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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

CONDENSATE STORAGE TANK SEISMIC QUALIFICATION

ENTERGY OPERATIONS INC.

ARKANSAS NUCLEAR ONE, UNIT NO. 1 (ANO-1)

DOCKET NO. 50-313

INTRODUCTION

On May 21, 1986, Arkansas Power and Light Company requested NRC staff approval of a proposed change to ANO-1 Technical Specification (TS) Section 3.4.1.3 and the corresponding Bases. The TS change was required as a result of the installation of a new condensate storage tank (CST) which is to be used for the emergency feedwater (EFW) system and as such is classified as a seismic Category I structure. On July 2, 1986, the staff requested that the licensee provide additional information on the design of the CST. In response, the licensee stated by letter dated July 31, 1986, that the tank was designed and installed under the provisions of 10 CFR 50.59 and the requested information was provided not for staff review and approval but only for information. However, because of the importance of the structure the staff felt a review of the design was in order.

With the assistance of consultants from Brookhaven National Laboratory (BNL), the staff reviewed the information and found it to be insufficient to conduct an adequate review. In order to facilitate the review, a site visit/audit by a team consisting of the staff and BNL consultants was made on April 7 and 8, 1987. From the audit, the team raised nine questions which appeared to invalidate the seismic analysis of the CST. These questions were transmitted to the licensee by letter dated June 11, 1987. As a result of the questions raised by the staff, the licensee had its consultant reanalyze the CST. On the basis of the reanalysis, the licensee stated by letter dated June 18, 1990, that the analyses in the associated calculations demonstrated that the CST, foundation and drilled piers are adequate without modification. By letter dated August 22, 1990, the staff asked for clarification of some aspects of the reanalyses and details of the CST design. The licensee provided all the requested information in a submittal dated October 25, 1990.

EVALUATION

The ANO-1 CST is a steel tank with a diameter of 42 feet and a height of 32 feet, resting on a 30-inch thick reinforced concrete (RC) slab. The slab is supported by a system of 27 RC drilled piers 42 inches in diameter. The average length of the drilled piers is about 29 feet and they are embedded into the underlying bedrock at the bottom.

The original analysis was a soil-structure interaction analysis of the CST with the objective to generate design response spectra for the tank-foundation-pier-soil system utilizing the FLUSH Program. The seismic loads generated from this analysis were subsequently used by CBI (tank vendor) in the load combinations employed for the design of the tank. The parameter values used in the analysis were found to be inappropriate during the audit. As a result of the staff's findings the licensee performed a reanalysis.

In the reanalysis, shear wave velocities and poisson's ratios compatible to the geophysical data of the clay at the site were used. One most critical issue is the point of application of the control motion. In the original analysis, the control motion was applied at the surface and deconvolution methods were used to calculate a consistent bedrock motion. In the opinion of the staff and its consultants, such a procedure is inappropriate in view of the fact that the tank is supported by piers which are founded on bedrock. In response to the staff's concern, the licensee performed the reanalysis with the control motion applied at a rock outcrop and the bedrock motion and free surface motion computed using SHAKE. Such a procedure appears to give results more representative of the actual condition. Other concerns related to the adequacy of various considerations in the design and analysis of the tank were effects of water sloshing, rocking of the tank and the effects of the vertical seismic acceleration, and the design of the tank foundation and piers. In response, the licensee indicated that in the reanalysis a duration of 24 seconds was used for the input acceleration time history, which is judged to be adequate for computing responses at low frequencies, e.g. 0.25 cycles-per-second. In the tank reanalysis only the foundation translation response spectra were used. The rotation or rocking motion of the foundation was neglected. However, considering the manner in which the tank is supported, the rocking, if any, will be negligible, and has no effect on the tank design. In the reanalysis, the vertical seismic acceleration has been considered and the vertical effects are combined with the horizontal ones by the square root of the sum of the squares method, which is judged to be acceptable.

The staff's other minor concerns have also been satisfactorily resolved. The detailed evaluation by BNL is contained in the Technical Evaluation Report attached to this report.

CONCLUSION

With the assistance of consultants from BNL, the staff has reviewed and evaluated the responses to the staff's concerns and the detailed design calculation of the CST. The reanalysis by the licensee has not resulted in any modification of the CST; however, there is some reduction in the margin of safety as indicated by the new stresses. It should be pointed out that if the tank-foundation mat-pier system were assumed to be fixed at the bottom of the piers and the specified input ground motion had been applied there, as was done in the seismic design of seismic Category I structures in the adjacent ANO-2, most of the staff's concerns would not have been raised. The staff concludes

that in spite of the discrepancies in the original design analysis as pointed out by the staff, the CST as designed is expected to perform satisfactorily when subjected to the design loads including the specified safe shutdown earthquake.

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Attachment: Technical Evaluation Report

Date: April 23, 1991