NATHAN M. NEWMARK
CONSULTING ENGINEERING SERVICES

1114 CIVIL ENGINEERING BUILDING
URBANA, ILLINOIS 61801

10 July 1972

Mr. Edson G. Case, Director
Division of Reactor Standards
U.S. Atomic Energy Commission
Washington, D.C. 20545

Re: Contract No. AT(49-5)-2667
Commentary
Summary Comments
Watts Bar Nuclear Plant Units 1 and 2
Tennessee Valley Authority
AEC Docket Nos. 50-390 and 50-391

Dear Mr. Case:

Dr. N. M. Newmark and I have completed our review of the Preliminary Safety Analysis Report for the Watts Bar Nuclear Plant Units 1 and 2, and are transmitting herewith our Commentary and Summary Comments.

Sincerely yours,

W. J. Hall

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Enclosures

cc: N. M. Newmark

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COMMENTARY

ON

PRELIMINARY SAFETY ANALYSIS REPORT

FOR

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2

TENNESSEE VALLEY AUTHORITY

AEC Docket Nos. 50-390 and 50-391

by W. J. Hall and N. M. Newmark

1. Seismic Hazards

The seismic hazards for which the Watts Bar Nuclear Plant is being designed correspond to a Design Basis Earthquake characterized by a maximum horizontal transient ground acceleration of 0.18g and an Operating Basis Earthquake of half this magnitude. A peak vertical acceleration of two-thirds the horizontal ground acceleration is to be employed in the design and is assumed to act simultaneously with the horizontal acceleration. We concur in this approach.

2. Structural Foundations

A summary of the field exploration program and criteria studies leading to the foundation schemes employed in the construction of the plant is presented in Section 2 of the PSAR. It is indicated there that the foundations for plant structures will be founded on the shales and limestones of the Conasagua Formation.

From the material presented in the PSAR, including inspection of the boring logs and exploratory information, it appears that cavities will not be a problem in these foundations. It is indicated in Appendix 2.8C that a major portion of the plant will be founded 5 to 10 feet below the surface of the weathered rock, which will significantly reduce the settlements to be expected under the structures.

An intake canal southeast of the pumping station is shown in Fig. 2.2-4. We assume that this intake canal is a Class I item and that standard computational and review techniques will be employed. None-the-less, it would be our recommendation that the applicant describe in the FSAR the dynamic analysis approach used to evaluate the dynamic stability and/or liquefaction potential of the slopes when subjected to seismic excitation. The answer to Question 2.19 outlines slope stability which is acceptable.

On page B.2-4 it is indicated that for Class I structures founded upon soil, the surface acceleration will be considered to be amplified or attenuated through the soil. Further information on this point is contained in the answer to Question B.9 and in Section B.2.5. The only Class I structure founded on soil is noted to be the Diesel generator building which rests on 20 ft of soil overlying rock. It is indicated in the answer to Question B.9 that studies of soil amplification will be made and probably employed in the design. It is our belief that the calculation of soil amplification for such a thin layer holds little meaning since the soil is constrained to move with the underlying rock material; thus the approach outlined is acceptable to us so long as the seismic motions equal or exceed those corresponding to the response spectra presented in Appendix B (Amendment 5), Figs. B.2-1 and B.2-2.

3. Seismic Analysis and Design

Seismic Analyses

The containment for each of the reactors is noted to consist of a free-standing steel containment vessel surrounded by a shield building constructed of reinforced concrete. An ice condenser is located within the containment vessel.

The response spectrum method of analysis will be employed for the containment vessel, shield building, and ice condenser, as outlined in Section B.2.4 of Appendix B.

It is noted on page 5.1-26 that due to the method of supporting the ice condenser, and the procedure used in the design of the air locks, there is no significant coupling between the structures above the base slab.

The criteria applicable to other Class I structures, including the auxiliary building, the Diesel generator building, and the intake pumping station, are discussed in Section 5.2 and it is indicated there that the provisions of Appendix B will be applicable for the seismic design.

The load combinations for which the analysis will be carried out are described in Section 5 of the PSAR.

It is indicated on page 5.2-3 that stresses determined by seismic analysis, as described in Appendix B, will be added linearly to the stresses resulting from the analyses for other loadings. In Appendix B it is indicated that horizontal and vertical loadings will be considered to act simultaneously.

Time history analysis may be employed in the design. In the answer to Question B.6, it is noted that the time histories will lead to response spectra which equal or exceed the response spectra specified as design criteria for the plant.

We concur in these approaches.

Response Spectra

The response spectra to be employed in the design are presented in Appendix B, Figs. B.2-1 and B.2-2 (as revised in Amendment 5). We concur in the spectra adopted.

Damping Values

The damping values to be employed in the analysis are summarized in Table B.2-1. We concur in the use of the values given there and to the use of the damping value of 10 percent of critical for soil-supported structures.

Design Stresses

The design stresses for the containment vessel will be governed by Section III of the ASME Pressure Vessel and Boiler Code. In the case of the shield building, the stress criteria are presented in Tables 5.1.4-1 and 5.1.4-2. In the case of other Class I structures, the allowable stress criteria are presented in Table 5.2-1. We concur in the criteria presented.

Junction with Adjacent Buildings

The shield building and the auxiliary building are not structurally connected. Separation is accomplished through a joint between the shield building and the auxiliary building, which is designed to accommodate the deflections of the two buildings, plus an additional thickness to preclude their interaction during the Design Basis Earthquake. The details of the sealing materials to be used below grade and above grade are described on page 5.1-85 (Amendment 7) and we believe the approach described there to be acceptable.

Equipment and Personnel Hatches and Other Penetrations

The discussions beginning on page 5.1-30 et seq. pertain to penetrations of various types and indicate the design is to be carried out to accommodate the thermal and mechanical stresses and for accommodating the differential motions between the containment vessel and the shield building under normal operating and accident conditions, including the Design Basis Earthquake. The general design approach and criteria presented are acceptable.

Piping

The stress criteria for handling the design of the piping are in accordance with Report WCAP 5890 Revision 1. It is noted on page B.3-9 that the damping value to be employed for the DBE will not exceed 1 percent for stresses at or near yield.

The answer to Question B.7 indicates that floor response spectra will be employed in the seismic analysis of the piping, and that relative floor deformations will be accommodated.

We concur in the criteria presented.

Buried Piping

It is noted on page B.3-9 that for underground piping, special studies for buried piping will be carried out; further details on the criteria to be employed are contained in the answer to Question B.5. It is noted in the answer to that question that the piping will be designed to accommodate the relative deflection between structures and to avoid overstress at points where the piping enters major structures. We concur in the approach outlined.

Equipment

Certain aspects of the seismic design approach for equipment are contained in Appendix B and further information is contained in the answer to Question B.8. The design of the equipment will be based in part on the calculated floor response spectra and will include provisions for both horizontal and vertical excitation. The design approach for cranes is presented in several places in Section 5 of the PSAR, and the criteria indicate that the cranes will be designed to resist seismic overturning and dislodgement forces. We concur in the approach outlined.

Class I Controls and Safety-Related Instrumentation

The approach for handling procurement and design of Class I equipment is described briefly in Section 7, Appendix A of the PSAR, and in the answer to Question B.3. The approach outlined generally in the PSAR is acceptable.

REFERENCES

"Preliminary Safety Analysis Report, Watts Bar Nuclear Plant, Tennessee Valley Authority, Vols. 1-5 and Amendments 1 through 5, 7, 9-10", AEC Docket Nos. 50-390 and 50-391.

W. J. Hall

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SUMMARY COMMENTS

ON

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As a result of our review of the PSAR, including Amendments 1 through 7, we believe that the design criteria described in the PSAR for the Watts Bar Nuclear Plant Units 1 and 2 can be considered adequate in terms of provisions for safe shutdown for a Design Basis Earthquake of 0.18g maximum transient horizontal ground acceleration and capable otherwise of withstanding the effects of an Operating Basis Earthquake of half this intensity.

Our review was based on consideration, among other things, of the seismic adequacy of the structural foundations, seismic analyses, response spectra, damping values, design stresses, junction with adjacent buildings, equipment and personnel hatches and other penetrations, piping, buried piping, equipment, Class I controls and safety-related instrumentation.

We believe that the criteria and procedures presented in the PSAR as being applicable to the design of this plant are in accord with the state-of-the-art and that the design should incorporate an acceptable margin of safety for the earthquake hazards considered.

W. J. Hall