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ENCLOSURES:
Comments on the review of the geologic and seismologic data relevant to the Bellefonte Units.....

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PLANT NAME: Bellefonte Units 1 & 2

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50-438-439

United States Department of the Interior

GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

JUL 9 1974

Mr. L. Manning Muntzing
Director of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muntzing:

Transmitted herewith, in response to a request by your staff, are reviews of geologic and seismologic data relevant to the Tennessee Valley Authority, Bellefonte Nuclear Plant, Jackson County, Alabama (AEC Docket Nos. 50-438 and 50-439). Inasmuch as the geologic and seismologic conditions are somewhat different for each site, a separate report is enclosed for each.

The reviews for the site were prepared by Mr. F. A. McKeown and Mr. W. V. Mickey of the Geological Survey.

We have no objection to your making the reviews part of the public record.

Sincerely yours,

V. E. Schuchert

Acting Director

Enclosure

6210

Tennessee Valley Authority
Bellefonte Nuclear Plant
Jackson County, Alabama
AEC Docket Nos. 50-438 and -439

Introduction

The geology described in the Preliminary Safety Analysis Report (PSAR), the amendments through number 11, and the preliminary information received at the site on June 17, 1974, have been reviewed. Sections of the PSAR concerning hydrology, rock mechanics and soils engineering were not reviewed. A satisfactory, detailed geologic map of the site area has not been received. Exclusive of the inadequate site map, the applicant has responded satisfactorily to all other geologic questions and comments posed by the U.S. Geological Survey. The site was visited on September 19, 1973, and again on June 17, 1974, in company with AEC and TVA officials.

In the preliminary Review and Interim Review reports transmitted to W. P. Gammill from E. H. Baltz on November 15, 1973, and January 21, 1974, respectively, the U. S. Geological Survey noted in particular the lack of an adequate and accurate map. This is especially important to an evaluation of the Bellefonte site, because the site is in an area of major structural deformation. That an accurate map based on careful field observations and throughtfully interpreted is essential, has become very obvious, because of the recent discovery of a small reverse fault in the intake area. This discovery was cause for the site visit of June 17, 1974.

Geology

The Bellefonte Nuclear Plant site is in Browns Valley in Alabama which is coextensive with Sequatchie Valley in Tennessee. The valley is in the erosionally breached Sequatchie anticline that extends for over 150 miles, from near Blount Springs, Alabama, to Crab Orchard, Tennessee. In the vicinity of the site the valley is about 5 miles wide, and the elevation of the valley floor is about 600 feet. Sequatchie anticline is a western outlier of the Valley and Ridge Province, but the anticline is generally considered to be in the Cumberland Plateau section of the Appalachian Plateau Province.

The plant will be founded on limestone of the middle part of the Chickamauga Formation whose total thickness in the vicinity of the site is about 1400 feet. Carbonate rocks of the Knox Group underlies the Chickamauga and crops out about 1 mile northwest of the site. Shale, siltstone, and limestone of the Red Mountain Formation crop out in a ridge between the site and Guntersville lake about 1/2 mile southeast of the site.

The site is on the southeast flank of the Sequatchie anticline where the rocks generally dip 15° - 20° to the southeast; the dip becomes less towards the southeast. The northwest flank of the anticline is truncated by the Sequatchie thrust fault about 2 1/2 miles northwest of the site. This fault is a major geologic structure and extends northeast-southwest for about 150 miles from central Alabama to northern Tennessee. The fault dips to the southeast, probably flattening at depth. Its location below the plant site is not known

but according to the applicant (p. 2.5-5 amend. 1) is probably several thousand feet. The only other fault reported by the applicant in the vicinity of the site is about 4,000 feet east of the site. This fault was discovered as the result of careful lithologic logging of exploratory drill holes in the intake area. In the preliminary information received during the site visit of June 17, 1974, the applicant reports that the fault is a reverse fault, has about 8.5 feet of displacement on it, dips 34° SE, and strikes N 33° E. The applicant also states that the fault represents adjustment of less competant limestones and siltstones in the Red Mountain Formation associated with folding of the Appalachian system near the end of the Paleozoic era.

Both the Sequatchie thrust and the small reverse fault are reported by the applicant to have been immobile since the end of the Paleozoic era.

It is not surprising that a small fault was discovered during recent exploratory drilling. Other faults are likely to be discovered during excavation of the site. The available data do not appear to be adequate to determine the location of faults prior to excavation or to infer with reasonable assurance the existence of faults. It is not likely however, that any large faults are in the vicinity of the site. No major discontinuities in rock type appear evident from the logs of drill holes at the proposed location of the reactor facilities. We recommend that all excavations for foundations or other purposes at the site be mapped in detail and documented.

The age of the faults as given by the applicant seems reasonable. This judgment however, is based only upon search of the literature and discussion with colleagues. The generally accepted geologic history of the area and surface geologic characteristics of the faults suggest that the known faults are not capable as defined in AEC criteria (10 CFR, Part 100). Recent geologic deposits suitable for absolute dating of the last movements of the faults do not appear to exist in the vicinity of the site.

The available data lead us to conclude that there is no basis to assume that an earthquake will occur on any particular known fault.

Seismology

The seismologic aspects of the Preliminary Safety Analysis Report (PSAR) and Amendments through 11 for the Bellefonte Nuclear Plant (BNP) have been reviewed by the U.S. Geological Survey seismologists.

The geological review has contained the first reports of a reverse fault 1210 metres (4000 ft.) east of the site with 2.6 metres (8.5 ft.) of displacement, dipping 34° SE and striking North 33° E. It further reports that the fault represents "adjustment of less competent limestones and siltstones in the Red Mountain formation associated with faulting of the Appalachian system near the end of the Paleozoic era." Both the 240 kilometre (150 miles) long Sequatchie thrust fault and the recently discovered reverse fault are reported to have been immobile since the end of the Paleozoic era. This age was based only upon judgment, literature search, and discussions with colleagues since "material and recent geological deposits suitable for dating the faults do not appear to exist in the vicinity of the site."

The BNP site is located near the boundary of Zones 1 and 2 of the Seismic Risk Map of the United States (Algermissen 1969) and is in the southern Appalachian Tectonic Province, bounded on the east by the western extent of the Piedmont Province; on the west by the Cumberland Plateau; on the south by the Gulf Coastal Plain Province; and on the north by the Valley and Ridge Province. Accelerations for the site, as selected by the applicant, were based upon the MM VIII Giles County, Virginia earthquake of May 31, 1897. The applicant uses the Gutenberg-Richter relationship

for acceleration and intensity which is based mainly upon California observations. This empirical equation yields 0.15g. The applicant selected 0.18g as the Safe Shutdown Earthquake (SSE) and acknowledges that the empirical relationship is questionable when applied to the eastern United States.

A member of the Advisory Committee on Reactor Safeguards has issued a formal statement concerning the need for an additional margin of safety (seismic) for all future nuclear plant sites east of the Rockies.

The tabulations on Figure 2.5-14-2 show earthquakes having a Richter scale magnitude equal to or greater than 4.3 within the geodetic coordinate lines of 30 to 37 degrees north and 78 to 92 degrees west. This includes the southeastern states of Alabama, Georgia, Mississippi, South Carolina and Tennessee with portions of Kentucky, Virginia, North Carolina, Arkansas, Louisiana, and Florida. The data start with the New Madrid shocks of 1811. It is very interesting and relevant to note that from 1811 to 1931 (120 years) there was an average of one earthquake of intensity MM VII or greater every 5.5 years. From 1931 to 1974 (July 1974, the present) there has been only one intensity VII. The change from one every 5.5 years to the present span of 43 years for only one emphasizes the need for the additional margin of safety.

Although it is generally accepted that earthquakes in the eastern U.S. cannot be identified with geological structure it is difficult to be confident that the MM V shock of June 16, 1927 near Scottsboro, Alabama did not occur on the Sequatchie thrust zone or the new found reverse

fault 1210 metres east of the site. If the 1927 shock had occurred near the site the overall gound motion would probably be below the proposed SSE accelerations; however, there would have been higher accelerations. The September 4, 1972 earthquake of magnitude only 4.5 near Bear Valley, California was recorded on a nearby accelerograph with one "spike" of 0.7g.

Studies of earthquake magnitude and displacement along resultant faults would infer a magnitude 7.5 earthquake for the new found reverse fault. Conversely the 240 km long Sequatchie fault would result in a displacement of about 6 metres if the rupture occurred as one episodic event.

The geological review concludes that "the available data lead us to conclude that there is no basis to assume that an earthquake will occur on any particular known fault."

With this assumption and assurance that the major concerns can be accepted, we conclude that the proposed acceleration value of 0.18g for the Safe Shutdown Earthquake is adequate. It is our intention that the acceleration value be used as the zero period and acceleration in the development of the appropriate design response spectra as described in the AEC Regulatory Guide 1.60, Revision 1, December 1973.