

# 831 Power Building TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

January 27, 1976

# REGULATORY DOCKET FILE COPY

Director of Nuclear Reactor Regulation Attention: Mr. Karl Kniel, Chief Branch No. 2-2 U.S. Nuclear Regulatory Commission Washington, DC 20555

Dear Mr. Kniel:

In the Matter of the Application of ) Docket Nos. 50-438 Tennessee Valley Authority ) 50-439

Enclosed for your review are ten copies of our responses to a request for additional information concerning the Borated Water Storage Tank, which resulted from your review of Amendment 13 to the Bellefonte Nuclear Plant PSAR. These responses were discussed with your staff during telephone conversations held on December 9, 1975, and January 6, 1976.

Very truly yours,

J. E. Gilleland Assistant Manager of Power



1119

An Equal Opportunity Employer

Enclosure (10)

- 1. You have indicated that the new design of the borated water storage tank will be in accordance with ACI 318-71. However, this code is only applicable to the reinforced concrete portions of the tank. Describe the design and analysis procedures and structural acceptance criteria utilized in the design of the stainless steel liner. (MTEB is reviewing the materials, fabrication, and inspection procedures for the tank liner.)
- (3.8.4.4.6) The applicant is requested to identify for the stainless steel liner; (1) the code or standard to be applied for fabrication, (2) the non-destructive examination to be performed, and (3) the grade and specification of the material(s) of construction.

#### Response

The liner is to be of stainless steel with a system of carbon steel angles, channels, or concrete studs as required to maintain stability of the liner during construction. The sole purpose of the liner is to provide a watertight membrane. The liner shall be designed for temperature stresses and working stresses in accordance with the requirements of the AISI "Specification for the Design of Cold-Formed Stainless Steel Structural Members," 1974 edition.

The stainless steel liners shall be fabricated in accordance with the TVA drawings and specification and shall conform with applicable portions of the AWS Structural Welding Code Dl.1-75. Joint welding procedures to be used in fabrication of the stainless steel liner will be qualified, in accordance with ASME Boiler and Pressure Vessel Code, Section IX, prior to use by TVA or the fabricator.

There will be 100-percent dye penetrant examinations of all welds exposed to the contents of the lined vessel using properly qualified or experienced personnel and in accordance with the ASME Boiler and Pressure Vessel Code, Section III, Subsection NC, latest edition.

The stainless steel liner shall be SA-240 or ASTM A167, Type 304. Stiffener bars or shapes on the outside of the liner shall be ASTM A36.

The PSAR lists the BWST as a category I structure. Therefore TVA drawings and specifications will require certified material test reports and complete traceability on all stainless steel liner plates; all other material attached to the liner will require certification that it conforms to the appropriate ASTM specification.

Figure 1.1 shows penetrations through the BWST.



Figure 1.1

- You have indicated that the BWST will now be supported on a reinforced concrete pedestal foundation founded on rock. However, the design of this foundation is not clear. Provide the following information
  - (a) Fig. 3.8-40c shows only an elevation of the tank foundation. Provide a horizontal section through the foundation to permit a better understanding of the foundation plan.
  - (b) Provide the factor of safety against sliding and overturning for each applicable load combination.
  - (c) Provide the permissible bearing and shear stresses at the concrete rock interface used in computing the factors of safety in (b) above and discuss the bases of these values.

#### Response

2.

- (a) Figure 2.1 shows the latest dimensions and configurations of the foundation for the borated water storage tank. Note the footings will be keyed into sound rock to a depth of 4 feet.
- (b) The minimum factors of safety against sliding, overturning, and floatation will be shown for the following load combinations.

· .	Minimum	Factors of	Safety
Load Combination	Overturning	Sliding	Floatation
(1) D + H + E (2) D + H + W (3) D + H + E' (4) D + H + W (5) D + F (6) D + F'	1.5 1.5 1.1 1.1 -	1.5 1.5 1.1 1.1 - -	- - - 1.5 1.1

## Loads, Definitions, and Nomenclature

D---Dead loads or their related internal moments and forces including any permanent equipment loads and hydrostatic loads.

H---Loads from lateral earth pressure.

F---Loads from bouyant force of normal ground water.

E---Loads generated by the operating basis earthquake.

W---Loads generated by the design wind specified for the plant.

E'--Loads generated by the safe shutdown earthquake.

- $W_+$ --Loads generated by the design tornado specified for the plant.
- Tornado loads include loads due to the tornado wind pressure, the tornado-created differential pressure, and to tornado-generated missiles.

F'--Loads from buoyant force of the probable maximum flood.

(c) The results of TVA's testing program on foundation rock samples showed the rock compressive strength is greater than the concrete compressive strength. Therefore, the permissible bearing stress at the concrete rock interface is limited to the concrete stress allowable of ACI 318-71. <u>Note</u>: A detailed investigation of all loading conditions revealed a maximum calculated bearing stress less than 700 psi.

For purposes of resisting horizontal forces, no bond is assumed along the plane of contact between concrete and rock or at bedding planes or fault zones in rock. Frictional forces along the plane of contact between concrete and rock are not assumed to exceed 70 percent of the normal force of the plane. The horizontal forces are resisted by the normal forces multiplied by the coefficient of friction between the concrete footing and the rock. The normal force includes the effects of the vertical acceleration of the structure for seismic load combinations. However, the normal force also includes a soil wedge weight acting on the 2-foot flange extension each side of the footings. This wedge will be formed with an angle of (45 degrees - $\phi/2$ )off the vertical where  $\phi$  is the angle of internal friction of the soil.



Figure 2.1

3. Since your consider the BWST to be completely supported on rock, you have deleted all procedures in Section 3.7 which refer to soil structure interaction. However, your proposed pedestal foundation, although founded on rock, will be embedded in 30 feet of soil. Thus, the embedded depth exceeds 15 percent of the least base width (50 foot diameter) and the foundation should be considered deeply embedded as indicated in SRP Table 3.7.2-1. Clarify how the concrete pedestal foundation, its surrounding soil, and the retaining structure adjacent to the pedestal are modeled in the dynamic analysis of the sturcture. Discuss the bases for all assumptions which are made.

0--

The proposed configuration of the borated water storage tank and foundation is shown in figure 2.1. As shown in this figure, the tank is supported by two concrete walls intersecting at right angles and embedded in approximately 30 feet of soil and 4 feet of rock. The seismic analysis of this system was performed using two independent methods. The first model, figure 3.1, used beam elements to represent the foundation and tank with lateral springs representing the influence of the soil. The lateral springs were evaluated using reference 1. It is recognized that this representation of the soil is an approximation but it is felt a reasonable one since the soil is not expected to be a significant factor in the response of this rock-founded structure.

The site design response spectra is defined at top of rock. For ease of comparison with the finite element analysis, a time history analysis was performed with this model using the enveloping acceleration time history as input. Damping values of 4 percent and 7 percent were used for the operating basis earthquake and the safe shutdown earthquake.

The second model, figure 3.2, consisted of a finite element representation which includes the retaining wall. The lower boundary of the model is bedrock with one side boundary being the retaining wall. The other side boundary is taken at a distance greater than three base slab diameters. As mentioned above, the site design response spectra is defined at top of rock; therefore, the acceleration time history which envelops this spectra is used directly as input at the base of the finite element model. Deconvolution is not required. The analysis of this model was performed using the LUSH code, reference 2.

The design of the tank and foundation system will be based on the larger results from the two models and analyses discussed above. The design of the retaining wall will be based on the larger of results from the finite element analysis and the TVA's Kentucky Dam shaking table experiment, reference 3. It is felt this approach will produce a conservative design. The details and results of the analysis will be reported in the Final Safety Analysis Report.

# REFERENCES

- 1. Whitman, Robert V., "Analysis of Foundations," Vibrations in Civil Engineering, Buttersworth, London, 1966.
- Lysmer, J., T. Udaka, H. B. Seed, and R. Hwang, "LUSH-A Computer Program for Complex Response Analysis of Soil-Structure Systems," EERC 74-4, Earthquake Engineering Research Center, University of California, Berkeley, 1974.
- 3. Tennessee Valley Authority, Kentucky Dam, Report No. 8-194, "Dynamic Effect of Earthquake on Engineering Structures."



4. Section 2.5, and in particular Section 2.5.1.2.12, should be revised to reflect the changes in the foundation criteria.

## Response

Text revisions to reflect the changes in foundation criteria will be made in the next amendment to the PSAR.

ocket File ACTION ROUTING AND TRANSMITTAL SLIP INITIALS CIRCULATE TO (Name, office symbol or location) R. Birkel (5) -OATE COORDINATION cc: H. Denton R. Ballard INITIALS FILE W. Gammill B. Grimes DATE INFORMATION E. Conti L. Hulman NOTE AND INITIAL E. Adensam H. Berkson DATE PER CON -J. Boegli R. Codell INITIALS SEE ME K. Eckerman R. Overstreet OATE SIGNATURE D. Schreiber F. Clark REMARKS A. Postma - Staff Consultant OPS LIQUID PATHWAY GENERIC STUDY Attached please find 5 copies of "Report on Development of Source Term Estimates for Reactor Accidents," provided on December 9, 1975, by the applicant. This is a report completed for the applicant by his consultant. Please use these copies to file in PDR's or where necessary. Also note the distribution I made of the remaining 15 copies. Val : I have taken my copy : would you flee distribute the other - POR etc. This info-une product to the stiff dairy 12/9 mily with 013 Do NOT use this form as a RECORD of approvals, concurrences, 1045, disapprovals, clearances, and similar actions. DATE FROM (Name, office symbol or location) 12/10/75 PHONE D. Schreiber 27288/89 OPTIONAL FORM 41 5041-101 c43-16-81418-1 419-015 GPO AUGUST 1967 G5A FPMR (41CFR) 100\*11-206 and the start