NRC PDR

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JUL 26 1979

DOCKET NO. 50-395

APPLICANTS: SOUTH CAROLINA ELECTRIC AND GAS COMPANY
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

FACILITY: VIRGIL C. SUMMER NUCLEAR STATION, UNIT NO. 1

SUBJECT: SUMMARY OF MEETING HELD ON JUNE 22, 1979 WITH SOUTH CAROLINA ELECTRIC AND GAS COMPANY CONCERNING RESERVOIR INDUCED SEISMICITY AT THE SUMMER SITE

On June 22, 1979 we met with representatives of the South Carolina Electric and Gas Company (SCE&G), Dames and Moore, and Woodward-Clyde. Dr. Pradeep Talwani, an independent consultant, also attended the meeting. The principal purpose of the meeting was to discuss the microseismic activity in the area of the Summer site. Also, at the conclusion of the meeting a few items relating to foundation engineering matters were discussed.

The meeting was held in Bethesda, Maryland and the persons attending all or part of the meeting are listed in the Enclosure. The slides presented in the meeting are available from the project manager.

In the portion of the meeting dealing with microseismic activity SCE&G covered the following subjects: (1) Monticello Reservoir and operation of the Fairfield Pump Storage Facility, (2) regional and local geology, (3) regional and local seismicity, (4) seismic studies at Monticello Reservoir, and (5) reservoir induced seismicity. The following discussions summarize the presentations:

Monticello Reservoir and Operation of the Fairfield Pumped Storage Facility

The Monticello Reservoir is the upper pool of the Fairfield Pumped Storage Facility. The reservoir is formed by 4 earthen dams; the main dam is 5000 feet long and 180 feet high. The reservoir has a total volume of 400,000 acre-feet. The reservoir was filled, between December 3, 1977 and February 8, 1978, by pumping water from the lower pool of the pumped storage facility. During a normal operating cycle, 29,000 acre-feet of water will go through the power house; the drawn-down on the Monticello Reservoir is 4.5 feet. Under emergency conditions, SCE&G can lower the level of the reservoir 7.5 feet. A normal generation/pumping cycle would have about eight hours of generation, 9.5 hours of pumping and 6.5 hours where the pump/turbines are idle.

Regional and Local Geology

The site is located in the Charlotte Belt metamorphic zone of the Piedmont physiographic province. The Charlotte Belt is complised of metamorphic rocks that are approximately 360 million years old. The metamorphic rocks are interrupted by plutons of granodiorite, an igneous rock approximately 270 million years old.

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Previous field investigations defined five mappable rock units within ten miles of the plant: Charlotte Belt gneiss (country rock), Carolina Slate Belt rock, migmatite, granodiorite (granitic rock), and "granosfel." The rock units under the reservoir and immediately surrounding the plant are country rock, migmatite, and granodiorite. In general, the migmatite separates the country rock and the granodiorite; the migmatite is a gradational assortment of intimately mixed and altered elements from the country rock and the granitic rock.

The fault system closest to the site is the Goat Rock fault system; the site is 14 miles from the closest splay of this fault system. No faulting is observed on the surface in the near site area. In the excavation for the reactor building, near-vertical shear zones were found. Investigations conducted at that time indicated that the shear zones were at least 45 million years old.

Regional and Local Seismicity

The most significant earthquakes in the region were the Charleston, South Carolina earthquake (August 31, 1886), the Union County earthquake (January 1, 1913), and the Lake Murry earthquake (July 26, 1945). The epi-central intensities of these events were X, VII, and VI, respectively; the intensity at the site from these earthquakes were VI to VII, IV and V, respectively. The Charleston earthquake was in the Coastal Plain province; and therefore it is not moved to the site area. However, repetition of the Charleston earthquake in the Charleston area is the basis for the operating basis earthquake (OBE). The safe shutdown earthquake (SSE) is assumed to be an intensity VII earthquake. The g values for structures on rock and structures on soil are .15g and .25g, respectively, for the SSE and .1g and .15g, respectively, for the OBE.

Seismic Studies at Monticello Reservoir

When the reservoir was filled in December 1977, the applicants had in place a microseismic monitoring network. The network consisted of four stations surrounding the reservoir. The microseimic activity began about three weeks after the filling began. The seismic activity prior to filling the reservoir was about one event every six days; this is based on a seisometer at Jenkinsville, South Carolina, 3.2 miles from the station. The activity increased to 85 locatable events per days by February 1979. The activity then decreased to about 8 per day, but bursts of activity (up to 30 events per day) have occurrred. The mean magnitude for the locatable events is about 0.5; the highest magnitude recorded was 2.8. Several of the higher magnitude events were also recorded on a USGS accelerograph located on the abutment of one of the dams. Magnitude 2.7 and 2.8 events, recorded in August and October of 1978, were found to have peak acceleration of about .25g at 10-15 Hertz. The peak acceleration in each case, occurred in a single spike. Both events were very short; the durations did not exceed .6 seconds.

The applicants were asked to comment on (1) the comparison of these two events and OBE and (2) the foundation conditions under the accelerometer. The applicants' consultants responded to the first item with a discussion of three points. First the OBE is an event with many relatively high amplitude frequencies; the high amplitudes of local events were associated with a single frequency. Second,

designing for the OBE results in combining the stresses of many modes of vibration; the local events would only excite a single mode, if any. Third, the local events were of short duration and produced only a single cycle of the peak acceleration; resonance would not occur. In summarizing they concluded that the local events would have not an effect on the seismic design of the plant. We asked the applicants' consultants if they had done a comparison of the OBE design response spectra and the spectra from the 2.7 and 2.8 events. They had not. They did not have digitized versions of these records; the USGS still had the original records. We felt that such a comparison was very important; SCE&G stated that they would provide such a comparison.

We briefly discussed the foundation conditions at the accelerometer. It was not known if the instrument was located on rock. With the exception of several water storage tanks and the essential water intake structure and pumphouse, the seismic Category I buildings are founded on rock. SCE&G stated they would provide us with information on the instrument's foundation.

Dr Talwani gave a presentation on his studies of the microseismic activity at the Monticello Reservoir. The main points of his presentation are as follows:

1. The delay in the initial seismic activity and change in the level of activity suggest that the cause of the activity is a mechanism other than direct loading by the increased water level. Dr. Talwani suggested that movement resulted from changed in pore pressure in the rocks. Movement would then be be a function of a change in water level and the time it took for the pore pressure at the epicenter to be affected. Dr. Talwani had correlated seismic activity with reservoir elevation, with some success; he was now attempting to also correlate reservoir elevation with depth of the epicenters.

2. The microseismic events were located in two general areas; one was a band under the center of the reservoir and the other was under the main dam. The location of the events started under the center of the reservoir and then moved about 0.5 miles to the west. Later the activity developed in the area of the main dam. The events were first calculated to be between 1 to 5 kilometers in depth, but additional stations provided a better estimate of the depths. Dr. Talwani believes most of the earthquakes are located in the upper 500 meters.

3. The activity appeared to be focused in the transition zones between the county rock and the igneous plutons. From the records it appeared that the direction of the movement did not correspond to any geological features. Dr. Talwani suggested that joint patterns may influence focal mechanisms.

Reservoir Induced Seismicity

A representative of Woodward-Clyde stated that reservoir induced seismicity in shallow reservoirs like the Monticello Reservoir is very rare (26 cases out of 10,700 reservoirs). However, he also stated that the reservoir could not trigger

an earthquake larger than the current OBE at the Summer site. This was based on two points. First, large earthquakes (magnitude 5.0 or greater) have been triggered only in those cases where active faulting was also present in the hydrologic regime of the reservoir; there are no active faults in the immediate area of the Summer station. Second, large triggered events are generally very deep events (depths greater than 5.0 km). The earthquakes at the Summer site were at smaller depths. The reviewer agreed that large earthquakes are not expected; however, the activity, while minor, warranted careful attention. We requested that SCE&G document their assessment in the FSAR. The applicants stated that the information we requested would be provided by September 1979.

Foundation Engineering

In the week prior to the meeting, we had several telephone discussions with SCE&G regarding the seismic Category I tanks founded on engineered fill and saprolite, the foundation conditions of the by-pass line to the circulating water intake structure, and inspections of the essential service water intake structure. The applicants provided additional information on these subjects in the meeting.

Regarding the tanks, the condensate storage tank (CST) and the diesel generator fuel oil tanks were not founded on rock. The settlement of the CST was computed by comparing the elevation of the CST's concrete pad taken before construction of the tank (October 1976) with elevation after the tank was completed and filled (June 1979). The settlement appeared to be about 0.04 or less feet. The geotechnical reviewer stated that this satisfied his concerns and he requested that SCE&G document this in the FSAR. The fuel oil storage tanks were buried underground; a layer of saprolite separated the engineered fill of the foundation and rock. We requested that they determine if there had been any significant settlement. They stated that they currently had no data on this, but they were confident that the fuel oil tanks and fuel oils were sound. We requested that they provide us with more information on this matter.

The foundation conditions for the by-pass line was presented as documented in the QC files. The foundation was similar to other seismic Category I lines even though the line was not seismic Category I. SCE&G stated that they would include surveillance requirements in the technical specifications for this line.

The last item discussed was the recent underwater inspection of the service water tunnel. Only four new cracks were observed. SCE&G stated that the results of the inspection would be documented in a final report on the settlement of the intake structure and pumphouse. SCE&G also agreed to bi-yearly survey the pumphouse and intake structure after the unit receives and operating license.

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Enclosure:
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ccs w/enclosure:
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ENCLOSURE

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JUNE 22, 1979

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