2; review the implementation of the QA program (electrical and instrument components, 5105.03, and cables and terminations, 5205.03) for instrumentation (Attachment H) and electrical (Attachment I) per PI 3800/2; and secure data on the concrete aggregate used in the concrete for Class I structures.

SUMMARY

Safety Items - None

Nonconformance Items -

1. Loss of control of liner fabrication in violation of Criterion V. (See Section E.2.)

2. The halogen leak test is not being performed in accordance with the approved procedure in violation of Criterion IX. (See Section E.)

Unusual Occurrences - None

Status of Previously Reported Problems -

1. Decay Heat Service Heat Exchanger Channel Heads (CO Report No. 50-302/70-4)

   During the stress relief of the channel head for the decay heat service heat exchanger by Struthers Wells Corporation (SW) the dimensional tolerances were exceeded due to warpage. The vendor had been held liable for holding dimensional tolerance; therefore, a new channel head casting is to be furnished to SW for machining which must be installed at the site by SW. All documentation will be brought to the site and will be reviewed by Florida Power Corporation (FPC) and Gilberts Associates, Inc. (GAI).

   This will remain an open item.

2. Containment Liner Welding and Halogen Leak Testing (CO Report No. 50-302/70-4)

   The resumé for C. R. Hoffman, GAI Resident Inspector, who was inspecting the containment liner erection, was available and was reviewed by the Region II inspector. He has worked on seven different sites since 1960, none longer than two years. Five of the jobs were overseas.

FPC (Froats) stated that the resident inspector is responsible for auditing Chicago Bridge and Iron Company (CB&I) QC and is not required to physically mark unsatisfactory work but bring his findings to the attention of CB&I's QC. FPC QA has reviewed the qualifications of Hoffman and is satisfied as to his technical qualifications but is concerned about his age (born in 1908) and size (obese) limiting his ability to climb and inspect.

The leak chase channels which were heavily rusted during the last inspection were wire brushed prior to tack welding and final fillet welding to the containment liner. Now all weld preparations are being wire brushed to remove rust prior to welding.

CB&I is continuing to pressurize the leak chase system to above 5 psi using a six-inch 100 psi gage. CB&I (Dutton) has taken the position that the error in a high pressure gage due to the hysteresis is on the conservative side and FPC (Pedrick) has instructed CB&I to increase the pressure to 8 psi. This is not in accordance with CB&I Halogen Leak Test Procedure, HLP-1L. (See Section I.)

Other Significant Items -

1. FPC's contract with Energy Operating Company, Tampa, Florida, signed approximately 1966, for supplying coal on a Btu basis for 20 years will be terminated in 1971. The termination of the contract is by mutual agreement by both parties due to increased cost of coal. Energy Operating Company is losing money and it will be cheaper for FPC to convert Unit 1 to oil. (Unit 2 is oil fired.)

2. FPC has contacted B&W and has requested that the butt weld ends of the Aloyco valves conform with their specification and not the non-standard weld end preparation found on other sites. This was the result of a conversation between FP&L (Gaines) and FPC (Pedrick) when Pedrick was visiting the Turkey Point site.

3. Unit 1 turbine was brought off the line in October 1970 for regular outage and maintenance. After the turbine was overhauled, it was brought back on line in November 1970 and remained in service for one night when an operator noted a peculiar noise. The turbine was brought off the line, disassembled and it was found that 23 buckets from the last stage had been broken off of the wheel. The head of the lifting tool for breaking the gasket was found to have been left inside of the turbine. The entire last stage was removed and the turbine placed back in service. General Electric Company (G-E) estimated that the efficiency would decrease by 10% at maximum load.

4. FPC is continuing with its effort for an April 1, 1971, meeting in Atlanta, Georgia, of the utilities in the southeast to discuss and formulate policy for a Nuclear Quality Control Committee. C. Hayes of Georgia Power Company (GPC) has agreed to make the necessary arrangements for the meeting in Atlanta. GPC is exploring the possibility of the forming of a Production Committee for (Nuclear) Quality Control under the auspices of Southeastern Electrical Exchange (SEE). Pedrick has been granted time during the SEE meeting of April 29-30, 1971, in New Orleans, Louisiana, to present FPC's program.

   Future meetings of the committee may be held onsite by one of the utilities who is a member of the committee.

5. CB&I continued to erect the cylindrical section of the containment with the toriconical section being as much as two inches below elevation. This will require match marking and cutting the toriconical section and making a six-inch-wide plate to correct the gap. (See Section D.)

6. Criteria for Type II Portland Cement for Crystal River Unit 3 has been made more restrictive than originally required by the purchase specification and ASTM C150-67.

   Tests of samples of concrete of the type to be used in the containment building indicate the compressive strength of the concrete exceeds that required by the concrete specification. The 28-day samples tested from 6410 psi to 7110 psi compared to the required 5000 psi.

Management Interview - A management interview was held on February 12, 1971, at 10:30 a.m. in the FPC construction office at the Crystal River Nuclear Plant Unit 3 site. The meeting was attended by the following persons:

FPC

H. L. Bennett - Manager, Power Construction
E. E. Froats - Quality Engineer
D. W. Pedrick - Engineer, Quality Program
H. Hobbs - Electrical Construction Supervisor

The following items were discussed:

1. Containment Liner

   FPC was informed that the Region II inspector had reviewed the CB&I repair procedure for correcting the two-inch gap between the toriconical

section and the first course of the cylindrical section of the containment and was concerned that CB&I would attempt to bridge a 3/8-inch gap with E7018 electrodes with no backing strip. It was pointed out that CB&I had found it necessary in welding the knuckle section to backgouge approximately one-half of the weld deposited from one side before welding the second side to eliminate slag in the weld deposit. CB&I was informed that if the repair procedure met the reference code requirements, it was acceptable to Compliance; however, a distortion had been noted of the toriconical to knuckle section weld and FPC should review this area because it was a pressure boundary and not a membrane since it was backed up with cork.

2. Channel Head for the Decay Heat Service Heat Exchanger

FPC was informed that the channel head for the decay heat service heat exchanger would remain an open item until the head was received, installed, and tested in accordance with the applicable specifications.

3. Reactor Coolant Bleed Tank ASME 'N' Stamp

FPC was informed that the application of the 'N' stamp by Pittsburgh-Des Moines Steel Company (PDM) to the reactor coolant bleed tank at the site would remain an open item until the 'N' stamp has been applied and audited by the Region II inspector.

4. Aggregate Used for Class I Structures

FPC was informed that there were no comments on the information supplied to the Region II inspector on the aggregate used in FPC's Class I concrete.

5. Electrical and Instrumentation (E/I) QA Program

FPC was informed that the results of the Region II inspector's E/I system review centered on the importance of detailed planning in several problem areas reviewed and the subsequent vigorous implementation of the planned program.

The planning action to date, that had resulted in the general criteria documents reviewed, could not be considered faulty even though it was obviously very general in scope and would not provide the detailed control and assurance usually expected from a viable QA/QC program. The Region II inspector stated that program procedures should be developed that provided sufficient detail to assure that all safety requirements would be met.

FPC was urged to use this time interval, preceding actual E/I construction activity, to work in conjunction with the design group in the development of meaningful criteria and QA/QC procedures.

DETAILS

A. Persons Contacted

FPC

H. L. Bennett - Manager, Power Construction
D. W. Pedrick - Engineer, Quality Program
E. E. Froats - Quality Engineer
J. Hobbs - Electrical Construction Supervisor
C. E. Jackson - Mechanical Construction Supervisor

Pittsburgh Testing Laboratory (PTL)

W. T. Hurst - Chief Inspector

CB&I

C. O. Saint - Project Manager
J. R. Herman - QA Engineer
W. Batchelor - Boilermaker Foreman
J. A. Pritchard - NDT Supervisor
J. Sisk - Assistant Welding and QA Supervisor

B. Construction Status

There were 568 employees onsite during the week of February 1, 1971, to February 6, 1971. There were 147 carpenters, 72 ironworkers and 143 laborers employed by J. A. Jones Construction Company (JAJ) and 21 boilermakers employed by CB&I and 26 pipefitters employed by Livsey Company (Livsey).

The placement of reinforcing steel and concrete for the turbine building foundation, turbine pedestal, and auxiliary building north wall containing approximately 1450 cubic yards of concrete was poured the week of February 1, 1971, and 4190 cubic yards for the month of January.

CB&I has erected the containment building liner to the fourth course of plate; however, CB&I has a large repair to make where the toriconical section was below elevation.

The University of Florida was conducting environmental surveys and the State Department of Natural Resources was onsite conducting thermal and ecology studies.

All subsurface grouting was completed the week of February 7, 1971.

Major installation effort on the E/I systems of interest to the Region II inspector remains some months in the future. Present work is limited to facility construction with the ground grid being the only project work performed by the electrical unit to date.

C. Administration and Organizational Changes

Two of PTL's concrete technicians (A. Von Nyrenheim and D. Moore) resigned to accept positions on the Cross Florida Barge Channel. They have been replaced by two concrete technicians (L. Brown and K. Boyer).

An offer of employment has been made by FPC to fill a position, Manager of Quality Program. He will report to the Nuclear Project Manager (Rodgers) and will be on the same level as the Assistant Nuclear Project Manager (May) and Manager of Power Construction (Bennett). This revision of the organizational chart will be included in the FSAR. The title of the quality engineer will be changed to quality program staff.

D. Reactor Coolant Bleed Tank - Attachment E (4805.03, 4805.05.a, 5405.03, 5405.04.b, c, d, f and 5405.05.a)

In CO Report No. 50-302/70-4, it was reported that the ASME stamp for the reactor coolant bleed tanks did not conform with the requirements of the ASME Section III, Class C vessels. Namely the "U" stamp in conformance with Section VIII had been affixed to the vessel but did not have the "N" stamped beneath it as required by Section III, Class C vessels. FPC (W. S. O'Brian) called PDM on December 28, 1970, to inform PDM that the tanks had not been properly stamped as required by paragraph N-2115 of Section III of the ASME Code. PDM requested FPC by letter dated December 30, 1970, that since the tanks were presently at Crystal River site, FPC apply the "N" stamp to the nameplate of the three reactor coolant bleed tanks and the one miscellaneous waste storage tank (National Board Numbers 730 through 733). A copy of the letter was forwarded to the Mutual Boiler and Machinery Insurance Company stating that FPC would be applying the code stamp. FPC (O'Brian) in its letter of February 2, 1971, to PDM (J. K. Ward) advised that FPC considered it advisable to have an authorized representative of PDM visit Crystal River site and properly stamp the vessels in accordance with Section III of the code. FPC asked that the arrangements for this work be made through the FPC Manager of Power Construction (Bennett).

PDM and FPC agreed that the quality assurance documentation including NDT reports and radiographs that are required in accordance with the ASME Code would be stored at the FPC plant. All documentation has been received at the site transmitted from FPC, Power Engineering Department, St. Petersburg, Florida, with its Quality Program Document Transmittal No. 2 dated February 2, 1971. It is signed by the responsible engineer, O'Brian, stating that these records are complete and in compliance with the requirements of FPC's quality program. The documentation includes a certification of specification certified by E. R. Hottenstein, Professional Engineer, Commonwealth of Pennsylvania, Certification No. 7173E, that the design specification is in accordance with N141 of ASME Code, Section III, "Nuclear Vessels"; however, an exception is taken in stating "The final loads on the vessel nozzle have not been specified. The effects of these loads, when fully determined, will be evaluated and if necessary, the load will be reduced, and the vessel will be reinforced, so that the stresses are equal to or less than those permitted by the design of the tanks." The documentation presented by PDM also includes its quality control manual and shop travelers. Copies of the travelers also include a signoff by the operators and the Inspection Department. Mill certifications are available and had been checked for accuracy and appear complete. Radiographs were reviewed by the Region II inspector and they met the code requirements as far as penetrameter placement, penetrameter size, density, density range, and evaluation of the defects by PDM.

PDM required a procedure to be written and followed for any damages or repairs of a vessel. The damaged area of the miscellaneous storage tank had been radiographed and the radiographs were reviewed by the Region II inspector and were acceptable and met code requirements.

Control of the material was accomplished through the use of the shop travelers. The welding procedures were identified on the as-built drawings by PDM welding procedure number and designated in accordance with requirements of AWS.

Records of the heat numbers and radiographic identification numbers are kept on rollout drawings of the tank. Weldor identification stencils are etched on the tank with an electric vibrating tool. The documentation includes a cross index of the weldor identification by name, clock number and stencil identification. Ultrasonic inspection was not required; however, in a group of plates that had been ground, they were visually inspected and the decision was made to check the thickness using ultrasonics. Ultrasonic examination revealed that all plates met the minimum wall thickness. The record of the liquid penetrant test is kept on PDM Form 17959 and filed in the quality control book for each tank. The form included evaluation of the test and it was signed by the quality assurance inspector and

the quality assurance supervisor. The records of the hydrostatic test of the tanks were available; however, neither the record nor the procedure for the test specified the length of holding time for the hydrostatic test. The shop hydrostatic test identified by Contract No. 18130 stated in paragraph 3.4 that after satisfactory inspection pressure was releaved, the vessel drained, and all test piping removed. The hydrostatic test was not witnessed by FPC authorized inspector of GAI. The documentation of the tanks is considered as meeting the requirements of the contract, code, and the applicable specifications.

E. Containment - Attachment C

1. Prestressed Concrete - Review of QC System (4705.04.a, b, c and 4705.05.a.1)

The plates for the trumpet section for the tendons was purchased by the Prescon Corporation (Prescon) from Armco Steel Corporation (Armco). The Prescon Purchase Order No. FP-117 dated July 24, 1970, specified that the three-inch-thick plates were to be in accordance with Armco bulletin, Design and Application Data, Armco VNT Steel. The purchase order stated that the chemical properties should be 0.25% maximum carbon, 1.30/1.65 manganese and 0.12/1.17% vanadium with physical properties of 60,000 psi minimum yield and 95,000 psi minimum tensile. It was required that the NDT be in accordance with ASTM E208 and equal to or lower than -15°F. The purchase order further identifies the material as Armco's modified VNT steel, single normalized, to meet the quality requirements of steel plate pressure vessel per ASTM A20.

Armco certifications of tests were available for the base plates and they met or exceeded the requirements of the purchase order. The certifications had been notarized and stamped as being reviewed by the GAI quality assurance.

FPC's Report of Materials Received, No. 5427, shows that a total of 72 trumpets were received on January 27, 1971, from Prescon and inspected on January 3, 1971, by J. Rashinsky, Quality Control Engineer, for JAJ. The inspection report states that the trumpets were inspected and acceptable.

GAI Specification RO-3040 dated June 12, 1970, for prestressing tendon conduit requires that the conduit be three different types. The rigid type conduit is 5-1/2-inch O D. having a minimum wall of 0.065 inch in accordance with ASTM A513-69 for resisted welded steel tubing with the supplement requirement of nondestructive electrical test on the welded seam. The flexible type conduit

is to be five-inch I.D. with a minimum of 22 gage galvanized steel and gasketing incorporated that meet the leak-tight criteria of the specification. The third type of conduit is specified as five-inch I.D. Schedule 40 pipe conforming to ASTM A53-69A welded and seamless steel pipe. The vertical conduits through, and extending two feet above the foundation, are five-inch Schedule 40 pipe, the dome conduit will be five-inch Schedule 40 pipe, flexible conduit will be used around penetrations and openings, and the balance of the conduit will be the 5-1/2-inch, 22 gage tubing. GAI Specification SP5583 dated September 18, 1968, is for tendons in the reactor building. The specification requires that the conduit be capable of withstanding a hydrostatic pressure of 10 psig without leaking water. Both pneumatic and hydrostatic tests have been conducted at the site to determine if this criteria can be met. A report of the findings of the test has been made and has been forwarded to the St. Petersburg office for review.

FPC Material Received Report No. 5380 indicates that a total of 360 feet of galvanized steel tubing for tendon conduit was received from Swan Manufacturing Company on January 26, 1971. The FPC report indicates that the tubing was visually inspected and revealed no cause for rejection and that the documentation required, covering all materials on the purchase order, was in the QC files. The report was signed by Rashinsky, Quality Control Engineer, JAJ, on February 2, 1971. The tubing was furnished by Swan Manufacturing Company from one heat of material. The mill certifications were reviewed by the Region II inspector and there was some confusion due to a letter attached to the certification that contained incomplete sentences which were not meaningful. FPC agreed that the test data would be reviewed and available at the next inspection.

GAI Specification SP5583 specified that the permanent corrosion protection for the tendons be ON-OX-ID (CM), casing filler -- nuclear grade as manufactured by the Dearborn Chemical Division, W. R. Grace and Company, except it should be modified to develop a minimum pour point at 150°F.

It is required that the material be tested for chloride, sulphide and nitrate content. It is required that the initial screening test for chlorides be on the raw materials and the finished product be given the Beilstein test. If a positive indication is obtained, a conforming test must be made on water extracts of the product using the standard colorinetic procedures described in ASTM B512-67. The limit of 10 ppm of chloride has been set for either raw material or finished product. It is required that sulfide presence be determined by measurements in accordance with paragraph 8 of ASTM D1255-65T. A limit of 10 ppm sulfide is set for either

raw material or finished product. Nitrates shall be determined by a colorinetic measurement based on ASTM D992-52 and a limit of 10 ppm nitrate is set for the raw material of the finished product.

GAI Specification SP-5583 states that after fabrication, each wire or strand shall be protected with a coating of wax with corrosion inhibitor. Prescon presently button heads, twists, coils, straps and then dips the completed coil of tendon wires into a vat containing the wax corrosion inhibitor. (See Prescon Report Prescon 70/1.) Prestressing tendons are to be kept dry and stored in a dry place at Crystal River. It is required that as the tendons are inserted in the conduit, the surface of the tendon be visually inspected to insure that the tendon is coated as specified in the specification. Tendons that are not coated as specified are to be recoated with the corrosion inhibitor wax before installation. Tendons are to be installed under dry conditions and if the tendons are not stressed immediately after installation, a temporary end cap is to be installed to prevent the entrance of moisture. After stressing, the end anchors and exposed portions of the tendon are to be coated with the wax corrosion inhibitor and the end cap installed.

The stressing sequence of the vertical tendons is to be performed using a minimum of four jacks equally spaced at the circumference of the vessel. The stressing positions are to be alternated to prevent concentration of multiple stressed tendons adjacent to multiple unstressed tendons. The hoop and dome tendons will be stressed in a sequence so as to minimize stress concentration in the shell. Each tendon will be stressed no greater than 80% of the minimum guaranteed ultimate capacity of the tendons. The jacking tensioning must be reproduced to 70% of the ultimate capacity when locked in position with shims in place. If the loss of prestress force due to broken wires or strands exceeds one-half of 1%, GAI shall be notified immediately. Force and strain measurements are to be checked by measurement of the elongation of the prestressed steel after taking up initial slack and comparing it with a force indicated by the jack dynamometer. The gage on the dynamometer is to be within 2% accuracy, and records must be kept of the elongation and of the pressure during jacking. The jack dynamometer is to be checked against the elongation of the tendon and any discrepancy that exceeds $\pm 5\%$ of that predicted by calculation be corrected. The cause of any variation in load or elongation from average shall be documented. An unstressed specimen of the material used in the tendons is to be installed in each tendon conduit and is not to be less than five feet in length and be capable of being removed any time during the life of the structure without having to detension the tendon.

Prescon has submitted its field installation manual which is a step-by-step description of how the tendons are to be received and stored, unwound, installed and tensioned.

2. Welding (4805.04.e.3, 4805.05.a.3, 4805.06.a.3 and 4)

CB&I will not use dye penetrant examination as required by the specifications for examining the butt welds of the containment liner. FPC has approved the use of magnetic particle inspection in lieu of the dye penetrant examination. The examination will be in accordance with the CB&I magnetic particle examination procedure that has been used on the other sites and has been approved by FPC.

The spot radiographs for the containment liner were reviewed by the Region II inspector and they met the requirements of paragraph UW-52 of Section VIII of the code. The field foreman's weekly X-ray report issued by CB&I was audited and the Region II inspector concurred in the evaluation of the radiographs. Radiographs have been accepted by FPC for storage and FPC has issued a Receipt of Radiographic Film Transferred to Owner to CB&I.

The identification of welds, weldor and NDT inspection is continued to be recorded on a rollout drawing of the containment liner. At the completion of the job, the working copy of the rollout drawing at the jobsite will be sent to CB&I's Birmingham Engineering office, and the data will be transferred to permanent drawings and issued for permanent records. FPC is requesting that the original field copy be sent to them in case of error in transferring data.

Only E7018 coated electrodes are kept onsite and no loose electrodes were observed by the Region II inspector in his inspection of the containment liner.

The Region II inspector inspected the liner welding and made the following observations. It was observed that the top of the toriconical section had not been welded to the first cylindrical section of plate due to a gap that was approximately 40% of the circumference and as wide as two inches in width on the east side of the containment vessel and another gap 25% of the circumference was on the west side of the containment. (See Exhibit A, Photos 2 and 3.) The welding was of poor workmanship and quality with cold laps where a fingernail could be run underneath the cold laps. Excessive buildup in the repairs where the total reinforcement was as much as 5/16 of an inch in height, arc strikes, undercut and excessive ampere and electrode size used for defect pickup. (See Exhibit A, Photos 4 and 5.) Flat spots in the first

course of the cylindrical section that were out of tolerance, excessive rework indicating that the men were possibly not following procedures, excessive weaving as much as two inches on the dams for the leak chase system and temporary attachments being welded over paint were also noted.

A meeting was held in the FPC conference room on February 11, 1971, to discuss the problem. The meeting was attended by the following persons:

FPC

H. L. Bennett
E. E. Froats
D. W. Pedrick

CB&I

C. O. Saint - Project Manager, Birmingham
J. I. Hammond - QA Engineer
W. Batchelor - Foreman
J. A. Pritchard - NDT Supervisor
J. Sisk - Assistant Welding and QA Supervisor, Birmingham

Saint explained that a written welding repair procedure had been prepared to perform rework necessary for correcting the gap between the toriconical section and the first course of the cylindrical section. This is referred to as CB&I Special Welding Procedure SRP-1L dated January 29, 1971. The procedure requires the bottom of the first cylindrical be set at elevation 103 feet and the toriconical section be cut out off at elevation 102 feet and six inches where its top elevation is less than 102 feet, eleven five-eights inches. A six-inch-wide plate of the same base material as the liner will be then inserted and welded with the same welding procedure used in the welding of the rest of the liner. (See Exhibit B.) Sisk admitted that they had had trouble with their welding, that cold laps did exist and that excessive repair welding buildup would be ground back to a reasonable reinforcement. Sisk stated the Welding and QA Supervisor, O. Copeland, was relieved of his responsibility that morning and would be replaced on February 12 by L. Corelius.

After the meeting, a copy of the special repair procedure was made available to the Region II inspector for his review. The procedure requires that the CB&I field QA engineer measure and lay out the required burning lines and the six-inch filler plate be fitted and welded in accordance with Sketches A and B of the procedure. Filler plate welds will be spot radiographed in accordance with paragraph UW-52 of Section VIII of the ASME Code and CB&I Procedure RTP-5L

and vacuum box tested in their entirety in accordance with CB&I Procedure VTP-1L, Revision 2. The field weld rollout drawings will be so marked as to locate any filler plate joints and the engineering contract drawings will be subsequently revised to show the as-built filler plate locations. Filler plate material will be identified as well as the weldor identification and the location of spot radiograph will be shown on the field as-built drawings. Results of the radiographic examination will be recorded on CB&I Form GE-5A and the results of the vacuum box test will be recorded on CB&I standard vacuum box forms. A review was made of the elevations of the 26 points measured and the top of the toriconical section with J. Hammond and he explained that those areas that were above the 103-foot elevation were trimmed back to this elevation and the first course of the cylindrical section welded to it. Those areas that are below the 103-foot elevation in measurement are the areas in which the filler plate will be added.

Saint was questioned by the Region II inspector as to what occurred to cause the large gap at the top of the toriconical section. He explained that in the fitup of the toriconical section to the knuckle section, the knuckle section had been permitted to roll down causing the gap. Subsequent to the meeting, it was discussed with FPC that a change in the configuration of the knuckle would possibly cause a high stress concentration at the weld. The knuckle section is backed with cork and is not reinforced by the concrete; therefore, it is a pressure containing section and not a membrane and should be so analyzed. In office correspondence written to the attention of Bennett from Pedrick brought this to his attention and asked that an evaluation in the form of a stress analysis be initiated by Engineering.

The Region II inspector is satisfied that the corrective action has been taken by CB&I and its quality control will now function in accordance with its QA manual.

F. Instrumentation - Attachment H (5105.03 and 5205.03)

Electrical - Attachment I (5105.03 and 5205.03)

The inspection was planned to encourage suitable QA/QC program development for the E/I installation rather than make a program evaluation. The inspector confined the discussion to those problem areas identified at other projects. (Note: All such problems were discussed in general terms. No other project was referenced specifically.) The results of this approach were generally encouraging. Although it seemed apparent

that details of many of their proposed actions were not yet developed, some of the problems discussed had been identified by the staff and they were anticipating early action to develop appropriate procedures.

Several of the discussion subjects are listed in the following narrative with a paragraph or statement of discussion details included to indicate reaction.

1. Cable Tray Installation Standard

Hobbs' response to the inspector's questioning on this subject revealed that his present knowledge was limited to FPC workmanship standards which he assured would be imposed. He had no specific nor detailed knowledge of the criteria developed to govern cable tray design and installation.

Since the cable tray location is the basic guide and support for the cables, it is one of the principal variables requiring control for success in meeting the provisions of IEEE-279, single failure criteria.

Hobbs was urged to coordinate his installation procedures for this installation with the responsible design group with the viewpoint of such requirements as imposed by the applicable criteria as the primary guide.

Although Hobbs confirmed that no specific standard, such as the National Electrical Code (NEC), had been specified as a requirement, the point was made by the inspector that adherence to provisions similar to those set forth in Article 318 of the NEC would have ameliorated many of the problems associated with cable and cable tray installations that continued to surface at many other projects.

2. Cable/Conductor Splicing

All such splices will be made within boxes or cabinets designed for the purpose. Specifically, splices will not be made in the trays.

3. Safety-Related Instrument/Control Impulse Lines

Nothing in the form of a procedure for control of this class of equipment installation has been started.

In the development of suitable procedures, the inspector noted that the IEEE-270 standard, as it relates to the "single failure criterion," may furnish suitable guidance for these systems even though the criterion does not specifically include such items.

4. Redundant Systems Separation Criteria

Hobbs and other site staff members claim to have a good working relationship with their Design Engineering associates in the main office. Nonetheless, Hobbs did not know if a separation criterion had been developed nor what guides were being used by the designers to meet attendant requirements. Additionally, no field procedure had been developed to assure that the installed hardware met the separation requirements.

This was categorized as one of the major problem areas encountered by the inspector which had caused difficulty at one time or another at almost every project visited.

Hobbs was urged to take prompt planning action, in concert with the design engineering group, in developing an overall QA/QC program (procedures) to provide assurance that this difficult phase of the work will be performed in a qualified manner.

5. Cable Certification

The order has been placed for cable with the Kerite Company. A review of the cable purchase specification was made which revealed that suitable testing was required of the manufacturers to be confirmed by the submission of a certificate listing test results and confirming that the cable met all requirements.

From the review of this specification and receiving procedure, it was not clear that their QA/QC recording program would provide continuous cable/certification identification (traceability) once the cable was received and placed in storage at the site. This was discussed as a problem at many other projects by the inspector. They agreed to review this problem with their suppliers and will work out some method of assuring this capability.

6. Seismic Requirements

The ramifications of an appropriate QA/QC documentation program to provide suitable assurance that the safety-related E/I systems and components would perform as expected during a design seismic event were discussed. From the staff response, it seemed clear that this requirement had not been given serious consideration at the field construction level.

7. Vendor Control

The site review of various purchase specifications shows that the suppliers of safety-related E/I equipment/materials are required

to submit their QC programs with their proposals. This proposal is reviewed and found suitable by FPC and/or its QA/QC advisors prior to placing the purchase order. During production of the items, GAI or FPC source inspectors will make random audits of the vendors' QC actions.

Upon receipt of the hardware at the site, the receiving inspection checkoff list requires that all QC documentation be provided before the shipment is released from the "hold" category.

The inspector noted that this is a suitable program that should provide the assurance needed; however, similar programs at other sites have encountered great difficulty in assembling all the required documentation in a timely manner.

8. Field Changes

The need for a field change procedure has just recently been recognized. A handwritten predraft form of such a procedure was reviewed at the site. It was obvious that this draft was a "first-cut" attempt at such a procedure since it was just a group of questions on the subject. It was clear from the discussion with Hobbs that a great deal of informality is anticipated in any event with documentation to be provided "after-the-fact."

Problems associated with this type program were pointed out to both Hobbs and Froats. In response, Froats indicated that QC would tag any work not meeting current requirements which would be carried as an open item until suitable documentation was provided to the site. Their argument for this type operation was that it would assure continuity of the work with minimum delay and cost and still confirm that quality requirements had been met.

9. Termination Control

The staff reports that they are considering a program to provide assurance that conductor terminals are made as trouble-free as possible. The program will probably include the designation of crimper and stripper tools along with a procedure for periodic test, calibration and certification of such devices. Termination inspection procedures and documentation are expected to form a part of this program.

10. Relay Coordination Study

FPC has a special division of its technical organization that controls the settings, calibration, repair and testing and any other work related to the power protective relays for its entire

generation and distribution system. This group will perform related services at the Crystal River project. When the work has advanced to a suitable degree, a detailed inspection of this program will be scheduled.

11. Work Procedures and Quality Control Procedures

A number of procedures were reviewed at the site. Most all of these procedures are in the "draft" or "prereleased" stage of development. Two exceptions are FPC-W8, "Procedure for Warehouse Functions," and FPC-Q11, "Procedure for Work Stoppage, Tagging Control and Deficiency Reports." These procedures are complete and implemented. FPC-W8 is considered adequate. FPC-Q11 seemingly affords the quality supervisor decision prerogatives without full assessment by Engineering although the staff assured the inspector that this was not the intent nor would such a condition develop.

The remaining procedures reviewed were found to be general in scope. Those meant to be effective for safety-related installations will require broad revision with more specific detail before they can be considered suitable to assure that requirements have been fulfilled.

The following list represents all procedures available for the inspector's review:

FPC-W8 - Procedures for Man-hours Functions
FPC-Q11 - Procedures for Work Stoppage, Tagging Control and Deficiency Reports
FPC-W24 - Determining and Maintaining Equipment Insulation Levels
FPC-W25 - Receiving, Storage, Handling, Testing and Installing Switchgear and Load Centers
FPC-W29 - Receiving, Handling, Storing, Installing and Maintaining the D.C. Battery System
FPC-W30 - Receiving, Handling, Storing, Installing and Testing Electrical Penetrations and Assemblies
FPC-W31 - Receiving, Handling, Storing, Testing and Installing Isolated Phase Bus Duct and Related Equipment
FPC-W32 - Receiving, Handling, Storing, Installing and Testing Cable
FPC-W33 - Installing Conduit, Cable Tray and Underground Duct Banks
FPC-W34 - Receiving, Handling, Storage, Installing and Testing for Bus Duct

An unnumbered, hand written, predraft manuscript of "Field Change Procedures."

G. Organization (To Insure Quality of Concrete)

FPC is acting as the general contractor for the Crystal River 3 project. In this capacity, it has direct responsibility for construction scheduling, coordination, quality assurance, and quality control.

In addition to the construction staff, FPC has two quality engineers onsite (Froats and Pedrick). They are positioned in the organization in a manner giving them administrative independence from the site construction staff. They are charged with the responsibility of project quality surveillance which is described as an audit function.

FPC has hired GAI of Reading, Pennsylvania, to perform quality assurance work. To further fulfill its responsibility, FPC has hired PTL to perform the quality control tests and inspections on the concrete. PTL's concrete inspection staff consists of the following:

1 Chief Inspector - W. Hurst
1 Quality Supervisor - G. Browne
2 Principal Concrete Inspectors - W. Faulkner
- Unfilled Position
3 Batch Plant Technicians - J. Van Dyke
D. Whitehead (Dan)
D. Whitehead (David)
1 Lab Technician - D. Coffey
4 Concrete Technicians - K. Boyer
L. Brown
R. Collier
D. Westover

The Chief Inspector, Hurst, appears to be well qualified. He attended the University of Mississippi and the Lawrence Institute of Technology and graduated as a civil engineer from the International Correspondence School at Scranton, Pennsylvania. He is certified as a Radiographer by PTL and has special knowledge and experience in foundations. Hurst's ability is evidenced by the suggestions he has made to FPC, which it has adopted, to improve the quality of the concrete.

H. Concrete Quality

The structural concrete for Crystal River Unit 3 is being supplied by West Coast Concrete Company according to FPC's Specification for Furnishing and Delivering Structural Concrete, SP5569. The specification requires the concrete to be in accordance with the "Specification for Structural Concrete for Buildings," ACI 301-66, and "Building Code Requirements for Reinforced Concrete," ACI 318-63. Specification SP5569 was written by GAI and approved by FPC.

FPC's specification requires the concrete to have a minimum compressive strength at 28 days of 5000 psi as determined by ASTM C39-66, a maximum placing temperature of 70°F, a three-inch slump, and a maximum water to cement ratio of five.

The mix for the Crystal River Unit 3 containment building was designed by Law Engineering Testing Company of Atlanta, Georgia, and has been designated T-21565. Samples of this mix have been tested for compressive strength by both Law Engineering Testing Company and PTL. Compressive strength was measured by Law Engineering Testing Company at 28 days at 6410 psi and 6430 psi while PTL measured three 28-day samples at 7010 psi, 7010 psi and 7110 psi, all considerably stronger than the required 5000 psi.

Samples of the coarse and fine aggregates used in the construction of Crystal River Unit 3 were obtained from the stockpiles at West Coast Concrete Company's batch plant.

The criterion for Type II cement as supplied by Florida Portland Cement Company for Crystal River Unit 3 was changed on December 29, 1970. The changes tighten up on what ASTM C150, Standard Specification for Portland Cement, allows and are as follows:

Specific Surface (Blaine) sq. cm/gm	3500 to 3900
Air Content	6% min.
Compressive Strength psi	
7-day	3200 min.
28-day	5200 min.
Loss on Ignition	2% max.
C_3A	5% to 8% with 6% target
C_3S	42 min.

I. Coarse Aggregate

The coarse aggregate used by PFC in Crystal River 3 is Ocala limestone from the Crystal River formation, which includes all calcareous deposits of upper Eocene Age. The coarse aggregate is from Florida Crushed Stone Company of Citrus County, Florida, and it conforms in size to ASTM C33 No. 67 (3/4-inch stone). The Ocala limestone which is synonymous with Crystal River formation is primarily (95-98%) calcium carbonate.

FPC's Specification SP-5569 requires the coarse aggregate to conform to "Specifications for Structural Concrete for Buildings," ACI 301-66, which, in turn, required compliance with ASTM C33-67. (However, Specification SP-5569 specifically waives the freezing and thawing

tests required by ASTM C33.) In addition, and to assure control of the quality of the aggregate, Specification SP-5569 requires samples of the fine and coarse aggregate to be tested to ascertain conformance with ASTM Specifications C29-67T, "Test for Unit Weight of Aggregate," C40-66, "Test for Organic Impurities in Sands for Concrete," C137-59, "Test for Specific Gravity and Absorption of Coarse Aggregate," C128-59, "Test for Specific Gravity and Absorption of Fine Aggregate," and C136-67, "Test for Sieve or Screen Analysis of Fine and Coarse Aggregates."

ASTM C33, "Standard Specifications for Concrete Aggregates," establishes limits for grading the coarse aggregate, and limits for deleterious substances in coarse aggregate for concrete. It also establishes requirements for soundness and abrasion. The West Coast Concrete Company had Law Engineering Testing Company performed prequalification tests on the fine and coarse aggregates in October of 1968.

The No. 67 coarse aggregate experienced a 41.4% loss on the Los Angeles abrasion test, ASTM C131-66, which is within the maximum abrasion loss of 50% allowed by ASTM C33. As a parenthetical note of interest, ASTM C33 states that "coarse aggregate failing to meet this requirement (of 50%) may be used providing it produces satisfactory strengths in concrete of the proportions selected for the work."

The size 67 coarse aggregate experienced 13.47% loss on the sodium sulfate soundness test, ASTM C88-63. ASTM C33 limits the coarse aggregate to a maximum sodium sulfate soundness loss of 12% except that "aggregate failing to meet this requirement may be accepted, provided that concrete of comparable properties, made from similar aggregate from the same source, has given satisfactory service when exposed to weathering similar to that to be encountered; or, in the absence of demonstrable service record, provided that the aggregate gives satisfactory results in concrete subjected to freezing and thawing tests, and produces concrete of adequate strength." As noted previously, Specification SP-5569 specifically waives the freezing and thawing tests required by ASTM C33.

I. Halogen Leak Testing

The halogen leak testing of the leak chase channel over the butt weld of the containment bottom, knuckle section and toriconical section that will be inaccessible after final construction was witnessed by the Region II inspector. During the previous inspection, the Region II inspector had reviewed the Halogen Leak Testing Procedure HLP-1L and had noted that the procedure required charging the leak chase system to 5 psig with freon using a 100 psig gage then pressurizing

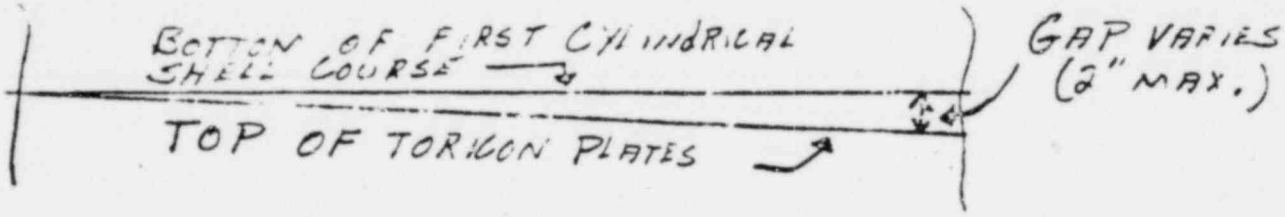
to 63.3 psig with air. It was brought to the licensee's and CB&I's attention that it was industry practice to use a gage at one-half of it's dial capacity and that with the 100 psig gage it would be difficult to read the 5 psig freon pressure accurately and the gage may not be accurate at the low range.

FPC discussed this with CB&I after the Region II inspector completed his inspection and CB&I (F. Dutton, Welding and QA Manager) took the position that the hysteresis of the gage was on the conservative side and they would not use a 10 psig gage for charging the system with freon. FPC (Pedrick) instructed CB&I to increase the freon charging pressure to 8 psig which violates the CB&I procedure.

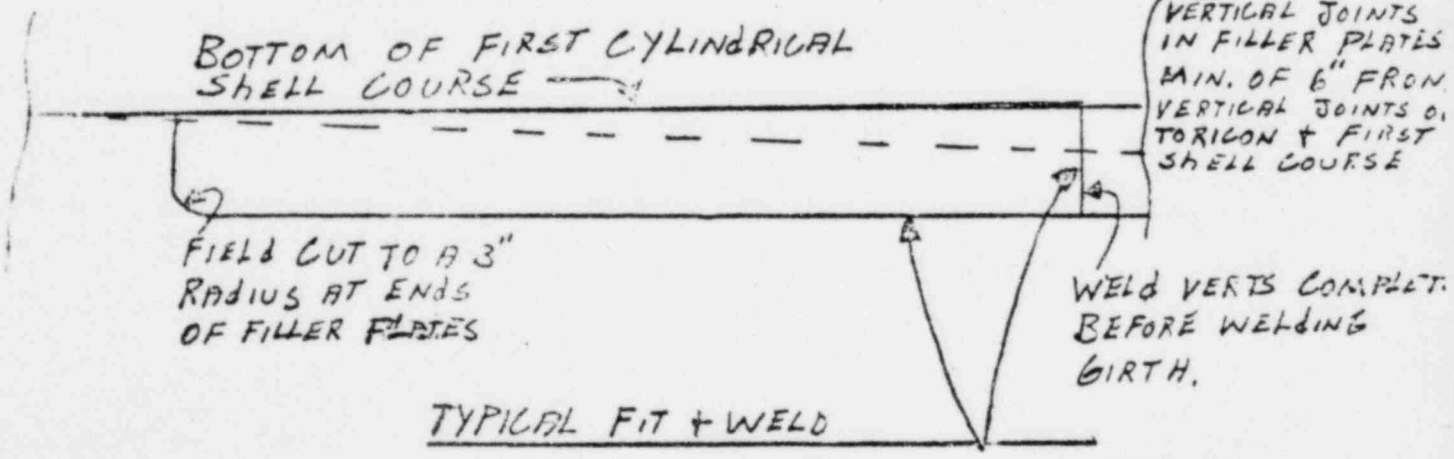
The leak testing was being performed in accordance with the test procedure except for the increased charging pressure of the freon.

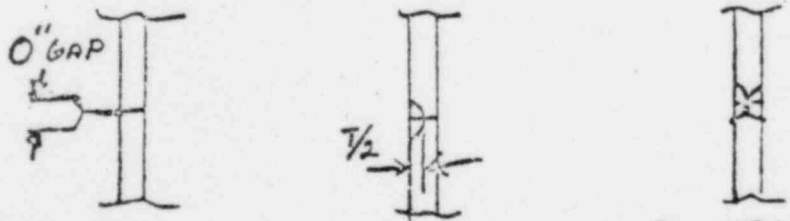
Attachments:
Exhibits A (CO:HQ copy only) and B

SKETCH-A
(SEE PARAGRAPH 1.1)



SKETCH-B
(SEE PARAGRAPH 3.2)





1. FIT JOINT TIGHT-NO GAP
2. ARC GOUGE BEVEL IN 1ST. SIDE + WELD.
3. ARC GOUGE + WELD 2ND. SIDE

168A Rev 3-70

	IDENTIFICATION SPECIAL REPAIR PROCEDURE SRP-1L
TITLE SPECIAL REPAIR PROCEDURE	
PRODUCT NUCLEAR CONTAINMENT VESSEL	PAGE NO. 4 OF 4
CUSTOMER FLORIDA POWER CORPORATION	DATE ORIGINATED 1/29/71
	REV. NO. 0 BY FPD DATE 1/29/71

POINT #1 IS LOCATED AT 0° CENTERLINE (Plant North)

POINT NO.	ELEVATION
P N 1	103' 0 1/4
2	103' 0 3/8
3	103' 0 3/8
4	102'11 3/8
5	102'11 3/8
6	102'10 3/8
7	102'10 1/8
8	102'10 1/2
9	102'11 1/8
10	102'11 1/8
11	102'10 3/8
12	102'10
13	102'11 3/16
14	103'0
15	103'0
16	103'0
17	103'0
18	102'11 7/8
19	102'11 9/16
20	102'11 3/8
21	[illegible]'11 3/16
22	[illegible]'11 1/2[illegible]
23	102'11 3/4
24	103'0
25	103'0 1/8
26	103'0 1/4

THEORETICAL ELEVATION IS 103'0

PHOTO 1

Fitup of 1st course of cylindrical section to toriconical section at plant north. Note cut-out at top of penetration insert and gap at weld preparation due to toriconical section being erected below elevation.

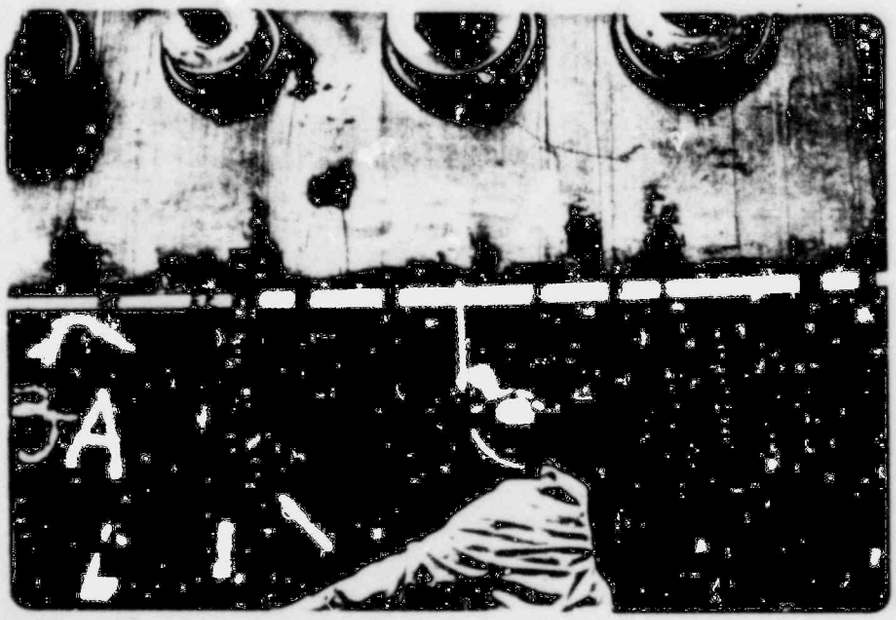


PHOTO 2

Point 12 (southeast quadrant) on containment liner where the toriconical section elevation is 102'-10" which is 2" below elevation.

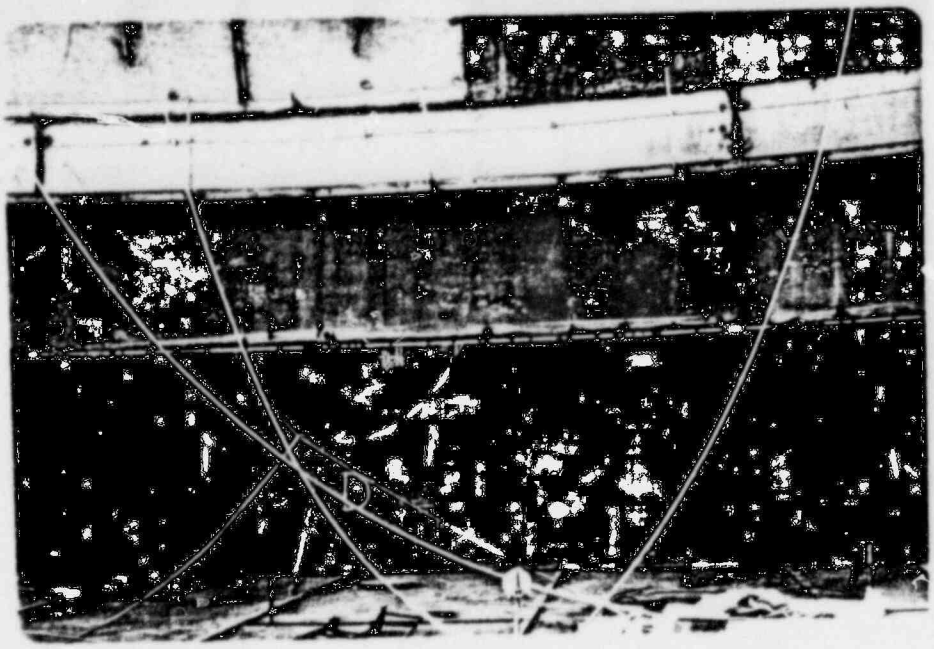


PHOTO 3

Fitup of 1st course of cylindrical section to toriconical section at west quadrant of containment liner.

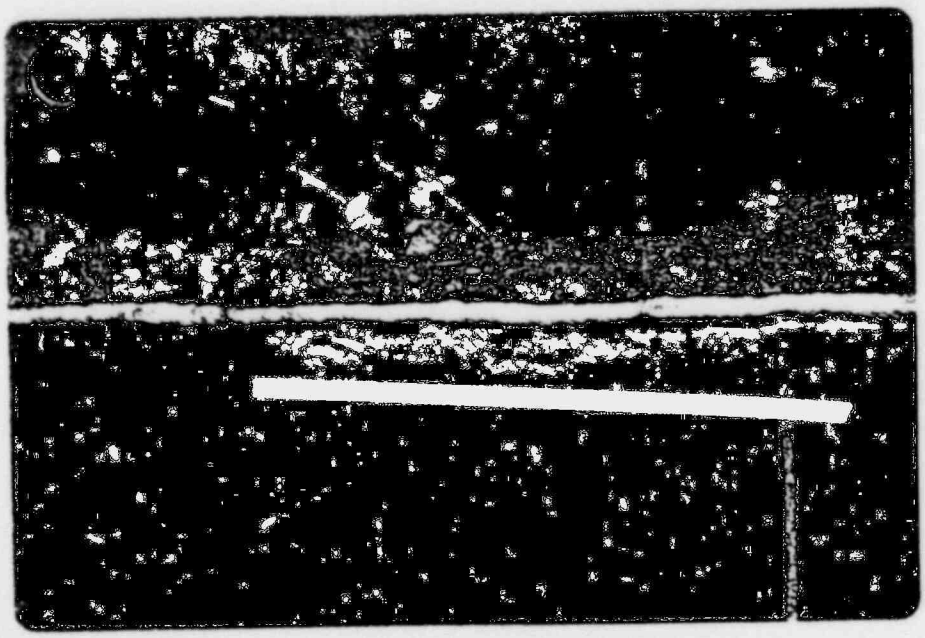


PHOTO 4

Welding of 1st course to 2nd course of the cylindrical section of the containment liner with submerged arc welding in the 3 o'clock position. Note arc strikes, undercut and cable arc burn.

PHOTO 5

Welding of 1st cylindrical section to the toriconical section of the containment liner with manual metal arc. Note rough bead conture and poor welding of repairs adjacent to weld.