REVIEW OF THE SEISMIC DESIGN CRITERIA

FOR THE

DAVIS-BESSE NUCLEAR POWER STATION

(Docket No. 50-346)

July 17, 1970

JOHN A. BLUME & ASSOCIATES, ENGINEERS

San Francisco, California

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INTRODUCTION

This report summarizes our review of the engineering factors pertinent to the seismic design criteria of the Davis-Besse Nuclear Power Station. The power station will be located on the south western shore of Lake Erie in Ottawa County, Ohio, approximately 21 miles east of Toledo and 9 miles northwest of Port Clinton, Ohio. The design and construction of the plant will be performed by Bechtel Corporation under the direction of the applicant, The Toledo Edison Company. The nuclear steam supply system will be manufactured by Babcock & Wilcox Company. Application for a construction permit has been made to the U.S. Atomic Energy Commission (AEC Docket No. 50-346) by The Toledo Edison Company. A Safety Analysis Report has been submitted in support of the application to show that the plant will be designed and constructed in a manner which will provide for safe and reliable operation. Our review is based on the information presented in the Safety Analysis Report and is directed specifically towards an evaluation of the seismic design criteria for Class 1 structures, systems, and components. The list of reference documents upon which this review has been based is given at the end of this report.

DESCRIPTION OF FACILITY

The Davis-Besse Nuclear Power Station site region is characterized by flat plains having poor drainage and consists primarily of marshland with the western area rising to 4-6 feet above Lake Erie. The major streams in the region are the Maumee River and the Toussaint River (or Creek) which have very low flow velocities. All the streams generally flow toward the northeast into Lake Erie. Site soil is composed of a surficial deposit of stiff, desiccated lacustrine clays ranging from 6 to 9 feet in thickness and underlain by 4 to 20 feet of till. Immediately below is

bedrock composed of argillaceous dolomite with shale partings and varying amounts of gypsum and anhydrite. No faults are known to exist in the site locally.

The containment system consists of a cylindrical steel pressure vessel with hemispherical dome and ellipsoidal bottom enclosed by a reinforced concrete shield building having a cylindrical shape with a shallow dome roof. An annular space of about 4'-6" is provided between the containment vessel and shield building along with space between the domes. Both structures are joined at the base and supported on competent rock at finished grade. The height of the shield building from top of foundation ring to top of dome is 274'-6". The wall and dome thicknesses will be about 2'-6" and 2'-0" respectively. A shell thickness of 1-1/2 inches will be used in the design of the containment vessel to enclose the 130-foot diameter interior space. Reinforced concrete construction will be used for the Auxiliary Building including the spent fuel and control room areas. The Turbine Building will consist primarily of steel frame construction with concrete slabs and a massive concrete turbine support 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 Class II as defined in Appendix 5A 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 design basis accident. They are designed to withstand the appropriate seismic loads simultaneously with other applicable loads without loss of function. Structures and equipment under Class II designation are those whose failure would not result in the in the release of significant radioactivity and would not prevent reactor shutdown. A listing of Class I structures, equipment, and systems is given in Appendix 5A.

The design loads for the Davis-Besse Station shield building are based on ultimate strength design criteria as presented in ACI 318-63 and as modified in Appendices 5B and 5D. Structure design loads are increased by load factors based on the probability and conservatism of the predicted design loads. Yield capacity reduction factors are applied to the stresses allowed by the applicable building codes.

The containment structure will be designed in accordance with the ASME Boiler and Pressure Vessel Code, Section III, Class B. A "design internal pressure" of 36.0 psig along with a coincident design temperature of 264° will be used. All structures are designed for 40 psf roof load.

Wind loads will be determined from ASCE Paper 3269 including gust factors and variation of wind velocity with height. The criteria of the fastest wind for a 100-year recurrence results in 90-mph basic wind at 30 feet above grade. The structure will be designed for tornado loading which corresponds to a design tornado with a total tangential and forward velocity of 360-mph and an atmospheric pressure drop of 3 psi in 3 seconds. Tornado-generated missiles considered in the design will be a 12 foot long, 8 inch diameter wooden pole traveling at 250 mph and a 4000 lb automobile at 50-mph up to 25 feet above ground.

ADEQUACY OF THE SEISMIC DESIGN CRITERIA

We have reviewed the Preliminary Safety Analysis Report and Amendments No. 1 through 7. In addition, we have discussed the various aspects of the seismic design of the plant with members of the staffs of the Divisions of Reactor Standards and Reactor Licensing at several meetings and with the members of the staffs and the applicant at a meeting on May 19, 1970. We have the following comments regarding the adequacy of the seismic design criteria:

1. The applicant has selected a peak ground acceleration of 0.08g for the "Maximum Probable Earthquake" and 0.15g for the "Maximum Possible

Earthquake." We concur with the selection of these ground accelerations. In addition, the site response spectra for the Maximum Probable Earthquake and the Maximum Possible Earthquake as shown on pages 2C-47 and 2C-48, respectively, are satisfactory.

2. The applicant has stated that the procedures for the design of the reactor internals are discussed in Topical Resports BAW-10008. We have reviewed these documents for the Oconee plant and have similar concerns for the Davis-Besse plant. We understand that these reports have been revised and will be submitted for the Davis-Besse application. Review and approval of these reports should be completed before implementation of the results of the reports in the final design, but the review need not be completed prior to issuance of the construction permit.

3. The applicant has stated that he will use the response spectrum method of dynamic analysis for Class 1 structures, piping, and equipment. The structures will be analyzed for response in both the horizontal and vertical directions. Time-history analyses of Class 1 structures will be performed to develop response spectra in vertical and horizontal directions at the points of support of piping and equipment.

   The applicant has stated that he will perform comparative analyses of the containment structure to confirm the assumption of a rigid base mathematical model. In these comparisons, a range of foundation material moduli will be used in the analyses to account for variations in these moduli. Should the results of the analyses of the rigid base and flexible base models differ significantly, the most conservative values will be used in design.

   We concur in general with the proposed approach to the seismic design of Class I structures, piping and equipment. The analytical techniques proposed by the applicant are satisfactory and if properly implemented will result in a conservative design.

CONCLUSIONS

On the basis of the information presented by the applicant in the Preliminary Safety Analysis Report and Amendments, it is our opinion that the seismic design criteria and approach to seismic design as outlined in the PSAR and Amendments 1 through 7, if properly implemented by the applicant, will result in a design that is adequate to resist the earthquake conditions postulated for the site.

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REFERENCE DOCUMENTS

DAVIS-BESSE NUCLEAR POWER PLANT

Preliminary Safety Analysis Report, Volumes 1-4

Amendments Number 1-7