April 10, 1986

Docket No. 50-344

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Mr. Bart D. Withers
Vice President Nuclear
Portland General Electric Company
121 S.W. Salmon Street
Portland, Oregon 97204

Dear Mr. Withers:

Enclosed for your information is the staff's review of the U.S. Army Corps of Engineers' (COE) study regarding possible flood levels at the Trojan Nuclear Plant. Results of the COE study showed higher flood levels, in some instances, than the Trojan design basis flood level of 45 feet, mean sea level.

We have determined that the condition for which the COE assumed would result in flood levels greater than the plant grade of 45 feet exceeded the staff's assumptions regarding the design basis flood. However, for the condition which is consistent with our design basis flood, water levels would reach plant grade. This level is 4 feet higher than the maximum water level assumed in the Final Safety Analysis Report (FSAR). This difference is attributed to the actual determination of the Columbia River's discharge profile and is considered more accurate than the projected discharge information used in the FSAR.

We conclude that permanent flood protection in this case is not necessary; alternative measures have been suggested in the enclosure.

/s/TChan

Terence L. Chan, Project Manager
PWR Project Directorate No. 3
Division of PWR Licensing-A

Enclosure:
As stated

cc w/enclosure:
See next page

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Mr. Bart D. Withers
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cc:

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REVIEW OF CORPS OF ENGINEERS REPORT CONCERNING FLOODING AT THE TROJAN NUCLEAR PLANT

Background

The design basis flood considered by the staff in licensing the Trojan Nuclear Plant is the flood that would result from a catastrophic failure of Grand Coulee Dam, which is located on the Columbia River about 524 miles upstream of Trojan. This flood would result in a maximum stillwater level of 41 feet at the Trojan Plant. To allow for higher water levels which could result from wind generated water waves, the Trojan plant grade elevation was set at 45 feet.

In 1982, the U.S. Army Corps of Engineers (COE) conducted inundation mapping studies for the lower Columbia River. The portion of the river studied included the reach of the river on which the Trojan Plant is located. The COE studies showed higher flood levels, in some instances, than the Trojan Plant design basis flood level of 45 feet msl.

This report discusses the result of the staff's review of the COE report and the staff's conclusions regarding the safety of the Trojan Plant with respect to flooding.

Purpose and Results of the COE Studies

The COE studies were performed under the COE's Dam Safety Program to determine the extent of flooding associated with hypothetical dam failures on the Columbia River. The studies reflect events of an extremely remote nature and as such are not intended in any way to reflect upon the integrity of the dams included in the study.

The purpose of the studies was to prepare inundation maps showing the extent of flooding associated with various postulated conditions at each of the lower Columbia River dam projects. In downstream order these projects are McNary, John Day, the Dalles, and Bonneville Dams. The Trojan Plant is located about 73 miles downstream of Bonneville Dam.

For each of the dams considered by the COE, three postulated conditions were analyzed as follows:

CONDITION 1 Probable Maximum Flood (PMF) Without Dam Failure

For this condition it was assumed that a PMF would occur on the lower Columbia River. With the exception of Bonneville Dam, all other dams were found capable of discharging the PMF without overtopping. The COE study concluded that because of its outdated hydrologic design, Bonneville Dam would be overtopped under PMF Conditions. Under conditions of overtopping, Bonneville dam was assumed to fail.

CONDITION 2 Probable Maximum Flood (PMF) With Dam Failure

Although none of the dams except Bonneville would be overtopped by the PMF, the COE in this scenario assumed that all dams would fail during the PMF. The dam failures were modeled using the National Weather Service (NWS) DAMBRK computer model. The outflow hydrographs were routed downstream through the Bonneville tailwater. The Bonneville hydrograph was then routed down the Columbia River past the Trojan Plant to the Pacific Ocean using the NWS DWOPER unsteady flow model.

CONDITION 3 Dam Failure at Normal High Pool Level

This condition assumed that a dam failure would occur during the spring normal high pool. The flood hydrograph from each failed dam was routed downstream to the Pacific Ocean using the same NWS computer models as noted above.

For the three conditions described above, the COE computed water surface elevations using cross-sections along the lower Columbia River. These elevations were then used to develop floodplain maps for the reach of the Columbia River extending from McNary dam to the Pacific Ocean.

Staff Review of COE Studies

General Design Criteria (GDC-2), "Design Basis for Protection Against Natural Phenomena," requires that structures, systems and components important to safety be designed to withstand the effects of natural phenomena such as floods. Regulatory Guide (RG) 1.59, "Design Basis Floods for Nuclear Power Plants," describes combinations of flood-causing events which provide adequate design flood bases to meet the requirements of GDC-2. With the exception of Bonneville Dam, all of the dams studied by the COE can safely pass their respective PMF's without being overtopped. Therefore, hydrologic events would not cause any of the dams, except Bonneville, to fail. Dam failures then, would have to be caused by seismic or other non-hydrologic events.

RG 1.59 suggests that a 25 year flood be considered coincident with a non-hydrologic dam failure. Therefore, considering a PMF coincident with a dam failure, as was done by the COE in condition 2, is a sequence of events more severe than required to be considered for a design basis flood because a PMF is a much more severe event than a 25 year flood.

The COE study determined flood levels at cross-sections located both upstream and downstream of the Trojan Plant. The cross-sections closest to the Trojan Plant are at river miles 66.1 and 75. Water surface elevations at the Trojan Plant, which is located at river mile 72.4 were determined by interpolation by the NRC staff. The tabulation below shows interpolated flood elevations at the Trojan site for the three conditions considered by the COE.

Columbia River Water Surface
Elevations in ft msl
at the Trojan Plant

Dam	Condition 1 PMF without dam failure	Condition 2 PMF with PMF multiple dam failure	Condition 3 Dam Failure at normal high pool level
McNary	45	48	16
John Day	45	47	19
The Dalles	45	45	12
Bonneville	45	45	12

This tabulation shows that for Condition 2, flood levels would equal or exceed the Trojan Plant grade elevation of 45 feet. However, as discussed above, Condition 2 floods are of greater magnitude than floods which have to be considered for design of nuclear power plants.

Condition 1 floods, which are consistent with design bases floods, would result in water levels of 45 feet for all scenarios considered by the COE. Although this elevation is the same as the plant grade elevation, wind generated waves could cause water levels to exceed plant grade elevation and potentially affect the safe operation of the plant.

The Columbia River drainage basin is very large, comprised of an area of approximately 260,000 square miles. The upper reaches of the drainage area are bounded by the Rocky Mountains on the east and the Cascade Range on the west. It is in these mountainous areas that snow can accumulate in the winter months and contribute to high river flows when the snow melts in the spring. A PMF on the Columbia River would result from rapid melting of an extraordinarily large and extensive snow pack. Such a snow pack would be evident several months before actual melting occurred.

Flood forecasts for the Columbia River are made through the cooperative effort of the Columbia River Water Management Group (CRWMG). This group consists of representatives of eleven federal agencies and from the states that border the Columbia River. As part of the flood forecasting program, the Soil Conservation Service (SCS) regularly conducts airplane flights over the Columbia River basin during the winter months to determine depth and extent of snow pack. Using the information obtained during these snow flights, the COE is able to forecast potential river floods, weeks or even months before they actually occur.

Staff Conclusions

Since the Trojan Plant grade elevation of 45 feet is the same as the COE's predicted PMF level, only the effects of water waves running up on safety-related structures are of concern. However, since potential floods can be forecast well in advance of their occurrence, there would be sufficient time for the licensee to implement some temporary actions to protect any safety-related structures or equipment which could be adversely affected by flooding. Thus the staff concludes that permanent flood protection measures are not necessary. However, it would be prudent for the licensee to determine if wind wave runup could adversely affect the safe operation and shutdown of the plant. If the conclusion is that there would be no adverse effects, the basis for the conclusion should be provided. Otherwise, an operating procedure to define the actions to be taken in the event of an impending PMF on the Columbia River should be developed. These procedures should as a minimum identify the actions to be taken and the event that will initiate implementation of those actions. An example of such an event could be a flood level in Bonneville or other upstream impoundments or a discharge from the dams or any other measurable activity that could be identified with sufficient warning time to permit implementation of protective plans at the Trojan Plant before the actual flood occurred. In addition, the procedures should describe the level to which flood protection would be provided at the plant and identify the safety-related structures, systems or components that would have to be protected.