

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)	
)	
PUGET SOUND POWER & LIGHT)	DOCKET NOS. STN 50-522
COMPANY, et al.,)	50-523
)	
(Skagit Nuclear Power Project,)	
Units 1 and 2))	
)	
)	

PREFILED TESTIMONY OF ROY BLUNDON
October 18, 1979

Q. Would you state your name, address, and occupation, please.

A. Roy H. Blunden, Geologist
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My statement of qualifications is on record in this proceeding.

Q. What documents have you reviewed in preparation for your testimony?

A. I have reviewed the reports contained in the Report of Geologic Investigations in 1978-1979 concerning investigation of deformed Pleistocene sediments. Included was a report by Dr. Don T. Easterbrook, dated April 3, 1979. I have also had a general discussion with Dr. Fred Pessl, Jr. of the U.S. Geological Survey.

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Q. What conclusions have you reached?

Two specific areas of deformed Pleistocene sediments were considered in the reports, neither of which have been studied in the field by the writer. Of the two areas referred to in the Bechtel Inc. reports only the Cavanaugh Road exposures were subjected to sub-surface investigation and are here considered in the following analysis. This analysis is concerned with the expectations, findings and interpretation of the investigation findings by Dr. Easterbrook and Bechtel Inc.

Review of Lake Cavanaugh Road
Auger-Hole Investigation

The purpose of the sub-surface investigation conducted by Bechtel Inc. was to determine the causes of the deformation of Pleistocene sediments observable in road cuts along Lake Cavanaugh Road. These deformed sediments occur along the southern projection of a regional lineation postulated by Dr. John Whetton as being a fault-line. This postulated fault-line, the Gilligan Creek fault, has been studied by the U.S. Geological Survey (U.S.G.S. who presumably located and reported the occurrence of the deformed materials.

A description of the area of investigation by the U.S.G.S. and by Dr. Easterbrook indicates the presence of a till morainal ridge to the west, and transverse to the road, backed to the east by lacustrine deposits folded into

anticline-syncline deformations. Along the inner flank of the western anticline, multiple faults were observed. In addition, flame structures were present in the syncline and inner flank of the eastern anticline. An auger hole investigation conducted by the U.S.G.S. suggested there might be a displacement of underlying glacial deposits on the order of some seven metres.

The apparent intent of the Bechtel Inc. investigation, as suggested by the data presented, was to determine the continuity of the sub-surface glacial deposits and, by inference, the presence or absence of faulting associated with the Gilligan Creek lineation.

Dr. Easterbrook ascribes the surface morainal ridge a Vashon age and the lacustrine deposits as being of similar recessional Vashon age. In the same report, however, Dr. Easterbrook identifies two sub-surface glacial sequences encountered in auger holes, the lowermost of which he also ascribes to be of contemporary Vashon age without citing additional supporting evidence.

Within the auger hole logs of Bechtel Inc. (report dated December 29, 1978), the lowermost till of Dr. Easterbrook was visually recognized and generally described as "Till: blue-gray diamicton, dense to very dense." Standard penetration test results indicate that after an initial penetration of six inches, hammer blows required to drive

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the split spoon sampler a further twelve inches (N-value) varied between

$$N = 21 \text{ \& } 100^+$$

The mean N-value was 62 blows per foot which tends to confirm the field attribution.

In contrast, Dr. Easterbrook also identified an upper till which in no instance is reported to have been recognized as such in the field. Dr. Easterbrook would appear to have established the existence of the upper till according to the jumping action of the auger bit when gravel and boulders were encountered at an approximately common depth within a bedded silty sand sequence. General auger hole log descriptions for this 'upper till' are "Silty Sand: blue-gray, variously sorted, scattered gravel and cobbles throughout" occasionally with bedded materials. Logged drilling indications (i.e. the jumping action of the rods) for the same horizon range from small gravel to small boulders. Reported standard penetration values fall between

$$N = 8 \text{ \& } 97$$

The mean N-value was 27 blows per foot, less than half that of the recognized lower till. The two highest V-values, viz: $N = 80$ (AH #19) and $N = 97$ (AH #12) are reported from gravel zones and are therefore spuriously high.

Dr. Easterbrook in his analysis of the sub-surface conditions places considerable stress upon the existence of

the "upper till" to demonstrate that tectonic faulting was not the cause of the soil deformations. The auger-hole logs, in contrast, would suggest that, rather than an irregular till horizon v to three meters in thickness, the "upper till" is the fortuitous assemblage of gravel seams and small boulders in a bedded silty sand assemblage. Unless Dr. Easterbrook based his identification of the "upper till" upon data not reported in the quoted sources, it must be concluded that the existence of the "upper till" is unproven.

The continuity of the basal till horizon would appear to have been confirmed within the limitations of the investigations. From the data presented, it must be concluded that any single, large displacement of this horizon, suggested by the U.S.G.S., has been shown to be nonexistent. In contrast, however, the assertion by Dr. Easterbrook that the faulted and deformed sediments do not persist to significant depths below road level due to the presence of the "upper till" cannot be substantiated from the investigation findings.

The sub-surface investigation also has neither proven nor disproven the existence of recent post-glacial faulting within the Lake Cavanaugh Road investigation area. Both Dr. Easterbrook and Bechtel Inc. would appear to have assumed that any recent fault activity would involve the glacial deposits in easily identifiable vertical dislocations, as originally suggested by the U.S.G.S. Such reasoning would

imply that the absence of dramatic evidence of recognizable dislocation would nullify any postulated recent faulting along the Gilligan Creek lineation. The form and method of the investigation confirms that only dramatic evidence was sought. Indeed, using the augering methods adopted, this was the only evidence that could have been identified.

Quaternary faulting reported near Lake Cushman, Washington (Wilson et al. 1979) do offer the dramatic uplifts of up to eight metres. Examination of the published photographs of test trenches excavated across those faults reveals that had they been investigated using core drilling they would probably not have been recognized. In the photograph (Figure 2, A p. 237, loc. cit.) an approximately 3-1/2 metre faulted uplift, had that been core drilled, would have yielded a log:

0.7 m ⁺	Till
1.1 m	Cataclastic rock
0.2 m	Till
1.1 m ⁺	Vitric tuff

With coring breaks, even had the lower till been recovered, the most probable interpretation of such a log would have been a regular till deposit, containing large boulders, overlying a puckered rock surface. In a soil formation composed of silty sands and tills, such as along Lake Cavanaugh Road, such alternating materials would not be identified as evidence of faulting.

In contrast, slip faulting with surface rupturing associated with the California Galway Lake earthquake (Hill & Beeby, 1977) yielded shear planes which would be unrecognizable in any augering investigation. Similarly, in the absence of information other than the results of drilling investigations, such shear planes would be interpreted as soil fissures resulting from dessication, even if advanced sampling techniques were used.

A critical review of the investigation reports of Bechtel Inc. for the Lake Cavanaugh Road Auger-hole study of deformed Pleistocene sediments has neither confirmed nor disproved a tectonic origin for the features observed. The crudity of the augering process adopted would be unlikely to yield unequivocal evidence of even dramatic faulting. Similarly, the auger-hole investigation has yielded insufficient evidence to confirm or disprove alternative origins for the features observed.

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