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

JUN 30 1980

Docket No.: 50-395

Mr. E. H. Crews, Jr.
Vice President and Group Executive
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South Carolina Electric and Gas Company
P. O. Box 764
Columbia, South Carolina 29218

Dear Mr. Crews:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION - VIRGIL C. SUMMER NUCLEAR STATION, UNIT NO. 1

To continue our review of your application for a license to operate the Virgil C. Summer Nuclear Station, additional information is required. The information requested is described in the enclosure and covers the area of materials engineering, secondary water chemistry control and seismology. Please note that these seismology questions, numbered 361.13 to 361.22, replace those numbered 361.12 to 361.19 sent to you in my letter dated May 6, 1980.

Please inform us after receipt of this letter the date you anticipate providing an answer.

Sincerely,

A. Schwencer

A. Schwencer, Acting Chief
Licensing Branch No. 3
Division of Licensing

Enclosures:
As stated

cc: See next page

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121.0 MATERIALS ENGINEERING BRANCH - COMPONENT INTEGRITY SECTION

121.16 Paragraph III.B.3, Appendix G, 10 CFR Part 50, specifies that calibration of temperature instruments and Charpy V-notch impact test machines comply with Paragraph NB-2360 of the ASME Code. Calibration of test equipment for V. C. Summer was conducted in accordance with Paragraph NA-4600 of the 1971 ASME Code through 1971 Summer Addenda. Paragraph NA-4600 requires that a procedure be in effect to ensure that measuring and testing equipment is calibrated and properly adjusted at specific periods, and that calibration is against certified measurement standards. Provide details of this required procedure and measurement standards used.

121.17 Provide the qualifications of individuals who performed fracture toughness tests as required by Paragraph III.B.4, Appendix G, 10 CFR Part 50. Include training and experience.

121.18 In order that we may determine compliance with Appendix G, 10 CFR Part 50, supply the following information:

(1) For the reactor vessel beltline materials, provide full Charpy V-notch curves, including data points, reported impact energy and lateral expansion, both as a function of temperature;

(2) For welds and weld heat affected zones in the beltline region, provide fracture toughness data from either available data or additional tests. Include transition temperature data, upper shelf energy data, and the significant variables that affect fracture toughness properties, e.g., weld wire, flux, base metal combinations, and heat treatment. Correlate this information with data already presented in the FSAR and provide analyses of the additional data, to demonstrate compliance with all the fracture toughness requirements of Appendix G; and

(3) For all reactor vessel beltline materials, define an initial reference temperature, RT_{NDT}, and the most limiting RT_{NDT}. Provide details of the method used to establish both values.

121.19 In order to demonstrate compliance with Appendix G, 10 CFR Part 50, Paragraph IV.A.3, provide the impact test results required by ASME Code Paragraph NB-2333 for all ferritic bolting materials used in the reactor coolant pressure boundary.

121.20 Appendix G, 10 CFR Part 50 requires that the effects of radiation on the fracture toughness of the reactor vessel beltline material be accounted for in the pressure-temperature limits. This is done by shifting the reference temperature, RT_{NDT}, of the affected material upward.

The method used by South Carolina Electric and Gas Co. (SCE&G) to predict the shift in RT_{NDT} for the first 10 EFPY of plant operation is at least as conservative as that in Regulatory Guide 1.99, Revision 1. However, after this period of time, the predictions of radiation damage become less conservative than those of Regulatory

Guide 1.99. Consequently, SCE&G must not use their alternate method of predicting radiation damage beyond 10 EFPY and must delete Figure B 3/4.4-2 of the Technical Specifications.

Subsequent to plant operation, predictions of radiation damage can be based upon the actual measured shifts in reference temperature as determined from the results of the materials surveillance program.

121.21 To demonstrate the integrity of the reactor coolant pump flywheels, supply the Charpy V-notch impact and tensile data for each flywheel, explicitly identifying the material used for each flywheel.

Also, confirm that welding, including repair welding, was not performed on any finished flywheel. If welding were performed, identify the flywheel(s) and locations of the welds.

121.22 The data in FSAR Table 5.2-11 must be revised to show the individual C_V data points to demonstrate explicitly the minimum Charpy V-notch upper shelf energy and compliance with Paragraph IV.B of Appendix G, 10 CFR Part 50.

121.23 The response to Question 121.13, concerning the fracture toughness requirements of certain high strength steels, is not adequate. To provide acceptable information, we require that:

(1) The applicant supply the specific fracture toughness test results, for those tests required by Appendix G to 10 CFR Part 50 and detailed in Question 121.13, for the actual SA-533 Grade A Class 2 material used in the V. C. Summer steam generators and pressurizer; and

(2) The generic fracture toughness requirements of high strength materials, required by Paragraph I of Appendix G and detailed in Question 121.13, be satisfied. Westinghouse Topical Report WCAP-9292 has been referenced by the applicant as the information necessary to fulfill these generic requirements. However, our review of this report is still open and our acceptance of this report is contingent upon adequate responses to questions submitted by the staff to Westinghouse.

SECONDARY WATER CHEMISTRY CONTROL PROGRAM FOR SUMMER

1. Attachment I, Daily Chemistry Report, of your submittal provides the limits for the critical parameters and their sampling schedule only for normal operation, and indicates that the limits of the critical parameterers for secondary water chemistry control are available under plant conditions other than normal operation. Provide a summary of the limits of these parameters and the sampling schedule for plant startup, hot standby, hot shutdown, and cold shutdown/cold wet layup conditions.

2. On page 1 of Attachment I, the limit for free OH^- in the steam generator blowdown is listed as 1.5 ppm. Justify why this limit is over 0.15 ppm OH^-.

3. Provide the critical parameter limits and sampling schedule for condensate under normal operation, startup, hot standby, hot shutdown, and cold shutdown/ cold wet layup conditions.

4. Describe the procedures defining corrective actions for out-of-specifications chemistry conditions, including the authority for evaluating the data and the sequence and timing of administrative events required to initiate corrective action. We will require that the control of condenser leakage be based upon the water chemistry of the discharge of the hot well pump since this sample point is a better indicator of condenser leakage than a sample from the hot well. When a condenser leak is confirmed the leak should be repaired or plugged within 96 hours as stated in Branch Technical Position MTEB 5-3 which is appended to Standard Review Plan, Section 5.4.2.1.

5. Attachment I of your submittal indicates that sodium and silica in steam generator blowdown are analyzed every Monday, Wednesday, and Friday. Provide the basis for not analyzing these two impurities everyday for sodium and at least 5 days per week for silica.

6. Attachment I of your submittal indicates that ammonia in the condensate is analyzed weekly. Provide the basis for not analyzing it at least three times per week (Monday, Wednesday, and Friday).

7. Indicate if amines (such as morpholine) are to be used as additives. If so, provide their sampling schedule.

8. For the continuous process analysis instrumentation, describe the method and frequency for calibrating these instruments.

9. For pH, conductivity, free hydroxide, and ammonia in the steam generator blowdown; for pH, conductivity, hydrazine, and oxygen in feedwater; and for pH, conductivity and sodium in condensate, Attachment I of your submittal indicates the frequency of analysis to be 5 days per week. Confirm whether these five days imply Monday through Friday. For these parameters, weekend analyses may be omitted provided that:

(a) Chemical operating conditions are normal with stable chemistry control maintained,

(b) In-line analysis instrumentation and automatic controls for chemical feed are functioning properly, and

(c) Emergency operating procedures are established and operating personnel are indoctrinated to exercise the proper corrective action.

Confirm that conditions (a), (b) and (c) will be implemented for your program if weekend analysis is to be omitted.

10. Identify the various process sampling point locations within steam condensate, feedwater, and steam generator systems. Reference to sample point locations on a system schematic flow sheet is acceptable.

361.0 Seismology

Q361.13: In the interest of conservatism of OBE spectra with respect to nearby moderate-sized earthquakes, the Final Report, Significance of the Monticello Reservoir Earthquake of August 27, 1978 to the Virgil C. Summer nuclear station for South Carolina Electric and Gas Co., submitted to the Nuclear Regulatory Commission on May 6, 1980, does not fully address the staff concern about the significance of the above-named earthquake. Specifically, the staff wants the applicant to assume that the subject earthquake occurred at the recording station and that the station was near the plant. In correcting the time series and preparing the response spectra reduction should not be made for geometric spreading or attenuation of high frequencies due to propagation in the soil. The spectra, thus generated, are to be compared to the Operating Basis Earthquake spectra for Virgil C. Summer nuclear station.

Q361.14: With respect to FSAR Question 361.7-2, the microzonation of seismicity associated with Monticello Reservoir comprises three major zones (Teledyne Geotech Technical Report 79-8, pages 11-17): (a) single zone near the north end of the reservoir; (b) an east-west zone, containing possibly four subzones, across the central part of the reservoir; and (c) a zone near the end of the reservoir consisting possibly of two subzones. Produce composite fault plane solutions of each zone (or subzone, where possible). Include first motions derived from MEQ-800 portable seismographs and the six-station USGS network (Talwani, Induced Seismicity and Earthquake Prediction Studies in South Carolina, 1979e, page 16').

Q361.15: Discuss the relationship between the stress field determined from the fault plane solutions and (a) local (150 km) structural/tectonic geology and (b) the stress field determined in the two USGS deep wells located west and southwest of the reservoir (Talwani, Induced Seismicity and Earthquake Prediction Studies in South Carolina, 1979e, page 21).

Q361.16 On the basis of the more recent seismicity reports by Teledyne Geotech (1978a,b,c,d; 1979a,b,c) and Talwani (1979a,b,c) for Monticello Reservoir, update the discussions of the spatial and temporal distribution of hypocenters and their relationship to the local (150 km) structural/tectonic geology.

Q361.17: Re: The maximum earthquake potential under Monticello Reservoir during the lifetime of the Virgil C. Summer Nuclear Station.

(1) In response to FSAR question 361.7, the applicant presents arguments that earthquakes associated with Monticello Reservoir cannot be very large because of the shallow focal depths, 0.5km. Two problems exist with that argument: (a) the assumption is made that the vertical extent of the fault plane equals the focal depth, and (b) calculated focal depths are as much as 4km (Talwani, 1979c, d). Justify assumption (a) in view of focal mechanisms calculated by Talwani that indicate nodal plane dips between 30^{0} and 60^{0} (Talwani, et al., 1980), or propose a different assumption that can be justified. Determine whether new evidence exists that the focal depths are really

different from those published (Talwani, 1979 and Talwani, et al , 1980). Using the justified assumption and the most recent estimates of focal depth, evaluate the maximum earthquake potential under Monticello Reservoir. Present and justify the limitations or uncertainties of that estimate.

(2) In several recent reports (Talwani, 1979a, 1979b, and Talwani, et al., 1980), the applicant's consultant has mentioned that the areal extent of the seismic activity has increased with time since the initiation of activity with the initial impounding of the reservoir in December 1977. Is the seismic activity continuing to spread horizontally and to deepen? If it is still spreading, present graphically, with a clear unambiguous description, a representation of the seismically active area and the rate of the spread with respect to time. If it is not still spreading, present the above mentioned representations up to the time of cessation of spreading and estimate the limitations on the maximum undetectable rate of spreading. What effects would continued spreading of the seismicity have on the maximum earthquake potential under Monticello Reservoir? Explain and justify selection of the effects.

(3) Prior to the most recent technical report (Talwani, 1979d) nearly all the seismicity under Monticello Reservoir has occurred in previously jointed or fractured rock. At a recent meeting with the applicant and his consultants (2/21/80 at the plant site), Talwani indicated that earthquakes were beginning to occur in the more competent plutonic rock, similar to the rock which is under the plant. Does this indicate that the reservoir is inducing more energetic earthquakes (breaking fresh or unfractured rock) i.e., earthquakes with greater stress drops? Explain consequences with respect to maximum earthquake potential.

(4) What peak accelerations and what response spectra would be expected at the Virgil C. Summer Nuclear Station for a Magnitude 4.0 earthquake and a Magnitude 5.3 earthquake (two non-simultaneous events) if the earthquake occurred at a distance of 10.0, 3.0, and 1.0 km from the plant? (The staff is asking for peak acceleration and response spectra estimations at three distances for each of two earthquakes - 6 cases). Consider the 1.0 km cases at 0.0 horizontal range and 1.0 km depth. Compare the resulting spectra to the V.C. Summer OBE and SSE response spectra. Discuss the effects of the above calculated spectra exceeding the OBE and SSE response spectra.

Q361.18: A graph of the common logarithm of cumulative number of events of magnitude M or greater can be plotted as a function of M. Such a graphical representation is useful in describing the seismic history of a seismic zone. Insofar as an assumption can be made that the magnitude distribution will continue as it has been, estimates of future seismicity can be made from the graph. Although the latter assumption is not always tenable, such a graph is a useful resource in describing seismicity levels. Therefore, produce a graphical representation of magnitude-cumulative frequency of occurrence of all events assumed to be associated with the reservoir impoundment. From this curve estimate the magnitude of the largest earthquake with a return period of one year, of ten years, and of 40-50 years (the life of the plant). (See, for example, Teledyne Geotech (1979c) No. 79-8, page 27, Figure 8). Compare these to the maximum potential event obtained in the previous question based on focal depth considerations. Discuss the limitations or uncertainties of those estimates.

Q361.19: Using historical earthquake catalogs for the southeastern U. S., and excluding the microearthquakes induced by Monticello Reservoir, obtain recurrence intervals for Modified Mercalli (M.M.) epicentral intensities, I_0, for (a) I_0 = VIII within 100 km of the V.C. Summer Site and (b) I_0 = IX within 225 km of the site.

Q361.20: Re: Reservoir-induced seismicity occurring on pre-existing joint or fracture planes.

(1) In Talwani, et al., 1980, the authors stress the observation that the nodal planes of the focal mechanisms for earthquakes under the Monticello Reservoir are oriented parallel to existing fracture planes. What significance does this observation have, particularly with respect to the maximum earthquake potential? Explain the significance.

(2) What would be the consequences of a Reservoir-induced earthquake on one joint or fracture plane nucleating a series of events (a multiple event) on nearby joint or fracture planes? Estimate the possibility of such an event and describe the conditions that would mitigate against such an event.

Q361.21: The USGS measured in situ stresses at greater depths than those reported in the FSAR (Appendix 2D). Summarize those measurements. Do those data support the hypothesis that in situ normal and shear stresses are sufficiently close to shear movement along pre-existing planes of weakness that raising pore pressure to hydrostatic levels governed by Lake Monticello has caused the observed seismicity in the area of the stress measurements? What is the stress drop associated with the maximum potential earthquake that might occur from the greatest observed (S_1-S_3) stress conditions? Could the response spectrum of an earthquake with this stress drop exceed the design response spectrum?

Q361.22: On Page 2.5-14, paragraph 1, it is reported that McKenzie postulated northwest-trending faults with 1500 feet of displacement. What evidence has been observed which supports the conclusion that these "faults" are an unsupported hypothesis by McKenzie.

References

Talwani, P., 1979a, Technical Report 79-1; Seismic Activity near the V. C. Summer Nuclear Station for the period January-March 1979

Talwani, P., 1979b, Technical Report 79-2; Seismic Activity near the V.C. Summer Nuclear Station for the period April-June 1979.

Talwani, P., 1979c, Technical Report 79-3; Seismic Activity near the V.C. Summer Nuclear Station for the period July-September 1979.

Talwani, P., 1979d, Technical Report 79-4; Seismic Activity near the V.C. Summer Nuclear Station for the period October-December 1979.

Talwani, P., 1979e, Eighth Technical Report for USGS contract No. 14-08-0001-17670; Induced Seismicity and Earthquake Prediction Studies in South Carolina.

Talwani, P. 1980, Technical Report 80-1; Seismic Activity near the V.C. Summer Nuclear Station for the period January-March 1980.

Talwani, P, B. K. Rostogii & D. Stevenson, 1980, Tenth Technical Report for USGS contract No. 14-08-0001-17670; Induced Seismicity and Earthquake Prediction Studies in South Carolina

Teledyne Geotech, 1978a, Technical Report 78-1; December 1977 seismicity near the V.C. Summer Nuclear Station.

____________, 1978b, Technical Report 78-5; January 1978 Seismicity near the V.C. Summer Nuclear Station.

____________, 1978c, Technical Report 78-7; February 1978 Seismicity near the V.C. Summer Nuclear Station.

____________, 1978d, Technical Report 78-10; March 1978 Seismicity near the V. C. Summer Nuclear Station.

____________, 1979a, Technical Report 79-2; April-June 1978 Seismicity near the V.C. Summer Nuclear Station.

____________, 1979b, Technical Report 79-4; July-September 1978 Seismicity near the V.C. Summer Nuclear Station.

____________, 1979c, Technical Report 79-8; October-December 1978 Seismicity near the V.C. Summer Nuclear Station.