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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In The Matter of	)	
	)	
COMMONWEALTH EDISON COMPANY	)	Docket Nos. 50-454-OL
	)	50-455-OL
(Byron Nuclear Power Station,	)	
Units 1 & 2)	)	

SUMMARY OF THE TESTIMONY OF
ERNEST B. BRANCH
ON CONTENTION 1
(REINSPECTION PROGRAM - WORK QUALITY)

I. Ernest B. Branch is an Associate and Mechanical Design Director of Sargent & Lundy.

II. Mr. Branch's testimony addresses the portion of the engineering evaluation prepared as part of the Reinspection Program by Sargent & Lundy engineers with respect to various discrepancies identified during the reinspection of objective attributes of work performed by Hunter Corporation. Mr. Branch also discusses engineering evaluations performed with respect to certain weld discrepancies under the ASME Code that were produced by welders employed by Hunter Corporation.

III. Mr. Branch explains that Hunter was responsible for installation of nearly all the mechanical systems at Byron. Its work fell into the three basic categories for reinspection: hardware installation; related documentation; and welding. The work was also divided into objective and subjective attributes. A total of 71,510 objective Hunter attributes were reinspected. An additional 3,725 reinspections of Hunter subjective attributes (welding) were performed.

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III. Mr. Branch explains that Hunter was responsible for installation of nearly all the mechanical systems at Byron. Its work fell into the three basic categories for reinspection: hardware installation; related documentation; and welding. The work was also divided into objective and subjective attributes. A total of 71,510 objective Hunter attributes were reinspected. An additional 3,725 reinspections of Hunter subjective attributes (welding) were performed.

IV. A total of 689 (approximately 1%) of the objective attributes were reported discrepant. Mr. Branch explains that the discrepancies associated with the objective attributes were evaluated by three methods: by comparing them with current design parameters to determine acceptability; by use of engineering judgment; or by engineering calculations. Mr. Branch concludes that, based on the detailed evaluation of the Hunter objective discrepancies, none of the discrepancies had any design significance.

V. Mr. Branch explains that "design signficance" refers to those qualities necessary to meet established design criteria.

VI. Mr. Branch also discusses the result of the engineering evaluation of the 49 discrepant ASME welds. The engineering evaluation for these welds first categorized the welds into four types and then applied a three-method approach similar to that applied to the objective discrepencies. Mr. Branch concludes that none of the 49 discrepant Hunter ASME welds had design significance.

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TESTIMONY OF ERNEST B. BRANCH

Q.1. Please state your full name and place of employment for the record.

A.1. My name is Ernest B. Branch. I am an Associate and Mechanical Design Director of Sargent & Lundy which is a Consulting Engineering Firm, located at 55 East Monroe, Chicago, Illinois 60603.

Q.2. Please describe your job responsibilities.

A.2. As Mechanical Design Director, I am responsible for the overall coordination and management of two of Sargent & Lundy's key mechanical divisions that have the responsibility for piping design and analysis. These divisions are the Mechanical Design & Drafting Division and the Engineering Mechanics Division. I am responsible for providing leadership, overall management, direction, supervision,

progress monitoring, and quality of design work for all of the projects under design at Sargent & Lundy.

Q.3. Please describe your educational background and work experience.

A.3. I am a 1964 graduate of Virginia Polytechnical Institute and State University with a Bachelor of Science Degree in Engineering Mechanics. I am a registered professional engineer in Illinois (1970). I have over 29 years of experience in power plant and marine propulsion plant design.

I started working for Sargent & Lundy in March of 1969 as the Supervisor of Piping Stress Analysis. Over the years, I have had increasing job responsibilities on both fossil fuel and nuclear generating station design projects and in the management of the Mechanical Department. My assignments have included Division Head of the newly formed Engineering Mechanics Division in 1970 and Mechanical Design Director in 1982. While at Sargent & Lundy, I have had direct design responsibility for piping systems for the following nuclear projects: Marble Hill - Unit 1, Zimmer - Unit 1, LaSalle - Units 1&2, Byron - Units 1&2, Braidwood - Units 1&2, Fermi - Unit 1, Zion - Units 1&2, Dresden - Units 2&3, Quad Cities - Units 1&2, and Clinton - Unit 1.

Prior to joining Sargent & Lundy, I was employed from 1955 to 1969 by the Newport News Shipbuilding and Dry

Dock Company in Newport News, Virginia. During that period of employment, I had engineering experience in the procurement of nuclear power plant components for ship board use, mechanical system startup and testing, and piping design and analysis. I was also engaged in various design activities for the USS Enterprise, nuclear power aircraft carrier CVAN65. I began my employment at Newport News as an apprentice piping designer and my last position was Senior Design Supervisor in the Nuclear New Design Division.

Over the years, I have been directly involved in the development of nuclear codes and standards. This involvement began with a charter membership of the ANSI B31.7 Nuclear Power Piping Code Task Group on Design that was founded in 1966. Subsequently, I was a charter member of the ASME Section III Piping Design Working Group founded in 1970. I later became Chairman of the Section III Piping Design Working Group for the period of 1975 to 1982.

I am currently a member of the Section Committee of the ASME Section III Boiler and Pressure Vessel Code (Code), which was applied in the evaluation of Hunter weld discrepancies. I am also a member of two subcommittees under the Code Section Committee, the Subgroup on Design and the Working Group on Piping. In addition, I am a member of the ASME Pressure Vessel Research Council -- Technical Committee on Piping Systems and I am Chairman of the Technical Committee Task Group on Industry Practice. I

have published numerous technical papers on Piping Design and Analysis.

Q.4. Are you familiar with the Byron Reinspection Program?

A.4. Yes, I was involved in the program in December of 1983 and January of 1984 as a Consultant in the preparation of the Report on the Byron QC Inspector Reinspection Program that was published in February of 1984. The consulting I provided was for Sargent & Lundy's activities associated with the engineering evaluations of the Hunter objective attribute discrepancies, including pipe ovality, and ASME subjective attribute discrepancies. I had some direct involvement in the preparation of these engineering evaluations, but was not involved in every detail.

Q.5. Are you adopting the testimony of Donald L. Leone as previously filed.

A.5. Yes.

Q.6. On what basis do you adopt that testimony?

Q.6. I have reviewed Mr. Leone's testimony concerning the engineering evaluations of the reinspection program by

Sargent & Lundy engineers with respect to various discrepancies identified by the reinspection of objective and subjective attributes of the work performed by Hunter Corp. As discussed above, I have been involved in the reinspection program and I have been thoroughly briefed by the responsible project team members. I have also reviewed the underlying calculations and data for the Hunter evaluations. I understand and adopt that work. Based on the foregoing, I adopt the testimony of Mr. Leone.

Q.7. What work was performed by Hunter Corporation at Byron Station?

A.7. Hunter was responsible for the installation of nearly all the mechanical systems at Byron. This work included installation of mechanical equipment and interconnective process piping and supports, and the supply of miscellaneous piping and welding materials.

Q.8. How was this work classified for reinspection?

A.8. The Hunter work fell into three basic categories involving hardware installation, related documentation and welding. Therefore, these areas were established

as attributes. The Hunter work was divided into objective and subjective attributes depending on the degree of qualitative judgment inherent in the inspection activity.

Each attribute consists of a number of elements. For example, the documentation attribute was subdivided into such inspection points as work process sheets, weld material requisition sheets, field inspection reports and discrepancy reports. A complete listing of this attribute and the hardware and welding attributes is shown on Attachment B of Mr. Del George's testimony.

Q.9. How many reinspections of these attributes were performed?

A.9. A total of 69,624 reinspections of objective attributes was performed as part of the Program. Another 1,886 Hunter installations of concrete expansion anchors were reinspected by PTL. Thus, the total reinspections of Hunter objective attributes equals 71,510. In addition, 3,725 reinspections of the subjective attribute, visual welding, were performed.

Q.10. What were the results of the reinspections of the objective attributes?

A.10. A total of 689 (approximately 1%) objective attributes was reported to be discrepant. Five of these discrepancies were associated with concrete expansion anchors reinspected by PTL. The 689 discrepancies involved 441 documentation and 248 hardware discrepancies.

Q.11. How were the discrepancies associated with the objective attributes evaluated?

A.11. The discrepancies were first compared with the current design parameters and tolerances or other documentation to determine if they were acceptable on this basis. The remaining discrepancies were evaluated by either engineering judgment or by engineering calculations. Evaluations by engineering judgment consisted of a review of the component design functions to determine whether the function of the component was affected by the discrepancy or consisted of a comparison of the discrepancy to the current design to determine whether the discrepancy had design significance. The third method of evaluation was by performing detailed engineering calculations.

Q.12. How many of the discrepancies associated with objective inspections were evaluated by comparison to the design parameters and tolerances?

A.12. A total of 614 (39%) discrepancies were evaluated in this manner. This included all 441 documentation discrepancies and 173 hardware discrepancies. Discrepancies evaluated typically included cosmetic flaws, minor dimensional errors, and documentation errors. The dimensional errors consisted primarily of minor as-built piping and pipe support dimensional errors or incomplete as-built information. Documentation errors consisted primarily of minor data entry errors and omissions on work reports and process sheets. These discrepancies were evaluated by reviewing corroborating information on the affected documents and other independent documents. The evaluation showed that all hardware discrepancies were within the current design parameters and tolerances. All documentation discrepancies were deemed acceptable based upon reviewing other corroborating documentation.

Q.13. How many of the discrepancies associated with objective inspections were evaluated using engineering judgment?

A.13. A total of 54 (8%) discrepancies were evaluated by engineering judgment with all discrepancies hardware related. Discrepancies evaluated included dimensional errors and omissions for piping, pipe supports and pipe whip restraints; hardware substitutions, minor configuration changes; and minor mechanical joint bolting deviations. None of these discrepancies impaired component design functions or had design significance.

Q.14. How many of the discrepancies associated with objective inspections were evaluated using detailed engineering calculations?

A.14. A total of 21 (3%) discrepancies were evaluated in this manner with all discrepancies hardware related. Discrepancies evaluated included 3 as-built pipe support dimensions, 4 concrete expansion anchors, 3 pipe whip restraints, and 11 small bore pipe bends with excessive ovality. These elements were originally established by engineering calculations and a new calculation was necessary in order to account for the identified discrepancy.

Q.15. What was the nature of the engineering evaluations with respect to pipe ovality?

A.15. Ovality is a measure of the pipe roundness at the point of bending. The 11 pipe bends exhibited average ovality values of 10.5%, which is in excess of the 8% limit of the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code -- Section III, Nuclear Power Plant Components -- Division I (1974 Ed. Summer, 1975 Addenda). Accordingly, calculations were performed verifying the acceptablity of the pipe wall thickness and flow area reductions allowed by the ASME Code. Stress intensification effects were evaluated as negligible since all of the pipe bends are five pipe diameters in radius.

Q.16. What does the engineering evaluation of the discrepancies in the objective work attributes performed by Hunter demonstrate?

A.16. The detailed evaluation of the Hunter objective discrepancies showed me that none of the discrepancies has any design significance and, hence, no safety significance.

Q.17. What does the term "design significance" mean?

A.17. Design significance is a term used to describe the relative importance of discrepancies. Design significance refers to those qualities necessary to meet established design criteria. These qualities vary depending on the aspect of the design being evaluated. A discrepancy that reduces the strength of a member, component or structure is only design significant if the strength is reduced below that required to meet design requirements. A discrepancy, such as a missing component or a material configuration change, is design significant only if the operation of the plant is affected. As I indicated, none of the Hunter discrepancies discussed above had design significance.

Q.18. How many welds produced by Hunter Corporation covered by the ASME Code were reinspected?

A.18. Of the 3,725 welds which were reinspected, 2,721

(approximately 73%) were covered by the ASME Code. Forty-nine discrepancies were observed in these welds.

Q.19. How were the 49 discrepant ASME welds evaluated?

A.19. The 49 ASME welds were grouped by type into large bore butt welds, socket and fillet welds, NF support welds, and pipe penetrations and reinforcing saddles. The welds then were evaluated to ASME Section III Code design criteria using three methods to determine whether the discrepant welds had design significance.

The initial method involved comparing the weld discrepancy with the current design parameters and tolerances and the ASME Code to determine if it was acceptable on that basis. For example, the visual welding reinspection criteria were too stringent in some cases (surface porosity) which exceeded code acceptance criteria. These reported discrepancies were determined to meet code design criteria and were, therefore, determined to be acceptable.

If resolution was not possible using the first approach, the next approach involved evaluation by engineering judgment based on a comparison of the weld discrepancy with design margins or the component design function. A determination was made whether the function of the component was affected by the weld discrepancy.

The final method of resolution of the weld discrepancy was an evaluation by detailed engineering calculation.

Q.20. Would you describe the analysis performed for the ASME weld discrepancies requiring engineering calculations?

A.20. All engineering calculations utilized ASME Code design criteria. Weld assessment calculations were performed with appropriate weld material reductions where a relevant discrepancy was located. Weld discrepancies involving ASME Class 1 piping were evaluated against the fatigue analysis for the piping system. There were only 3 ASME Class 1 discrepancies and all 3 involved undersized seal welds for threaded radiographic plugs, which are non-pressure retaining piping welds. For the socket welds which were reported to be undersized, ASME Code Case N-316 was used to establish the required fillet weld size on the basis of the socket minimum wall thickness.

Q.21. What were the results of the engineering evaluation of large bore piping butt welds which were discrepant?

A.21. A total of 3 discrepancies were reported. Two were within current design parameters and tolerances, and one was compared to design margins and determined to be acceptable by engineering judgment.

Q.22. What were the results of the engineering evaluation for socket and fillet discrepant welds?

A.22. A total of 30 discrepancies were reported. Three were within current design parameters and tolerances; four were compared to design margins and determined to be acceptable by engineering judgment; and 23 were evaluated by engineering calculation and met ASME Code design criteria. The majority of the calculations involved a simple arithmetic computation of the Code required fillet weld size.

Q.23. What were the results of the engineering evaluation for NF support discrepant welds?

A.23. A total of 14 discrepancies were reported. One was within current design parameters and tolerances, and 13 were reviewed by calculation and met ASME Code design criteria. The majority of the calculations involved recalculating the designed weld with consideration of the discrepancy accounted for and all welds were found to meet ASME Code design criteria.

Q.24. What were the results of the engineering evaluation for the discrepant welds for pipe penetration and reinforcing saddles?

A.24. A total of two discrepancies were reported. Both

were reviewed by engineering calculation and met ASME Code design criteria. Both welds were compared with actual design requirements and neither of the discrepancies were determined to have design significance.

Q.25. Did any of the 49 ASME discrepant weld joints fail to meet ASME Code design criteria?

A.25. No. In all cases, discrepant weld joints met, or exceeded, Code design criteria.

Q.26. What does the engineering evaluation of the weld discrepancies of work performed by Hunter demonstrate?

A.26. The engineering evaluation of all of the weld discrepancies showed that none of the weld discrepancies had any design significance and, hence, no safety significance. The quality of the work reinspected is adequate.