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UNITED STATES NUCLEAR REGULATORY COMMISSION WASHINGTON, D. C. 20555

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Ms. June Allen North Anna Environmental Coalition 112 Hallmark North Briarcrest Gardens Hershey, Pennsylvania 17033

Dear Ms. Allen:

Thank you for your letter of January 7 and your mailgram of January 9. This letter responds to both the seismological issues that you raised in those communications and in your letter to Dr. Leon Reiter dated January 4, 1978.

You expressed concern over the regional epicenter map showing earthquakes recorded by the North Anna Seismic Monitoring Program from January 21, 1974 through August 1, 1977. All the epicenters shown on that map had already been listed and partially plotted in the periodic and summary reports of the monitoring program. We requested the map in order to obtain a single comprehensive plot of earthquakes of all magnitudes occurring within 100 kilometers of the North Anna site which had been recorded by the network. The concentration of events near the shores of Lake Anna has been noted before and discussed by our staff in both written affidavit and oral testimony. It should be remembered that in many ways the distribution of epicenters on the map is a function of the ability of the network to detect these events. Near the plant site earthquakes as small as magnitude -1 can and have been detected. At a distance of 100 kilometers the detection capability is close to magnitude 2. This represents a thousand fold increase in the minimum amount of detectable earthquake energy release. The largest earthquake which occurred within 100 kilometers and was recorded during the monitoring program was magnitude 2.5.

It is clear that there exists a concentration of microearthquake activity in the southeastern part of the lake. We cannot however state with certainty whether this activity has any relationship to the lake itself. While the microearthquakes are concentrated near the deeper part of the

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lake there seems to be no clear correlation with changes in the water level. This correlation has been observed in many cases of reservoir induced seismicity. Detailed microearthquake monitoring conducted prior to the filling of the lake could have provided a more conclusive answer to whether this activity was induced or not. A recent authorative review by Dr. David Simpson of Columbia University has classified reservoir induced seismicity into several categories. Almost all major (magnitude 5.0 or greater) and minor (magnitude 3.0 to 5.0) induced earthquakes occurred at reservoirs where the water depth was greater than 100 meters. The shallowest water depth associated with even a minor event was 44 meters (a magnitude 3.5 earthquake in Spain). The maximum water depth at Lake Anna is 22 meters. Even if we make the questionable assumption that the activity is induced we only seem to be dealing with a change in microearthquake activity (one of Dr. Simpson's categories). This change cannot be very significant since our review of the microearthquake activity at the lake indicates that it is at the same level as that of background microearthquake activity in Central Virginia as a whole and poses no danger to the safe operation of the plants. This conclusion is based upon the following:

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a. The rate of activity within the vicinity of the site is similar to the average rate observed in Central Virginia. In three and one half years of recording there was an average of one event occurring every 12 days within 10 km of the site. In 91 days of recording in different parts of Central Virginia, Dr. G. Bollinger of the Virginia Polytechnical Institute found an average of one event every 13 days for similarly sized areas. This activity was not uniform but varied spatially. In other investigations, Dr. Bollinger has found a ten fold variation in microearthquake activity in different parts of east-Central Virginia. We should consider the microearthquake activity in Central Virginia as having a patchwork nature of which the activity near Lake Anna may be typical.

b. The largest events to occur near the lake were a magnitude 2.1 on September 7, 1975 and a magnitude 2.0 on August 24, 1977. If we consider the total energy released by these and all other events occurring near the lake, it is about the same as the energy released by the occurrence of magnitude 2.0 and 2.5 events in November 1976, 76 kilometers to the south. This is due to the exponential relationship between earthquake magnitude and energy. Of course the 76 kilometer distance precluded the network from recording numerous smaller earthquakes that may have also occurred in that vicinity. Thus, when viewed in context of activity in other parts of the region, the level of microearthquake energy release near the lake does not appear anomalous. Ms. June Allen

c. During the three and one half years of operation, there were 3 events within 100 kilometers of the site that were reported as felt by people. None of these were near the lake, the closest being 50 kilometers away.

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The only geological or geophysical feature of any length near the microseismic activity at the lake is Neuschel's Lineament. The geological nature of this geophysical lineament has not been determined. Whatever Neuschel's Lineament does represent (fault or not) or whatever the cause of local microseismicity (reservoir induced or not) the lack of both instrumentally and historically determined earthquake epicenters along its extent argues strongly against its being seismically active.

After obtaining additional information from you on February 3, we have been able to identify the geological investigations in Central Virginia to which you referred as being funded by the National Science Foundation. We have contacted Professor Goodwin and learned that the work is being conducted by some of his students as undergraduate projects. The investigations are within a region southward of the James River, well south of the North Anna site. They are in a preliminary stage and no conclusions have been reached.

Our evaluation of seismic design is based upon several factors. These include the local and regional geology, and the instrumentally and historically recorded seismicity. The North Anna units have been designed to withstand the largest earthquake that has occurred within the past 200 years in Central Virginia. Three and one half years of microearthquake monitoring yielded no results which suggest that this basis is unconservative.

The ACRS has suggested that 0.2g be a minimum reference value for the sate shutdown earthquake that should be applied with flexibility to new plants in the East for which construction permits have not yet been submitted. The Committee has not recommended this value for the North Anna units.

Our review of the margin available in selected components, equipment and systems to withstand a seismic event larger than the design basis earthquake, as discussed in the Safety Evaluation Report and its supplements. is proceeding and is expected to be completed by the end of the first quarter or early in the second quarter of 1978. Areas of the review which have been completed to date indicate that margin is

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available. This seismic reevaluation was discussed in Supplement 7 to the Safety Evaluation Report, a copy of which was sent to the Atomic Safety and Licensing Board on September 2, 1977.

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The microcarthouake studies would only have an impact upon the seismic reevaluation if they indicated a needed change in the safe shutdown earthquake. We have carefully reviewed these data and have determined that they do not.

The Dames and Moore Foundation Conditions Report of May 3, 1969 was received and docketed by our office on July 31, 1973 as part of Amendment 20 to the North Anna Units 1 and 2 Final Safety Analysis Report.

Thank you for your interest.

## Sincerely,

Original Signed By F E. G. Case

				Edson G. Case, Acting Director Office of Nuclear Reactor Regulation			
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