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In reply, refer to letter R86-3497

Mr. O. L. Olson, Director
Basalt Waste Isolation Division
Department of Energy
Richland Operations Office
Richland, Washington 99352

Dear Mr. Olson:

NUCLEAR REGULATORY COMMISSION REQUEST FOR BASALT WASTE ISOLATION PROJECT GEOLOGICAL DATA
(Contract DE-AC06-77RL01030)

My staff is submitting, under separate cover, the following items requested by the Nuclear Regulatory Commission:

(1) One Mylar copy of "Structural and Tectonic Map of the Columbia Plateau," SD-BWI-TI-320

(2) Supporting Document SD-BWI-TI-293, "Preliminary Stratigraphic and Structural Model of the Reference Repository Location, Hanford Site"

(3) Mylar copies of the cross sections from Data Package SD-BWI-DP-039, "Suprabasalt Stratigraphy Within and Adjacent to the Reference Repository Location"

(4) Enlargement (11x17) of Table 3.5, "Characteristics of Folds and Faults Within or Near the Pasco Basin," from the Environmental Assessment, Reference Repository Location, Hanford Site, Washington, Volume 1

(5) Mylar enlargement of Figure 3-19 from the Environmental Assessment, Reference Repository Location, Hanford Site, Volume 1

If there are questions, please contact T. A. Curran (6-6903) of my staff.

Very truly yours,

D. C. Gibbs, Director
Basalt Waste Isolation Project

DCG/DLB/jah

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WM Project 10
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Maps are located in the Map Library

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 1 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Saddle Mountains anticline		1	26	110	Asymmetric, amplitude to 600 m, plunges to E., E.-SE. trend, gentle to open, box fold in part, faulted on north side, second-order folds trend E.-W. to NW.-SE.					Myers, Price et al. (1979), Price (1982), Reidel (1978, 1984)
	Related folds or structure	1a-1p	23	3-11						
	Saddle Mountains fault	2	29			>40	E.-W./45° or less west side Sentinel Gap; 45° at Smyrna Bench	Reverse fault at base of the Saddle Mountains structure. Maximum stratigraphic displacement 600 m; maximum shortening 3 km on west side of Sentinel Gap	<10.5 m.y.	Reidel (1978, 1984), Grolier and Bingham (1978)
	Smyrna fault	3	26			2	NW./vertical	Tear fault that separates Smyrna Bench and Sentinel Gap segments of Saddle Mountains	<10.5 m.y.	Reidel (1978, 1984)
	Hansen Creek fault	4	29			~5	E.-W./S.	Interpreted to be a high-angle reverse fault, displaces Priest Rapids against Frenchman Springs flows	<14 m.y.	Bentley (1977), Myers, Price et al. (1979)
	Unnamed faults	5a-5h	23			4-5	E.-W./ unknown and N.-S./ unknown	High-angle normal; high-angle reversed; tear faults. See Grolier and Bingham (1971) for alternative mapping; superseded by Reidel (1984)	<12 m.y.	Myers, Price et al. (1979), Reidel (1984)

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 2 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Saddle Mountains anticline (cont.)	Related folds on south side of structure	6a-6c	34	3	Low amplitude <30 m; >1-km wavelength					Reidel (1984)
Umtanum Ridge-Gable Mountain structure		7	3	130	Asymmetric, E.-W. trend, first-order fold, segmented, plunging at east end, open to tight					Myers, Price et al. (1979), PSPL (1982)
	Folds related to Umtanum Ridge	7a-7p	2	2-5	Asymmetric, amplitude to 750 m, variable plunge, E.-W. to W.-NW., E.-SE. trend, open to tight, box fold in parts					Goff (1981), Myers, Price et al. (1979), Price (1982)
	Umtanum fault and fault zone	8 8b-8e	18			>12	N. 60° W./30° to 40°S.	Reverse, dip-slip, displacement on order of 150 m vertical and 300 m horizontal	>13,000 yr B.P.	Goff and Myers (1978), Price (1982), PSPL (1982)
	North reverse fault	8a	24			1.5	NW./inferred toward S.	Reverse, inferred	Post-Wanapum Basalt/pre-Ellensburg growth	PSPL (1982)
	Reverse (?) fault	8b	18			Un-known	Unknown	Reverse, inferred	<14 m.y.	PSPL (1982)
	Twin fault	8c	21			>0.6	NE./ unknown	Interpreted to be tear fault within Umtanum anticline	<14 m.y.	Myers, Price et al. (1979), PSPL (1982)
	Buck thrust	8d	19			2.6	N. 50°-N. 80° W./gently NE.	Thrust, zone 9 to 15 m thick, dies out in Umtanum anticline, 250-m displacement	<15.5 m.y.	Price (1982)
	Upper reverse	8e	21			~2.4	N. 60°E./S.	Thrust, similar to Buck thrust	<15.5 m.y.	PSPL (1982)

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 3 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Umtanum Ridge-Gable Mountain structure (cont.)	Umtanum Ridge cross faults	9a-9i	8			<1	NW.-SE. and N.-S./ unknown	All normal cross faults of the Umtanum anticline, displacements of a few meters	<12 m.y.	Goff (1981)
		9j	27			7 km		Tear fault		Swanson et al. (1979a)
	Folds related to Gable Butte	7a-7f	2	1-5	Symmetric, amplitude to 150 m, generally plunge to SE., W.-NW., E.-SE. to E.-NE., W.-SW. trend, open, rounded hinges					Fecht (1978), PSPL (1982)
	Folds related to Gable Mountain	7g-7l	5	≤13	Asymmetric to symmetric, amplitude to 300 m, most plunge to SE., W.-NW., E.-SE. to NW.-SE. trend, open to tight, rounded to angular hinges					Fecht (1978), PSPL (1982)
	West fault, Gable Mountain	7m	5			~0.8	N. 34°E./ steeply W.	Normal, stratigraphic throw <5 m	<10.5 m.y.	Fecht (1978), PSPL (1982)
	Central fault, Gable Mountain	7n	8			<3.2	N. 55°E./30°S.	Reverse, 50-m dip-slip displacement, variable displacement with depth	13,000 yr B.P.	Fecht (1978), PSPL (1982)
	South fault, Gable Mountain	7o	13			≤1.2	E.-W./35° to 40°S.	Reverse, displacement 12 m	<10.5 m.y.	PSPL (1982)
	North-dipping fault, Gable Mountain	7p	6			Unknown	N. 65°W./ 13°N.	Reverse, 9.1 to 15.2 m wide in drill holes, stratigraphic throw 98 m	<10.5 m.y.	PSPL (1982)

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 4 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Umtanum Ridge-Gable Mountain structure (cont.)	DB-10 (upper) fault	7q	8			0.8	Due S./25° to 45°W.	Reverse, dip-slip, ~55-m displacement 2 m wide in drillhole	<10.5 m.y.	Myers, Price et al. (1979), PSPL (1982)
	Southeast anticline fault	7r	14			Un-known	N.39°W./ 30°SW.	Reverse fault based on borehole data	>730,000 yr B.P.	PSPL (1982)
Yakima Ridge anticline	Cairn Hope Peak anticline and related folds	10a-10k	2	≤75	Asymmetric, SE. plunge, W.-NW.-E.-SE. trend, E. end buried by sediments, eastern exposed part is series of an echelon, doubly plunging, asymmetric folds					Bond et al. (1978), Goff (1981), Myers, Price et al. (1979), Cochran (1982)
	Silver Dollar fault	11	11			~7	W.-NW./ unknown	Interpreted to be high-angle-reverse fault (or normal), zone width 50 to 70 m, displaces Frenchman Springs Member against Umatilla and Pomona Members	<14 m.y.	Goff (1981), Myers, Price et al. (1979)
	Other Yakima Ridge faults	12a-12f	3			≤1	Variable	Reverse and tear faults; small faults associated with larger folds	<10.5 m.y.	Myers, Price et al. (1979)
Rattlesnake Hills-Rattlesnake Mountain uplift	Rattlesnake anticline, western segment	13, 13a-13j	11 8	56	Asymmetric, E.-W. trend, tight, rounded hinge, numerous second-order folds on hinge and crest					Bond et al. (1978), Myers, Price et al. (1979)
	Rattlesnake anticline, eastern segment	14a-14l	14	70	Asymmetric, NW.-trending series of doubly plunging, slightly en echelon, locally faulted folds. #14a is asymmetric, amplitude 350 m NW. trend, and faulted on north side					Bond et al. (1978), Jones and Landon (1978), Myers, Price et al. (1979)

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 5 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Rattlesnake Hills-Rattlesnake Mountain uplift (cont.)	Rattlesnake anticline, second-order folds on south limb	15a-15i	24	5 to 16	Variable plunge and trend					Bond et al. (1978), Myers, Price et al. (1979)
	Faults of western Rattlesnake Hills		18			<2	N.-S. and NW.-SE./ unknown	Minor dip-slip cross faults associated with larger anticlines. Displacements in tens of meters	<10.5 m.y.	Myers, Price et al. (1979)
	Maiden Springs fault	16c	29			~2.5	Unknown	Inferred, high-angle-reverse fault with 45 to 60 m displacement	<10.5 m.y.	Bond et al. (1978)
	Twenty-Nine-Thirty-Six fault	16g	13			4	N.-S./vertical	Scissor fault, west side up, 90 m displacement	<10.5 m.y.	Bond et al. (1978)
	Fault of central Rattlesnake Hills	16h	10			1.5	NW./ unknown	Vertically juxtaposes Priest Rapids and Pomona basalts	<10.5 m.y.	Bond et al. (1978)
	Thrust faults of Snively Basin area	16i-16k	7			>1	NW.-SE./ moderate	Not exposed, but Saddle Mountains Basalt section is repeated three times vertically with angular discordance at lower fault	<10.5 m.y.	Myers, Price et al. (1979)
	Rattlesnake Mountain fault	18	11			16 km	N.50°W./ steep	Probably reverse, 400 m vertical displacement, zone 100 m wide, includes upper local fault, dies out into Rattlesnake Mountain anticline to SE. Appears to merge with faults of Snively Basin	<10.5 m.y.	Bond et al. (1978), Myers (1981)

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 6 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Rattlesnake Hills-Rattlesnake Mountain uplift (cont.)	Rattlesnake Springs fault	12d	3			~1.5	N.-NE./ unknown	Inferred fault to account for geometry change of Yakima Ridge strike-slip	<10.5 m.y.	Myers, Price et al. (1979), Fecht et al. (1984)
	South Yakima Ridge normal fault	12e	3			1.5	E.-W./N.	Inferred reverse fault under south limb of Yakima Ridge	<10.5 m.y.	Myers, Price et al. (1979)
"The Rattles" brachyanti-clines		14c, 14e-14l	24	3-10	Aligned asymmetric doubly plunging anticlines (brachy-anticlines); NW.-SE. trend; represent the SE. part of the Rattlesnake-Wallula alignment					Myers, Price et al. (1979), WPPSS (1977, 1981)
	Related folds	14d, 14m-14o	32		Second-order asymmetric anticlines and synclines paralleling "The Rattles"					Myers, Price et al. (1979)
	Wallula Gap fault	15d	66			50	NW./steep	Maximum vertical offset 330 m, scissor-type displacement, last movement horizontal. Fault zone ~330 m wide	>13,000 yr	Gardner (1977), Gardner et al. (1981), Farooqui (1979)
	Wallula fault	15b	67			~5	NW./steep	Splay extension of Wallula Gap fault (#15d) west of Columbia River		
	Other faults	15a,15c	40			variable up to 8	Generally NW. to W.-NW./ unknown	Related to brachy-anticlines; dip-slip movements up to 50 m; includes faulting at Finley Quarry (#16d)	At least 7,000 yr at Finley Quarry	Jones and Landon (1978), Bond et al. (1978a), Farooqui and Thoms (1980)

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 7 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Horse Heaven Hills uplift (western segment)		17	32	>80	Asymmetric, ~200-m amplitude, NE.-SW. trend, open, monoclinal northern hinge. Complex with many segments					Bond et al. (1978), Myers, Price et al. (1979). See Hagood (1985) for most recent interpretation
	Prosser anticline	17d	34	24	Asymmetric, double hinged, N.70 to 80°E. trend, northeast plunge					Hagood (1985)
	Drake anticline	17c	37	11	Asymmetric, low-relief, double hinged, parallels Prosser anticline					Hagood (1985)
	Gibbon anticline	17f	33	12	Asymmetric, locally double hinged, N.70°E. trend, broad, may be en echelon with Prosser anticline					Hagood (1985)
	Chandler anticline	17g	32	7	Asymmetric, double hinged, N.70°E. to N.85°W. trend					Hagood (1985)
	Kiona anticline/ Badger Canyon anticline/ monocline	17h	31	29	Asymmetric, double hinged, W. to NW. trend					Hagood (1985)
	Phelps anticline/ monocline	17j	58	10	Asymmetric, NE. trend, monocline at northeast end					Hagood (1985)
	Gibbon fault	18	32			5	NE./vertical	Reverse, juxtaposes Selah interbed against Levey interbed, 70-m vertical displacement	<10.5 m.y.	Hagood (1985)

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 8 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Horse Heaven Hills uplift (western segment) (cont.)	Prosser fault	19	37			13	NE./ unknown	Interpreted fault to account for topographic relief along Horse Heaven Hills	<10.5 m.y.	Hagood (1985)
	Phelps fault	20c	31			10	NE./ moderate	Thrust or reverse, juxtaposes Pomona against Elephant Mountain	<10.5 m.y.	Hagood (1985)
	Other faults of western Horse Heaven Hills	20a-20k	28			Variable	Variable	Small faults on north slope of Horse Heaven Hills, partly owing to landsliding	<8.5 m.y.	Hagood (1985)
Horse Heaven Hills uplift (eastern segment)		17h, 17j	32	70	Asymmetric, doubly plunging, NW.-SE. to W.-NW.-E.-SE. trend, gentle to open					Bond et al. (1978), Jones and Landon (1978), Myers, Price et al. (1979). See Hagood (1985) for most recent interpretation
	Webber Canyon anticline	17k	40	5	Western extension of Webber Canyon monocline					Hagood (1985)
	Webber Canyon anticline/ monocline	17i	34	5	Subtle, low-relief, NW. trend					Hagood (1985)
	Badger Coulee fault, Webber Canyon fault	16a,16b	40, 55			5, 9	NW./vertical	Faults of the Badger Canyon monocline. Maximum vertical displacement 80 m down to NE.	Unknown	Hagood (1985), Bond et al. (1978)

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Table 3-5. Characteristics of folds and faults within or near the Pasco Basin (sheet 9 of 9)

Primary structure	Secondary structure	Map number (Fig. 3-19)	Minimum distance from RRL (km)	Fold characteristics		Fault characteristics				References
				Length (km)	Geometry	Length (km)	Strike/dip	Type of displacement	Age of latest displacement	
Pasco syncline		21	~25	>40	Symmetric, SE. curvilinear trend, not exposed					Myers, Price et al. (1979)
Wahluke syncline		22	~8	~40	Asymmetric, plunges SE. from the NW. and to the NW. from the SE. end of structure, not exposed					Myers, Price et al. (1979)
Benson Ranch syncline		23	~5	~25	Asymmetric, low amplitude, SE. plunge, E.-W. to NW.-SE. trend, not exposed					Myers, Price et al. (1979); Myers and Price (1981)
Cold Creek syncline		24	0	60	Asymmetric, low amplitude, 3° to 5° SE. plunge, W.-NW.-E.-SE. trend, gentle, two depressions along trough					Myers, Price et al. (1979); Myers and Price (1981)
Related anticlines		25	13	5	W.-NW. trending					Myers (1981)
Folds of the Eastern Pasco Basin (Palouse subprovince), including Jackass Mountain		26a, 26c, 27, 28a-28c	42	3 to 6.5	Low-amplitude folds on the Palouse slope, W.-NW.-E.-SE. and N.-NW.-S.-SE. trends, parallel to Pasco syncline					Myers, Price et al. (1979)

NOTE: 1 meter = 3.28 feet.
1 kilometer = 1.62 miles.
RRL = reference repository location.
B.P. = before present.
m.y. = million years.

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		CIN No.: N/A Date: N/A	Page 1 Of 35 / Total Pages 152

Document Title: Preliminary Stratigraphic and Structural Model of the Reference Repository Location, Hanford Site

Baseline Doc.: Yes ☐ No ☒ Class: N/A

WBS No. or Work Package No.: L3C6 | CEI No.: 003

Borehole No.:	Stratigraphic Formations:	Doc. Type	Subj. Code
NA	Columbia River Basalt Group	2070	E902

Prepared by (type & sign name): R. D. Landon, B. N. Bjornstad — Date: 1/86
See reverse side for additional approvals

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Abstract

A preliminary stratigraphic and structural model has been developed for the Reference Repository Location (RRL), Hanford Site, Washington State. The model is based on integration of outcrop, borehole, and geophysical data. It is a three-dimensional representation of the RRL subsurface. The model provides a stratigraphic and structural framework for use in geologic and hydrologic studies of the RRL. This model can serve as a predictive tool for future borehole locations within the RRL. The model is in a flexible computer format, which will allow for efficient updating of the model as new data become available, and for display of contour maps, block diagrams, and cross sections.

35 Text Pages

4 Appendices
Pg. A-1 to A-43
B-1 to B-10
C-1 to C-31
D-1 to D-33

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Jim

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