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July 31, 1980

D. L. ASWELL Vice President-Power Production

LPL 14739 0-3-A35.07.15

Mr. K. V. Seyfrit, Director, Region IV U. S. Nuclear Regulatory Commission Office of Inspection & Enforcement 611 Ryan Plaza Drive, Suite 1000 Arlington, Texas 76012

Subject: Waterford SES Unit No. 3 Docket No. 50-382 Final Report of Significant Construction Deficiency No. 15 "Procedural and Performance Deficiencies in Ultrasonic Testing of Structural Welds Performed by Industrial Engineering Works"

Reference: LP&L Letter LPL 14395 dated June 27, 1980

Dear Mr. Seyfrit:

In accordance with the requirements of 10CFR50.55(e), we are hereby providing two copies of the Final Report of Significant Construction Deficiency No. 15, "Procedural and Performance Deficiencies in Ultrasonic Testing of Structural Welds Performed by Industrial Engineering Works".

Very truly yours,

SI aswell

D. L. Aswell

DLA/LLB/grf

Enclosure

- cc: 1) Director Office of Inspection and Enforcement U. S. Nuclear Regulatory Commission Washington, D.C. 20555 (with 15 copies of report)
 - Director, Office of Management Information and Program Control U. S. Nuclear Regulatory Commission Washington, D.C. 20555 (with 1 copy of report)

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LOUISIANA POWER & LIGHT COMPANY

WATERFORD SES UNIT NO. 3

Final Report of Significant Construction Deficiency No. 15 Procedural and Performance Deficiencies in Ultrasonic Testing of Structural Welds Performed By Industrial Engineering Works

7/30/80 Date Site Manager Reviewed by iser - P roject Superintendent 7-30-80 Date Reviewed by Project Licensing Engineer J. Hart -Hartnett - Q. A. Site Supervisor Date Reviewed by for R. Α.

July 28, 1980

FINAL REPORT OF SIGNIFICANT CONSTRUCTION DEFICIENCY NO 15 PROCEDURAL AND PERFORMANCE DEFICIENCIES IN ULTRASONIC TESTING OF STRUCTURAL WELDS PERFORMED BY INDUSTRIAL ENGINEERING WORKS

INTRODUCTION

This report is submitted pursuant to 10CFR50.55(e). It describes procedural and performance deficiencies in Ultrasonic Testing of structural welds by Industrial Engineering Works (IEW) for Louisiana Power & Light Company, Waterford Steam Electric Station Unit No. 3. The problem was identified on November 26, 1979, by Ebasco's Corporate ASNT Certified Level III Examiner during a routine surveillance visit of IEW's facility. In addition, this report includes all corrective measures taken by Ebasco and IEW to correct deficiencies and preclude recurrence.

DESCRIPTION

The extent of the deficiencies which are identified on Nonconformance Reports in accordance with Parts 1 and 3 of Ebasco's Nuclear Quality Assurance Program Manual (ETR-1001) is as contained herein.

I. PERFORMANCE DEFICIENCIES

Insufficient Ultrasonic Examination

- a. Affects Purchase Order NY 403573 and NY 403611. In accordance with the ASME Section III Subsection NF Boiler and Pressure Vessel Code, Ultrasonic Examination is required of the entire weld. Furthermore, Paragraph T535.2D.1 of the code specifies that "The search unit shall be placed on the contact surface with the beam aimed at about 90 degrees to the weld and manipulated laterally and longitudinally so the Ultrasonic beam passes through all of the weld metal in two different approaches of the beam to the reflector."
- b. Affects Purchase Orders NY 403593, NY 403573, and NY 403611. In accordance with AWS D1.1, 100% volumetric inspection is required when specified by the design engineer.

The IEW examination was performed in one direction only using a single search unit from the web surface(s) only. This resulted in not achieving 100% volumetric coverage. The attached sketch of a typical "T" weld representing the worst condition illustrates the area where the beam did not pass through the veld in two directions. The portion of the weld that did not receive complete examination was approximately 20%.

II. IMPROPER CALIBRATION

Potentially all Purchase Orders with IEW affected.

The Ebasco Corporate ASNT certified Level III Examiner during his November 26, 1979, surveillance visit at IEW's facility, noted that IEW was not calibrating its equipment in strict accordance with Para. 6.18 of AWS D1.1 edition or its own procedure UT-120, Revision 1. The Ebasco Level III Examiner required IEW to calibrate equipment as specified by its procedure in order for him to verify compliance with AWS D1.1. The equipment was calibrated by IEW with Ebasco's Level III Examiner present. It was determined that when equipment calibration was performed as specified by its procedure, UT-120, Revision 1, IEW complied with or exceeded applicable AWS D1.1 requirements, thereby eliminating the following:

- (a) Insufficient Ultrasonic Testing Sensitivity
- (b) Equipment not meeting performance requirements
- (c) Incorrect range and location calibration

III. PROCEDURAL DEFICIENCIES

A) Affects NY Purchase Orders 403573 and 403611.

Incorrect procedure requirements in shop drawings

- The IEW Procedure used for UT examination was in accordance with ASME Section III, Subsection NF requirements in lieu of Ebasco's specification requirement of AWS D1.1
- B) Affects NY Purchase Orders 403593 and 403611.

Incorrect requirements for detecting and evaluation of fusion line indications

Note: Item III.B should have been discussed as a Performance Deficiency and was incorrectly identified as a Procedural Deficiency in the Interim Report dated January 2, 1980.

SAFETY IMPLICATION

The below listed Ebasco Purchase Orders require Ultrasonic examination on Seismic I full penetration welds to ensure that the subject welds comply with the quality standard of the ASME or the AWS Code, when specified by the Design Engineer. The welds requiring Ultrasonic examination are associated with the following structures:

ASME Welds

- a) Reactor Coolant Pump Supports NY Purchase Order NY 403573
- b) Reactor Coolant Pipe Stops NY Purchase Order NY 403573
- c) Pressurizer Support NY Purchase Order NY 403611
- Note: These welds were designed in accordance with AISC requirements but welded and examined in accordance with the requirements of the ASME Code Section III Subsection NF.

AWS Welds

- a) Pipe Whip Restraints NY Purchase Order NY 403593
- b) Safety Injection Tank Supports NY Purchase Order NY 403611
- c) Framing over steam generator NY Purchase Order NY 403573

If corrective action had not been taken, potential weld defects may have existed in these Seismic I structures and may not have been detected. Such potential weld defects may under certain conditions lead to higher than allowable stress levels on these structures and if left uncorrected result in failure of the weld and possible subsequent failure of the affected component when subjected to the dynamic events postulated as the basis for design.

CORRECTIVE ACTION

Due to the findings of Ebasco's ASNT Certified Level III Examiner during his November 26, 1979, surveillance visit at IEW's facility, the following steps were immediately taken by Ebasco's Quality Assurance Engineering Group to ensure that construction progress did not preclude problem evaluation and any required corrective action. All equipment on site and at the supplier's facility was placed on restricted hold in accordance with Section QA-III-6, Revision 1, Nonconformances, and QA-III-10, Revision 1, Identification and Control of Items, of Ebasco's Nuclear Quality Assurance Program Manual. In addition, the Ebasco Project Manager, Project Superintendent, and Project Engineer were notifed resulting in the establishment of an Ebasco project team with the Project Quality Assurance Engineer acting as team coordinator. This team solicited IEW's input and in conjunction with IEW, established IEW and Ebasco discipline responsibilities and determined priorities for Engineering evaluation, reinspection and possible rework of welds in the field based on Engineering status, safety impact and construction schedules. The priority list and retest program were based on construction schedule requirements to the extent practicable, taking into consideration the final position of the structural members and the resultant access for re-examination and possible rework in place. In order to systematically accomplish the above, the following responsibilities and corrective action implementation requirements were established by IEW and Ebasco.

IEW

- a Initiation and disposition of nonconformance reports.
- b Preparation of NDE procedures for ultrasonic testing in the field to assure uniformity of inspection techniques. One procedure was prepared by IEW in accordance with the requirements of ASME Section III, Subsection NF. This procedure was determined to provide acceptable examination of components which had previously been partially examined in the IEW shop using either ASME or AWS criteria.
- c Qualification for ASNT certification of ultrasonic technicians (levels 1, 2, and 3) as applicable per ASME.
- d Correction of all performance deficiencies.
- e Ultrasonic examination or re-examination either at its facility or in the field.

f - Rework of all welds determined to be unsatisfactory.

g - Submittal of a, b, c and d to Ebasco for review and comment.

EBASCO

The project team consisting of members from Engineering, Quality Assurance Engineering, Materials Application, Construction and Licensing was responsible for the following:

- a Identifying field and shop welds of concern (Engineering).
- b Verification of codes used (Engineering, QA & Materials Application).
- c Weld accessibility to support UT Re-examination and possible rework (Engineering, QA & Construction).
- d A complete review of all 1EW Shop Drawings, including identifying all affected welds and indicating classification of each weld (Fngineering).
- e A stress investigation by Engineering was conducted to determine whether stress levels actually encountered in operation would require the previously specified full penetration welds.
- ⁵ A tabulated presentation of all concerned welds for each purchase order drawing and each joint to indicate the classification, design criteria, and code standards (All).
- g Preparation of historical data from the PSAR stage, through design and specification development, and into the present status of the FSAR to include standards involved, design classification, design criteria and code standards (Engineering and Licensing).
- h Review of IEW UT procedures to AWS and ASME-NF requirements (QA).
- i Development and maintenance of Priority Lists (Construction, QA).

Ebasco Engineering conducted an engineering analysis based on design criteria to determine which welds actually required full penetration welding in accordance with AISC, AWS D1.1 and Ebasco Standard Practices for Structural Design. Based on this engineering study it was determined that certain welds specified as full penetration actually could have been designed as partial penetrations and as such would not have required ultrasonic examination.

Based on this engineering evaluation, all full penetration welds which could have been designed as partial penetration welds were identified and reinspection by Ultrasonics was not performed. The engineering evaluation performed was as follows:

There are a total number of one thousand two hundred fourteen (1,214) weld joints associated with the reactor coolant pump supports and reactor coolant pipe stops. One thousand sixty-six (1,066) welds were reclassified as partial penetration leaving the remaining one hundred forty-eight (148) weldments as full penetration. The pressurizer support structure had one hundred sixty-six (166) weld joints in which all welds were reclassified as partial penetration welds. Data supporting this analysis is available in Ebasco's Engineering files.

The result of this effort was the determination that 148 full penetration weldments required re-examination by ultrasonics at the Waterford III Site.

Parallel with and aided by the engineering analysis, on January 3, 1980, IEW mobilized on site and commenced ultrasonic testing. Prior to starting UT Examination Ebasco reviewed IEW NDE procedures and personnel qualifications. Ultrasonic examination at the site was conducted in order to reinspect items previously tested at the IEW facility to ensure 100 percent volumetric examination of the required welds. To minimize impact on construction scheduling, initial UT was performed without removal of Amercoat 71 and Amercoat 90 paint coatings. Since the surface to be scanned was coated, it was therefore necessary to develop a technique (documented by Addendum A to procedure UT-124) for ultrasonic attenuation correction required to compensate for the surface coating.

During the week of February 25, 1980, a team of Quality Assurance Engineers from Ebasco's New York Office revisited the Waterford III Construction Site. The purpose of this visit was to analyze test results being obtained from IEW's ultrasonic examination of structural steel items.

To maximize the effectiveness of this investigation, attention was directed in the following major areas:

- A. Equipment Suitability
- B. Personnel Qualifications
- C. Procedure and Technique
- A. The ultrasonic equipment being used by IEW consisted of both Krautkramer and Branson instruments and a variety of transducers. Equipment certification records and linearity checks were maintained by IEW. In addition, IEW had calibration blocks representing the range of wall thickness for the welds involved.
- Additional certification records for IEW NDE personnel were reviewed. This review disclosed one minor deficiency which was immediately resolved.
- C. The procedure used by IEW for on-site examination was UT-124, Revision 1, dated 12-8-79 supplemented by UT-124S for defect sizing. The procedure and supplement had been reviewed by Ebasco prior to use and it was observed that IEW was implementing the procedure properly.
- D. The variables in coating condition and thickness were such that required confidence in the results could not be obtained and the procedure was determined to be ineffective and discarded. Based on this decision, all items in the field requiring reinspection by UT examination were stripped of all coatings by mechanical means and cleaned prior to examination. Testing validation of this conclusion is discussed in Paragraph F. Further, Ebasco determined that the additional ultrasonic testing would be performed on only those welds classified as full penetration welds to satisfy stress levels.
- E. The required UT re-examinations were made with test sensitivity established in accordance with procedure UT-124, Revision 1. Both straight and angle beam examinations were performed with satisfactory results.

F. Welds as specified by the Design Engineer representing various joint configurations not previously inspected 100% volumetrically were re-examined. This re-examination resulted in no rejectable indications based on signal response. However, three (3) indications were interpreted as "lack of fusion" and were rejected. These rejectable indications were recorded and dispositioned as acceptable on Nonconformance Report W3-1802-007 Add A.

On March 20, 1980, the same team revisited the Waterford III Site to review the results of all IEW field activities related to UT reinspection and to assist site personnel in the close-out of IEW's site activities.

- G. During ultrasonic re-examination of eight ... (8) stops known as "D" Stops, it was determined by IEW that the four (4) welds at the top of each of these eight "D" Stops had been made as partial penetration welds in lieu of full penetration welds. This problem was documented on Nonconformance Report W3-1802-011 dated March 19, 1980. Exploratory ultrasonic testing was performed on these welds to establish the depth of weld penetration for the welds. An engineering evaluation of this information concluded that based on the stress levels in these welds, partial penetration welds were acceptable. At the request of a Nuclear Regulatory Commission Inspector during the week of April 7, 1980, these "D" Stops were sand blasted and reinspected. During this reinspection, it was noted that small areas of non-fusion or incomplete weld existed at each end of the seven-inch welds at the top of the "D" Stop. This problem was then documented on a Nonconformance Report W3-1992. The "D" Stops were returned to the manufacturer's facility for repair and rework. As a result of this problem, IEW reviewed their inspection procedures with IEW inspectors and established additional weld inspection criteria to preclude recurrence of this type of problem. Ebasco Vendor Mechanical/Welding Inspectors were provided copies of the entire documentation package relating to the "D" Stop problems as a training aid and guidance for their future inspections to preclude recurrence of this type of problem. The "D" Stops are planned for return to the Waterford III Site on August 4, 1980.
- H. The items listed in the <u>DESCRIPTION</u> paragraph of the Interim Report dated January 2, 1980, were further evaluated during the progress of this effort. Items listed in paragraphs II and III.B were determined to be isolated occurrences not contributing to the overall problem.

CONCLUSION

Since all AWS and certain NF welds were reclassified by Engineering as partial penetrations based on low stress levels, re-examination by UT was not required. This determination was further reinforced by the fact that the UT inspection (approximately 80% of weld in lieu of 100%) initially performed did not uncover discontinuities which exceeded code acceptable limits.

As a result of the analysis and testing program described herein, it has been determined that the original problem definition should have been limited to proper implementation of procedures to assure that 100 percent volumetric examination of all required welds was accomplished. As stated above, <u>all</u> IEW welds requiring full penetration to satisfy stress levels were re-examined at the Waterford III Site and found acceptable.





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Weld & HAZ Examined with Ultrasonic Beam Passing through in two directions



Weld & HAZ Examined with Ultrasonic Beam Passing through in one direction

HAZ - Heat Affected Area