November 17, 1983

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Docket No.: 50-354

APPLICANT: Public Service Electric & Gas Company (PSE&G)

FACILITY: Hope Creek Generating Station

SUBJECT: SUMMARY OF MEETING WITH GEOSCIENCES BRANCH (BB)

On October 5, 1983, a meeting was held with PSE&G, their consultants and representatives from the Geosciences Branch of the NRC. The purpose of the meeting was to allow the applicant the opportunity to present to the staff for comment their draft responses to Requests for Additional Information (RAI) resulting from the Safety Review. A list of attendees is included as Enclosure 1 to this summary and the RAIs are included as Enclosure 2. The applicant's formal response to the items contained in the RAIs is scheduled for October 31, 1983.

Other than the items attached to this summary, no written information was exchanged.

Original signed by:

David Wagner, Project Manager
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Enclosures:
As stated

cc: See next page

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ENCLOSURE 1

Hope Creek Generating Station

Geosciences Branch
October 5, 1983

Bethesda, MD

Name	Title	Affiliation
Dave Wagner	Project Manager	NRC
Leon Reiter	Section Leader, Seismology	NRC/GSB
Phyllis Sobel	Geophysicist	NRC/GSB
Bob Jackson	Chief	NRC/GSB
J. M. Ashley	Licensing	PSE&G
Shan Bhattacharya	Civil Deputy Group Supv.	Bechtel
Steve Brown	Leader, Geology Section	NRC/GSB
James T. Dette	Partner	Dames & Moore
Dick McMullen	Geologist NRC	NRC/GSB
Phil Schuetz	Civil Licensing Engineer	Bechtel
Jim McWhorter	Geologist	Dames & Moore
C. W. Churchman	Principal Engineer	PSE&G
Carolyn Zimmermann	Lead Engineer	PSE&G
A. S. Kao	Senior Engineer	PSE&G

Hope Creek Generating Station

230.2 (SRP 2.5.1) Provide a map showing all Late Mesozoic and Cenozoic structures within 200 miles of the Hope Creek site. Discuss the potential of these structures to generate seismicity.

230.3 (SRP 2.5.2.1) Update Table 2.5-1 to include recent events contained in Bulletins of the Southeastern and Northeastern U. S. Seismic Networks. For the magnitude values listed in Table 2.5-1 note the reference and type of magnitude. Wherever possible note the hypocentral depth of the earthquakes.

230.4 (SRP 2.5.2.1) Provide maps clearer than Figures 2.5-22 and 2.5-23 showing earthquake epicenters and seismic zones. The maps should not have contour lines showing depth to bedrock.

230.5 (SRP 2.5.2.1) The applicant has designated the SSE as an intensity VII earthquake with its epicenter near the site. A similar size event, the October 9, 1871 Wilmington, Delaware earthquake, occurred about 15 miles north of the Hope Creek site in an area associated with historic earthquakes. Provide a complete discussion of seismicity near Wilmington, Delaware. What have been the suggested causes of seismicity in the Wilmington area? Does this seismicity indicate the Fall Zone is seismically active? (See, for example, Sbar et al, 1975, BSSA, pp. 85-92). Assess the significance of the seismicity in the Wilmington area with respect to the OBE and SSE.

230.6 (SRP 2.5.2.2, 2.5.2.3, 2.5.2.4) In licensing decisions made since approximately 1976, regarding the seismic design basis of nuclear power plants located in the northern Piedmont, the staff has recognized the New England-Piedmont Tectonic Province. In the FSAR the northern Appalachian region is subdivided into a number of tectonic provinces which are different than the New England-Piedmont Province. On January 9, 1982 a magnitude 5 3/4 earthquake occurred in central New Brunswick, Canada in geologic terrain that is similar to that which characterizes the New England-Piedmont Province. With respect to the appropriate choice of tectonic provinces and the effect of the New Brunswick earthquake on the site, two options, either of which would be generally acceptable to the staff, can be chosen to resolve this issue. We will also review any other approaches that are suggested.

Option A: Due to the small distance to the Fall Zone (the boundary of the Piedmont province) and the shallow sedimentary cover at the Hope Creek site, assume that the m_b = 5 3/4 New Brunswick earthquake is the maximum historical earthquake that can occur near the site. Current staff practice is to evaluate the SSE by comparison to site specific response spectra developed by performing statistical analyses on strong motion records for sites with similar foundation conditions at appro-

priate distances from events within one-half unit of the maximum magnitude. (See, for example, Wolf Creek, NUREG-0881.) Calculate a site specific spectrum using m_b = 5 3/4 as the target magnitude event and using records at distances less than about 25 km on soil sites. Compare the Hope Creek SSE design spectrum to the 84th percentile of this site specific spectrum. The staff recommends developing a spectrum specifically for a m_b = 5 3/4 event using the most recent information that is available and with foundation conditions similar to the Hope Creek site. Compare shear wave velocity profiles for the recording sites with the profile for the Hope Creek site.

Option B: Extensive research is under way regarding the New Brunswick earthquake and its relationship to the New England-Piedmont Province. A large portion of this effort has been undertaken as a result of reviews of the Seabrook and Maine Yankee sites. We recommend active attention and awareness of these studies. Using information provided by these and other studies, update and provide a complete discussion regarding the current choice of tectonic provinces. Include as a minimum the following information:

1) A discussion and justification of any association of the Central New Brunswick earthquake sequence with a specific geologic structure or fault within the meaning of Appendix A 10CFR100.

2) A discussion and justification of any province subdivision with respect to the New England-Piedmont Tectonic Province.

3) An estimate of the ground motion and response spectra at the site resulting from any province sub-division. Both peaks and spectra should be compared to that of the SSE. It has been the staff's practice to use the "trend of mean" of the relationship in Trifunac and Brady (1975) coupled with a Regulatory Guide 1.60 response spectrum, when intensity is used to describe the SSE. In addition, in recent OL reviews the staff has requested the comparison of site specific spectra using the magnitude of the maximum historical earthquake which has not been associated with a fault or structure. It has been the staff's position that a maximum Modified Mercalli Intensity VII event (the SSE) corresponds to a m_b = 5.3 (Nuttli and Herrmann, WES, 1978). The staff recommends developing a spectrum specifically for at least a m_b = 5.3 event using the most recent information that is available and with foundation conditions similar to the Hope Creek site. Compare shear wave velocity profiles for the recording sites with the profile for the Hope Creek site.

230. 7
(SRP 2.5.2)
RSP

On November 18, 1982 the USGS in a letter from James F. Devine, USGS, to Robert Jackson, NRC, clarified its position regarding the localization of the seismicity in the vicinity of Charleston, S.C. The staff is presently evaluating the significance of the USGS clarification regarding the localization of Charleston seismicity. Attached are copies of the staff's interim position on the Charleston earthquakes and our recommended plan to address Eastern U. S. earthquakes. This position will be included in the Safety Evaluation Report.

Interim Position on Charleston Earthquake for Licensing Proceeding

The NRR Staff position with respect to the Intensity X 1886 Charleston earthquake has been that, in the context of the tectonic province approach used for licensing nuclear power plants, this earthquake should be restricted to the Charleston vicinity. . This position was based, in part, on information provided by the United States Geological Survey (USGS) in a letter dated December 30, 1980 from J. E. Devine to R. E. Jackson (see Summer Safety Evaluation Report). The USGS has been reassessing its postion and issued a clarification on November 18, 1982 in a letter from J. E. Devine to R. E. Jackson. As a result of this letter, a preliminary evaluation and outline for NRC action was forwarded to the Commission in a memorandum from W. J. Dircks on November 19, 1982.

The USGS letter states 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."

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 locale in the eastern seaboard of future Charleston-size earthquakes. Some of these could be very restrictive in location while others would allow this earthquake to recur over very large areas. Presently none of these hypotheses are definitive and all contain a strong element of speculation.

We are addressing this uncertainty in both longer-term deterministic and shorter-term probabilistic programs. The deterministic studies, funded primarily by the Office of Research of the NRC should reduce the uncertainty by better identifying (1) the causal mechanism of the Charleston earthquake and (2) the potential for the occurrence of large earthquakes throughout the eastern seaboard. The probabilistic studies, primarily that being conducted for NRC by Lawrence Livermore National Laboratory (LLNL) will take into account existing uncertainties. They will have as their aim to determine differences, if any, between the probabilities of seismic ground motion exceeding design levels in the eastern seaboard (i.e. as affected by the USGS clarified postion on the Charleston earthquake) and the probabilities of seismic ground motion exceeding design levels elsewhere in the central and eastern U.S. Any plants where the probabilities of exceeding design level ground motions are significantly higher

than those calculated for other plants in the Central and Eastern U.S. will be identified and evaluated for possible further engineering analysis.

Given the speculative nature of the hypotheses with respect to the recurrence of large Charleston-type earthquakes as a result of our limited scientific knowledge and the generalized low probability associated with such events, we do not see a need for any action for specific sites at this time. It is our position, as it has been in the past, that facilities should be designd to withstand the recurrence of an earthquake the size of the 1886 earthquake in the vicinity of Charleston. At the conclusion of the shorter-term probabilistic program and during the longer-term deterministic studies, we will be assessing the need for a modified position with respect to specific sites.

231.2 (SRP 2.5.1) Page 2.5-36. The last paragraph on this page implies a genetic relationship among subsidence and sediment accumulation, warping of shorelines, and reverse faulting along the eastern continental margin during the Cenozoic. Please expand this discussion and show how these phenomena are interrelated.

231.3 (SRP 2.5.1 & 2.5.3) Pages 2.5-30 through 2.5-32. Presentation is made on these pages of numerous faults in the Coastal Plain and Piedmont within the site region. Many of these faults apparently displace relatively young strata. What is the significance, if any, of these young faults to the HCGS site in light of several of the current hypotheses on the causes of eastern seismicity?

231.4 (SRP 2.5.1 & 2.5.3) Pages 2.5-29 through 2.5-32, 2.5-65 and 2.5-67. The text appears to favor the hypothesis that eastern seismicity is related to the reactivation of high angle faults in a reverse sense as being the most plausible explanation for the cause of eastern seismicity. Figure 2.5-6, Sheridan (1974), Spoljaric (1979) and Dames and Moore (1972) all indicate the presence of numerous northeast-southwest striking, high angle faults in the region. On page 2.5-67 and Figure 2.5-25 it is stated that most fault plane solutions determined from instrumentally recorded earthquakes indicate a maximum principal, horizontal stress oriented in a northwest-southeast or east-west direction, and a reverse sense of movement on NE-SW faults. Wentworth and Mergner-Keefer (1983) postulate that the 1886 Charleston earthquake resulted from displacement along high angle reverse faults in that kind of fault-stress environment, and wherever that type of domain existed, an earthquake of that size is possible. With all of these things considered, what is the earthquake potential of nearby high angle reverse faults?

231.5 (SRP 2.5.1) Reference 2.5-61, (J.A. Fischer, J.A. Syzmanski, and M.R. Werner III "A New Approach to Dividing the Northeastern U.S. into Tectonic Provinces," in Dames and Moore Engineering Bulletin, 1976, pp 1-76) is cited as the basis for the applicant's designation of tectonic provinces. Please provide a copy of that reference.

231.6 (SRP 2.5.1 & 2.5.3) Figures 2.5-19, and 2.5-20 show contours on the surface of the Vincentown formation and Figure 2.5-21 shows contours drawn on the contact between 2 horizons within the Kirkwood formation. On these figures there is a very strong NNW oriented grain. What is the probable cause of this trend on these strata?

231.7 (SRP 2.5.1) Page 2.5-49, last paragraph, and Figure 2.5-17, describes and illustrates a minor anomalous feature on the excavation wall at Station WO 1 + 90 as being of erosional origin. What is the basis for that interpretation? Can an interpretation that this feature was caused by liquefaction during an earthquake be ruled out? On what basis?

231.8 (SRP 2.5.1 & 2.5.3) Spoljaric, N., 1979, Landsat View of Delaware, Delaware Geological Survey, Open File Report No. 12, maps a number of faults in Delaware based on Landsat lineaments. Many of these faults were investigated in 1972 during studies for the Summit Power Station. However, there are several faults shown that have not been addressed, including several showing Middle Tertiary displacements. Examine the data regarding these faults and assess their significance to the HCGS site.

REFERENCES

Dames and Moore, 1972, Delmarva Power Preliminary Safety Evaluation Report, Summit Power Station, Responses to AEC Questions, Vol. 1, Docket Nos. 50-450 and 451.

Sheridan, R.E., 1974, Atlantic Continental Margin of North America; in The Geology of Continental Margins, G.A. Burk and C.L. Drake, eds; Springer-Verlag, New York, pp 391-407.

Spoljaric, N. 1979, Landsat View of Delaware; Delaware Geolcgical Survey Open File Report No. 12.

Wentworth, C. M. and M. Mergner-Keefer, 1983, Regenerate Faults of Small Cenozoic Offset - Probable Earthquake Sources in the Southeastern United States; in Studies Related to the Charleston, S.C. Earthquake of 1886 - Tectonics and Seismicity, G. Gonn ed., USGS Professional Paper 1313, pp S1-S20.

DATED: November 17, 1983

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