REVIEW OF THE SEISMIC ANALYSIS AND DESIGN

FOR THE

MAINE YANKEE ATOMIC POWER STATION

(Docket No. 50-309)

June 18, 1971

JOHN A. BLUME & ASSOCIATES, ENGINEERS
San Francisco, California

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This report summarizes our review of the engineering factors pertinent to the seismic and structural adequacy of the Maine Yankee Atomic Power Station. The plant is located on the west shore of the Back River approximately 3.9 miles south of the center of Wiscasset, Maine. The design and construction of the plant was performed by Stone and Webster Engineering Corporation. The Nuclear Steam Supply System (NSSS) was supplied by Combustion Engineering, Inc. Westinghouse Electric Corporation has supplied and erected the turbine generator. The pressurized water type reactor plant has a capacity of generating 2,440 MWt (830 MWe). Application for an operating license has been made to the Atomic Energy Commission (Docket No. 50-309) by the Maine Yankee Atomic Power Company. The Final Safety Analysis Report (FSAR) has been submitted in support of the application to show that the plant has been designed and constructed in a manner which will provide for safe and reliable operation and safe shutdown in case of a loss-of-coolant accident. Our review is based upon the information presented in the FSAR and is directed specifically towards an evaluation of the seismic design of Class 1 structures, systems, and components. The list of reference documents upon which this report is based is given at the end of this report.

DESCRIPTION OF FACILITY

The Maine Yankee Atomic Power Plant site is located in a stable geologic region where no major geologic changes other than those produced by glaciation have occurred. The overburden at the site consists of medium soft to medium stiff silty clay varying from 15 to 20 ft in thickness. Underlying this layer is steeply dipping schistose bedrock of the Cape Elizabeth formation interlayered with granite and coarse crystalline pegmatite. It is stated that the major structures are directly founded on hard crystalline rock.

The containment structure is a reinforced concrete cylindrical structure topped with a hemispherical dome. The reinforced concrete foundation slab is 10 ft in thickness and is bearing on the bedrock. The cylinder is of 135'0" inside radius with 4'6" wall thickness. The hemispherical dome is of the same inside radius with 2'6" wall thickness. The spring line of the dome is at 102'0" above top of the foundation slab. The containment structure is completely lined on the inside with a steel liner plate which is 1/4", 3/8" and 1/2" thick at top of the foundation slab, vertical walls, and dome respectively.

The primary auxiliary building and fuel building are shear wall type reinforced concrete structures located north of the containment structure.

STRUCTURAL DESIGN CRITERIA AND LOADS

All structures, equipment, systems, and piping are classified according to function or consequence of failure as either Class I or II, as defined in Section 5.4 of the Safety Analysis Report. Class I structures, systems, and equipment are those whose failure could cause uncontrolled release of radioactivity or are those essential for immediate and long-term operation following a loss-of-coolant accident. They are designed to withstand the appropriate seismic loads simultaneously with other applicable loads without loss of function. Class II structures, systems, and equipment are those whose failure would not result in a release of radioactivity and would not prevent reactor shutdown but may interrupt power generation.

The design loads for the Maine Yankee Atomic Power Station are basically divided in two categories. The first category includes dead loads, ice and snow loads, normal live loads. operating loads, normal temperature loads, hydrostatic loads, etc. The second category includes seismic loads due to Design Earthquake (DE) and Hypothetical Earthquake (HE), tornado loads and tornado-blown missile loads, turbine-generator missile loads, accidental pressure and temperature loads, accidental pipe rupture loads

etc. The structure design loads were increased by load factors based on probability and conservatism of the predicted design loads. It is stated that these increased designed loads were used for the design of Class I structures by the ultimate strength method. Capacity reduction factors were applied to the yield stresses allowed by the applicable codes.

ADEQUACY OF THE SEISMIC ANALYSIS AND DESIGN

We have reviewed the Final Safety Analysis Report, Volumes I and 2, and Amendments numbered 14 and 17 to 25. Our review also included discussions with DRS and DRL staff during meetings on January 21, 1971 and May 19, 1971; data gained during a site visit on May 18, 1971; and discussions with DRS and DRL staff and the applicant during a conference call on June 18, 1971. We have the following comments regarding the seismic analysis and design.

1. The maximum horizontal ground acceleration (Section 2.5.1) used by the applicant in the seismic design of the Class I items was 0.05g for the Design Earthquake (DE), and 0.10g for the Hypothetical Earthquake (HE). The maximum vertical ground acceleration was assumed to be equal to two-thirds of the maximum horizontal ground acceleration. Horizontal and vertical ground accelerations were assumed to act simultaneously.

   The horizontal acceleration response spectra cruves (Section 2.5.4) used in the seismic design of the Class I items are shown in Figure 2.5-6 and 2.5-7 for the DE and HE respectively. These spectra are as originally defined in TID 7024.

   These criteria were accepted prior to the issuance of the construction permit.

2. The applicant has performed dynamic analysis of all Class I structures. Although certain approximations were made in the analytical techniques, we understand that the resulting seismic stresses are quite low, and therefore the seismic design of these structures should be adequate.

3. [redacted] We understand that modification will be made if required by the follow-up analysis.

4. For Class I piping systems other than the reactor coolant system, and for Class I equipment, the applicant has stated that he has initiated a program to verify the adequacy of this piping and equipment and/or identify those systems which require modification.

   a. The applicant has proposed to perform static analysis of Class I piping and equipment systems, by using a static horizontal acceleration equal to 1.3 X [redacted] X peak ground acceleration. [redacted]

   b. [redacted]

   c. The applicant will revise, expand and update Tables 4.6.1 and 4.6.2 showing comparison of actual stresses and allowable stresses in the NSSS. These revised tables will be submitted for review.

   d. The applicant will use appropriate damping ratio in the analysis of all Class I piping.

   This program, when completed, will provide assurance of the adequacy of the seismic design of Class I piping and equipment.

5. The applicant has stated that Class II structures are either designed to adequately withstand Class I loads without failure, or in case of a collapse of a Class II structure, the Class II structure will collapse away from the adjacent Class I structure. Accordingly, the applicant has stated that the Turbine Building and the adjoining Class Control Room Building have been designed for Class I design criteria.

CONCLUSION

On the basis of the information presented by the applicant in the Final Safety Analysis Report and Amendments 14 and 17 to 25, and provided that adequate analysis and evaluations and implementation in construction are performed for the reactor coolant system and all Class I piping systems, equipment, instrumentation and control panels, as discussed in Comments 3 and 4, it is our opinion that the approach to the seismic analysis and design for the Maine Yankee Plant as outlined in the FSAR, and Amendments will have resulted in a design that is adequate to resist the earthquake conditions postulated for the site.

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REFERENCES

1. "Maine Yankee Atomic Power Station, Final Safety Analysis Report." Volumes I and II, including Amendment no. 14, and 17 through 25 by Maine Yankee Atomic Power Company, Wiscasset, Maine.