Technical Report

on

# EVALUATION OF THE USE OF ARCHING THEORY IN THE ANALYSIS OF MASONRY WALLS UNDER DIFFERENTIAL PRESSURE– TURKEY POINT PLANT UNITS 3 & 4

by

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## INTRODUCTION

On August 16, 1983, the NRC staff and FRC staff and consultant visited Turkey Point Plant in Florida to observe and examine the block masonry walls in the plant. Following the site visit, the NRC staff and FRC staff and consultant conducted a meeting at Bechtel's Gaithersburg office to discuss design criteria and to review calculations and analyses used for masonry wall qualifications. Among the main issues were the use of arching theory and the increase of code allowable stresses.

As a result of the meeting, Florida Power and Light company ( FPL ) decided to adopt a more conserative design approach by using an elastic analysis with stress allowables except for walls in the Steam Generator Feed Pump Building where arching theory was used to qualify the walls under pressure differential loading.

The FRC consultants discussed the applicability of arching theory with the Bechtel staff in a subsequent conference call. They also reviewed the utility's response to the questions raised during the meeting at Gaithersburg.

This report presents the FRC cosultants' review and evaluation of the calculations and analysis procedures used for the qualification of masonry walls in the Steam Generator Feed Pump Building using the arching theory.

## DESCRIPTION OF MASONRY WALLS

Masory walls in the Steam Generator Feed Pump Building are fully grouted block walls. The wall thickness is 12 in. nominal. The maximum wall height is 14 ft. Construction details call for a filled solid mortar joint at the top of the wall. No clip angles are provided.

## ARCHING MECHANISM OF MASONRY WALLS

Unreinforced masonry walls have a very limited capacity under the action of out-of-plane loads. Higher resistance could be developed by creating large in-plane clamping forces, thereby forming a three hinged arch mechanism after mid-span and support flexural cracking has occurred (1,2,3).

## THE USE OF ARCHING THEORY FOR WALLS UNDER PRESSURE LOADING

The design methodology used at Turkey Point was originally developed by McDowell et al. (2). FPL considers a pressure of 1.14 psi to be applied to unreinforced block walls in the Steam Generator Feed Pump Building. Based on FPL calculations presented in the response to NRC questions, consideration of the load as equivalent static loading is justified. The applicability of arching theory to block walls is justified by FPL based on available URS test data (3) of block masonry walls under blast loading. There are similarities existing between URS test walls and walls at Turkey Point that could justify the use of the methodology with adequate margin of safety. These include the type of loading, construction details and material properties.

Shear stresses at the support sections are low enough not to cause any web shear cracking or faceshell spalling. Due to the fact that cracking has a significant effect on the development of the arching mechanism, this technique should not be applied to precracked walls . The few walls that expreinced cracking at Turkey Point are hollow block walls that are located in the Auxiliary and Turbine Buildings.

## CONCLUSION

It has been demonstrated by URS tests that block masonry walls could withstand high pressure loacing. Therefore, FPL design methodology ,based on arching theory, used to qualify block walls at Turkey Point under pressure differential is adequate.

## REFERENCES

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