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Bucket No.

MEMORANDUM FOR: Ronald L. Ballard, Branch Chief  
Technical Review Branch  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards

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THRU: Philip S. Justus, Section Leader  
Geology/Geophysics Section  
Technical Review Branch  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards

(Records WM, 623-SS)

FROM: Harold E. Lefevre  
Keith McConnell  
Geology/Geophysics Section  
Technical Review Branch  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards

SUBJECT: REPORT DESCRIBING ACTIVITIES ASSOCIATED WITH THE SEPTEMBER  
30, 1987 FIELD TRIP TO THE BUREAU OF RECLAMATION'S  
EXPLORATORY TRENCHES NEAR O'SULLIVAN DAM AND AT SMYRNA  
BENCH IN THE SADDLE MOUNTAINS

PLACES VISITED:

O'Sullivan Dam/Potholes Reservoir Area - Located in Grant County on the north  
slope of the Frenchman Hills approximately eleven miles north of Othello,  
Washington. O'Sullivan Dam is about thirty miles northeast of the BWIP's  
Exploratory Shaft site.

Smyrna Bench Segment of the Saddle Mountains - Located in Grant County near  
Smyrna approximately nineteen miles north of the proposed Exploratory  
Shaft site, BWIP.

DATES OF TRIP: September 29 and 30, 1987.

PERSONS PRESENT:

The following organizational representatives participated on one or more  
occasions in the activities/events described in this trip report:

<u>NRC</u>	<u>DOE</u>	<u>WESTINGHOUSE HANFORD (DOE)</u>	<u>YAKIMA NATION</u>
H. Lefevre	A. Lassilla	S. Reidel	Not represented
K. McConnell			

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<u>WESTINGHOUSE HANFORD CONSULTANT (DOE)</u>	<u>LLNL (NRC)</u>	<u>WASHINGTON PUBLIC POWER SUPPLY SYSTEM</u>
D. West (Golder Associates)	R. Galster	W. Kiel
<u>NEZ PERCE AND UMATILLA INDIAN TRIBES CONSULTANT</u>	<u>STATE OF WASHINGTON</u>	<u>BUREAU OF RECLAMATION</u>
M. West	W. Brewer	D. Ostenaar
<u>U.S. GEOLOGICAL SURVEY</u>	<u>BUR REC CONSULTANTS</u>	<u>CENTRAL WASHINGTON UNIVERSITY</u>
J. Yount	R. Bentley M. Schaffer M. West	R. Bentley (NRC consultant)

BACKGROUND AND PURPOSE OF TRIP:

The Bureau of Reclamation, in conducting seismotectonic investigations in the Saddle Mountains and O'Sullivan Dam areas, has found evidence suggesting what may be Late Pleistocene faulting. The site investigations visited on this trip were initiated as a part of the Bureau's Safety of Dam Studies for O'Sullivan Dam. The areas examined, Saddle Mountains (Smyrna Bench) and O'Sullivan Dam (Lind Coulee area of Potholes Reservoir), are approximately 19 miles north and 30 miles northeast, respectively, of the proposed location of the BWIP Exploratory Shaft.

Young faulting in the region surrounding the Basalt Waste Isolation Project is of considerable interest to the NRC Staff because of the apparent similarity of tectonic deformation (folding and faulting style) between the locations investigated by the Bureau in the Saddle Mountains (Smyrna Bench)/ Frenchman Hills (O'Sullivan Dam) areas and the BWIP area (Umtanum Ridge-Gable Mountain/Yakima Ridge).

SUMMARY OF PERTINENT POINTS:

Although investigations are continuing and the report describing their findings is not scheduled for release until early 1988, it is the NRC's impression that the Bureau's preliminary indications are:

- 1) That some faulting in the Lind Coulee portion of the O'Sullivan Dam area may be as young as 13,000 years.
- 2) That the faulting in the Lind Coulee area may involve as much as five meters of displacement in the Pleistocene.
- 3) That direct demonstration (visible evidence of strata offset) of

young faulting was not found in the Saddle Mountains trench (the absence of evidence for young faulting could result as much from difficulties with trench construction as the absence of young faulting).

#### SUMMARY OF ACTIVITIES

##### Supplemental Activities - September 29, 1987:

The day prior to the Bureau of Reclamations' trip, September 29, Harold Lefevre (NRC), Keith McConnell (NRC), and Dick Galster (NRC-LLNL-consultant) traveled with Bill Brewer (State of Washington) to the Sentinel Gap area to inspect features that Dr. Brewer felt might be faults with significance to BWIP. In the afternoon, we met with Dr. Robert Bentley (Central Washington University-NRC/LLNL consultant) for a preparatory field trip to the Smyrna Bench area.

At a pavement exposure in the Columbia River at Sentinel Gap, Dr. Brewer pointed out some north-northwest trending features in basalt. The features appear to be joints of uncertain origin with little to no associated faulting. These features are probably of only minor, if any, importance to BWIP.

Dr. Bentley led an informal trip to Smyrna Bench area to familiarize Lefevre and McConnell on the geology of one area where the Bureau of Reclamation is conducting their neotectonics investigation. Dr. Bentley and several of his students have been working on detailed basalt stratigraphy and structure in the Smyrna Bench area for the last several weeks.

The trip began with an overview of Smyrna Bench from Red Rock Coulee north of Crab Creek and the Saddle Mountains. Generally, Smyrna Bench has two segments (East and West) with the eastern segment at a slightly higher elevation than the western segment. Smyrna Bench is composed of Pleistocene-age fanglomerates of the Ringold Formation and Saddle Mountains Basalt and interbeds.

The trip continued by heading to the eastern end of the western segment of Smyrna Bench and climbing onto the northern face of the bench. Looking south, we observed features which could represent late stage graben-bounding faults. Grolier and Bingham (1978) noted scarps in this area (i.e., bounding Smyrna Bench on the south side) and believed that the sense of shear along these scarps is opposite to that of the main fault. Reidel (BWIP/Westinghouse) interprets these scarp-like features as the result of differential weathering along interbeds in the overturned basalt sequence.

We continued westward along Smyrna Bench stopping at various localities to observe the graben(?) structures on the south side of the bench. The final stop of this day was near the western end of Smyrna Bench where we traversed a small north-trending ridge in which was exposed the frontal fault of the Saddle Mountains structure. We observed Frenchman Springs basalt thrust over fanglomerates of the Ringold Formation.

Bureau of Reclamation Investigations - September 30, 1987O'Sullivan Dam Area

Two trench excavations and three shoreline exposures had been, and are presently continuing to be, examined in considerable detail by contractors to the Bureau of Reclamation in the Lind Coulee/Potholes Reservoir area near the east abutment of O'Sullivan Dam. The trenches, with an effective depth of 6 to 8 feet, were made along the northeasterly-trending,  $\frac{1}{4}$  mile long fault-line scarp. Because of unstable soil conditions and post-faulting disturbances associated with glacial processes, excavations made at the two trenching locations were not successful in demonstrating clear evidence of datable faulting. However, at three natural exposures along the Potholes Reservoir shoreline at the south face of Lind Coulee, evidence of several phases of young (at least Late Pleistocene) faulting was visible. The Bureau of Reclamation has been able to reach preliminary conclusions about faulting in two areas along Lind Coulee - one about two miles to the east of the dam (Area No. 1) with the other approximately one mile east of O'Sullivan Dam (Area No. 2).

In Area No. 1, four locations (two trenches and two natural exposures) along the a northeast-trending fault line scarp were visited and described by Bureau of Reclamation contractor personnel. The trenches, with effective depths of 6 to 8 feet, were made along this one-quarter mile long fault line scarp, but because of post-faulting (principally-glacially related) processes, definitive age relationships (fault plane-bedrock/soil) were not preserved. Therefore only indirect assumptions regarding the timing of deformation could be made from the trenching operations. However, at the two shoreline exposures along the south bank of Lind Coulee provide more definitive information about fault relationships. At these two locations, basalt identified as the Roza member of the Wanapum Basalt has been thrust over loess (Holocene/Pleistocene) and the Pliocene Ringold Formation. The general trend of the faulting is  $N80^{\circ}E$  and the dip is approximately  $38^{\circ}$  to the southeast. Although it is not possible to precisely state the age of the faulting at this preliminary stage of the investigation, the Bureau of Reclamation tentatively suggests a minimum age of 30,000 to 50,000 years for the most recent offset.

The fault relationships examined in Area No. 2 are similar to those observed and described above in Area No. 1. That is, Roza member basalts overlies and displace Quaternary sediments (loess) and the Pliocene Ringold formation. Based upon assumed relationships (volcanic ash and disrupted soil horizons), younger deformation - 13,000 to 35,000 years is being considered at Area No. 2 than at Area No. 1. Soil samples, for radiometric dating purposes have been taken in an attempt to better constrain the fault timing. Likewise, the assumed strike ( $N70^{\circ}W$ ) and dip ( $25^{\circ}$ - $30^{\circ}$  southwest) of the faulting differs from that measured at Area No. 1 (strike of  $N80^{\circ}E$ , dip of  $38^{\circ}$  southeast).

Saddle Mountains-Smyrna Bench Area

One trench approximately 8-12 feet deep was excavated across a very subtle scarp on the northern part of west Smyrna Bench. Aerial photographic investigations of this scarp and several graben(?) features on the south side of Smyrna Bench suggested that recent faulting was present. Grolier and Bingham (1978) had earlier proposed that the scarps and truncated spurs on the south side of Smyrna Bench were the result of near vertical faults related to slumping. The theory being tested in the Bureau of Reclamation's investigation was that the graben(?) structures on the southern part of Smyrna Bench formed as a result of extension in the hanging wall of a young and active thrust fault. The trench was an attempt to expose this thrust which, based on the aerial photography, was believed to be a continuation of the thrust observed on the west end of Smyrna Bench.

The trench on Smyrna Bench exposes 3 to 4 meters of Holocene loess overlying calcareous Pleistocene(?) soil. The Pleistocene(?) soil is locally disrupted with fragments of up to one meter found in the lower part of the loess. The Bureau of Reclamation's consultant (Mike West) suggested that the indurated soils floating in loess may be a tectonic feature, however, Dick Galster (NRC-LLNL consultant) suggested that this feature could result from the normal development of colluvium on a gentle slope. The trench provided no firm evidence for faulting or shearing along the scarp.

NRC STAFF IMPRESSIONS OF THE INVESTIGATIONS AT O'SULLIVAN DAM AND SMYRNA BENCH

The NRC's staff impressions of the Bureau of Reclamation's efforts at the O'Sullivan Dam area and the Smyrna Bench segment of Saddle Mountains are:

1. Multiple phases of Quaternary faulting are probably represented in the O'Sullivan Dam area, with the most recent disruption having occurred as recently as 13,000 years ago in Area No. 2 and somewhat later (30,000 to 50,000 years ago) in Area No. 1. Therefore, the BWIP area is regionally bracketed by areas where there is probable Holocene faulting (i.e., Toppenish Ridge on the southwest; O'Sullivan Dam on the northeast).
2. The results of the investigation at Smyrna Bench were inconclusive with respect to recent faulting. While alternate, non-tectonic, interpretations can explain the features present, their presence approximately 19 miles north of BWIP and their possible implications on the style and timing of deformation in the BWIP area suggest that further investigation is warranted. [Telephone conversations between H. Lefevre (NRC) and Mike West (Bureau of Reclamation consultant) following the field trip indicated that the Bureau of Reclamation would not extend the investigation on Smyrna Bench any further than the work already accomplished.]

3. Conclusions regarding the Bureau's faulting characteristics (including defensible ages, sequence of faulting episodes, amount of offset, etc.) are tentative and subject to the Bureau's on-going investigations (additional field investigations are planned for the O'Sullivan Dam area and dating of selected strata samples from both areas is incomplete at this date). The Bureau of Reclamation's report on these investigations is planned for release in January or February. H. Lefevre is on distribution for this report.

SIGNATURES

DATE

**ORIGINAL SIGNED BY**

**OCT 27 1987**

Harold E. Lefevre

**OCT 27 1987**

**ORIGINAL SIGNED BY**

Keith I. McConnell

REFERENCE CITED

Grolier, M.J., and Bingham, J.W., 1978, Geology of parts of Grant, Adams, and Franklin Counties, East-Central Washington: Washington Department of Natural Resources Bulletin No. 71, 91 p.

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OFFICIAL CONCURRENCE AND DISTRIBUTION RECORD

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