



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

ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

CLOSEOUT BULLETIN 88-02

RAPIDLY PROPAGATING FATIGUE CRACKS IN STEAM GENERATOR TUBES

PUBLIC SERVICE ELECTRIC & GAS COMPANY

PHILADELPHIA ELECTRIC COMPANY

DELMARVA POWER AND LIGHT COMPANY

ATLANTIC CITY ELECTRIC COMPANY

SALEM GENERATING STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-272, 50-311

1.0 INTRODUCTION

Public Service Electric and Gas Company (the licensee) submitted its response to NRC Bulletin 88-02, "Rapidly Propagating Fatigue Cracks in Steam Generator Tubes" by letters dated March 28, 1988, April 5 and July 31, 1989, and January 19 and July 10, 1990. Bulletin 88-02 requested that licensees for plants with Westinghouse steam generators employing carbon steel support plates take certain actions (specified in the bulletin) to minimize the potential for a steam generator tube rupture event caused by a rapidly propagating fatigue crack such as occurred at North Anna Unit 1 on July 15, 1987.

2.0 DISCUSSION

The licensee reports that the Salem Units 1 and 2 steam generators exhibit indications of corrosion with magnetite and denting at the uppermost support plate. Accordingly, items C.1 and C.2 of the bulletin are applicable to both Salem Units 1 and 2.

In accordance with item C.1 of the bulletin, the licensee has implemented an enhanced primary-to-secondary leak rate monitoring program which is described in the licensee's March 28, 1988 submittal. This enhanced leak rate monitoring program is an interim compensatory measure pending completion of the actions requested in item C.2 of the bulletin and NRC staff review and approval of these actions.

The licensee has implemented the generic program developed by Westinghouse to resolve item C.2 of the bulletin. The licensee's implementation of this program for Salem Unit 1 is described in Westinghouse reports WCAP-12136 (Proprietary version) and WCAP-12137 (Non-Proprietary version) which were submitted with the licensee's letter dated July 31, 1989. The implementation of this program for Salem Unit 2 is discussed in WCAP-12090 (Proprietary version) and WCAP-12091 (Non-Proprietary version) which were submitted by the

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licensee's letter dated April 5, 1989. These reports described the analyses which were conducted to establish the susceptibility of the Salem steam generator tubes to rapidly propagating fatigue cracks and to identify any needed corrective actions.

The staff has reviewed the Westinghouse generic program and documented its evaluation in reference 1. The staff concluded in Reference 1 that the Westinghouse program is an acceptable approach for resolving item C.2 of the Bulletin. The staff further concluded that the Westinghouse program, if properly implemented, will provide reasonable assurance against further failures of the kind which occurred at North Anna Unit 1. The safety evaluation herein incorporates the staff's generic Reference 1 evaluation by reference.

The analyses for the Salem steam generators conservatively assumed that all unsupported tubes are dented at the uppermost support plate. In addition, the stress ratio and fatigue estimates were based on the assumption of a full mean stress effect (i.e., yield stress), consistent with staff findings in Reference 1.

The analyses documented in WCAP-12296 and WCAP-12090 show that two unsupported tubes in Unit 2 failed to satisfy the Westinghouse stress ratio criterion. These tubes have been stabilized and plugged. In its letter dated January 19, 1990, the licensee reported that one additional tube, at Salem Unit 1, was calculated not to satisfy the stress ratio criterion, and the licensee committed to stabilize and plug this tube at the next refueling outage. This finding was the result of an additional air model test which was conducted to resolve a staff comment concerning a potential non-conservatism in the assumed flow peaking factor for this tube. All other unsupported tubes in the Salem steam generators satisfy the Westinghouse stress ratio criterion and are acceptable for continued service. The fatigue usage factor for the most limiting tube remaining in service is calculated to be 0.32 for a 40 year operating period with the assumed reference operating parameters.

By letter No. NS-NRC-90-3498, dated March 27, 1990, Westinghouse informed the staff of its plans to update the steam generator fatigue analyses for a number of plants including Salem 1 and 2 in response to concerns from the NRC staff regarding uncertainties in the AVB positions used in earlier analysis. Based on subsequent information from Westinghouse, the licensee informed the staff by letter dated July 10, 1990, that the Westinghouse March 27, 1990 letter was in error. The licensee stated that the fatigue reassessment for Salem 1 and 2 was in fact complete and the results included as part of the licensee's January 19, 1990 submittal. The staff considers this matter to be closed.

3.0 CONCLUSION

The staff concludes that the actions taken and committed to by the licensee resolve the issues identified in Bulletin 88-02 and are, therefore, acceptable. Consistent with staff finding No. 11 in Reference 1, the above findings are subject to the development of administrative controls by the

licensee to ensure that updated stress ratio and fatigue usage calculations are performed in the event of any significant changes to the steam generator operating parameters (e.g., steam pressure and flow, circulation ratio) relative to the reference parameters assumed in the analyses for Salem Units 1 and 2.

4.0 REFERENCE

1. Safety Evaluation Report, "Evaluation of Westinghouse Methodology to Address Item C.2 of NRC Bulletin 88-02" which was transmitted to Westinghouse by letter dated October 2, 1989.

Dated: August 16, 1990