TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

400 Chestnut Street Tower II

June 23, 1982

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Adensam:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

Enclosed is a copy of material that will be included in Amendment 48 of the Watts Bar Nuclear Plant Final Safety Analysis Report. This information concerns Section 3.7.3.12, "Buried Seismic Category I Piping Systems and Tunnels," and should resolve NRC concerns resulting from a meeting with the NRC Hydrologic and Geotechnical Engineering Branch on May 14, 1982.

If you have any questions concerning this matter, please get in touch with D. P. Ormsby at FTS 858-2682.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

L. M. Mills, Manager
Nuclear Licensing

Sworn to and subscribed before me
this 23rd day of June 1982

Paulette H. White
Notary Public
My Commission Expires 9-5-84

Enclosure
cc: U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly Administrator
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

B001

3.7.3.12 Buried Seismic Category I Piping systems and Tunnels

Category I buried piping which penetrates structures where fill
settlement or seismic movements are expected to be high is
protected from differential movement of the soil and structure by
Category I concrete slabs or encasements. The slab or encasement
is supported by a bracket on the structure on one end and on
undisturbed or Class A backfill at the other end. Bearing piles 41
are used if required to support the slab. The encased pipes are
insulated to prevent bonding between the pipes and concrete.
For details of the slab at the intake pumping station and the
encasement at the Diesel Generator Building, refer to Section
3.8.4.4.8.

For seismic classed buried piping that penetrates structures in areas where very little fill is involved and seismic movements are low, protection from differential movement of the soil and structure is provided by an oversized opening in the structure. The annular space between the pipe and opening is filled with a resilient material. The first support inside the structure is located to allow for relative movement of the pipe and structure. The soil-structure interface is treated as an anchor, and stresses are limited to code allowables.

Where practical, seismic classed buried piping is routed to avoid
areas of weak soils. Where weak soils are encountered, the bad
material is removed and replaced by backfill. The backfill is
placed to standards that insure suitable bearing conditions,
therefore, the transition from one material to another, i.e., 41
insitu soil to backfill should not be a problem. In lieu of the
above, in some cases an analysis is performed to show that the
pipe has sufficient strength to bridge the discontinuity and
support the soil above the pipe without exceeding the allowable
stress of the piping material.

Category I piping supported by two structures is attached to only one of the two at the interface of the two structures. Sufficient clearance is provided between the pipe and the second structure to permit maximum relative longitudinal and radial movements. The seismic spectral data for these systems are developed by superimposing data from both buildings and developing curves which envelop the individual spectral data for two perpendicular, horizontal plant directions.

Buried piping complies with the ASME Boiler and Pressure Vessel
Code, Section III and is analyzed seismically as follows. 48

> The soil is considered to be a horizontal 1-layer system which responds to the earthquake by moving in a continuous sinusoidal plane wave and supported by a second layer or base material. The top layer is assumed to pick up accelerations from the base material.

The wave length, L, is calculated as

$$L = V_{ST}\ T$$

The bending moment resulting from the seismic disturbance, assuming the pipe follows the soil and deforms as a sine wave, is given by

$$M = \frac{\pi^2\ E\ I\ A}{(L/2)^2}$$

Where: M - Maximum bending moment, in-lb
E = Modulus of the pipe, psi
I = Moment of inertia of the pipe, in^4
A = Maximum amplitude, in.
L = Wave length, in.

The corresponding bending stress is obtained by dividing the moment by the section modulus of the pipe. The above bending stress is combined with bending stresses due to other loads according to the applicable loading combinations. 48

The geotechnical parameters used in the seismic analysis of the ERCW system buried piping are:

Average soil shear wave velocity, V_{ST} = 1000 f/s (approx.)
Soil unit weight = 120 pcf
Average rock shean wave velocity = 5900 f/s
Rock unit weight = 170 pcf

The average soil shean wave velocity was determined by the layered approach using cross-hole geophysical data and corresponds well with the downhole geophysical data. In addition, a $\pm$ 30% variation of shean wave velocity is considered.

Utilizing the average values for the shear wave velocity and density for the top layers, the ground deformation pattern in terms of wave length and amplitude is determined. The buried pipes are assumed to deform along with the surrounding soil layers. No relative displacement between the soil and the buried piping is considered.

The average shear wave velocity of a single layer representation of a multi-layed soil system may be determined by:

$$V_{ST} = \frac{V_S \; h'}{h}$$

Where: V_{ST} = Average shear velocity in the top layers of soil, ft/sec
V_S = Shear velocity in each layer of soil, ft/sec
h = Depth of each layer of soil, ft
h = Total depth of top layers of soil, ft

The fundamental period of the single layer is calculated from the following equation: 48

$$T = \frac{4\,h}{V_{ST}} \quad \text{(seconds)}$$

If the depth of the soil layer varies over the distance traversed by the buried pipe, both cases, for maximum and minimum depths, are considered.

The maximum amplitude of the sine wave which represents the maximum displacement of the pipe is:

$$A = \text{Displacement} = \left(\frac{T}{2\pi}\right)^2 * \text{Accel}$$

where: T = Fundamental period, sec
Accel = Amplified soil acceleration value, in/sec