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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO MARK I CONTAINMENT PROGRAM - VACUUM BREAKER INTEGRITY

BROWNS FERRY NUCLEAR PLANT UNITS 1, 2, AND 3

DOCKET NO.: 50-259, 50-260, AND 50-296

I. INTRODUCTION

In addition to the evaluation of the suppression chamber, torus attached piping, pressure relieving lines, etc, under the newly defined loadings, the Mark I containment program required assurance of the structural integrity of vacuum breakers during operation in all Mark I plants. This additional requirement was categorized as a separate effort, as the adequacy of other components was already discussed in a separate Safety Evaluation.

The Franklin Research Center (FRC) has performed an evaluation of the structural integrity of vacuum breakers in the Browns Ferry Nuclear Plant Units 1, 2 and 3 (Browns Ferry) for the NRC staff. Results of the review are reported in the attached document, TER-C5506-323, "Structural Evaluation of the Vacuum Breakers (Mark I Containment Program), Tennessee Valley Authority Browns Ferry Nuclear Plant Units 1, 2 and 3." FRC has concluded that actions taken by the licensee are adequate to restore the original design margin of safety for its vacuum breakers under the revised loadings in the Mark I containment. NRC staff reviewed the attached document and concurred with the FRC findings.

II. DISCUSSION

In every one of the Browns Ferry Mark I Containments, there are twelve 18" internal type vacuum breakers made by General Precision Engineering. One vacuum breaker is located at the intersection of each vent line and the ring header in every suppression chamber. Loadings on Mark I structures and vacuum breakers are based on the General Electric Company Report, NEDO-21888, "Mark I Containment Program Load Definition Report," Revision 2, dated November, 1981. For vacuum breakers, the loadings included are gravity, seismic, and hydro-dynamic loads. The hydrodynamic forcing functions were developed by Continuum Dynamics, Inc. by using a dynamic model of a Mark I pressure suppression system and the full scale test facility data. The system model was capable of predicting pressure transients at specific locations in the vent system. Loading across the vacuum breaker disc caused by pressure differentials based on test data was thus quantified as a function of time. This issue was reviewed and approved by NRC on December 24, 1984. Loadings were combined according to FSAR commitments.

To determine the structural integrity of the vacuum breakers, results from a finite element model and ANSYS program analyses were compared with design limits specified in the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NC, 1977 Edition and addenda up to Summer 1977. It was found that the hinge arm, the hinge pin, and the hinge arm to pallet bolts could become overstressed. The licensee decided to remedy the situation by using different materials for these parts to increase their allowable stress limits. By using 316 stainless steel material for hinge arms, 303 stainless steel material for hinge pins and A193 Gr B6 material for hinge arm to pallet bolts, proper safety margins were thus restored. The licensee also upgraded the design of pallet gaskets and hinge bushings so that functionality of the Browns Ferry vacuum breakers was improved.

III. CONCLUSION

The licensee has restored the safety margins of the Browns Ferry vacuum breakers by replacing critical parts with adequate materials. The corrective action is acceptable.

Principal Contributor: H. Shaw

Dated: November 25, 1986

Attachment: Structural Evaluation of the Vacuum Breakers