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SHIELDS L. DALTROFF
VICE PRESIDENT
ELECTRIC PRODUCTION

May 23, 1983
Docket No. 50-277

Mr. Darrell G. Eisenhut
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Eisenhut:

This letter is a follow-up to the afternoon meeting held in Bethesda, Maryland, on Friday May 20, 1983, at the NRC offices wherein representatives of Philadelphia Electric Company and General Electric Company discussed the continued operation of Peach Bottom Atomic Power Station Unit 2.

As a result of findings associated with performing pipe weld examinations associated with In-Service Inspection and Induction Heat Stress Improvement on Peach Bottom Atomic Power Station, Unit 3 primary system, selected Unit 2 pipe welds were examined on May 6, 1983. The examinations resulted in indications of some circumferencial cracking in pipe weld 10-0-6 on the Residual Heat Removal System for Unit 2. The nature of this cracking was characterized and a fracture mechanics analysis was performed which determined that code allowable margins exist for the Unit to be operated continuously until a scheduled refueling outage in October of 1983. In addition to the performance of the fracture mechanics analysis ten welds on Unit 2 were selected for the installation of a moisture sensitive monitoring device in order to provide warning in advance of the existing techniques utilized for determining unidentified leakage from the Units primary system. Specific action to be taken upon indication of a pipe leak are presented in an attachment to this letter. Since the analysis and field experiences confirm that these type of weld cracks are characteristically of a leak before break nature and do not constitute an undue risk to the health and safety of the public as stated in NUREG-0313, Rev. 1, Appendix A, Section 3, continued operation of Unit 2 under the

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augmented leak detection requirements until the October refueling outage is warranted.

This letter and its attachments are also intended to document answers to certain questions addressed in the May 20, 1983, meeting and also provide a detailed description of augmented leak detection systems and interim surveillance requirements with associated action statements.

Sincerely,

cc: A. R. Blough
Site Inspector

List of Attachments

1. Peach Bottom Atomic Power Station Unit 2 Safety Evaluation for continued operation to Fall, 1983, refueling outage, with pipe crack indications

2. Licensee Event Report

3. PBAPS Unit 2 augmented leak detection system for primary containment

4. Response to questions addressed in PECo/NRC Meeting of 5/20/83

5. Interim Surveillance and limiting conditions of operation for PBAPS Unit 2 thru October, 1983

May 23, 1983

Docket No. 50-277

ATTACHMENT I

SUBJECT: Safety Evaluation of Continued Operation of Peach Bottom Atomic Power Station Unit #2 with Circumferential Crack Indications in RHR System Weld No. 10-0-6

Introduction

On May 3, 1983, Peach Bottom Unit 2 was removed from service to repair a valve packing leak. During the course of this outage, an inspection was performed on certain welds which had shown intergranular cracking on Peach Bottom Unit #3. One of these welds, 10-0-6, on the residual heat removal suction line was found to possess circumferential crack indications. A thorough characterization was performed on these crack indications. This characterization was evaluated using ASME Code approved fracture mechanics analysis which concluded that there was sufficient wall thickness remaining to allow a minimum of 4,000 hours of continuous full load operation.

Background

The residual heat removal suction line on the Peach Bottom Atomic Power Station Unit #2 is a 20" 0.775 minimum wall thickness ASTM Type A358 Grade TP-304 stainless steel. The weld in question, 10-0-6, is a field weld joining a straight length of pipe to a 90 degrees ASTM A403 Grade WP-304 stainless steel elbow. This weld was examined by General Electric Company and Sonic Systems International personnel on May 5, 1983, using ultrasonic techniques which had been demonstrated to be able to find intergranular stress corrosion cracking. This examination was conducted in accordance with General Electric Company Procedure PB 83-1, Rev. 4 (Exhibit One).

The initial examination showed the weld to possess circumferential indications on both sides of the weld which were concluded to be intergranular stress corrosion cracking (IGSCC). A further examination was conducted on weld 10-0-6 on May 7, 1983, to better determine the crack characterization as to its

length and depth (Exhibit 2). The methods used to characterize the crack are documented in Exhibit 3 and are similar to those described in Exhibit 4. The results of this characterization show 10-0-6 to possess circumferential indications as diagramed in Figure 1.

The crack characterization produced on May 7, 1983, was telecopied to General Electric Company in San Jose, California, for fracture mechanics analysis in accordance with Appendix "X" of Section XI of the ASME Code. For purposes of this fracture mechanics analysis, a crack depth of 0.3" was assumed together with a crack length of 360 degrees. As part of the fracture mechanics analysis, normal as well as upset conditions were evaluated. The IGSCC crack growth rate used in the analysis was based on a conservative estimate of the sustained stresses. The sustained stresses consisted of pressure (axial), weight, and thermal expansion stresses. In order to make conservative estimates of the crack growth rate, the residual stress, which is compressive in the mid thickness region in a large diameter pipe, was not considered in the evaluation. The sustained stresses at the weld 10-0-6 were determined to be approximately 13 ksi. The calculated crack growth is shown on the flaw acceptance diagram in Figure 2.

The fracture mechanics analysis concluded that the crack indications believed to be present in weld 10-0-6 would not propagate to the Section XI wall thickness limit of 0.58" for at least 4,000 hours of full load operation.

Evaluation

The ultrasonic examination technique used in the detection of the crack indications in weld 10-0-6 has been demonstrated to be capable of finding inservice IGSCC at both Battelle Columbus Laboratories and the EPRI NDT Center in Charlotte, North Carolina. The technicians participating in the actual examination have also been certified as being able to detect service induced IGSCC by actual hands-on demonstration on cracked specimens. The crack characterization method utilized to describe the crack indications as shown in Figure 1 is conservative since it ignored the down-bending of ultrasound as it is transmitted through weld material. Therefore, the crack indications as characterized in Figure 1 represent a maximum depth indication since straight line plots were used in their characterization.

The fracture mechanics analysis performed on the crack indications shown in Figure 1 is in accordance with ASME Section XI criteria and has built into it a safety factor of 3. Furthermore, it is well-documented that welds contained in large diameter heavy wall piping similar to 10-0-6, possess compressive residual stresses in the mid wall region, which is the area of the indicated crack tip (see Reference 1). These compressive stresses when acting on the crack tip would slow the crack growth rate. The analysis performed ignored the beneficial effects of the weld residual stresses. An applied stress value of 13 ksi was used and crack growth data for furnace sensitized material in 0.2 ppm oxygen was used. The analysis showed that the 0.3" (33 percent wall) crack would grow to 0.376" (42 percent wall) in 4,000 hours. This is within the allowable crack depth of 0.58" (64 percent wall) corresponding to Pw + Pb = 0.7Sm as stipulated in Appendix "X" of ASME Code Section XI.

Conclusion

We have concluded, based on the considerations discussed above, that:

1. Because the ultrasonic examination procedures have demonstrated the ability to detect intergranular stress corrosion cracking, and since the crack characterization procedures are inherently conservative due to the use of straight line plotting, that the crack characterization presented in Figure 1 represents a conservative picture of any cracking present in weld 10-0-6.

2. Since the fracture mechanics analysis performed on the crack indications possesses an inherent safety factor of 3, and since the fracture mechanics analysis neglects the beneficial contribution of compressive residual welding stresses, then the predicted crack propagation life of 4,000 hours reflects a conservative minimum operating time.

3. Since the overwhelming laboratory and industry experience to date has shown that weld sensitized material in austenitic stainless steels exposed to intergranular stress corrosion cracking will fail in a "leak before break" manner (Reference 2), and

that it has been shown that intergranular stress corrosion cracking does not represent an unresolved safety issue (Reference 3), then it can be concluded that Unit #2 of the Peach Bottom Atomic Power Station can operate at full load power for at least 4,000 hours with reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner.

May 23, 1983

Docket No. 50-277

ATTACHMENT I

References

1) General Electric Company Report on Induction Heating Stress Improvement for Stainless Steel Piping (NEDE-25394 Class III, July 1981).

2) EPRI Report NP-2472 Vol. 2, Project T118-1, July 1982. The Growth and Stability of Stress Corrosion Cracks in Large-Diameter BWR Piping.

3) Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping (NUREG-0313, Rev. 0,1).