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NUCLEAR REGULATORY COMMISSION
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MEMORANDUM FOR: Gus C. Lainas, Assistant Director for Operating Reactors, DL

FROM: James P. Knight, Assistant Director for Components & Structures Engineering, DE

SUBJECT: SAFETY EVALUATION REPORT, MARK I CONTAINMENT LONG-TERM PROGRAM, VERMONT YANKEE NUCLEAR POWER STATION

The Mechanical Engineering Branch, Division of Engineering, has conducted a review of the Mark I Containment Long-Term Program in the Vermont Yankee Nuclear Power Station. The evaluation results, with the exception of vacuum breakers, are attached. The evaluation of vacuum breakers will be performed at a later date. For further questions, contact H. Shaw at x24420.

James P. Knight, Assistant Director for
Components & Structures Engineering
Division of Engineering

Attachment: As stated

cc: R. Bosnak
H. Brammer
D. Vassallo
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H. Shaw

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Safety Evaluation Report

Mark I Containment Long-Term Program

Vermont Yankee Nuclear Power Station

INTRODUCTION

The capability of the boiling water reactor (BWR) Mark I containment structures and piping systems to withstand the effect of hydrodynamic loads resulting from a loss of coolant accident (LOCA) and/or a safety relief valve (SRV) discharge was not considered in the original design of the structures. The resolution of this issue was divided into a short-term program and a long-term program.

Based on the results of the short-term program, which verified that each Mark I containment would maintain its integrity and functional capability when subjected to the loads induced by a design-basis LOCA, the NRC staff granted an exemption relating to the structural safety requirements of 10CFR50.55(a). The study was reported in NUREG-0408, "Mark I Containment Short Term Program".

The objective of the long-term program was to maintain a margin of safety when the Mark I containment structures and piping systems are subjected to the additional hydrodynamic loads. The detailed guidance of the long-term program are contained in the NRC Safety Evaluation Report, NUREG-0661, "Mark I Containment Long-Term Program" which describes the generic hydrodynamic load definition and structural acceptance criteria consistent with the requirements of the applicable codes and standards.

To fulfill the objective of the long-term program, the Vermont Yankee Nuclear Power Station has completed all modifications on its containment and torus attached piping. The adequacy of these modifications was documented in the report prepared by the Teledyne Engineering Services (Teledyne), TR-5319-1, "Plant-Unique Analysis Report of the Torus Suppression Chamber for Vermont Yankee Nuclear Power Station." Under contract to the NRC, the Brookhaven National Laboratory (BNL) reviewed the loads and loading combinations part of the Teledyne report, and the Franklin Research Center (FRC) reviewed the structural adequacy part. This SER will be limited to the FRC effort.

DESCRIPTION

The Mark I long-term program of the Vermont Yankee Nuclear Power Station was described in the plant-unique analysis (PUA) report prepared by Teledyne. This report describes modifications performed on containment structures and torus attached pipings in the Vermont Yankee Nuclear Power Station. Areas covered by the Teledyne report include the torus shell, external support system, vent header system, internal structures, torus attached pipings, SRV lines and vent pipe penetrations. The materials, design and fabrication requirements of the modifications were in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Division 1, Section III with Addenda through Summer 1977 and Code Case N-197, "Service Limits for Containment Vessels".

Modifications were performed in accordance with the requirements of Section XI of the same Code. To determine the appropriate Code Allowable service limits for the specified loading combinations, the Teledyne report followed guidelines set by NUREG-0661 and the GE report, NEDO-24583-1, "Mark I Containment Program Structural Acceptance Criteria Plant Unique Analysis Application Guide." The portion of the Teledyne report applicable to loadings and loading combinations was audited by BNL. Results of this audit will be discussed in a separate SER.

Using the properly determined loadings and loading combinations, Teldeyne employed the computer program STARDYNE as a major tool to perform the analyses. STARDYNE has been used widely in the industry for similar purposes and was approved by NRC. Results of analyses were summarized to show that modifications are adequate under various loading combinations.

The adequacy of the modified containment structures and torus attached pipings was audited by the FRC. FRC developed audit procedures for all Mark I long-term program users, which is described in detail in the FRC TER-C5506-308, "Audit Procedures for Mark I Containment Long-Term Program - Structural Analysis." The review performed by FRC has followed this document closely. Results and conclusions of this effort were reported in FRC TER-C5506-320, "Audit for Mark I Containment Long-Term Program-Structural Analysis for Operating Reactors-Vermont Yankee Nuclear Power Corporation-Vermont Yankee Nuclear Power Station." The audit verified Teledyne analyses by examining mathematical models and

loading combinations used and summarized the results to see whether the modifications met the required criteria. A check list was complied to insure the completeness of the auditing. The staff has reviewed the FRC report and concurs with its conclusions that the modifications meet the Mark I Containment Long-Term Program objective. An augmented fatigue evaluation method for ASME Code Class 2/3 piping was developed by MPR Associates for GE (Reference 1). This report was reviewed by the staff and the conclusion that all torus piping systems had a fatigue usage of less than 0.5 during the plant life is acceptable for the Vermont Yankee Nuclear Power Station.

CONCLUSION

Except for the vacuum breakers, the modifications performed in the Vermont Yankee Nuclear Power Station followed the guidelines of NUREG-0661 and met the respective requirements of Sections XI and III ASME B&PV of the Code. The licensee's analyses have been verified by the FRC audit and approved by the staff under the LOCA and SRV discharge loads. The definition of vacuum breakers loadings needs further clarification. A separate report addressing vacuum breakers will be prepared on completion of the work.

REFERENCE

MPR-751, "Augmented Class 2/3 Fatigue Evaluation Method and Results for Typical Torus attached an SRV Piping Systems", dated November 1982.