



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO MARK I CONTAINMENT LONG-TERM PROGRAM

STRUCTURAL REVIEW

PILGRIM NUCLEAR POWER STATION

DOCKET NO. 50-293

1.0 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 10 CFR 50.55(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 system are subjected to 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" and its supplement which describe 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 Boston Edison Company has completed all modifications on the Pilgrim Station containment and torus attached piping. The adequacy of these modifications was documented in reports prepared by Teledyne Engineering Services, entitled, "Mark I Containment Program, Plant-Unique Analysis Report of the Torus Suppression Chamber for Pilgrim Station Unit 1" and "Mark I Containment Program, Plant Unique Analysis Report of the Torus Attached Piping for Pilgrim Station Unit 1."

The Franklin Research Center (FRC) was contracted to review the structural adequacy issue for compliance with the staff's acceptance criteria.

2.0 EVALUATION

The Mark I long-term program of the Pilgrim Station was described in the plant-unique analysis report (PUAR) prepared by Teledyne. This report describes modifications performed on containment structures and torus

attached piping at the Pilgrim Station. Areas covered by the 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 I, 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 report followed guidelines of 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 report applicable to loadings and loading combinations was audited by BNL, and results of that audit are discussed in a separate Safety Evaluation.

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

The adequacy of the modified containment structures and torus attached piping was audited by the FRC. FRC developed audit procedures for all Mark I long-term program users, which are described in detail in FRC TER-C5506-308, "Audit Procedures for Mark I Containment Long-Term Program - Structural Analysis." The review performed by FRC followed this document closely. Results and conclusions of this effort were reported in FRC TER-C5506-328, "Audit for Mark I Containment Long-Term Program - Structural Analysis for Operating Reactors - Boston Edison Company - Pilgrim Station Unit 1."

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 compiled to ensure 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 in MPR Report-751 entitled, "Augmented Class 2/3 Fatigue Evaluation Method and Results for Typical Torus attached on SRV Piping System", dated November 1982. This report was reviewed by the staff and the conclusion that all torus piping systems having a fatigue usage of less than 0.5 during the plant life are acceptable for the Pilgrim Station.

3.0 CONCLUSIONS

The modifications performed at the Pilgrim Station followed the guidelines of NUREG-0661 and its supplement and met the respective requirements of Sections III and XI of the ASME Boiler and Pressure Vessel Code and are, therefore, acceptable. The licensee's analyses have been verified by the FRC audit and approved by the staff under the LOCA and SRV discharge loads.

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Attached: TER prepared by
Franklin Research Center,
dated September 26, 1984