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July 31, 1986

1CANØ78611

Mr. John F. Stolz, Director
PWR Project Directorate No. 6
Division of PWR Licensing - B
U. S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Request for Information on the
New Condensate Storage Tank

Dear Mr. Stolz:

In your letter dated July 2, 1986 (1CNAØ786Ø3) you requested additional information concerning the new seismically qualified, partially tornado protected condensate storage tank (CST). You stated that this request was as a result of your review of our May 21, 1986 (1CANØ586Ø3) Technical Specification submittal. It should be noted that the requested Technical Specification dealt only with the use of the new tank to store the required amount of EFW feed instead of the old tank. This new tank was designed and installed under the provisions of 10CFR50.59. Therefore, as discussed with members of your staff, the requested Technical Specification change and the adequacy of our design of the tank are two separate issues.

It should be noted that as the new condensate storage tank is being installed under provisions 10CFR50.59, the requested information is being submitted for information only, not for review and approval of the requested Technical Specification or tank design.

The information you have requested has been provided in two parts. The first part deals with the foundation of the new tank. The second part deals with the tank itself.

Very truly yours,

Dale E. James
for J. T. Enos, Manager
Nuclear Engineering and Licensing

JTE:MCS:lw

Attachment

A001
1/1

Condensate Storage Tank Foundation Design

The new Condensate Storage Tank (CST) foundation consists of a 30 inch reinforced concrete base slab supported by a series of 27 reinforced concrete drilled piers, 42 inches in diameter, extending down into unweathered shale. The CST foundation also consists of two (2) below grade valve pits. The CST will be encircled by a five (5) foot high reinforced concrete wall, 18 inches thick, to provide partial tornado protection for the tank as directed by NRC Letter dated October 5, 1984 (1CNA1Ø84Ø1).

The CST foundation was designed in accordance with the applicable portions of the ANO-2 Safety Analysis Report (SAR) design criteria. ANO-2 SAR design criteria was used as it is more conservative than the ANO-1 criteria. Using the ANO-2 Design Basis Earthquake (DBE) of .20g ground acceleration, (SAR Section 2.5.2.9) and ANO-2 design spectra (SAR Figure 2.5-27), an artificial time history was generated for the CST foundation. An artificial time history response spectra was then developed using this time history. The resulting CST time history response spectra enveloped the ANO-2 design spectra at all points. A mathematical model of the CST tank and its foundation was prepared. The CST foundation model and artificial time history response spectra were input to the "FLUSH" computer program to generate the design response spectra (DBE & Operating Basis Earthquake (OBE)/Horizontal & Vertical). The "FLUSH" computer program performed the dynamic analysis of the CST foundation including external parameters such as soil-structure interaction, tank weight (full) and water sloshing. The CST design response spectra, developed from the artificial time history response spectra, were broadened by ±15% in accordance with NRC Regulatory Guide 1.122. This response spectra became the basis for the design of the CST and was included in the tank's procurement specification.

Calculations were then prepared to design the CST foundation using the CST design response spectra. The CST drilled piers were designed in accordance with the American Concrete Institute, "Building Code Requirements for Reinforced Concrete" (ACI-318-83) and "Suggested Design and Construction Procedures for Pier Foundation" (ACI-336-3R-72). Additional information for the design of the CST drilled piers was taken from the U.S. Department of Transportation, Implementation Package 77-21, "Drilled Shaft Manual". The CST base slab and valve pits were designed in accordance with ACI-318-83 with additional information obtained from, "Vibrations of Soils and Foundations" (Richart, Hall & Woods - 1970 Ed.).

The five (5) foot high partial tornado protection missile shield wall was designed to withstand the greater of the three (3) missile impingement design parameters identified in the ANO-2 SAR (Section 3.3.2.1.C). The controlling missile was determined to be the 4"x12" wood plank noted in SAR Section 3.3.2.1.C.1. The missile shield wall was designed in accordance with Bechtel TOPICAL Report, BC-TOP-9A, (Rev. 2, 9/74), "Design of Structures for Missile Impact" and ACI-318-83. Additional information was obtained from "Impact Effect of Fragments Striking Structural Elements" (Williamson & Alvy - Revised 11/73).

General design information on reinforced concrete was obtained from "Design of Reinforced Concrete" (McCormac - 1978).

Some key assumptions used in the CST foundation design were:

1. Seismic loading on foundation based on CST Design Response Spectra.

2. $f'c = 3$ ksi

3. $Fy = 60$ ksi

4. $\gamma c = .15\ ^{k}/ft^3$

5. $g = 386\ in/sec^2$

6. Tank height = 31 ft. (liquid level)

7. Approximate Bolt Circle = 42.5 ft.

8. Approximate water weight = 2680 kips

9. Tank ID = 42 ft.

A summary of the results (under worst case loading conditions) of key CST foundation design calculations is as follows:

Drilled Piers: Maximum stress = 91% of design allowable.

Tank Base Slab: Maximum stress = 31% of design allowable.

Valve Pit: Maximum stress = 86% of design allowable.

Tornado Protection Wall: Maximum stress = 86% of design allowable.

Condensate Storage Tank Design

The condensate storage tank is designed and built to the requirements of the ASME Boiler & Pressure Vessel Code, 1980 Edition through S82 Addenda. This was the latest edition and addenda approved by NRC when the Design Specification was prepared. Also, the tank was analyzed for Operating Basis Earthquake and Design Basis Earthquake utilizing response spectra developed for the tank foundation.

Seismic loadings, dead loads and live loads for the CST were analyzed using Chicago Bridge & Iron Company (CBI Services) computer code E0717 and TID-7024. The tank was analyzed to OBE and DBE response spectra, 2% damping for OBE and 5% damping for SSE as permitted by AP&L Technical Specification APL-C-2435. The tank was analyzed full and 50% full with water free to slosh.

A. The snow load was obtained from the Unit 2 SAR, Section 2.3.2.2.4. and loadings from straight wind, tornado wind and tornado missiles were obtained from the Unit 2 SAR, Section 3.3.

Wind forces on the tank due to straight winds and tornado winds were analyzed using ASCE Paper 3269. Additionally, a venting analysis was performed to ensure adequate venting to alleviate the effect of atmospheric pressure drop induced by the tornado.

Impact of tornado missiles were analyzed utilizing Bechtel topical report BC-TOP-9A, Revision 2, September 1974. The Design Specification permits perforation of the tank wall above the 5 foot missile shield. Buckling of the tank structure and tank bottom uplift are prohibited. Due to these restrictions, a scale model test was conducted to observe the effects of the impact of the largest SAR-defined missile, the 4000-lb automobile. The test was conducted since no analytical tools were believed to exist that would provide both a reliable and cost-effective solution.

For both wind and tornado analysis the tank is assumed full. This is reasonable since the tank will be used exclusively for emergency feedwater. The tornado is assumed to be the initiating event for use of EFW (i.e., loss of offsite power).

A summary of the results of some key CST design calculations is as follows:

<u>Tank Shell</u>

Load condition: Pressure + Dead Load + Live Load + DBE (Full)

Location: Joint between bottom ring and second shell ring

Maximum Stress: 83% of design allowable

Load condition: Pressure + Dead Load + Live Load + Tornado Wind

Location: Joint between bottom ring and tank bottom

Maximum Stress: 79% of design allowable

<u>Roof</u>

Load condition: Wind

Location: Roof-to-shell joint

Maximum Stress: 75% of design allowable

Bottom Nozzles

Load condition: Weight + thermal + DBE

Location: 1" diameter nozzle

Maximum Stress: 88% of design allowable

Internal Piping

Load condition: Weight + DBE (no thermal load)

Location: 6" diameter pipe at weld to tank bottom

Maximum Stress: 29% of design allowable.