ADVISO COMMITTEE ON REACTOR SA. EGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

May 16, 1973

Honorable Dixy Lee Ray
Chairman
U. S. Atomic Energy Commission
Washington, D. C. 20545

Subject: REPORT ON SEISMIC RESEARCH

Dear Dr. Ray:

The seismicity of the Eastern United States is considerably less than that of the Western United States; however, there have been a number of large earthquakes in historical times in the eastern region. The geological and seismological consultants to the ACRS have expressed concern that seismic conditions in the Eastern United States are poorly understood and have recommended that emphasis be placed on early development of information that would aid the AEC Regulatory Groups in the determination of appropriate parameters for the Safe Shutdown (or Design Basis) Earthquake. Three areas are of particular interest: South Carolina, the St. Lawrence Valley, and southeastern Missouri. Western Ohio and the Cape Ann region of Massachusetts also have had significant shocks and hence are areas of interest.

The ACRS agrees with its consultants and believes it is particularly important to determine the cause of the 1886 Charleston, South Carolina earthquake. This shock may represent a localized source; however, if it does not, it can become the determining factor in establishing the potential earthquake risk for the entire Atlantic coastal plain and Piedmont Province from New Jersey to Florida.

In the western part of the United States, it is usually possible to correlate occurrence of earthquakes with known active faults. Many of the earthquakes in Western United States are accompanied by visible fault displacements, and it is possible to relate the occurrence of these earthquakes to the tectonic framework of the region. In Eastern United States, the earthquake sources are not well understood and at the present time we must depend almost completely on the historic records to project a future pattern of earthquake occurrence. The ACRS endorses the recommendation of its consultants that vigorous investigation be carried forward in the Eastern United States to better understand the reasons for and sources of the earthquakes -- particularly in those regions where we know large shocks have occurred

in the past. NOAA and the U. S. Geological Survey have been collaborating in bringing up to date the historic seismicity in the Eastern United States and correlating it with the tectonic framework of the region. More detailed and sophisticated studies need to be carried forward, with high priority given to the Charleston area.

The most significant historic earthquake near Charleston occurred in 1886; this earthquake had a magnitude somewhere in the range of Richter 7, and the epicentral effects were such that a number of buildings and bridges were badly damaged and railroad tracks distorted. Some earthquake activity had occurred in the Charleston region prior to the great shock in 1886, and there have been a number of aftershocks in the succeding years, with small earthquakes continuing to occur.

A study was made of the Charleston earthquake shortly after its occurrence; however, this was before much was known of the mechanism of earthquake occurrence and some vital evidence may have been overlooked. Instrumentation for recording earthquakes had not been developed in 1886, so there are no useful instrumental records of the shock. The mechanism of the shock is uncertain. It probably occurred as a result of slippage on a fault that was deep enough so that there was no surface breakage. Because of the considerable damage at the surface, it has been inferred that the depth was not very great. The orientation of the fault is unknown and reasonable arguments may be presented for either a northeast or a northwest trend. The historical evidence could be interpreted to indicate a localized source but, even if the source is highly localized, a tectonic explanation is important.

The locations and frequency of occurrence of earthquakes in the region are only imperfectly known. There is only one seismograph station in the State of South Carolina, and the number of stations in this part of the United States is not sufficient to determine the local seismicity. A suitable network of strong-motion stations (at least six) should be put in the area so that the locations of all earthquakes of Richter magnitude 2.5 and up in the coastal plain and the Piedmont Province can be established and their time and space distribution determined. To supplement this network, micro-earthquake studies should be made throughout the region to determine if there are zones along which micro-earthquakes are frequent and whether or not these zones correlate with the larger shocks. Both the network and the micro-earthquake studies should cover an area considerably larger than the immediate vicinity of Charleston. The Committee understands that some micro-earthquake studies have been initiated by NOAA in this area in recent months.

Detailed geological studies need to be done in the Charleston area to look for any remaining evidence from the 1886 shock that may now be interpretable in light of what we now know of earthquake mechanisms. The geology, both surficial and subsurface, needs to be re-examined and compiled to develop any information pertinent to the seismicity of the coastal plain and Piedmont Province of South Carolina. Additional aeromagnetic and gravity studies should eventually be made for correlation with the seismic and geological investigations.

After a preliminary delineation of the seismicity by a modern network of seismograph stations and a re-examination of the geology, it will be necessary, almost certainly, to verify suspected structures by detailed reflection seismic profiles. The extent of such profiling will depend on the seismicity and geological investigations but could involve several hundred miles of profiling. Ultimately some drilling may have to be done for final verification.

If there is not a recent first order triangulation and level net in the Charleston area, the relevant state and federal agencies should be encouraged to update the existing nets. Should another large earthquake occur in this area, there may be significant changes in level or position that would help determine the nature of the source.

A program similar to that outlined for the Charleston area should follow in other areas in the Eastern United States where there have been large earthquakes in historic times.

Sincerely yours,

W. R. Stratton

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Acting Chairman