

TRIP REPORT  
BWIP ANNUAL REVIEW MEETING, DECEMBER 2-3, 1980  
AND  
MEETING WITH ROCKWELL, DECEMBER 4, 1980

BY

PAUL T. PRESTHOLT

LINDA L. LEHMAN

ROBERT J. WRIGHT

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## Introduction

Five NRC staff members attended the BWIP annual review meeting held on December 2 and 3, 1980: Robert J. Wright and Paul T. Prestholt, WMHT; Thomas J. Nicholson and Colleen Ostrowski, SD; and Philip Justus, NRR. On December 4, 1980, a meeting was held with Rockwell to discuss concerns arising from the site visit of July 1980, as outlined in a Wright/Vieth (DOE) letter of November 4. The five NRC members were joined by Linda Lehman, WMHL, on the evening of December 3rd.

The BWIP annual review meeting of December 2 and 3 was well structured and presented. The meeting was open to the public and was attended by members of the scientific community, legislators (Washington state), and local business men (merchants and farmers). The agenda centered on the accomplishments of the BWIP program for fiscal year 1980 and on plans for the future. Little was said, however, about results of the site investigations. The most significant information was the designation of Site A-H in the Cold Creek syncline (1980 annual report, page II-26 and Figure 1) as the "Reference Repository Location." This is a 10+ square mile area that has been chosen as the preferred location of the Exploratory Shaft Test Facility and for detailed borehole and geophysical investigations.

A copy of the agenda for the meetings held on December 2 and 3 is attached, and the content of each presentation is contained in "Basalt Waste Isolation Project, Annual Report - Fiscal Year 1980." Both Prestholt and Wright have copies.

The informal meetings held on December 4, 1980 were attended by members of the following organizations: USNRC, Rockwell, Vanderbilt University, Kaiser

Engineers, USDOE, ONWI-RPO, Georesults, Inc., WPPSS, and the USGS. Attendance lists for the various meetings are attached. In the morning, the hydrogeology of the BWIP project was the subject and the NRC was represented by T. J. Nicholson, P. T. Prestholt, L. Lehman, and R. Wright. In the afternoon groundwater modeling was attended by L. Lehman and T. J. Nicholson, while tectonics and geophysics was attended by R. Wright, P. T. Prestholt, C. Ostrowski, and P. Justus.

The December 4th meetings were informal and frank. A large number of subjects were discussed within the framework of the four main items mentioned above. Questions were freely asked and answered with comments that were frank and sometimes blunt. It is felt that the December 4th meetings were very informative, resulting in a better understanding of the BWIP program.

#### Site Screening

During FY80, three new sites were identified in the Cold Creek syncline within the area occupied by the seven sites selected during FY79. The ten sites were evaluated by a Woodward-Clyde/Rockwell team using a combination of geologic, hydrologic, ecologic, political and economic factors. Site A-H, at the Western end of the syncline, was nominated as the most attractive. Site J is the runner-up. Six drill holes (to less than 1000 feet depth) have been spotted on A-H to determine the top of the basalt and provide further information on structural configuration.

The origin and meaning of the structural blocks within the Cold Creek Syncline that contributed to selection of the "reference repository location" was discussed. The location, size and shape of the blocks was determined by anomalies resulting from the five layer aeromagnetic geophysical surveys. These

magnetic anomalies are felt by RHO geologists and geophysicists to represent possible groundwater pathways to the surface. The exact nature of the magnetic anomalies is not known; however, the boundaries of the structural blocks were drawn so as to include few, if any, anomalies within the blocks. The decision to designate block A-H as the "reference repository location" was taken, in part, by the absence of magnetic anomalies within the block.

### Hydrogeology

Progress has been made on several fronts - flowpaths in shallow, confined aquifers; groundwater chemistry, computer simulation and definition of hydrologic units. On the other hand, work is barely started on certain key problems, notably flowpaths in the Umtanum basalt and measurement of vertical conductivity in the basalts. One result is that the screening of sites and the selection of A-H as the "reference repository location" has proceeded with minimal hydrologic input.

Several projects are underway to fill in the information gaps. Two boreholes-- DC 14 and DC 15-- are being drilled and tested through the Umtanum. Each is located within 150 meters of the Columbia River, at the north end and southeast corner of the Hanford Reservation. Each hole will contribute important information about the possibility of groundwater discharge into the river.

On the matter of vertical conductivity, plans are to test the flow between different levels of paired holes. Two, possibly three, hole pairs are available for experimentation. We learned that no tests of this sort were undertaken in the two inclined offsets to drill hole number two (the only inclined holes drilled to date). Identification of the vertical component of groundwater flow is essential to any effort in 2D (cross-sectional) or three dimensional flowpath modeling.

A potentiometric map has been prepared for the Mabton Interbed, an aquifer about 2500 feet above the Umtanum. Results are preliminary, because data are

available from only 13 wells, and much of the character of the map depends on information from one well. The significance of the map is that it does not indicate discharge into the Columbia River. Rather, discharge is suggested along the Umtanum Ridge-Gable Mountain anticlinal axis. One interpretation is that faulting along the anticline permits upward passage of water with discharge to surface.

Chemical analyses indicate that the Saddle Mountain and Wanapum water is bicarbonate (of two types) and the Grand Ronde water is chloride. If confirmed, this tends to suggest that there is limited vertical communication among these formations, and the deep Umtanum water may be isolated.

One improvement in groundwater modeling is the abandonment of the concept "imaginary impermeable barrier," a feature of some earlier presentations that seemed somewhat less than credible.

Since the last NRC site visit proved critical of the RHO drilling procedures, namely the use of drilling mud in the less permeable formations, a study was undertaken by RHO to determine any effects that the mud may have on the hydraulic properties of the medium. The results of this testing has been sent to the DOE headquarters for review.

### Modeling

The modeling group's discussion centered around three major topics: I) Current modeling efforts, II) parameter estimation, and III) validation. A discussion of each of these topics follows.

#### I. Current Modeling Efforts

The status of the modeling effort at Hanford is still very preliminary; flow modeling is underway but transport modeling has not yet been attempted. Emphasis

is still on defining and characterizing all flow systems which could affect the repository site.

The code which had been used most extensively by RHO, a derivative of Gupta, is now being phased out in favor of a new 3-D finite element code "SEMTRA." This will be used in both the near field and the far field. It is a double porosity (fracture flow) code, which was chosen to give a better representation of the system based on variations in pump test data which may indicate lagged storage effects due to fractures.

Since this is a fully 3-dimensional code, leakage between layers is accounted for through the vertical hydraulic conductivity tensor. This quantity is estimated at the present time. RHO modellers have selected ratios of horizontal to vertical hydraulic conductivity. Varying these ratios leads to quite different results in the discharge to the Columbia River. (As the vertical conductivity ( $K^1$ ) becomes large, the Columbia acts as a line sink.  $K/K^1 = 10^{-2}, 10^{-3}$ ). As vertical conductivity becomes small ( $K/K^1 = 10^4$  or larger) then a potential low develops over the Gable Mt. area and discharge to the Columbia becomes more localized in aquifer outcrop areas.

Boundary conditions used by the modellers are "no flow boundaries" along the Saddle Mts. and Rattlesnake Ridge, and everywhere else, including the Columbia River, is considered a constant head boundary. The model "CHAIN" will be used to model radionuclide transport.

## II. Parameter Estimation

Currently RHO is using parameter values based on a best estimate of actual conditions. This approach is acceptable for preliminary modeling, but is a

\*A 2-dimensional transport code.

biased technique. It is now thought that certain parameters such as hydraulic conductivity may vary widely over the area of interest. It would appear that a statistical data parameter estimate would ensure sampling over the entire range of probable values and would be more conservative.

The values of conductivity, once chosen, are then averaged within a basalt flow, or series of flows, by a weighted averaging technique and an average velocity computed for each unit. This method is adequate for preliminary modeling efforts, but when transport is to be calculated, interstitial velocities must be calculated for interflows and interbeds, since using an average velocity could underestimate nuclide transit times to the biosphere by several orders of magnitude.

Data packages are distributed to subcontractors for a data base from which model parameters are selected. The NRC is being provided with a data package.

### III. Validation/Verification

RHO is currently engaged in verification efforts which involve benchmarking, or the comparison of codes, against a set of standard problems. A major validation program is in the planning stage for all phases of the operation, not just modeling. This program will be structured after the Rockwell space shuttle validation program. RHO has suggested meeting with various agencies and the NRC to formulate preliminary plans in this regard.

#### Geophysics

The Pasco Basin is one of the most difficult environments in which to conduct geophysical investigations in the United States. A variable surface sedimentary section up to several hundred feet thick, with (1) large horizontal and vertical

changes in acoustic impedance, (2) a thick basalt section with little change in acoustic impedance through the section and (3) gravity and magnetic properties that are very difficult to interpret, account for the difficulty in obtaining good geophysical data.

The three main geophysical techniques used by RHO geophysicists, namely seismic reflection, five level aeromagnetics and tensor magnetotelluric surveys, have helped to define secondary features on the flanks of buried Yakima folds within the Pasco Basin, define the structural blocks in the Cold Creek Syncline and give some data on deep geoelectric units and their related structures (Basalt Waste Isolation Project Annual Report - Fiscal Year 1980, page II-25). High resolution techniques including seismic refraction, resistivity, magnetic and gravity surveys on the ground have been used to detail structures of interest on the Hanford reservation.

Interpretation of much of the field data is incomplete with only the five level aeromagnetic and seismic reflection surveys giving significant input into geologic interpretations. RHO geophysicists expect that after interpretations are completed in FY81 geophysical data can make a real contribution to the BWIP effort.

To date, geophysical survey techniques have not been a major source of geologic information on the BWIP. The geophysical effort seems small in relation to the other activities within the BWIP effort. This attitude seems to have resulted in a restriction on the application of innovative data gathering and interpretation techniques. It is possible that, as the data now available are interpreted and integrated into the overall BWIP effort, new techniques or applications of

old techniques will be tried resulting in a greater contribution to the interpretation of the geology of the Pasco Basin.

### Tectonics

The question as to whether or not deformation of the Yakima Fold Belt occurred during the Holocene was discussed. RHO stated that the stratigraphic framework for the Holocene is not "fine tuned" and that occurrences of Holocene sediments is spotty, particularly on ridge crests. There is apparently no present evidence for continued deformation of the Yakima Fold Belt during the Holocene.

The present state of tectonics as related to stress within the Pasco Basin is unclear. RHO feels that there is very little uplift occurring at the present time. Maximum compression within the basin is in a NW-SE direction with the stress field in operation since the Miocene. RHO is apparently unclear as to what forces are in operation at present.

There are no isopach maps of distinct Quaternary age stratigraphic units available. RHO investigations of these sediments (including the Ringhold, which is probably not of Quaternary age) is ongoing. RHO has apparently observed no problems in the Quaternary sediments within the Cold Creek syncline that would indicate tectonic instability.

There is an inferred fault on the north flank of Umtanum Ridge near Priest Rapids dam. Evidence for this fault is +500 feet of stratigraphic offset. RHO indicated that the significance of this inferred fault is unknown.

During the discussion on tectonics, a secondary discussion took place concerning the scope and cost effectiveness of geologic investigations in relation to the investigators' responsibilities to completeness of the investigation and

safety. There is concern by RHO that demands for information might go beyond a real need for the data. It was emphasized that this concern should be kept in mind by all parties.

#### Experimental Shaft Test Facility (ESTF)

We understand that the ESTF has been proposed by Rockwell to ONWI. As shown to us, the ESTF would consist of a single, bored, 6 foot diameter shaft to the Umtanum with 140 meters of drifts. Rock mechanics tests would be carried out and 1000 foot horizontal core holes would provide information about the characteristics of the basalt host rock. Port holes cut in the shaft casing would permit inspection of the overlying rocks at selected points.

While boring the shaft affords advantages in cost and groundwater control, its great disadvantage is the loss of the best opportunity to inspect, map and test the rocks between surface and the Umtanum. The single shaft limits the extent of the underground development that is possible under federal mining regulations. Certain desirable tests, such as heater experiments and opening of full scale test rooms, are not feasible within the scope of this facility. The ESTF must, therefore, be considered an interim facility which will require expansion to fully satisfy the needs of underground testing. At a meeting in Richland, Washington during November, 1980, Ludwig Hartung was shown an ESTF design with two shafts, so it is unclear at the moment what the final DOE position may be.

HYDROLOGY  
12-4-80 - Morning

# Attendance List

12/04/80

<u>NAME</u>	<u>ORGANIZATION</u>	<u>DEPT.</u>
L R Fitch	Rockwell	Licensing
D. J. CARRELL	ROCKWELL	LICENSING
THOMAS J. NICHOLSON	U.S. NRC	
Paul T. Prestholt	U.S. N.R.C.	
LINDA LEHMAN	U.S. N.R.C.	LICENSING
Ron Jackson	Rockwell	Hydrology
Leo Leonhart	Rockwell	Hydrology
Rod Hedgerwood	Rockwell	Hydrology
FRANK L. PARKER	VANDERBILT UNIVERSITY	
FRANK DeLUCA	ROCKWELL	HYDROLOGY
Robert Beer	ROCKWELL	HYDROLOGY
Steve Strait	Rockwell	HYDROLOGY
Ron Arnett	Rockwell	"
Roy Gephart	Rockwell	Hydrology
Frank Spore	Rockwell	Hydrology
Bob Wright	NRC	
Alex Lindsay	Kaiser Engineers	
DAVID L. WATSON	Kaiser Engineers	MINING & GEOLOGY
Dave J. Squires	DOE-RL	BW IPO
REUBEN W. PETERSON	ONWI-RPO	

12/4/80

GROUNDWATER MODELING

Afternoon

NAME

ORGANIZATION

Don Correll

ROCKWELL - LICENSING

LINDA LEHMAN

NRC - LICENSING

Thomas J. NICITOLSON

U.S. NRC

Ron Annett

Rockwell

Bob Wunderlich

DOE/NPO

Dave Snow

Geosults, Inc (Consultant)

FRANK DE LUCA

ROCKWELL

CHET COMPTON

DOE/RL

BOB BACA

ROCKWELL

Tectonics and Geophysics  
12-4-80 Afternoon

Attendance List Pm-

<u>Name</u>	<u>Organization</u>	<u>Tele #</u>
L.R. Fitch	Rockwell	FTS - 444-6211
DAVID L. WATSON	KAISER ENGINEERS	415-271-4134
HAUP JUSTUS	USNRC	301-492-8158
Paul T. Prestholt	USNRC	
Ted Curran	Rockwell PA	444-6409
Colleen Ostrowski	U.S. NRC	443-5981
R.C. EDWARDS	Rockwell	444-2509
S.P. Strait	Rockwell	444-6943
Ed Price	Rockwell	444-2552
W. Kiel	WPPSS	372-5281
Tom Mitchell	Rockwell	FTS 444-2706
Jim Hait	USGS	FTS 234-4697
David Tilson	WPPSS	509-372-5383
Bob Wright	USNRC	FTS 427 4177