831 Power Building
TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

January 27, 1976

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U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

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

Enclosure (10)

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1119

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 D1.1-75. 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.

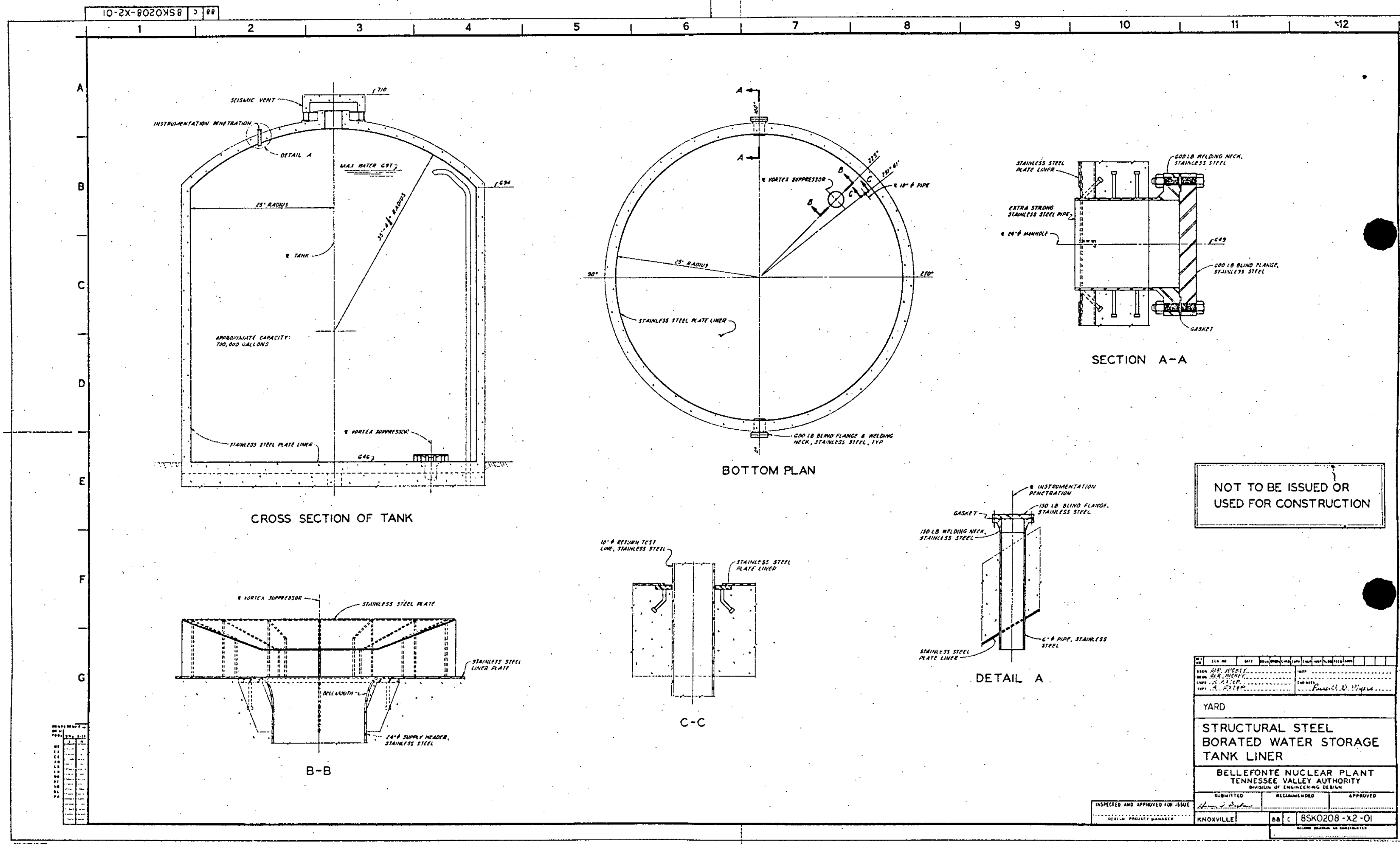
CROSS SECTION OF TANK
SEISMIC VENT
INSTRUMENTATION PENETRATION
DETAIL A
MAX WATER
25' RADIUS
℄ TANK
APPROXIMATE CAPACITY: 700,000 GALLONS
℄ VORTEX SUPPRESSOR
STAINLESS STEEL PLATE LINER
BOTTOM PLAN
℄ VORTEX SUPPRESSOR
℄ 10"φ PIPE
25' RADIUS
90°
270°
STAINLESS STEEL PLATE LINER
600 LB BLIND FLANGE & WELDING NECK, STAINLESS STEEL, TYP
SECTION A-A
STAINLESS STEEL PLATE LINER
600 LB WELDING NECK, STAINLESS STEEL
EXTRA STRONG STAINLESS STEEL PIPE
℄ 24"φ MANHOLE
600 LB BLIND FLANGE, STAINLESS STEEL
GASKET
NOT TO BE ISSUED OR USED FOR CONSTRUCTION
B-B
℄ VORTEX SUPPRESSOR
STAINLESS STEEL PLATE
STAINLESS STEEL LINER PLATE
BELLMOUTH
24"φ SUPPLY HEADER, STAINLESS STEEL
C-C
10"φ RETURN TEST LINE, STAINLESS STEEL
STAINLESS STEEL PLATE LINER
DETAIL A
℄ INSTRUMENTATION PENETRATION
150 LB BLIND FLANGE, STAINLESS STEEL
GASKET
150 LB WELDING NECK, STAINLESS STEEL
6"φ PIPE, STAINLESS STEEL
STAINLESS STEEL PLATE LINER
YARD
STRUCTURAL STEEL
BORATED WATER STORAGE
TANK LINER
BELLEFONTE NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN
SUBMITTED
RECOMMENDED
APPROVED
INSPECTED AND APPROVED FOR ISSUE
KNOXVILLE
8SK0208-X2-01

Figure 1.1

2. 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

(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	1.5	1.5	-
(2) D + H + W	1.5	1.5	-
(3) D + H + E'	1.1	1.1	-
(4) D + H + W_t	1.1	1.1	-
(5) D + F	-	-	1.5
(6) D + F'	-	-	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_t--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. Note: 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 $(45 \text{ degrees} - \phi/2)$ off the vertical where ϕ is the angle of internal friction of the soil.

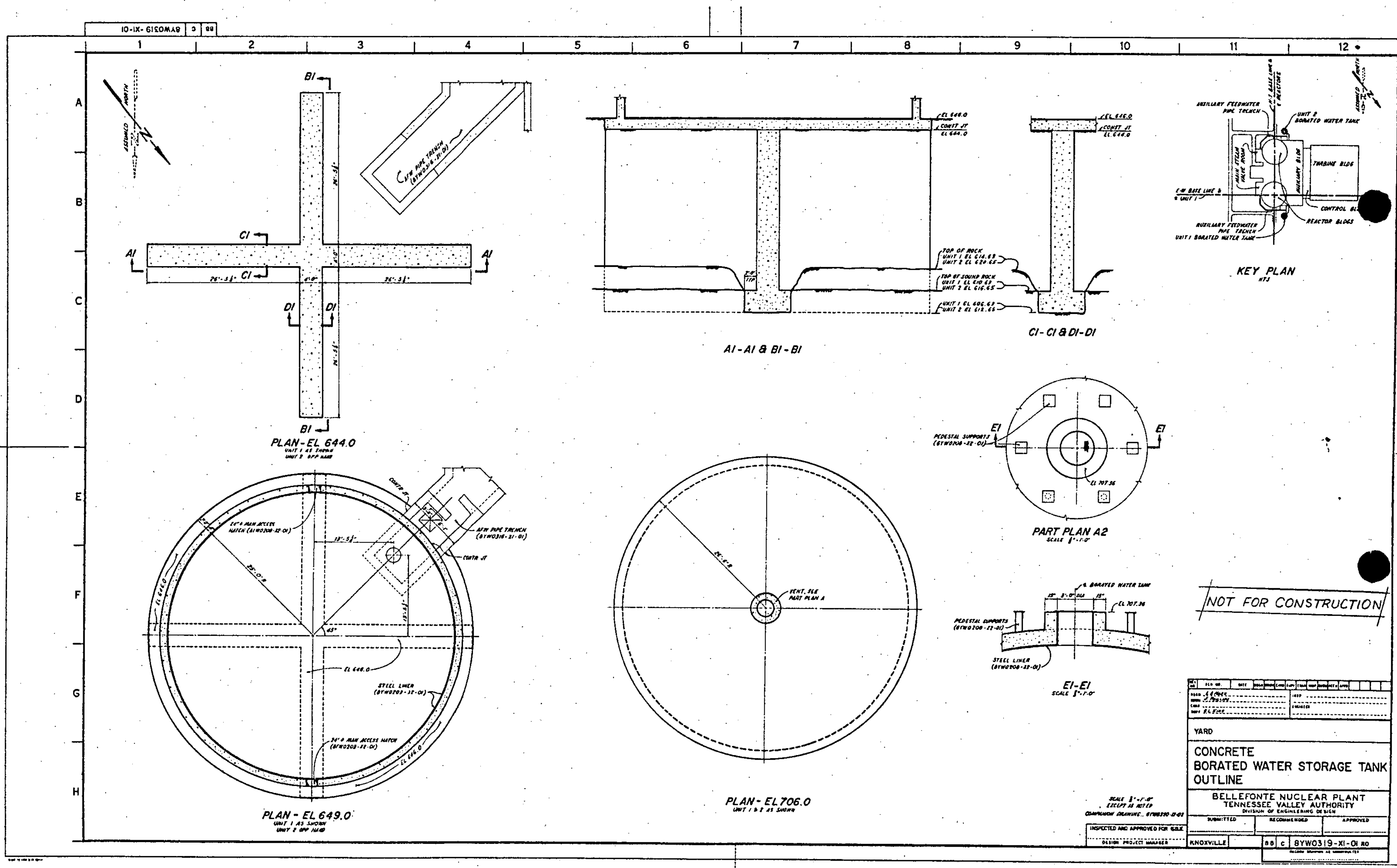
PLAN - EL 644.0
UNIT 1 AS SHOWN
UNIT 2 OPP HAND
A1 - A1 & B1 - B1
C1 - C1 & D1 - D1
KEY PLAN
PART PLAN A2
E1 - E1
PLAN - EL 649.0
UNIT 1 AS SHOWN
UNIT 2 OPP HAND
PLAN - EL 706.0
UNIT 1 & 2 AS SHOWN
NOT FOR CONSTRUCTION
YARD
CONCRETE
BORATED WATER STORAGE TANK
OUTLINE
BELLEFONTE NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN
KNOXVILLE
88 C 8YW0319-XI-01 R0

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.

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.

2. 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."

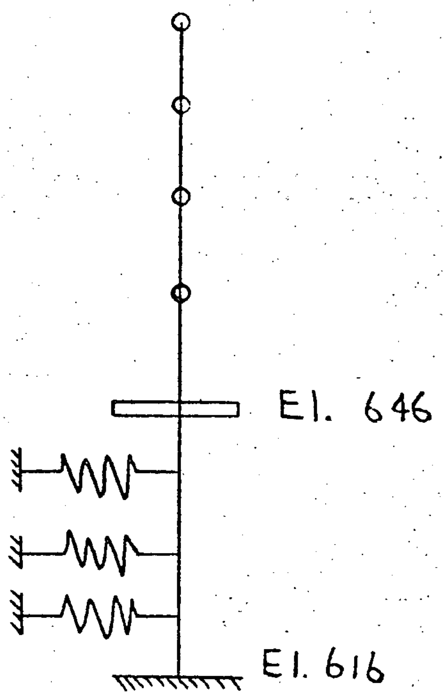

Figure 3.1

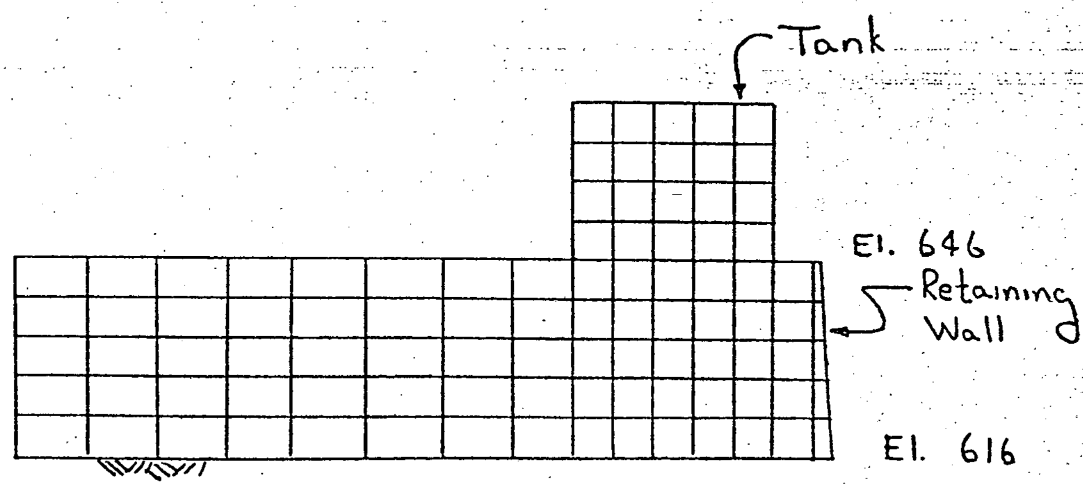

Figure 3.2

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.

Docket File

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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 please distribute the others - PDR, etc. This info was provided to the staff during 12/9 mtg with OPS. RBS

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