

December 10, 1975

Mr. L. C. Dail
Duke Power Company
P.O. Box 2168
Charlotte, North Carolina 28242

RE: Jocassee Hydro Consulting Board Meeting
December 2, 1975
Duke File No. J-4

50-269/270/287
10151
10-1-76

Dear Mr. Dail:

The Jocassee Hydro Consulting Board met on the evening of December 1, 1975 to review data collected since the previous meeting, and on December 2 at the job site. Mr. Phil McBride III, of the Federal Power Commission, attended the December 2 meeting. The top of the dam was inspected for evidence of propagation of the crack along the upstream face, previously noted. The upstream face of the right abutment was inspected by boat. This letter summarizes the Board's observations and recommendations.

I. Review of the Data on Dam Deflection

- a. As suggested at the previous Board Meeting of May 15, new deep concrete monuments have been established on the dam crest. Measurements of horizontal and vertical movement have been made at three month intervals, of the bench marks and the new monuments, as recommended by the Board. The movements recorded so far have been identical.
- b. The settlement of the dam crest is continuing at a decreasing rate: 0.2 feet since January 1, 1975. The rate of settlement is comparable to that of other rock fill dams. A plot of settlement as a function of log-time shows the rate to be approaching a straight line as for other rock fill dams.
- c. The vertical settlement device cross arms also indicate a decreasing rate of movement. There is an irregularity in the reading of vertical settlement device #1, that is the same at all levels, suggesting a local shift in the top section of the cross arm casing. All vertical settlement holes but six are now partially blocked by broken tape and lost reading torpedoes. The Board recommends that a lead or iron plug be forced down these blocked cross arm holes so that readings can be continued on the upper sections of the devices where practical. However, all of the data available indicates that the amount and rates of settlement of the dam are normal.

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- d. The horizontal movements have been in the downstream direction, a maximum of 0.55 feet at Monument 7 at about the center of the dam. The rate of movement is decreasing with time. There has been no difference between the movement of the upstream and downstream faces during the past three months. All the movements are normal and comparable to that of other rock fill dams.

The Board, as previously done, recommends readings at three month intervals. If unusual conditions such as high rains, sudden large drawdowns, or seismic activity shall occur, the measurements should be made as soon as possible after the event in order to determine if there had been any changes in movement.

2. Upstream Crack

A crack in the crest of the dam, on the upstream face, parallel to the axis, had been noted previously. The Board, in the May 15 meeting, recommended that the crack be filled with fine gravel and that it continue to be observed.

- a. The upstream and downstream horizontal movement measurements during the past six months indicate that there has been no movement across the crack.
- b. The slope indicator readings confirm no significant continuing movement across the crack.
- c. There is a little erosion of fines into small localized "maize holes" along the crack. There is no visible movement along the crack.
- d. The Board recommends that the crack continue to be observed at three month intervals and after unusual events, as outlined in Section 1 of this report. There is nothing in the crack movement to suggest a weakness or abnormality in the dam. Instead, it appears to be the result of the unequal strains between the core and the upstream shell produced by the normal deflection and settlement of the dam.

3. Seepage Observations

Data on seepage quantities being monitored downstream of the right abutment were presented. Flow at Weirs A, C, D, E, H and G is in accord with previous readings and is considered normal. The weirs monitoring powerhouse and diversion tunnel drainage produces only minor amounts of drainage.

The Parshall flume which was originally below Weir F has been moved upstream to about midway between Weirs F and F-1. A weir was suggested for the location in our previous report. Readings at these two locations are generally parallel, with Weir F presently reading 1000 GPM and the flume reading 1250 GPM. The present procedure of reading the F weir daily and continuously recording the Parshall flume should be continued. Comparison of the present readings with those recorded since completion of the grouting program in December, 1973 show good correlation with respect to rainfall and reservoir level. An additional factor which appears to be constant for all previously recorded years is that lower quantities of water are recorded during the late winter or early spring months. Preliminary studies have discounted the possibility that increased water viscosity during the winter months could be responsible. Continued observation of this feature will be of interest, although it has little effect on overall seepage. We recommend that observation of the abutment seepage should be continued at the present frequency. The quantities do not indicate any change in the condition of the abutment, and no remedial work is recommended at this time.

After the minor earthquake of November 25, 1975, slight turbidity of water in the flume was noted. This discoloration had disappeared by the following morning, and we do not consider it to be unusual or significant. However, in the event of future earthquakes, the amount and condition of the seepage should be closely observed, in addition to any other effect on the project.

Profiles across the abutments were presented, showing the phreatic line plotted from piezometer observations. In accord with our previous suggestion, piezometer W-6 has been repaired, and an additional piezometer W-19, has been added, and these are helpful in clarifying the section along station -0+50. The profiles confirm that the seepage lines through the abutment continue to reflect satisfactory abutment operation. We recommend that an additional piezometer be installed at the embankment toe along the line at station 4+00, to more fully define the piezometric surface at this location. Readings of these piezometers should continue at the present intervals.

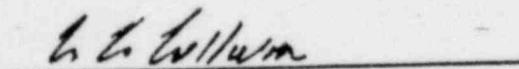
4. Seismic Events

- a. Four seismic events have been felt in the vicinity of the dam since reservoir filling. Three have been very small, and were felt by only a few people. The fourth, on November 25, 1975, was larger and was felt over a radius of more than 10 miles. The attached table provides a preliminary summary of the characteristics of all four events. Data on the last three which occurred within a period of six weeks, were obtained by observations by the University of South Carolina and Georgia Tech Seismograph Stations supplemented by portable instruments placed one-half to three miles from the dam following the October 18, 1975 event.

The largest event, November 25, had a magnitude of between 3.2 and 3.5, and an epicentral intensity of more than III and less than IV. The corresponding epicentral acceleration was probably no more than approximately 0.01g.

- b. In the opinion of the Board, the largest event would have no detrimental effect on the dam. The slope indicator on the crack showed no change. There was no changes in the abutment leakage or other seepage. There was a discharge of silty water from the right abutment springs for a few hours after the event of November 25 but the water cleared up by the next morning. Significantly, there was no appreciable accumulation of silt in the weir boxes.
- d. The Board recommends that Duke Power coordinate the investigative efforts of the University of South Carolina, Georgia Tech, and Law Engineering in evaluating the significance of these events and establishing a program for seismic monitoring.


W. V. Conn


C. C. Cullum


G. F. Sowers

PRELIMINARY EVALUATION OF SEISMIC EVENTS
JOCASSEE DAM

<u>Time</u>	<u>Epicenter</u>	<u>Hypocenter</u>	<u>Magnitude</u>	<u>Acc</u>	<u>Intensity</u>
<u>1973</u> 12:10 EST Aug. 12	Felt 3.5 mi. NE of Jocassee Dam	-	-	-	-
<u>1975</u> 00:31 EST Oct. 18	Aftershocks moni- tored by Talwani, lo- cated under Reservoir just upstream from dam.	?	1.5-2.0 m _b	-	II MM (est.)
5:30 EST Nov. 6	Aftershocks approx. 3000' south of dam.	Aftershocks less than 4000'	1.5-2.0 m _b	-	II MM (est.)
10:17 EST Nov. 25	Within 2 km of dam	Less than 2 Km	3.2 (3.5)	-	III-IV MM (est.)

Note: All data subject to verification from instrumental studies.