Portland General Electric Company

Bart D. Withers Vice President

September 2, 1983

Trojan Nuclear Plant
Docket 50-344
License NPF-1

Director of Nuclear Reactor Regulation
ATTN: Mr. James R. Miller, Chief
Operating Reactors Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington DC 20555

Dear Mr. Miller:

Response to Questions
On Hypothetical Failure of Spirit Lake Blockage

Your letter of July 25, 1983 forwarded 11 questions from the Hydrological Engineering Section regarding the "potential mudflow from a hypothetical failure of the Spirit Lake blockage". Attachment A to this letter provides an item-by-item response to each of those questions for your consideration. Attachment B to this letter is a final report on the potential mudflow from such a hypothetical failure evaluated by our consultants, Simons, Li and Associates, Inc. of Ft. Collins, Colorado.

Sincerely,

W D Withers for

Bart D. Withers
Vice President
Nuclear

Attachments

c: Mr. John B. Martin
Regional Administrator
Nuclear Regulatory Commission
Region V

Mr. Lynn Frank, Director
State of Oregon
Department of Energy

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121 S.W. Salmon Street, Portland, Oregon 97204

Responses to "Additional Questions 'Potential Mudflow from a Hypothetical Failure of Spirit Lake Blockage'"

Question 1

"The report appears to be a summary of a more detailed analysis and report. As such, however, it does not contain the information necessary to enable us to evaluate it. If you have a more complete report, please provide it."

Response 1

A final report was not available for transmittal with the PGE responses of July 1, 1983. Since that time, a final report has been completed entitled "Analysis of Flood Level at Trojan Nuclear Power Plant Associated with Hypothetical Failure of Spirit Lake Blockage" by Simons, Li & Associates, Inc., (SLA) August 15, 1983. A copy is attached (Attachment B).

Question 2

"The important case of a mudflow during a low Columbia River flow rate, with consequent high sedimentation in the Columbia River, followed by a large flow rate has been neglected. Records have shown that high flow rates (1,000,000 cfs) have followed periods of low flow by only a few days. Analyze the potential for flooding of the site by this scenario, or justify why this case was not considered."

Response 2

During the relatively short time period until permanent Spirit Lake level control is implemented (expected in the next 2 to 3 yr), the occurrence of Spirit Lake debris plug failure (which is considered by the Corps of Engineers to be precluded) and the simultaneous occurrence of lower Columbia River flow conditions increasing rapidly from low flow to a 1,000,000 cfs flood (return interval on the order of 1,000 to 10,000 yr) is considered to be a combination of events of negligible probability. However, analysis of the scenario has been included in the SLA evaluations.

The sediment routing analysis, assuming a flow rate of 125,000 cfs in the Columbia River and a 45-percent sediment concentration by volume from the Cowlitz River, gives a maximum accumulated sediment volume of 7.54 billion cubic feet (bcf) in the Columbia River (see Table 3.10 of the report). Using the fixed bed hydraulic routing model (HEC-2) a flow rate of 1,000,000 cfs for this volume of sediment accumulation along the Columbia produces a water surface elevation of approximately 42.1 ft MSL at the Trojan Nuclear Plant.

If sediment routing was performed for this case, the water surface elevations would be lower, since a greater Columbia River flow would increase the velocity and downstream sediment transport rates. Hence, it is concluded that flood protection at Trojan would be maintained even for this scenario, which is considered to be very unrealistic.

Question 3

"Item 1.3. The procedure used to reduce the sediment concentrations from 39, 52, and 65 percent to 20, 30, and 45 percent respectively, as summarized in Table 1 should be discussed and all assumptions should be justified. For example, what is the basis for reducing the volume of material into the Cowlitz by 40 percent (Column 2)? What is the basis for the ratio of sand to finer material of 2 to 1 (Columns 3 and 4)? Etc."

Response 3

Table 1 is referenced in the enclosed report as Table 3.6. The procedure used to determine the parameters in Table 3.6 is presented in the text of the report. Column 1 is the initial bulked volume estimated to be transported from the debris avalanche. (Bulked volume represents the volume of sediment and voids.) Sediment size distributions of the debris avalanche, as published by the USGS in Professional Paper 1250, show a fraction 0.6 of the material is sands and finer (particle sizes smaller than 2-5 mm). This volume is represented in Column 2. The remaining 0.4 fraction of the material is gravel, cobbles, and boulders and will not be transported out of the Toutle River system. The ratio of sand to sand, silt and clay (0.67), and the ratio of silt and clay to sand, silt and clay (0.33) is also based on the measured sediment size distribution of the debris avalanche (Columns 3 and 4). Column 5 is estimated based on similar percentages of sand deposited during the 1980 mudflows. Silts and clays (particle sizes less than .062 mm) are transported as wash load (no deposition assumed). Column 8 totals the bulked volume of sand, silt, and clay that pass through the Cowlitz River and converts this bulked sediment volume to sediment volume.

Question 4

"Item 1.4. Please explain the basis for the 30 percent moisture assumption. Is this figure based on available pore volume or on total volume of dry solid? What porosity was used and what is its basis?"

Response 4

A porosity of approximately 30-32 percent was assumed for the bulked sediment based on USGS data. The water content of the voids can range from about 15 percent (wilting point) to 50 percent (saturated soil). An intermediate value of 30-percent water was assumed.

Question 5

"Item 1.6. What is the basis for assuming a Columbia River sediment concentration of 500 ppm? What effect would varying the concentration have on your results?"

Response 5

Measured sediment concentrations on the Columbia River are presented in the main report in Table 3.4. Sediment concentrations are generally less than 100 ppm. A value of 500 ppm was assumed to be conservative. Assuming lower concentrations than 500 ppm, which would be reasonable, could slightly increase the sediment transport capacity of the Columbia River. This would decrease the calculated water levels at Trojan.

Question 6

"Several references are used in the text, but are not documented. For example, the 'Colby method' in Item 2.4. Provide the references."

Response 6

The Colby method is a standard procedure used to determine the bed material discharge. The reference text used for this report is Engineering Analysis of Fluvial Systems by Simons, Li & Associates, Inc., 1982.

Question 7

"Item 2.5. Define the term 'bulking factor'."

Response 7

Bulking factor is the ratio of the total volume of sediment and voids to the volume of sediment alone. The bulking factor equals 1/1-P, where P is the porosity. Porosity is the ratio of the volume of voids to the total volume of sediment and voids.

Question 8

"Item 2.6. Give basis for your assumption that the shape of the mudflow sediment deposit at the confluence of the Cowlitz and Columbia Rivers can be ratioed from the configuration of the deposition following the May 18, 1980 mudflow. That mudflow deposition was rather flat compared to other known mudflow slopes. What is the sensitivity of your results to variations in the slope of deposited sediments."

Response 8

The downstream slope of the mudflow is governed by slope stability and sediment transport rate and should be flatter than the angle of repose. The upstream slope is formed by sediment movement induced by density currents. The larger the deposit volume, the flatter the upstream slope due to higher water velocity in the upstream deposition area. The assumption

of the deposition profile similar to the observed profile of May 1980, for a larger deposition volume should yield a more conservative flood level prediction.

Question 9

"Item 3.4. Give basis for calculations of sediment load. Were formulas employed derived from relationships for sediment transport in rivers? If so, justify that these formulas are acceptable for the very-high sediment loads of the present case."

Response 9

Sediment transport rates were calculated based on the Meyer Peter, Muller equation for bed-load, and the modified Einstein method for suspended load (wash load). The transport rate increased with higher concentrations of fine sediments. The adjustment is based on the Colby Correction factor which is a function of flow depth, temperature and concentration (up to 200,000 ppm).

The sediment transport rates are defined from measured sediment size distributions and the hydraulics (velocity) of the Columbia River for a range of flow rates for varied bed elevation. Detailed descriptions of the equations used to determine the transport rates are presented in Appendix A of the report.

Question 10

"Item 3.8 Why is 400,000 cfs the 'most reasonable Columbia River flow to evaluate'? Is there a probabilistic basis for this conclusion?"

Response 10

The average annual lower Columbia River flow is approximately 230,000 cfs. A flow of 400,000 cfs corresponds approximately to the annual peak discharge (1- to 2-yr return interval for spring-summer freshets and 3- to 4-yr return interval for fall-winter freshets). The 400,000 cfs Columbia River flow is regarded, based on technical judgment, to be a reasonable worst-case discharge considering the 2- to 3-yr time interval until permanent Spirit Lake level controls are installed and the Corps of Engineers confidence in preventing failure of the Spirit Lake debris plug.

Question 11

"Table 1

"(a) Column 8 is unclear. Arithmetically it appears that the expression should be (Col 6 + Col 4)/1.4. Explain the meaning of the value 1.4, and why it is used here."

"(b) Explain the difference between Column 1 and 2. Also, why is 'material' used in Column 1 and 'sand, silt and clay' used in Column 2?"

Response 11

(a) 1.4 is the bulking factor based on a porosity of about 31 percent.

See Response 3.

(b) Material is used to refer to the entire range of sediment sizes; boulders, cobbles, gravels, sand, silt, and clay. According to measured size distributions of the debris avalanche, approximately 60 percent of the material is sand, silt, and clay. The boulders, cobbles, and gravels represent the remaining 40 percent and were assumed to be deposited in the Toutle River system.

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