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Mr. O. L. Olson, Project Manager
Basalt Waste Isolation Project Office
U.S. Department of Energy
P. O. Box 550
Richland, Washington 99352

Dear Mr. Olson:

We have reviewed SD-BWI-TP-007, Rev. 0-0, "Test Plan for Exploratory Shaft - Phase I and Phase II," by Rockwell International. We offer the following comments for your consideration.

In our opinion, the subject plan requires substantial upgrading to provide reasonable assurance that the testing to be performed in both Phase I and Phase II can meet the stated objectives of the plan, and that sufficient information is obtained to support a defensible decision on the overall suitability of the site. We are particularly concerned that the level of data needed to make an informed decision concerning the selection of the candidate repository horizon for shaft breakout may not be achieved. What will be the basis for this decision? Have criteria been established to facilitate an informed judgement? In our opinion, the proposed Phase I testing is a necessary but insufficient basis on which to assess the feasibility of a test and evaluation facility.

Throughout the report the objectives consistently overstate what can be reasonably expected from successful completion of the proposed tests. For example, the stated objective of exploratory shaft-Phase I testing is the in-situ characterization of the candidate horizon and immediate surroundings to resolve key site suitability issues which could not be resolved from the surface through small boreholes. It appears to us that such characterization cannot be accomplished without Phase II in-situ testing to define the critical geologic and hydrologic parameters that will not have been addressed by the Phase I testing. Such over statements detract materially from the credibility of the plan. An alternative is to list the key site suitability issues which must be resolved and identify the tests proposed that could lead to their resolution.

Somewhere in this plan the adequacy of the NC-size of the portals in the shaft liner needs to be evaluated with respect to its ability to accept suitable inflatable packers, geophysical logging tools, etc. For example, the discussion should specify the maximum length of such tools that can be accommodated in the space provided by the shaft liner and portals. In addition, assurance should be provided that suitable equipment for hydrologic testing can be used in the holes drilled from within the shaft.

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The hydrologic testing in this plan is limited to the potential repository horizons and immediately adjacent interflow zones. However, these horizons are only a part of the ground-water system that must be analyzed to determine the performance of a potential repository.

To date, investigation of this complex ground-water system has been limited to information that could be obtained from vertical boreholes. The exploratory shaft provides a unique opportunity to obtain needed information that could be provided by lateral boreholes from the shaft liner. We suggest that consideration be given to the location of ports in the shaft liner through which lateral boreholes may be drilled and tests made of the hydrologic system overlying the potential repository horizons.

The most notable feature of basalts is the extreme geologic heterogeneity within individual flows and between successive flows. Owing to the spatially discontinuous and variable nature of basalt flows, adequate characterization of the geologic system and predictive modeling of the thermal, mechanical, and hydrologic response of the rock mass to repository conditions is a unique and challenging task. Characterization includes definition of geologic structure, mineral composition and fabric of the rock mass, physical properties (including constitutive behavior), and initial in situ conditions of the rock mass. In situ testing is required as a part of the characterization process, for measurement of specific rock mechanical properties; for identification of phenomenological mechanisms; for model development, verification, and validation, and for development and confirmation of the repository design. In situ testing is also essential to determine the hydrologic properties of the media, initial in situ conditions, and the effects on the construction, operation, and long-term safety of a repository of the cross-coupling of thermal, mechanical and hydrologic phenomena. The in situ test facilities should be of sufficient size and the tests of sufficient duration to determine the response of a large representative volume of the rock mass. Considering the extreme geologic heterogeneity of basalt flows, both the size of the excavations required and the number, variety, magnitude and duration of in situ tests necessary to test a "representative volume" of the rock mass, deserve detailed consideration. To date, the only underground tests conducted in basalt are those at the Near Surface Test Facility (NSTF) which is above the water table and at shallow depth. There is general agreement in the technical community that the results of the tests at the NSTF will have little transfer value to a repository at depth. However, the tests conducted at the NSTF can provide useful information regarding the design and conduct of at-depth in situ tests and may be used to identify phenomenological mechanisms and to develop computer codes to aid in the development of predictive models. Our detailed comments follow:

Page 7, paragraph 1

It is a matter of record that the Hanford Reservation was selected for investigation because of its dedication as a Federal facility involved in nuclear activities and because a large volume of nuclear waste is in storage at the site. Basalt was selected for investigation as a host rock because it is the principal rock type underlying the Hanford Reservation.

Page 12, 1-2.1.1

Did the principal borehole, RRL-2, provide the information required for design and construction of the exploratory shaft and for ascertaining the overall suitability of the proposed exploratory shaft location? If so, this information should be presented in the plan or specific references should be cited, documenting the data acquired and the results of the tests performed. Also, a record of the drilling experience should be available, including penetration rate, zones of lost circulation, volume of drilling fluid lost, and zones of caving or unstable conditions. Specifically, how was the data from RRL-2 used to locate test port holes? What hydrologic tests were performed and what information obtained?

Page 13, first paragraph

It is our understanding that even successful completion of the 110-inch diameter exploratory shaft will leave in doubt whether or not a full-scale repository shaft can be drilled or mined to repository depths in the basalts at Hanford. How does the anomalous, thick, brecciated flow top in the Umtanum at RRL-2 affect objective 1-1?

Page 13, objective 1-3

This objective overstates what can reasonably be expected. Tests from a limited number of port holes in the shaft liner and subsequent breakout into a candidate repository horizon can, at best, indicate no leakage at the points tested. Such tests cannot address, let alone verify, the adequacy of the grout seal throughout the shaft length or evaluate its long-term performance. The possibility of channeling and(or) bridging of grout in the annulus between the shaft wall and the shaft liner that would permit vertical flow of ground water is not considered, although the location of utilities located exterior to the shaft liner enhance the possibility of this occurring.

Page 13, objective 1-5

It is to be hoped that the state and magnitude of the in-situ stress field will be obtained by the testing. In our judgment, however, very limited information on rock-mass properties will be obtained around the breakout station. The rock-mass response to existing and imposed stresses will be dominated by the behavior of discontinuities in the rock mass and very little will be known regarding this behavior at the end of Phase I testing. Is it reasonable to state that the limited data to be obtained will verify the constructability, stability, and safety of underground openings in the candidate repository horizon, or will enable a decision to be made for the construction of a Test and Evaluation Facility (TEF)? We believe that the basis for a decision on a TEF will have little technical justification before results from Phase II testing are available.

Page 14, I-4.1 Principal borehole tests

Under this heading the location of the principal borehole, the exploratory shaft and the six reference repository-location holes should be shown. Conspicuous by its absence is any discussion or summary of the principal borehole tests or the siting data they provided. As a minimum, a detailed summary of the results obtained from RRL-2, and the siting data they provided, should be presented or an appropriate document referenced. Were all of the parameters identified in table 1-3 measured? What techniques were used? What were the results? Specifically, how do the results of the tests support the shaft-siting decision and what specific information is provided concerning location, design, and construction of the exploratory shaft, including the location of port holes in the liner?

Page 16, table 1-1

We suggest that the acoustic televiewer log be included under "Downhole Geophysics." It is our experience that this log is the most effective tool available for use in fractured rock to determine the presence, orientation, and aperture size of fractures. We also suggest that zones of lost circulation and volume of drilling fluid loss be included under "Drilling Surveillance."

Because many of the tests listed in table 1-1 are necessary, but in themself insufficient to fulfill the requirements of the work element for the objective, it is difficult to determine whether or not the total requirements of either the work element or the objectives are adequately addressed. One of the most serious deficiencies in the plan is the omission of a detailed discussion of the test plans, procedures, and methods that are necessary for a reasoned evaluation of the adequacy of the tests to address the work elements either individually or collectively.

Page 20, paragraph 1, 2, and 3

Where are the data? What is indicated? What are the specifics? Everyone will agree the data are required.

Page 20, I-4.2

Successful construction of the ES by blindhole boring may leave unanswered the question of whether or not a repository-size shaft can be drilled or mined to repository depths in the Columbia River basalts. Specifically, what is planned to address the numerous issues?

Page 21, paragraph 3

We certainly endorse the concept of using numerical models to help evaluate the hydrology of the candidate repository horizon. However, the intrinsic complexity of flow in fractured media together with effects on flow of complex and coupled thermal and mechanical phenomena should be constantly kept in mind. The use of equivalent porous media models assumes that the fractures are continuous and interconnected and have a high frequency on the scale of the underground excavations. The fracture system in the rock mass may be highly anisotropic which would restrict ground-water flow to preferred directions. Also, fractures are non-uniform in aperture size, degree of wall roughness, and extent of mineral filling, and complex in terms of the degree and nature of their interconnection. Furthermore, fracture aperture size is generally stress dependent. Because these factors shed doubt on the validity of an equivalent porous media model or parallel-plate models, they must be addressed to the extent possible and constantly kept in mind in evaluating the predictions based on such models.

Page 27, paragraph I, first sentence

Does this mean that no hydrologic information is available from the primary borehole (RRL-2)? Surely not. Were the principal borehole tests summarized in table 1-3 performed? What were the results?

Page 27, paragraph 2

In our opinion, it is important to obtain sufficient, reliable stress measurements to ensure that design criteria are not derived from bad data. We recommend use of the acoustic televiewer to selected suitable sections of the borehole for stress measurements. To establish confidence in the knowledge of the stress field, we suggest determination of the stress gradient as a function of depth. A stress profile in a hole to the depth of potential repository horizons might require five to ten measurements.

Page 27, paragraph 3

Monitoring of the effect of shaft sinking in the primary borehole provides an opportunity to study the impact of this disturbance on the hydrologic system and through back-analysis, derive a set of parameters to describe that response. Pump tests should be performed in the primary borehole prior to shaft sinking to provide estimates of the hydrologic properties of the horizons of interest. The data obtained will assist the contractor developing the shaft in selection of appropriate construction procedures that will affect his costs. These data also will be useful to hydrologists in their evaluation of hydrologic conditions, particularly scale effects, as the shaft will intersect many more fractures than a borehole. We suggest that an appropriate piezometer network be established to monitor all transient disturbances to the ground-water system caused by exploratory shaft activities. Predictions of the effects on the ground-water system response of these activities should be made prior to shaft construction and the observed response compared with the predictions to evaluate the models and the adequacy of assumed and measured hydrologic parameters.

Page 27, paragraph 5

It remains to be determined whether or not the ES will provide the information necessary to extrapolate use of available technology to construction of large-sized shafts. What is proposed to address this issue?

Page 29, paragraph 3

We suggest that drilling and testing of holes not be limited to just the candidate horizons for Phase I testing. Hydrogeologic data from both overlying and underlying hydrogeologic units are needed to obtain an understanding of the ground-water system and to resolve key site-suitability issues.

Page 29, paragraph 4

What was learned from the data obtained from the principal borehole and what is indicated concerning the position, size, length, and number of portals, and types of tests to be performed for both Phase I and Phase II testing?

Page 29, paragraph 5

Why is the length of boreholes extending from the shaft limited to 150 feet? How many tests are planned in the interflow zones ("flow tops") above and below candidate repository horizons? How many boreholes are planned to intercept these horizons? We believe that testing from the shaft should include testing of horizons other than those in and adjacent to repository horizons. Boreholes extending from the shaft provide a unique opportunity to determine the hydrogeologic conditions in the ground-water systems near the shaft.

Page 29, paragraph 6

It is tacitly assumed that steady-state conditions prevail at the site. In any event the plans for measurement of undisturbed hydraulic potential require substantial modification. The effects of drilling, lining, and grouting the shaft will inevitably alter existing hydraulic heads in the ground-water systems, both within and outside of the candidate repository horizons. It is completely unrealistic and misleading to assume—"hydraulic conditions will be stabilized by maintaining the shaft fluid column equilibrium during drilling until linear grouting is completed." Maintaining fluid column equilibrium in a setting where the hydraulic head and other hydraulic properties are unknown is clearly impossible. Perhaps the intent is to minimize loss of drilling fluid, but this does not preclude inducing significant alteration in the in-situ hydraulic heads. This is particularly pertinent where the purpose of head measurements is to determine the hydraulic gradient. In a setting where the hydraulic gradient is expected to be low, even small induced changes in the measured hydraulic potential could result in major errors in the direction and magnitude of the hydraulic gradient. We agree that measurements of undisturbed hydraulic potential are needed. Recognizing that the hydraulic potential will be altered by shaft drilling, lining, and grouting, we suggest that monitoring the rate of decay of the induced changes with time in the proposed orthogonal boreholes from the shaft could permit close approximation of the undisturbed hydraulic potential. The length of time that might be required to determine definitive curves that could be extrapolated to provide this information depends on a number of variables and is not known. Other things being equal, the rate of decay of induced changes would be expected to be most rapid in those parts of the system with the highest hydraulic conductivity, the interflow zones, and slowest in the zones with poorly interconnected fractures of small aperture size. Monitoring of induced changes in hydraulic head during and following construction of the principal borehole should permit an estimate of the time that might be required for monitoring in the orthogonal drill holes.

<u>Page 39, paragraphs 1. 2, and 3</u>

Discussion of the candidate horizon deserves more than a discussion of the predicted tops and thicknesses of geologic units and their actual positions in RRL-2. How were the two candidate horizons identified? What criteria were used? What were the actual conditions encountered in RRL-2 and how do they compare with predictions of what was anticipated? How do the conditions encountered relate to the suitability of the candidate horizons? What is the basis for the last sentence in paragraph 2? Are there any firm data to support the conclusion that the rock quality is high or that hydrologic properties are not affected by the central vesicular zone? Is this the flow top of an individual flow in the Middle Sentinel Bluffs? Surely, the thick brecciated flow top in the Umtanum encountered in RRL-2 was not anticipated. How and to what extent does this affect the suitability of this zone as a candidate repository horizon? What are the implications of finding this unexpected feature on the suitability of the remainder of the Umtanum? We believe answers to these questions are important and have a direct bearing on the level of data needed to make a rational decision concerning siting of a repository and identifying a suitable repository horizon.

The level of data needed for a rational decision is directly related to the predictability of the subsurface geology and the hydrology. Clearly sites where the geology and hydrology are simple are the most predictable, and, therefore, require the least amount of data to permit a rational decision. As the complexity of the geology and hydrology increases, predictability decreases and the amount of data required to make a rational decision increases. To assure that an adequate level of understanding of geohydrologic conditions is developed before siting and repository horizon decisions are made, we suggest that a positive answer to the following question be included in the decision criteria: Are the geology and hydrology of the site and repository horizon sufficiently simple and predictable that with a reasonable expenditure of resources to obtain the additional data, sufficient information will be obtained to justify selecting a site and horizon for a repository and applying for a construction license? The location and extent of features such as the thick brecciated flow top encountered in RRL-2 and other features such as flow margins, flow fronts, and pillow lava zones, cannot be predicted in the Columbia River basalts and the possibility that such features might be encountered in the mining of a repository in the Cold Creek Syncline cannot be dismissed. Therefore, it is prudent to determine the implications of unexpectedly encountering one of these zones during construction of a repository. The effects on constructability, safety, repository performance, and licensing should be addressed.

Page 39, paragraph 5

Does the 6-foot diameter shaft provide adequate working space to perform the tests proposed? Can the appropriate logging tools and testing equipment for the lateral boreholes from the shaft be accommodated in the available space? Both the shaft diameter and proposed NC size of the boreholes would seem to preclude the use of the acoustic televiewer (in our experience the most effective tool available for fracture logging) which is about 13 feet long and has not been used successfully in holes of less than 3-inch diameter. Many other borehole geophysical logging tools are about 6 feet long and the posssibility of using them in the available space should be determined.

Page 41, paragraph 4

What is the purpose of sealing this borehole with packers during porthole tests. What flow and pressure interference are of concern? The statement should specify what is intended and for what purpose.

Page 41, paragraph 6

What is the weight and viscosity of the drilling mud that will be used to maintain hole integrity? What is the anticipated volume of mud loss during drilling?

Page 44, paragraph 4

In view of the thick brecciated flow encountered in the Umtanum in RRL-2, is there sufficient information to select, with confidence, the depth of ports to be installed in the liner? Is the intent to concentrate testing in the Umtanum to the lower 84 feet of the unit and not obtain information on the brecciated zone and how it might affect the suitability of the Umtanum as a repository horizon?

Page 44, paragraph 5

How many of the boreholes will be 150 feet in length; 6 feet; intermediate lengths? Can both horizontal and inclined boreholes be drilled from a port, or must the orientation be determined when the port in the liner is installed? How many holes will be available for hydrologic tests in each horizon? How will fracture geometry be determined in the test holes and how will the hydrologic tests on the fractures be performed? We suggest that sufficient details be provided to determine what is proposed and permit an informed evaluation of the adequacy of the proposal to meet the stated objectives.

Page 46, paragraph 2

We suggest that it would be prudent for DOE to solicit several independent assessments whenever such a situation develops.

Page 47, Table I-8

We suggest that measured and predicted values for hydrologic parameters in RRL-2 would be more appropriate in Column 3 than a reference to Ci<40 CFR 191 which is still in draft form. This would avoid having to use various assumed values involving much uncertainty in making the calculations required in the Ci determination. What values for maximum horizontal stress were determined in RRL-2 for both the Umtanum and the Middle Sentinel Bluffs?

Page 48, Paragraph 3

Final repository sealing is left virtually unaddressed by what is proposed and by the "key tests" shown in table I-10. Little confidence is elicited by stating, in table I-10, under the columns, predicted values, desirable characteristics, and even the rationale for desiring specific characteristics of the key parameters, that they remain "to be determined."

Page 51, table I-11

We suggest that "desirable characteristics" of the key parameters measured be given as values of hydrologic parameters in order to permit meaningful comparisons of the predicted and measured values. Furthermore, we should note that the key parameters for a 3-D transport model for estimating nuclide transport to the accessible environment involves many uncertainties that remain to be addressed and goes far beyond what is involved in Phase I testing. For similar reasons we suggest the last column in this table "Rationale for Desiring Specific Characteristics" be modified to address the key parameters measured.

Page 52, paragraph 1, sentence 2

Virtually nothing concerning rock-mass behavior will be provided by the port hole tests. Such tests will provide core for determination of rock properties and information on the stress field.

Page 53, table I-12, column 5, last item

Constructability and required ground support are more directly related to rock-mass behavior as movement and(or) failure are largely dependent upon the response of discontinuities to existing and imposed stresses.

Page 63

This schedule needs revision to bring it up to date.

Page 64

This schedule needs to be updated.

Page 69, paragraph 3

We suggest that in-situ testing, with extensive instrumentation, be continued throughout the construction, operation, and retrieval phases of a repository. To date, the number of potential interactions and uncertainties appear to increase in proportion to the geometric scale and timespan of a given test. Both larger scale tests and longer test times appear to be indicated to assure phenomenological understanding and to focus attention on long-term containment rather than relatively near-field and short-term concerns which are dominantly operational and engineering-oriented.

Page 70, paragraph 3

What is the basis for determining the maximum length of tunnel to be constructed? How was it decided that this will be adequate for characterization of a representative volume of the repository horizon? Why are lateral bore-holes limited to the horizontal plane? Inclined boreholes should be considered also.

Page 70, objective II-2

The plan provides for hydrologic measurements only in the potential repository horizons and adjacent interflow zones and includes no provisions for measurements in the remainder of the hydrologic systems at the site.

Page 70, objective II-3

In our opinion, the basic objective is flawed. We see no reason or basis for expecting that data obtained from the NSTF will be applicable to any at-depth repository horizon. This subject has been discussed repeatedly at various workshops and technical meetings extending over several years. There is general agreement in the technical community that the results obtained from the NSTF will have little transfer value to a repository at depth. This is acknowledged later in this plan on page 79, paragraph 2, which states, "Differing site conditions preclude direct application of Near-Surface Test Facility data to the exploratory shaft site." We see no basis for assuming that a limited scope test series will be adequate, or that a limited scope heater test or limited scope rock-mass-strength testing will be sufficient. This is particularly pertinent to this plan as the contemplated tests will be the first such test conducted at depth in basalt. As the objective is to characterize and determine the response of a large representative volume of the rock mass, we suggest that sizable excavations are required and that the number, variety, magnitude, duration, and instrumentation of in-situ tests should be sufficient to provide reasonable assurance the objective can be achieved.

Page 71, paragraph 3

We suggest that consideration be given to enlarging the size of the proposed testing facilities and expanding the scope and duration of the in-situ testing. Why are the length of boreholes limited to about 300 feet? Also, why are the proposed boreholes limited to the horizontal direction?

Page 72, table II-1.

Because many of the tests listed in table II-1 are necessary but in themself insufficient to fulfill the requirements of the work element or the objective, it is difficult to determine whether or not the total requirements of either the work element or the objective are adequately addressed. A detailed discussion of the test plans, procedures, and methods that are necessary for a reasonably thorough evaluation of the adequacy of the testing to address the work elements is needed but not presented. We suggest use of the acoustic televiewer log for logging of fractures in boreholes drilled from within the drifts.

Page 73-76, table II-2

The table of work elements should include activities related to the necessity of developing and validating, through testing, both partially and fully coupled mechanical, thermomechanical, hydrologic, and chemical predictive models.

Page 78, paragraph 1

We suggest that sufficient stress measurements be made to determine the stress gradient as a function of depth in order to establish confidence in our knowledge of the stress field.

Page 78, paragraph 2

In our opinion, in-situ stress measurements in the candidate repository horizons are necessary but insufficient to define the stress field at the site. The tests should not be limited to these horizons.

Page 78, paragraph 4

It is not clear which tests are supposed to support the heater tests. We thought that only one heater test is proposed and one in-situ direct shear test. We do not share the optimism expressed concerning the adequacy of these tests to provide adequate data on rock mass strength or rock mass behavior, in response to repository-induced stresses.

Page 78, last paragraph

The "large-scale room infiltration" test is intended to provide hydrologic properties of a representative elemental volume (REV) of the rock mass in the selected repository horizon, which, if achieved, could justify the use of equivalent porous media models at least in this horizon. However, there are no guarantees that the test conditions will simulate an REV, even for the selected horizon. The larger the volume of rock mass sampled, the better the chances of simulating an REV, assuming adequate instrumentation and testing.

Page 79, paragraph 2

We concur with the last sentence.

Page 79, paragraph 3

We question the validity of the attempt to relate rock mass performance in the NSTF to the repository horizon by accounting for differences in the physical characterization of the two rock masses. The obvious and desirable alternative is to determine rock mass performance by appropriate in-situ testing.

Page 79, paragraph 4

The key word here is "if." It should be remembered that the applicability of such models is restricted due to assumptions on materials behavior and geometrical constraints. Before the models can be used for repository design they must be verified by a comparison of a prior prediction and the measured response of an in-situ test in the repository horizon.

Page 81, paragraph 5

In our opinion, a single block shear test is in itself insufficient to establish confidence in determining the response of the rock mass to imposed stress. One test simply does not sample a sufficient volume of the rock mass, and its associated discontinuities, to assure that a deformation modulus derived from such a test would be applicable. We suggest that three or four block tests be performed and the derived deformation moduli be compared. It should be expected that the mechanical response of basalt will show a high degree of local variability depending upon the orientation, distribution, frequencies, and properties of the joints.

Page 81, paragraph 6

No information is provided in this plan as to the type of heater test to be performed, and the plan is completely deficient in this area. We suggest that a single test is likely to be insufficient and that consideration be given to a fully instrumented, full-scale heater test, a scaled heater test, and an accelerated room test and(or) other room-and-pillar scale tests.

Page 81, last paragraph

Of prime consideration in determining the suitability of a site is the hydrologic response of the system that will result from the fully coupled effects of mining, waste emplacement, and chemical changes. This plan is aimed primarily at identifying existing hydrologic conditions, a necessary first step. It includes some partially coupled tests but does not pretend to address fully coupled tests or the development of fully coupled models which will be necessary to evaluate ultimate containment properties. Throughout the planning and implementation of the hydrologic characterization process it is important to constantly keep in mind that there is no accepted theory of fluid flow in a fracture dominated rock mass that is in any way comparable to the tested and proven theory of fluid flow in porous media. Even if the relationship between fluid flow and pressure measurements in fractured media can be determined, such tests must yield highly variable results, due to the inherently variable distribution of joints and fractures in such rocks. Therefore, a very large number of measurements will be required to develop confidence in the characterization. We agree that, at the present time, the macro-permeability test is probably the best type of permeability test that can be carried out in basalt. Currently this plan does not provide sufficient detail concerning how this type of test will be conducted to permit meaningful evaluation of what is proposed. We suggest that detailed planning for this test be initiated immediately as it is essential for obtaining useful results. Has any thought been given to later pressurization of boreholes and conducting tracer tests between packed zones? The emplacement of heaters in the test area might also be considered to evaluate relationships among temperature, stress, and rock-mass permeability in a realistic geometric configuration.

<u>Table I-4 and the bullets on page 85 and 87</u>

These present absolutely no detailed information on how the tests outlined are to be performed, the location of boreholes, or the instrumentation requirements. These are simply a "wash" list of data to be acquired.

<u>Figure II-4</u>

Although this is only a conceptual diagram, it raises some questions. Why is the height of the test chamber limited to 13 feet? A greater height would provide more adequate space for maneuvering logging tools, packer assemblies, etc. Why is the length of instrumented drill holes limited to 150 feet? We suggest that much longer holes will be desirable. What determines the orientation of the boreholes? Would it be preferable to locate boreholes radiating from the test room in a fan configuration? What is the diameter of the proposed boreholes? Would orientation of the boreholes be modified following detailed fracture mapping?

<u>Page 88, paragraph 1</u>

As the structure and other physical characteristics of the Grande Ronde basalts at the proposed site have yet to be determined in any detail, their similarity to the basalt at the NSTF is yet to be established. We have no quarrel with the desirability of verifying the canister scale model by in-situ tests during Phase II and the proposal outlined in paragraph 2, seems reasonable. However, such a test simply cannot address room-scale or repository-scale thermomechanical issues.

We appreciate the opportunity to comment on this plan and hope that you will find our comments constructive. We shall be happy to discuss any questions that may arise.

Sincerely yours,

John B. Robertson
Chief,
Office of Hazardous Waste Hydrology

Copy to: L. R. Laird
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