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MAY 02 1977

MEMORANDUM FOR: Albert Schwencer, Chief, Operating Reactors Branch #1

FROM: J. Carl Stepp, Chief, Geosciences Branch, DSE

SUBJECT: OCONEE/JOCASSEE DAM SEISMICITY

PLANT NAME: Oconee
LICENSING STAGE: Operating Reactor
DOCKET NUMBERS: 50-269/270/287
RESPONSIBLE BRANCH: OR-1; Don Neighbors, PM

Attached is our recommended action for resolution of the issue which has been raised by seismicity at the Jocassee Dam. Since my memorandum to you on this subject dated March 7, we have met with Duke Power Company and consultants and visited the Dam site. As a result of those discussions, we have formed the attached informational requirements. We believe that this information will permit us to make a complete evaluation of the (1) hazard to the dam posed by earthquake activity in the region and (2) the stability of the dam under any potential earthquake loading.

We recommend that action be taken to assure compliance with the recommended actions. This request for information was prepared by Drs. L. Heller, R. Jackson, J. Kelleher and D. Simpson.

Original Signed by J. C. Stepp

J. Carl Stepp, Chief
Geosciences Branch
Division of Site Safety and
Environmental Analysis

Attachment:
As stated

cc: w/attachment
H. Denton
W. Gammill
K. Goller
J. Knight
D. Neighbors
J. Kelleher
R. Jackson
L. Heller
R. Hofmann
I. Sihweil

My

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This memo refers to the recent meeting concerning induced seismicity at Jocassee Dam among Duke Power Company (DPC), the NRC staff and various consultants. We herein describe appropriate steps to evaluate the potential seismic hazard. The program we recommend is threefold: A short-term report due July 1, 1977, a monitoring program to be implemented by August 1, 1977, and a longer-term report that will describe the findings of the monitoring program.

SHORT TERM REPORT

This report should address formally the questions raised during the recent meeting at Jocassee dam.

a) Seismicity: All seismic observations gathered to date should be provided in an organized manner, including numbers of events recorded, hypocentral data, focal mechanisms where determined, epicenter maps and depth cross-sections, locations and changes in operating stations and descriptions of network capacity. Also included should be a log of water-level fluctuation.

The report on seismic studies prepared by Law Engineering provides adequate seismic information for the time interval mid-October 1975 until late-June 1976. This report should be resubmitted as part of the total report. For the interval from late June 1976 until the present, no seismic data have been presented to us other than informal oral descriptions.

Consequently, the seismic information for this latter interval should be presented in a formal written report treated in all the detail described in the first paragraph of this section.

b) Geologic Reconnaissance of the Site Area:

The reports submitted to date do not appear to be current and should be modified to depict clearly the current understanding of the location of faulting in the vicinity of Lake Jocassee and the Lake Jocassee Dam. The report of Dr. Conn (Engineering Geology of the Keowee-Toxaway Project, of December 1966, and June 1974) discusses faulting in the vicinity of the dam; a clarification of his findings should be provided. The relevant geologic maps of the site and region and an assessment of the age of last movement on faults in the vicinity of the Lake Jocassee Dam should be provided. Typical construction photographs of the dam rock foundation and abutments should also be provided.

c) In order to evaluate the seismic adequacy of the dam the following information should be provided:

1. The embankment design and specification should be described along with the foundation treatments used;
2. Seepage rates and changes in seepage rates should be described and plotted;

3. Groundwater profiles (phreatic surface) through the abutments and foundation of the dam should be plotted;

4. The ability of the foundation of the dam to resist the effects of potential fault movements should be assessed and reported. Past measurements of the settling, displacement and cracking of the dam should be interpreted to estimate the existing state of strain, particularly in the core of the dam. The additional strain which can safely be tolerated should be estimated and related to the magnitude of potential fault movement;

5. The tolerance of the abutment material to strain and cracking resulting from fault movement should be estimated based on the properties of the saprolites and the magnitude of potential fault movement. If abutment cracking cannot be ruled out than the piping and erosional resistance of the weathered rock should be assessed.

6. A detailed description of the Federal Power Commission monitoring program for seismic safety should be provided. The dam operating plans in the event of significant seismic excitation should be provided together with plans for immediate inspections and readings of critical instruments. In addition, a plan for the prompt and formal involvement of Duke Power Co. geotechnical consultants should be developed to assure that evidence detrimental to the safety of Jocassee dam is not overlooked.

MONITORING PROGRAM

At present it cannot be stated that the relatively high levels of activity of late 1975-1976 will not resume. Consequently, it is essential to maintain a monitoring network which will provide accurate and timely information concerning size, frequency and hypocentral data for possible ~~fu~~ seismic activity of the future.

a) Seismic Stations: Until November 1978, three permanent stations should be operated by Duke Power and recorded at the damsite. Two to four microearthquake recorders should be used to augment these stations until December, 1977. At that time a decision will be made, based on the level of activity during 1977, as to whether to continue operation of the ~~x~~ microearthquake recorders. The two stations in addition to SMT should be installed as soon as possible. Suggested locations for these stations are shown in the attached figure. If possible, arrangements should be made with the USGS and USC to incorporate one or all of the Jocassee stations in the South Carolina network. This would allow recording of these stations on the develocorder at USC. If arrangements are made to include the stations in the network, it may be possible to use USGS radio frequencies for radio telemetry.

To improve the timing resolution for the permanent stations recording speeds of 120 mm/min should be used on the helicorders.

b) Reporting Procedures: Quarterly reports should be provided to the NRC within one month of the end of each reporting period. These reports should include the following:

1. Text: Short report of the general level of seismicity and and any changes in seismicity.

2. Tables:

   a. Catalog of all earthquakes recorded;

   b. List of all hypocenters located (HYPO71 Format);

   c. Operational report:

      i) Location of stations;

      ii) Times of operation of each station, number of days recording for each station, total number of station-days reporting;

      iii) Report of reasons for any station failures;

3. Figures:

   a. Station locations;

   b. Epicenter locations (with magnitude shown by symbol size);

      i) For reporting period;

      ii) Cumulative, from October, 1975;

   c. Graphs of daily water level (and daily range), change in water level/day, number of earthquakes/day, energy release/day, all plotted on the same time scale, for the the reporting period;

d. Graphs of the parameters in Item 3, above, for ten day intervals from October, 1975;

e. Cross-sections of earthquake depths (with error bars) along profiles oriented N-S, E-W, NE-SW, NW-SE and any other profiles suggested by the data.

4. Other Information: If sufficient data are available, "b-values" and focal mechanisms should also be determined. Interpretation of the significance of these parameters is not required from Duke Power Company station data (HYPO71 format) and direction of motion at each station should be included in the report for all earthquakes used in focal mechanism determinations.

A copy of at least one "typical" seismogram should be included with each report to show data quality and type of activity.

If felt earthquakes occur, intensity surveys should be carried out and summaries of intensity reports and contoured intensity maps should be included in the report.

5. Abnormal Activity: The NRC should be informed by telephone of any unusual activity as soon as possible. Any of the following unusual should be considered activity:

   a. Any earthquake larger than magnitude 2;

   b. More than 100 events per week;

   c. Any plans to make unusual changes in water level in the reservoir.