

Enclosure 1

SAFETY EVALUATION REPORT

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CLOSEOUT OF BULLETIN 88-02 ISSUES

MATERIALS ENGINEERING BRANCH
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INTRODUCTION

By letters dated March 25, 1988 and March 3, 1989, Rochester Gas and Electric Co. (the licensee) submitted its response to NRC Bulletin 88-02, "Rapidly Propagating Fatigue Cracks in Steam Generator Tubes". 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 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.

DISCUSSION

The licensee reports that the Ginna steam generator exhibit evidence of denting at the uppermost support plate. Accordingly, items C.1 and C.2 of the bulletin are applicable to Ginna.

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 25, 1988 and March 3, 1989 letters. 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 is described in its March 3, 1989 submittal which included Westinghouse reports WCAP-11802 (Proprietary version) and WCAP-11803 (Non-Proprietary Version), "R.E. Ginna, Evaluation of Tube Vibration Induced Fatigue", April 1988. These reports provide a detailed description of the analyses which were conducted to establish the susceptibility of the Ginna steam generator tubes to rapidly propagating fatigue cracks and to identify any needed corrective actions.

Enclosure 2 is the NRC staff review of the Westinghouse generic program. The staff concluded that the Westinghouse program is an acceptable approach for resolving item C.2 of the bulletin. The staff has further concluded that the Westinghouse program, if properly implemented, will provide reasonable assurance against future failures of the kind which occurred at North Anna Unit 1.

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Based on initial analyses documented in the licensee's March 25, 1988 letter, the licensee identified 20 tubes which did not satisfy the stress ratio criterion developed by Westinghouse of which were concluded to be susceptible to fatigue. Two of these tubes had previously been plugged (with non-sentinel plugs) and the remaining 18 were plugged during the Spring 1988 outage with sentinel type plugs. Sentinel plugs are used to ensure that any fatigue crack initiation subsequent to plugging will produce a detectable leak before the tube completely severs and causes damage to adjacent tubes. An additional eight tubes adjacent to previously plugged tubes were also preventively plugged with sentinel plugs during the Spring 1988 outage. This was to ensure that tubes previously plugged with non-sentinel plugs and which are susceptible to fatigue failure could not damage live (unplugged) tubes without first producing a small detectable leak in a tube containing a sentinel plug.

As described in WCAP-11802 and WCAP-11803, the initial analyses were subsequently upgraded with an improved version of the 3-D ATHOS thermal-hydraulic model used in the tube analysis to provide more accurate results in the peripheral region of the tube bundle. The analyses were based on steam generator operating parameters (e.g., steam flow and pressure, circulation ratio) for a reference operating cycle (i.e., cycle 17 for Ginna). The initial analyses were also upgraded to reflect flow peaking factor estimates based on Westinghouse air model test data for different anti-vibration bar (AVB) insertion depth configurations (see Section 3.3.4.2 of Enclosure 2). All tubes unsupported by AVBs were conservatively assumed to be 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 finding No. 3 in Section 4 of Enclosure 2.

Based on the updated analyses, only three tubes were found to exceed the Westinghouse stress ratio criterion compared to the 20 tubes indicated by the initial analyses. Thus, only those three tubes were believed to be potentially susceptible to fatigue crack initiation over the remaining lifetime of the plant. These three tubes did not include the two tubes which had been plugged prior to Spring 1988 with solid (non-sentinel) plugs. Thus, with the exception of these three tubes, Westinghouse concludes that the tubes removed from service in Spring 1988 using sentinel plugs are acceptable for continued service. It is the staff's understanding, based on phone conversations with the licensee, that these will be put into service (by removing the sentinel plugs) at the next refueling outage. The three tubes not meeting the stress ratio criterion will, of course, remain plugged.

CONCLUSION

The staff's review of WCAP-11802 and WCAP-11803 indicates that the Westinghouse generic program has been fully implemented for Ginna. The staff concludes that the actions taken by the licensee resolve the issues identified in Bulletin 88-02 and are, therefore, acceptable. Consistent with staff finding No.10 in Section 4 of Enclosure 2, 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 flow and pressure, circulation ratio) relative to the reference parameters assumed in the WCAP-11802 and WCAP-11803 analyses.