



United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

In Reply Refer To:
Mail Stop 905

NOV 16 1982

Dr. Robert E. Jackson
Chief, Geosciences Branch
Division of Engineering
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Bob:

The purpose of this letter is to clarify our position on the seismic potential of certain regions of the Eastern United States. In our letter of December 30, 1980, on the same subject we expressed the view that "... the likelihood of a Charleston sized event in other parts of the Coastal Plain and Piedmont is very low."

As you are aware, after several years of intensive study in the Charleston region, no geologic structure or feature can be identified unequivocally as the source of the 1886 Charleston earthquake. However, as studies in the Charleston region and elsewhere along the Atlantic margin have progressed, it has become evident that the general geologic structure of the Charleston region can be found at other locales within the eastern seaboard (Appalachian Piedmont, Atlantic Coastal Plain, and Atlantic Continental Shelf).

Because the geologic and tectonic features of the Charleston region are similar to those in other regions of the eastern seaboard, we conclude that although there is no recent or historical evidence that other regions have experienced strong earthquakes, the historical record is not, of itself, sufficient grounds for ruling out the occurrence in these other regions of strong seismic ground motions similar to those experienced near Charleston in 1886. Although the probability of strong ground motion due to an earthquake in any given year at a particular location in the eastern seaboard may be very low, deterministic and probabilistic evaluations of the seismic hazard should be made for individual sites in the eastern seaboard to establish the seismic engineering parameters for critical facilities.

As stated in our letter of December 30, 1980, earthquakes similar to the 1886 Charleston, South Carolina, event should be considered as having the potential to occur in the vicinity of Charleston and seismic engineering parameters of critical facilities in that area should be determined on that basis.

Sincerely yours,

James F. Devine
Assistant Director for
Engineering Geology

XA Copy Has Been Sent to PDR

8212170033

XA

November 19, 1982

FOR: The Commissioners

FROM: Executive Director for Operations

SUBJECT: CLARIFICATION OF U. S. GEOLOGICAL SURVEY POSITION RELATING TO SEISMIC DESIGN EARTHQUAKES IN THE EASTERN SEABOARD OF THE UNITED STATES

PURPOSE: To provide the Commissioners with information relating to the clarification of the U. S. Geological Survey Position with respect to the 1886 Charleston, S.C. Earthquake reoccurrence

DISCUSSION For the purpose of licensing of facilities in the Southeastern U. S., the NRC has taken a position, based primarily on the advice of the U.S. Geological Survey (USGS), that any reoccurrence of the 1886 Charleston, S.C. earthquake (Modified Mercalli Intensity (MMI) X, estimated Magnitude about 7) would be confined to the Charleston area. That is, the Charleston earthquake is assumed to be associated with a geologic structure in the Charleston area. Nuclear power plants in the region east of the Appalachian Mountains are, therefore, usually controlled in their seismic design, according to Appendix A to 10 CFR Part 100, by the maximum historical earthquake not associated with a geologic structure. This controlling earthquake is typically an MMI VII or VIII. Since 1974, the NRC has funded an extensive research project in the Charleston area to gain further information on the causative mechanism of this event.

On January 28 and 29, 1982 the Extreme External Phenomenona Subcommittee of the ACRS convened a meeting of expert professionals in the geosciences to obtain an overview of the state of knowledge and future NRC research needs in this area. During that meeting, we were informed by the USGS that it had formed a working group to reassess the validity of its position on the Charleston earthquake.

Contact:
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This information was conveyed to the Commissioners in a Commission Information Paper (SECY-82-53) on February 5, 1982. In that paper we indicated that any major modification of the former USGS position could have significant impact on many Eastern U.S. nuclear plant sites.

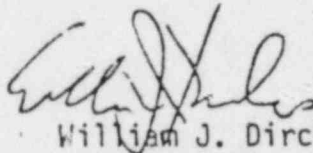
After many months of deliberation, the USGS has clarified its previous position relating to the 1886 Charleston, S.C. earthquake. The attached letter, James F. Devine, USGS, to Robert E. Jackson, NRC, November 18, 1982 provides the position and indicates that:

"Because the geologic and tectonic features of the Charleston region are similar to those in other regions of the eastern seaboard, we conclude that although there is no recent or historical evidence that other regions have experienced strong earthquakes, the historical record is not, of itself, sufficient grounds for ruling out the occurrence in these other regions of strong seismic ground motions similar to those experienced near Charleston in 1886. Although the probability of strong ground motion due to an earthquake in any given year at a particular location in the eastern seaboard may be very low, deterministic and probabilistic evaluations of the seismic hazard should be made for individual sites in the eastern seaboard to establish the seismic engineering parameters for critical facilities."

Based on our discussions with USGS senior personnel, this clarification is not intended to recommend that we categorically consider a Charleston-type event in the seismic design of all nuclear plants in the eastern seaboard of U.S. The USGS does believe, however, that an earthquake of this size should not be categorically ruled out at locations away from Charleston based solely on the statement in the December 30, 1980 USGS letter which states, "Consequently, earthquakes similar to the 1886 event should be considered as having the potential to occur in the vicinity of Charleston and seismic engineering parameters should be determined on that basis." Instead, this clarification provides guidance that indicates that such a conclusion should be reached only after deterministic and probabilistic evaluations of the seismic hazard for individual sites have been made.

Our evaluation of the significance of this clarification is underway. Currently, a two day review meeting between NRC (ORES and ONRR) and the USGS is planned for November 30, 1982 and December 1, 1982 to discuss both the status of geoscience knowledge in the Charleston region and future research efforts. The first day will be an open public meeting (noticed in the Federal Register) which will allow for comments and questions from interested parties and members of the public.

We have also attached our preliminary views on a plan to address this clarified USGS position. This plan includes elements which relate to both ongoing research and licensing efforts and possible requirements for new efforts (split approximately 75% and 25% respectively). This plan will be modified and completed after several meetings with the USGS take place in order that a more complete understanding of its clarified position can be obtained.



William J. Dircks
Executive Director for Operations

Attachments:
As stated

the



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Sincerely yours,

James F. Devine
Assistant Director for
Engineering Geology

8212174433

PDR

Outline for Recommended Plan
Eastern U. S. Earthquakes

Introduction

Based on our preliminary assessment of the U. S. Geological Survey's (USGS) clarification of position relating to a Charleston-type earthquake, we do not see a need for any immediate action for specific sites at this time. Instead, we foresee that this clarification can be addressed predominantly through existing ongoing programs at NRC with the possibility of additional requirements for work by the Utilities.

The USGS clarification indicates that deterministic and probabilistic evaluations should be made. Generally, for most existing sites, extensive deterministic studies have been undertaken and used in developing the existing seismic design basis. We therefore believe that this element of the clarification continue to be addressed through our long range research plan. Specific modifications to that plan can be made in order to address specific tectonic structures. If necessary, a few specific applicants or licensees may be required to investigate tectonic structures which may not have been previously identified during the licensing procedure.

As many of the current working deterministic hypotheses are not directly amenable to investigation in the short term, we believe that the clarification issue should be pursued in the short term principally through a probabilistic assessment of plants in the eastern seaboard. This probabilistic program can be coupled to the current ongoing NRC efforts in this area already underway. We also believe that utility-sponsored studies should be undertaken, preferably as a consolidated group, to assess the seismic hazard in the eastern seaboard.

Further specifics on this program will be provided after more extensive discussions with the USGS.

PROBABILISTIC EVALUATION:

In our view, the USGS clarification represents not so much a new understanding but rather a more explicit recognition of existing uncertainties with respect to the causative structure and mechanism of the 1886 Charleston earthquake. Many hypotheses have been proposed as to the location of the eastern seaboard of future Charleston-size earthquakes. Some of these could be very restrictive in location while others would allow this earthquake to reoccur over very large areas. Presently, none of these hypotheses are definitive and all contain a strong element of speculation.

Traditional deterministic approaches are not generally designed to deal with this situation. Probabilistic methods which allow for the consideration of many hypotheses, their associated credibilities, and the explicit incorporation of uncertainty are much better equipped to provide rational frameworks for decision making. We believe that the

probabilistic approach described below, which takes into account the uncertainties, should be used to determine differences (if any) between seismic hazard levels associated with seismic design values in the eastern seaboard (i.e. as affected by the USGS clarified position on the Charleston Earthquake) and seismic hazard levels associated with seismic design values elsewhere in the central and eastern U. S.

Probabilistic Plan

1. Continue development of Lawrence Livermore National Laboratory (LLNL) study on seismic hazard (probability of exceedance) for nuclear power plants east of the Rocky Mtns. This study (Seismic Hazard Characterization of the Eastern United States) is presently underway.
2. Compare of LLNL study with existing probabilistic studies (for example USGS Open File Report 82-1033) and other ongoing NRC Research into probabilistic seismic estimation.
3. Sponsorship by the industry as a whole of a probabilistic estimation of hazard for all nuclear plants on the eastern seaboard, along with existing studies for individual plants.
4. Make comparisons between plants in the eastern seaboard and other parts of U.S. using the LLNL and other studies to determine significant differences (if any) in seismic hazard associated with seismic design.
5. Integration of above into Systematic Evaluation Program-type evaluation for possible engineering reanalysis.

DETERMINISTIC EVALUATION:

Deterministic studies in response to the USGS clarification should continue to be oriented toward determining the causal mechanisms of the earthquake under NRC's existing research program. These studies should involve systematic testing of the several hypotheses of the causative structure of the Charleston earthquake and investigations in areas of high seismicity and designated areas of potential seismicity for additional evidence of the cause. The type of studies most likely to lead to a better understanding of the causes of seismicity in the eastern seaboard of the United States are neotectonic investigations (recent crustal motions and seismicity) coupled with examination of crustal structure:

These deterministic studies are basically four types:

1. The continuation of seismological research through the operation of the existing micro-earthquake networks and the development of a strong motion data base.

2. The determination of the geometry of structure and tectonics of the earth's crust at depths where earthquakes are occurring (5-20 km) in the eastern seaboard using such techniques as seismic reflection profiling.
3. The continuation of subsurface neotectonic investigations of earthquake source areas to determine if uplift, subsidence or differential movement is occurring. Such studies may include among others:
 - A. Tectonic Geomorphology
 - B. Geodetic Measurements
 - C. Geologic Mapping
 - D. Remote Sensing