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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
FLORIDA POWER AND LIGHT COMPANY, ET. AL.
ST. LUCIE, UNIT 2
DOCKET 50-389
SEISMIC ANALYSIS PROCEDURE OF SAFETY INJECTION PIPING

1.0 INTRODUCTION

In 1983, Region II expressed certain concerns during an inspection of the seismic analysis of two St. Luciė, Unit 2, safety inspection piping systems. NRR was requested to provide assistance in the clarification and resolution of these concerns.

The inspection concerns pertained to two piping problems, SI-2407 and SI-2412. The piping in these problems is routed from the Refueling Water Tank (RWT) located outdoor to the ECCS pumps located within the Auxiliary Building (AB), and then to the penetration in the Containment Building (CB). The two piping systems are joined at a tee which is welded fitting-to-fitting to a flange at the tank nozzle which acts as an anchor. For analytical purposes the two systems are considered decoupled and anchored separately at the tee. This makes the two piping calculations independent, but the tee and the tank nozzle are considered to be subjected to the loads from both calculations.

The seismic analysis of these systems used a variation of the envelope response spectrum method. The model of each system extended from the RWT thru the AB to the CB. Therefore, three sets of response spectra were required for an envelope type response spectrum analysis. However, because the spectra for the RWT were relatively severe compared to the AB and CB spectra, the licensee used a variant of the envelope response spectrum method called the overlap technique (actually a variant of this technique was used). In these analyses, each calculation was performed in two runs. Run 1 contained the entire piping model and the envelope spectra of the AB and the CB. This run was used for the design of all the restraints in the AB not influenced by the RWT. Run 2 contained the entire piping model and the envelope spectra of the RWT and the AB. This run was used for the design of all restraints in the RWT area and the first restraint in the AB near to the RWT. The basis for this procedure was that the RWT area is remote from the CB, and therefore, the restraints near to the CB would be unduly penalized if they would be required to be designed based on the envelope of the three spectra. The interface point between the two runs was chosen at a three-way restraint which exists on each line in the AB where the piping enters from the tank area. The stated basis for this was that these restraints are located in relatively long unidirectional piping runs where twisting and bending effects are minor.

The loads and stresses at the RWT nozzle and tee were determined from the combined loads from the two separate piping calculations. The stresses in the tee were shown to be low, but the loads acting on the nozzle were close to, but lower than, the allowable loads.

The basic concerns expressed by the Region were the acceptability of the interface point, and assurance that the stress evaluation of the nozzle and tee was based on combined loads from the two piping analyses.

2.0 EVALUATION

Recommended guidelines for the application of the overlap technique in static and dynamic analysis were published in NUREG/CR-1980 (March 1981). The approach taken by the licensee in the analysis of these piping systems does not totally conform with these guidelines; in particular, those guidelines pertaining to the determination of the interface point (actually an interface region). However, this approach is found acceptable on the following basis:

1. The analyses were performed with lower piping damping values than currently accepted. Analyses performed with the currently accepted damping values (based on ASME Code Case N-411) would indicate lower piping and restraint loads, thus increasing the safety margins to the allowable stresses or loads of the currently as-built piping configurations.

2. The Independent Support Motion Method, described in NUREG 1061, V.4 is available for analyzing piping subjected to dynamic loading which is characterized by large differences in response spectra. The application of this method, subject to the criteria as stated in the NUREG report, would also probably indicate piping and restraint loads of the same order as those determined by the licensee's approach.

3.0 CONCLUSION

1. Although the licensee did not conform fully with the guidelines for choosing the interface point in the piping calculations, there is reasonable assurance that the appropriate load and stress limits will not be exceeded if more accurate techniques are used in the seismic analysis of these piping systems.

2. The RWT nozzle has been shown to have been evaluated based on the combined loading determined from both piping analyses.

These issues are therefore considered resolved.

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