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TRIP REPORT

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

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

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

SUBJECT: REPORT DESCRIBING PROCEEDINGS ASSOCIATED WITH THE CO-SPONSORED (UMATILLA/NEZ PERCE) STRUCTURAL GEOLOGY/PETROLEUM POTENTIAL WORKSHOP HELD AT RICHLAND, WASHINGTON ON OCTOBER 28-29, 1987

PLACE VISITED: Richland, Washington (Shilo Inn Rivershore)

DATES OF TRIP: October 28 and 29, 1987

PERSONS PRESENT:

Representatives of the following organizations participated/attended the workshop:

1. Battelle Northwest Laboratories
2. CERT (Council of Energy Resource Tribes)
3. Department of Energy (part-time attendance)
4. W. E. Mays & Associates
5. Mobil Oil Corporation
6. Nez Perce Tribe
7. Northwest Oil Report
8. U.S. Nuclear Regulatory Commission and Consultants
   a. U.S. Bureau of Mines
   b. Lawrence Livermore National Laboratory
   c. Weston Geophysical Corporation
9. Confederated Tribes of the Umatilla Indian Reservation (CTUIR)
10. U.S. Geological Survey

2818

11. University of Washington at Seattle
12. Washington State, Division of Natural Resources
13. Washington State, Institute for Public Policy
14. Michael West Associates (CERT Consultant)
15. Westinghouse Hanford Company (DOE Contractor)
16. Woodward-Clyde/Mactec
17. Yakima Indian Nation

NOTE: Refer to the incomplete (not all of the attendees signed the register) scratch attendance list included in Attachment "A" for the identification, affiliation and phone number of those attendees documenting their presence.

BACKGROUND AND PURPOSE OF TRIP:

The workshop was organized by the Council of Energy Resource Tribes (CERT) under the sponsorship of the Nez Perce Tribe and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). As stated in the NRC's invitation from CERT, the workshop is to serve "as a technical bridge between several NRC/DOE field trips in the region and a NRC review of the geology of the BWIP project. The workshop is not to be a forum for discussions of political issues or the viability of the high-level nuclear waste repository program."

Actually, the scope of the workshop extended beyond the subjects encompassed in the most recent (August 3-6, 1987) NRC/DOE field trip which focused on stratigraphy, structural geology, neotectonics and deformation rates. In addition to the August field trip topics, the workshop included sessions on subjects such as macro- and microseismicity, geophysical exploration and multiple aspects related to the petroleum potential of the Central Columbia Plateau.

SUMMARY OF WORKSHOP ACTIVITIES:

Many issues, including stratigraphy, neotectonics, and structural geology through seismicity, geophysical exploration needs and the petroleum resource potential were presented and discussed. A concise report encompassing the individual presentations, the group and panel discussions as well as a summary and observations has been received from Richard Galster, consultant to the U.S. NRC's contractor, Lawrence Livermore National Laboratory. Since the NRC concurs with Mr. Galster's summary notes, observations and conclusions there is no need for the NRC to prepare similar workshop notes. Therefore, Mr. Galster's transmittal is being appended as Attachment "A" to the NRC Trip Report.

Mr. Galster's report, in addition to describing the workshop proceedings, includes the agenda, list of attendees and several figures taken from the high-resolution seismic profiling proposal as described by the U.S. Geological Survey's Rufus Catchings.

Highlights, in summary form, of significant matters discussed, both at structured workshop sessions and at informal discussions with workshop attendees follows:

Structural Geology

- Possibility of a graben (extension of the Chiwakum) underlying the Hanford Reservation (R. Catchings, USGS).
- Yakima Barricade feature may be an active fault (K. Fecht, Westinghouse).
- Earthquake swarm events may have a significant influence on the hydrologic regime (S. Malone, University of Washington).
- Constant rates of seismic activity should not be assumed (S. Malone, University of Washington).
- Segmentation may place constraints on the maximum earthquake generated by the Yakima folds (K. Fecht, Westinghouse).

Petroleum Potential

- Deep stratigraphic test well is being considered (Lynn Moses, Westinghouse).
- Seismic reflection studies planned (K. Fecht, Westinghouse).
- Shell's current well in Walla Walla County was recently reported at the 3,600 foot depth (R.Bowen, Northwest Oil Report).
- Structural closure indicates the potential for economical amounts of gas in the Yakima Fold Belt (T. Walsh, Washington State).
- Sub-basalt sediments are the likely source of the natural gas found in most test and water wells (K. Fecht, Westinghouse).
- Because of the lack of known gas deposits and the depth to promising gas-bearing horizons Mobil Oil has no plans for exploration in the Columbia Plateau (P. Spencer, Mobil Oil Company).

PROBLEMS ENCOUNTERED:

Lack of DOE Participation - Experience at this workshop as well as on three previous occasions since September, 1986 (Appendix 7 Assignment of September 8 through 12, 1986; Field Trip of August 2 through 6, 1987; Field Trip (Bureau of Reclamation) of September 30, 1987) indicates that direct participation in the proceedings by the managerial/technical staff

of DOE (as distinct from either contractors or consultants) is less than enthusiastic. As the prospective licensee, only DOE possesses the ability to change or redirect the issue-driven programs and investigations. If not physically present, DOE can not give the proper consideration to the issues (as seen by others) being discussed and, of course, would have no reason to modify its study plans or investigations until much later in the program.

Benefit Gained from Workshop - Taking into account the scope of the workshop topics and the number (17) of participating organizational entities, substantial additional value (in terms of cognizance of the views of many individuals on diverse subjects and consideration of these views for the possible implementation during site characterization activities) could have been derived from the workshop had the DOE staff elected to attend the sessions.

PENDING ACTIONS

Geophysical Exploration - Seismic Reflection - Dr. Sue Price of Westinghouse Hanford Company, DOE's BWIP Contractor, was informed by the NRC that Dr. A. Ibrahim, Staff Geophysicist, had recently examined proprietary reflection seismic records acquired in the Eureka, Washington area, about 45 miles east of the DOE's Hanford Site, by Shell Western Exploration and Production, Incorporated. These processed Shell records are of excellent quality, showing the details of the basalt flows and interbeds. These records are far superior to the processed reflection seismic data available to the DOE in the vicinity of the Basalt Waste Isolation Project. The acquisition of high quality reflection seismic data is essential for site characterization. Based upon Shell's success, the acquisition of such site characterization data at the Hanford Reservation appears promising. The DOE should be informed formally that, based upon Shell's success, in a geologic environment similar to that of the BWIP Site, that it is possible to acquire high quality reflection seismic data, and that the DOE should strive to collect similar quality data. Dr. Ibrahim was informed that Shell's staff is available for consultation by the DOE in the acquisition of high quality seismic data at the Hanford Reservation.

Geophysical Exploration - Full-Wavefield Seismic Profiling - The NRC acquired, through the USGS's Dr. Catchings, a copy of their proposal (high-resolution full wavefield seismic profiling in the Columbia Plateau) which has been submitted to the State of Washington and the DOE for consideration at the BWIP Site and vicinity. As described, this investigation appears to hold great promise for definition of the "shallow (less than 10 kilometer deep) subsurface which is of intense interest for purposes of seismic hazard assessment, nuclear waste isolation, and hydrocarbon exploration." Because of the confidence expressed by the USGS proposer in the potential success of this technique

and the clear, timely need for such quality information in the BWIP area, coupled with a relatively low data acquisition cost (approximately $1,600 per mile), NRC's consultant (Weston Geophysical Corporation) has been requested (because of Weston's extensive nuclear power plant-related experience on the Hanford Site) to conduct a review of the USGS proposal, pointing out both merits and shortcomings of the proposal in order to possibly expedite DOE's consideration of this technique at the BWIP site. Following NRC's evaluation of the proposal, discussions are planned with the USGS wherein suggested modifications of the technique will most likely be proposed to the USGS in order to improve the chances of the technique's success at the BWIP Site. NRC intends to inform (and perhaps directly involve) both the DOE and the State of Washington of our interactions with the U.S. Geological Survey. Assuming that the acquisition of valuable data through this modified technique appears promising, NRC will make appropriate suggestions, encouraging DOE to consider employment of this technique at the Hanford Site.

RECOMMENDATIONS:

1) DOE should be advised that, since high quality seismic reflection data has been obtained by commercial interest near the Hanford Site, that similar high quality data be acquired by the DOE. Rather than develop the processing expertise internally, DOE should be encouraged to consult, perhaps actively involve, commercial firms presently conducting such investigations in the site region.

2) DOE should be encouraged (in order to permit early identification of possible site disqualifiers) to give serious consideration to the U.S. Geological Survey's high-resolution full-wavefield seismic profiling technique as proposed by Dr. Catchings as an aid in the determination of the preferred structural model and assessment of the seismic potential in the Hanford area.

TRAVELER'S SIGNATURE

/S/
Harold E. Lefevre

DATE

NOV 19 1987

Attachment:

Attachment A - R. Galster's Trip Report

ATTACHMENT "A"

RICHARD W. GALSTER
Consulting Engineering Geologist

18233 - 13th Avenue Northwest
Seattle, Washington 98177
Telephone: (206) 542-2596

Trip Report -- Council of Energy Resource Tribes (CERT)

Workshop on Central Columbia Plateau

Structural Geology and Petroleum Potential,

28-29 October 1987

1. Pursuant to verbal requests from Messrs. D. H. Chung and H. L. McKague on 15 Oct. 1987, I attended the subject workshop with H. E. LeFevre of NRC. The meeting was also attended by NRC consultant E. M. Levine of Weston Geophysical. A final program, with annotated modifications, and an incomplete scratch list of attendees are attached (Attachments 1 and 2). The format of the workshop consisted of formal presentations during the morning sessions followed by panel and group discussion during afternoon sessions. The format proved to be most appropriate and encouraged considerable group participation. A summary of important points covered by the formal presentations and group discussions follows.

2. Structural Geology sessions

a. Bond's presentation was a general review of the stratigraphy, structure and western Cordillera Tertiary plate interactions. Nothing new was suggested.

b. Fecht reviewed the concepts of the Plateau tectonics developed by the BWIP staff and others over the past several years. He indicated that stratigraphic relationships have been established by about 200 sections measured in the Grande Ronde and 200 sections in the Wanapum, including chemical analysis from most sections. Fecht indicated that MT data suggests that both the Columbia River Basalt (CRB) and underlying Tertiary sediments thicken within the Yakima Fold Belt (YFB) as compared with the Palouse Slope region with thicknesses of CRB in the Pasco Basin on the order of 13,000 ft. He noted a thinning of the CRB to 11,000 ft across the Rattlesnake structure and suggested that this together with isopach data developed by BWIP (Myers and Price, 1979) indicates that deformation is coeval with CRB volcanism.

Fecht noted that a major zone of low resistivity in the Shell BN 1-9 (Saddle Mountains) well beetween 6500 and 8000 ft had been interpreted as a major fault, possibly the Saddle Mountains Fault. If so, it would constrain the dip of the fault to greater than 45 degrees. However there was no repeat of chemistry in the well. The conclusion was that the zone did not represent a fault zone. Fecht further noted a similar zone in RSH-1 (Rattlesnake) without a confirmed fault zone.

c. Canard presented a highly interpretive cross section (prepared for CERT) starting at the Yakima Minerals well and passing successively through the BISSA (Whiskey Dick), Shell BN well (Saddle Mountains), Gable Mountain and RSH-1 (Rattlesnake). The section showed the Entiat? Fault passing between the BISSA and BN wells. Canard noted that in the BISSA well gas shows were found in Eocene? sandstone below coal beds and that the well bottomed in granite at 14,900 ft. He reviewed the problems of lost circulation in the Shell BN well including heavy water flow at 2600 ft, loss of casing cement at 1800 ft and general openness of the basalt section to its base at 11,500 ft. He further noted coal and gas shows in the underlying sediments and that the (granite) basement was not reached when the well bottomed at 17,000 ft. Canard further noted similar heavy circulation loss in the Rattlesnake (RSH-1) well together with the presence of coal and gas within the basalt section and the possible structural complexity indicated by dip meter surveys.

Canard suggested that the thrust faults are asymptotic features perhaps dying out in the coal measures. He admitted that the cross section was speculative but because of gas shows in most of the deep holes in the Pasco Basin, he advocated a deep stratigraphic test.

d. Alan Rohay (Westinghouse Hanford) gave a very forthright presentation on instrumental seismicity of the region. He indicated some seismicity relating to mapped structures, but that there is much seismicity which does not. Many clusters (swarms) are seen in the Pasco Basin with major clusters east and southeast of the Saddle Mountains and on the eastern Royal Slope. Fault plane solutions indicate reverse faulting at depths of less than 3 km. Rohay's conclusion is that there is a relatively high incidence of low magnitude seismicity in the basalt, a moderate amount in the underlying sediments with the basement characterized as nearly aseismic. Rohay's data indicated a defuse seismicity along the Rattlesnake - Wallula lineament (RAW). Rohay further reviewed the difference in fault plane solutions in the Central Plateau (reverse), southern Cascades (dextral strike-slip) and the Walla Walla-Milton Freewater area (mixed).

e. The panel and group discussion relating to adequacy of structural models appeared to beg the question, and perhaps rightly so. The question of the kinematics of plate interaction producing N-S compression was not thoroughly discussed. The discussion on neotectonics research needs was included.

West indicated that there is definite evidence for post-Pliocene deformation in the Frenchman Hills-Saddle Mountains areas and that major E-W faults appear to steepen with depth. He also indicated a gross association of seismicity with structure and the possibility of seismicity being associated with segmentation of the long E-W structures.

Fecht indicated that the E-W structures are not deep rooted and that a more comprehensive geophysical investigation program is required on a regional basis to better understand sub-basalt structures. In addition a more detailed surface mapping of structures is required. There is a

definite need to better understand structures in areas away from the (Hanford) site. Fecht, responding to questions relating to trenching of segmenting (cross) faults, reviewed the Gable Mountain trenching where 12-20 ka glacio-fluvial offset may not be tectonic in origin. He indicated a cross fault in Rattlesnake Mountain where the presence of glacio-fluvial and Ringold deposits would provide an excellent trenching target. None of the cross faults in the Saddle Mountains have been trenched by BWIP. Fecht also suggested that the Yakima Barricade Fault may need to be considered capable or active. The possibility of a deep stratigraphic test is the Pasco Basin is being considered.

f. The panel and group discussion on seismicity surfaced a number of potentially important items.

Malone (University of Washington) immediately answered the question under discussion by indicating that small seismic events, even low magnitude swarms, may be a significant influence on the hydrologic system. He pointed out that swarm activity appears unique to the central Plateau as opposed to non-swarm activity on the Cascade flank and the random, isolated events of the Chelan area where 0-10 km depth activity in the crystalline basement show NW-SE compressional axes. Malone further pointed out that seismic rates have been observed to change in China over periods of 100 to 1000 years, and that it is not logical to assume constant seismic rates.

Fecht discussed limitations on maximum seismic events generated by the Yakima folds due to fold segmentation, pointing out that the Toppenish structure is not segmented and, therefore, may have a slightly higher potential event.

Fecht was critical of using displacement in Touchet beds as evidence of post-glacial fault displacement along CLEW, citing evidence for displacement in areas clearly not near known faults.

The question of use of "floating" earthquakes was discussed with respect to plateau swarms and events such as the Milton Freewater 1936 earthquake. Rohay indicated discomfort in defending the placement of earthquakes on mapped structures using present data and suggesting a maximum of magnitude 4.5 for swarm events on "unknown" structures. It was suggested that the NW-SE trend of seismic clusters from Royal Slope to east of White Bluffs may represent the boundary between the thinner basalt of the Palouse Slope to the east and the thicker basin basalt area to the southwest. The possibility of irrigation water influencing the swarm seismicity was discussed with little conclusion.

West summarized the search for evidence on neotectonics by emphasizing the need to investigate the areas where best evidence is likely to occur, regardless of the location with respect to any given site, in lieu of investigating more proximal areas which perhaps may have less significant evidence.

3. Petroleum Potential Sessions

a. Bond reviewed the basics of oil and gas generation in terms of parent sediments, their generating capacity and the geochemistry of oil and gas generation from marine sediments, the series of biogenic gas -- petroleum -- thermal gas, depending on maturity of sediments being an important factor. He emphasized the marine environment of the Cretaceous-Tertiary sediments within the Columbia Arc (south of the OWL) and reviewed the position of the wells drilled thus far.

b. Faley discussed the history and demographics of oil and gas leasing on the Columbia Plateau. He noted that the history of oil and gas leasing began between 1901-1906 with spaced periods of activity in the 1920s and 1930s, the "modern leasing" era beginning in the 1950s. He noted migration of leasing south into north-central Oregon and east into the southeast counties of Washington. Noted further that most leases are for 10 year period and present leasing costs are about $19/acre.

c. Bowen reviewed the history of oil and gas exploration on the Columbia Plateau which may be summarized as follows:

(1) Between 1913 and 1917 numerous wells were drilled in the Rattlesnake gas field. Between 1929 and 1941 the field furnished gas to Prosser via pipeline. Individual wells were reported to yield 100,000 to 3 million cfd of low pressure gas from within the basalt, probably leakage from deeper zones in the fractured basalt along the crest of the Rattlesnake Anticline.

(2) During the mid- to late-1950s, the Standard Rattlesnake (RSH-1) was drilled to a depth of 16,655 ft without penetrating the base of the basalt, and Standard Kirkpatrick was drilled in Morrow County, OR to an approximate depth of 8,000 ft, penetrating 4,000 ft of basalt and 4,000 ft of sediments including John Day, Carno and Mesozoic marine sediemtns.

(3) Shells Yakima Minerals #1 was drilled in 1981 at a site near Roza Dam on the Yakima River to a depth of 16,199 ft. It penetrated about 5,000 ft of basalt underlain by more than 11,000 ft of sediments. Although the sediments were quite tight, a few gas shows in the sediments yielded a total of 1.5 million cfd, not an economical quantity. A second nearby well was drilled into the upper sediments (5,604 ft depth) and encountered only minor gas.

(4) Shell's second effort was the BISSA Well drilled in 1983 to a depth of 14,960 ft from a site on Whiskey Dick Mountain between Vantage and Ellensburg. The well penetrated about 4,500 ft of basalt and more than 10,000 ft of sediments before encountering the granitic basement. Only minor gas flows were encountered.

(5) The third Shell effort was the 1-9 BN well drilled in 1985 from a site on the crest of the Saddle Mountains. The well penetrated 11,480 ft of basalt and about 5,000 ft of underlying sediments. Zones at

12,000 and 15,000 ft were reported to produce the best gas flows after acidizing though the reservoirs appeared small. At about 13,000 ft a 16-ft zone produced a minor amount of gas and petroleum condensate. The well has now been abandoned.

(6) Shell is currently drilling the Darcell Western No. 1 on the south side of the Snake River in Walla Walla County. This is the first location sited entirely on the basis of geophysics. The well was recently reported at a depth of 3,600 ft with the expectation of drilling to 15,000 ft, 8,000 ft in basalt and 7,000 ft in sediments.

(7) An additional exploration well is reported to be in the planning stage near Standard Kirkpatrick in Morrow County, OR. This would further investigate the deep sedimentary basin believed located beneath the basalt on the north flank of the Blue Mountains uplift.

d. Lynn Moses (Westinghouse Hanford) presented the general format of a study plan for assessing the petroleum potential on the Hanford Reservation, presumably work to be done during site characterization for the waste repository. The features of the study plan include:

(1) an integrated geological-geophysical approach to the stratigraphy and structure,

(2) identification of potential reservoirs based on margin geology,

(3) obtaining and assessing porosity and permeability data,

(4) evaluating source rocks for organiz carbons, kerogen, Vitrimite reflectance, level of maturity, and thermal history,

(5) researching shut down Rattlesnake gas field to determine whether the gas is biogenic or thermalgenic in nature, and its possible source.

A deep stratigraphic test is under consideration and additional geophysical investigations planned, coordinated with the structural geology study plan.

e. Rufus Catching (USGS) presented results of a 1984 long-range seismic refraction/wide-angle reflection investigation across the plateau. The data revealed eight major velocity zones to a depth of more than 40 km (attachments 3 and 4). Catching noted the unusual graben (rift-like) structure within the sub-basalt sediment layer (layer 3) beneath and south of the Hanford Reservation. A major rise in the granitic? basement (layer 6) beneath the same portion of the profile was noted. He suggested the possibility of the graben being an extension of the Chiwaukum Graben but indicated additional lines would be necessary to confirm or deny this relationship. The 1984 profile was 260 km long with shot points at 50 km intervals. He reviewed the problems and methods of deep seismic profiling, the necessity of using high frequency energy and much shorter shot point

intervals. A formal proposal has been submitted recently to Washington Department of Natural Resources and Westinghouse Hanford to accomplish the additional profiling (enclosure 1).

f. Canard completed the formal presentations with a discussion of the abundance of gas shows in wells on the Hanford Reservation. Without providing details he indicated that drilling records of borings DC-1, WW-6, Bensen Ranch, DC-19, DC-16, RRL-2 and DH-24 all had gas shows. Much of his information was based on a three-day search of the drilling files. He further emphasized the frequency of faulting in the basin and suggested that such shows are following fault and fracture zones in the basalt.

g. The panel and group discussions for questions shown on the program were combined. Important points may be summarized as follows:

(1) Walsh (WDNR) pointed out that some structures in the YFB could have the potential of 1 trillion cf of gas based on available structural closure but indicated that they have thus far been found wanting. He further indicated that well data thus far suggests immature sediments beneath the CRB which are likely to be more gas-prone than oil-prone.

(2) Catching (USGS) believes that data shows an ancient rift system and that depth of burial is great enough for mature sediments. He noted that the apparent graben in the sedimentary layer included the section of the seismic profile from near the Saddle Mountains on the NE to the Horse Heaven Hills on the SW.

(3) Fecht (Westinghouse Hanford) noted that gas is very common in wells drilled in basalt throughout the Plateau, even on the Palouse Slope. He suggested that the origin of such gas is probably due to upward seepage from sub-basalt sediments through the jointed basalt. Fecht further indicated the uniqueness of the Rattlesnake gas field trap in that gas came from the Priest Rapids Basalt beneath a Mabton Interbed cap. He further suggested a possible surface expression of a graben between the basin edge on the east and the Hog Ranch uplift on the west, similar to the N-S "graben" proposed by Davis (1981). He also noted that the present drilling in Walla Walla County lies between the Ice Harbor and Wanapum dike systems.

(4) Phil Spencer (Mobil) indicated that his company has no plans to explore the plateau but is keeping cognizant of activities of Shell. He emphasized that neither sources or reservoirs are known, that the basalt is not likely to be an economic source of gas or oil and the sub-basalt sediments are generally too deep to be economical in the near term. Spencer suggested that the basin (Plateau) margins would likely be more attractive targets.

(5) The consensus of the combined panel on needed research included:

(a) Detailed refraction/reflection seismic surveys to prove out what structures are in the sediments beneath the basalt, and

(b) determination of whether the gas found in the basalt is biogenic or thermogenic

4. Observations

a. The seismic profiling proposed by Catchings appears to have considerable promise in establishing gross details of the sub-basalt crustal structure. This would be extremely helpful for confirming structural models for the Yakima Fold Belt and may help provide answers on the "thick skin" - "thin skin" controversy.

b. The occurrence of gas in the basalt is most likely related to upward migration from sub-basalt sediments through the strongly vertically jointed basalt. The frequency of fine-grained interbeds high in the basalt section could well produce a multitude of small gas traps. The likelihood of large commercial quantities from such sources appears remote. This does not preclude the utilization of such resources for individual domestic use.

c. The maturity of potential source rock (sediments beneath the CRB) and their thermal and genetic history is not well constrained by present data. This has an important bearing on the hydrocarbon potential, equally with the understanding of the sub-basalt structure.

STRUCTURAL GEOLOGY OF THE CENTRAL COLUMBIA PLATEAU
Steve Hart, CERT, Moderator

WEDNESDAY MORNING, OCTOBER 28

8:30- 9:00	Registration ($15.00 per participant)	
9:00- 9:15	Welcome by Sponsors	Steve Hart, CERT
9:15- 9:45	Columbia Plateau Structural Evolution	John Bond, Geoscience Research
9:45-10:15	Tectonic Development, Central Columbia Plateau	Karl Fecht, Westinghouse
10:15-10:30	Break	
10:30-11:00	Tribal Cross-Section, Central Columbia Plateau	Curtis Canard, CERT consultant
11:00-11:30	Columbia Plateau Microseismicity	Alan Rohay, Westinghouse
11:30- 1:00	Lunch - buffet provided	

WEDNESDAY AFTERNOON, OCTOBER 28

1:00- 1:15	Introduction to panel discussions	Steve Hart, CERT
1:15- 2:15	Panel Discussion: Are current structural models of central Plateau adequate?	John Bond, Moderator Mike West, M.W. West Assoc. Karl Fecht
2:15- 2:30	Break	
2:30- 3:30	Panel Discussion: Are major seismic events possible in the central Plateau in next 100 years?	Mike West ~~Dave Bohlen~~, Moderator Stephen Malone, U of WA Alan Rohay
3:30- 4:30	Group Discussion: What specific research in neotectonics of Plateau is needed?	Steve Hart, Moderator Panel of speakers Audience
4:30- 5:00	Session Summary	Steve Hart

ATTACHMENT 1a

PETROLEUM POTENTIAL OF THE CENTRAL COLUMBIA PLATEAU
John Bond, Geoscience Research, Moderator

THURSDAY MORNING, OCTOBER 29

9:00- 9:15	Introduction	John Bond
9:15- 9:45	Oil & Gas Leases in Central Plateau	David Foley, W.E. Hays & Associates
9:45-10:15	Oil & Gas Exploration in Central Plateau	Richard Bowen, NW Oil Report
10:15-10:30	Break	
10:30-10:45	Hanford Petroleum Potential--Plans	Lynn Moses, Westinghouse
10:45-11:15	High-Res., Full-Wave Field Seismic Profile	Rufus Catching, USGS
11:15-11:45	Tribal Borehole Study	Curtis Canard
11:45- 1:00	Lunch - buffet provided	

THURSDAY AFTERNOON, OCTOBER 29

1:00- 1:15	Introduction to panel discussions	John Bond
1:15- 2:15	Panel Discussion: Is the central Plateau the next "Overthrust Belt"?	~~Newell Campbell~~, Moderator Karl Fecht Curtis Canard
2:15- 2:30	Break	
2:30- 3:30	Panel Discussion: Could economic oil & gas resources be located at Hanford?	Curtis Canard, Moderator Tim Walsh, WA Dept. Nat. Res. Rufus Catching Lynn Moses
3:30- 4:30	Group Discussion: What specific research is needed to determine oil and gas potential of central Plateau?	John Bond, Moderator Panel of speakers Audience
4:30- 5:00	Meeting Summary	John Bond Steve Hart

Continued

ATTACHMENT 16

10/28/87

List of attendees:

Name	Affiliation	City	Phone
Steve Hart	Council of Energy Res. Tribes	Denver	(303) 832-6600
Steve Malone	U of W Geophysics AK-50	Seattle	206-545-381
Richard W. Galster	Consulting Engng Geologist	Seattle	(206) 542-2596
Floyd L. Kuqzruk	Nez Perce Tribe	Lapwai, ID	(208) 843-2253
Ellen Caywood	Wash. State Institute for Public Policy	Olympia	(206) 866-6000 ext 6454
Mihai Pupeza	Umatilla - Nucl. Waste Study Program	Pendleton, OR	(503) 276-3018
Edward N. Levine	Weston Geophysical Corp (Consultant to NRC)	Westboro MA	(617) 366-9191
Abdul Alkezweeny	CTUIR/Nez Perce		(509) 943-5331
James Springer	Mactec/Woodward-Clyde	Richland	(509) 376-2444
R.W. Wallace	Battelle	Richland	(509) 376-8302
John Bond	Geoscience Research	Moscow Id	(208) 882 7499
Patricia McGee	EWA/YIN	MPLS, MN	(612) 332-0000
Timothy Walsh	WA DNR	Olympia WA	(206) 459-6372
Curtis Canard	Consulting for CERT	Tulsa, OK	918-493-1172
Harold Lefevre	US NRC	Wash., D.C.	(301) 427-4582
Karl R Fecht	Westinghouse	Richland	509-376-4047
Michael West 10/29/87	Michael West + Assoc.	Denver	(303) 972-1537
Russell G. Raney	U.S. Bureau of Mines (WFOC)	Spokane	(509) 456-5350
Richard Bowen	N.W. Oil Report	Portland	(503) 223-4139
Grant M. Valentine	Consultant	Olympia	(206) 866-0913
Steve Armstrong	YIN	Toppenish	865 5121 x 1676
David Faley	WE Myers Assoc.	Ellensburg	962-2644
Larry Calkins	CTUIR	Pendleton OR	503-276-3018
James Consort	Woodward Clyde	Richland, WA	509-3767642
Brian Dick	Mactec/Woodward-Clyde	Richland Wa	(509) 376-7486
Phil Spencer	Mobil Oil Corp.	Denver, CO	(303) 298-2555
Floyd L. Kuqzruk	Nez Perce	PO Box 305 Lapwai ID	(208) 843-2253
Rufus Catchings	USGS	Menlo Park, CA	(415) 329-4749

ATTACHMENT 2

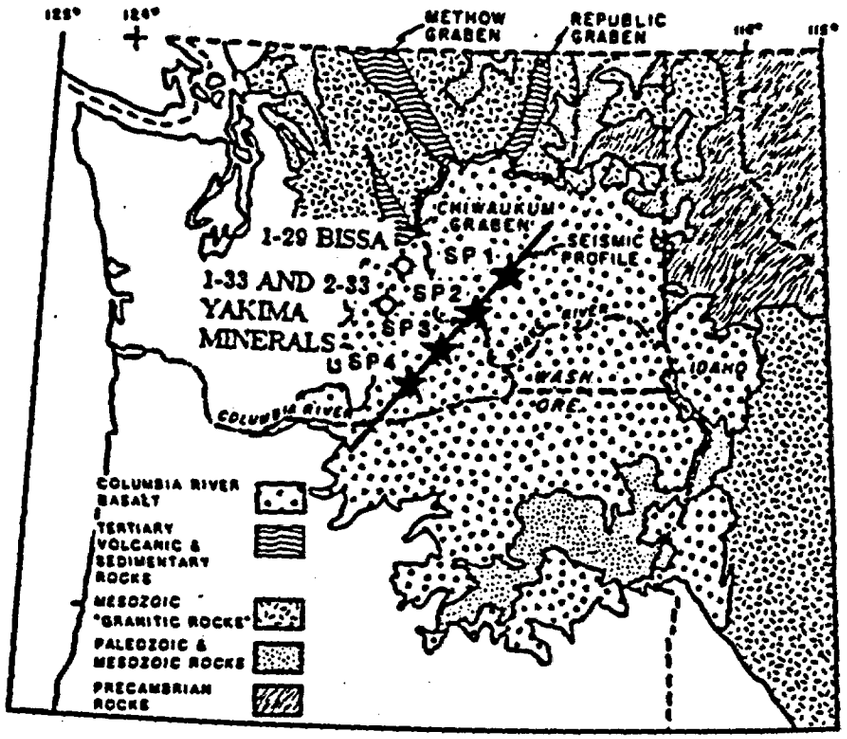

Figure 1: Location map for the Columbia Plateau (defined by the Columbia River basalts) of Washington, Oregon, and Idaho. The generalized surface geology of surrounding regions is also shown (after Gresens and Stewart, 1981). The bold, straight line corresponds to the 1984 seismic profile (SP = shot point). Note the location of the Shell Oil Company 1-33 Yakima Minerals, 2-33 Yakima Minerals, and 1-29 Bissa wells.

ATTACHMENT 3

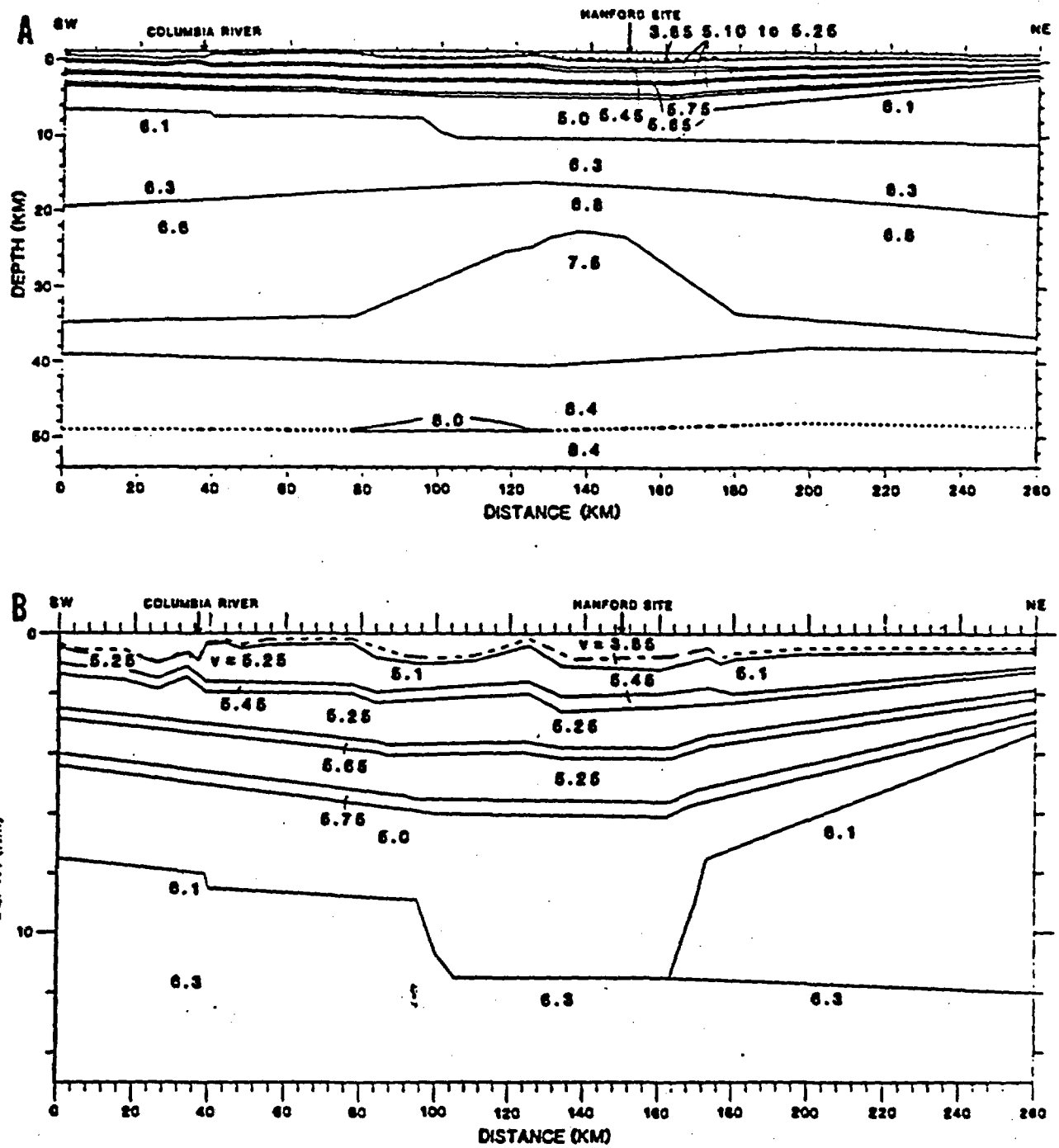

Figure 5: Large-scale average crustal model derived from the 1984 USGS Columbia Plateau seismic refraction data (from Catchings and Mooney, 1987a). Compressional velocities are indicated in km/s. (a) Entire model shown relative to a datum 1 km above sea level and with a vertical exaggeration of two to one. Note the rift-like characteristics of the crust (e.g. high velocities and unusual structure of the lower crust, shallow graben structures, etc.). (b) Same as (a), except only the upper 15 km of the crustal model is shown. Depth is relative to a datum 1 km above sea level, and vertical exaggeration is eight to one. Note the graben structure and the interlayered high- and low-velocity zones within the CRBG with average velocities much like those observed in sonic logs from boreholes in the Columbia Plateau.

ATTACHMENT 4

101.4 PDR-1
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Technical-Review Branch
Division of High Level Waste Management

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

FROM: Harold E. Lefevre, Geologist
Geology-Geophysics Section
Technical Review Branch
Division of High-Level Waste Management

SUBJECT: REPORT DESCRIBING PROCEEDINGS ASSOCIATED WITH THE CO-SPONSORED (UMATILLA/NEZ PERCE) STRUCTURAL GEOLOGY/PETROLEUM POTENTIAL WORKSHOP HELD AT RICHLAND, WASHINGTON ON OCTOBER 28-29, 1987

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