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Ben Rusche, Director
Office of Civilian Radioactive
Waste Management
U.S. Department of Energy
1000 Independence Avenue
Washington, D.C. 20585

RE: Revised Comments on the Draft EA

Dear Mr. Rusche:

Enclosed are the revised comments of the Nuclear Waste Board on the Draft Environmental Assessment. As we noted in our letter of March 19, 1985, additional time was required for review as a consequence not only of the massive nature of the document, but also because there were significant delays in availability of key references cited in the Draft EA. We are proceeding on the basis of your assurance to Governor Gardner that comments received within a reasonable time after the March 20 date would receive the same attention as those submitted before March 20.

Last week we met with Mr. Ellison Burton of your office to provide clarification of a few points raised in our March 19 draft comments. At that meeting we were informed of the team approach used by your staff to classify and aggregate EA comments for the response document. Accordingly, we have employed a format which is specifically designed to assist your reviewers in updating the March 19 document.

This submission consists of:

Revised Statement Overview
Revised Technical Commentary
Additional Public Comments, forwarded through the Board

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Where substantive changes have been made to the first draft text the symbol "'R" appears in the right hand margin of the line where the change is typed. This symbology applies to the Statement Overview and the Technical Commentary (Envirosphere Report).

Additional public comments received since March 19, and results of a questionnaire printed in the Newsletter of the Nuclear Waste Board, are attached as an appendix. The public comments have not been edited and do not reflect an official position of the Board.

We hope you will give the revised comments the same careful attention as the March 19 material. Please call on our staff for any needed clarifications.

Sincerely,

Warren A. Bishop, Chair

WAB:hlt

Enclosure

Bishop 5/20/85
101.5

May 20, 1985

NUCLEAR WASTE BOARD
STATE OF WASHINGTON
COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT

STATEMENT OVERVIEW

Introduction

These comments represent updating and revision of the preliminary response of the Washington Nuclear Waste Board, dated March 19, 1985, to the Draft Environmental Assessment of the Hanford nuclear waste repository site. The March 19 version provides background on the Board's functions and positions, which is not repeated here. R

In December, 1984, Governor Gardner requested an extension of time for EA review until approximately May 20, 1985. The request was denied, but assurances were given that additional comments by the state of Washington would be fully considered if submitted within a reasonable time. We believe this is acceptable and are proceeding on that basis. R

During the additional review period some important decisions have been made which directly affect the national repository program and which, in some cases, allow the Board to focus more sharply on policy, procedural and geotechnical concerns. Among these are the President's decision to include defense waste commingling in the first repository study, the USDOE announcement of intent to pursue monitored retrievable storage at a site in Tennessee, scheduling of regular technical exchanges with USDOE and contractor staffs to aid in evaluating proposed site characterization activities, announcement that hydrologic testing will be extended to cover the Pasco Basin, NRC's issuance of specific guidance for geotechnical procedures and informal notification that the final EA will deal with both defense wastes in the Hanford environment and MRS. R

Also during the March-May period a number of key references cited in the draft EA were obtained, and several other pertinent documents became available, allowing us to broaden and strengthen our technical positions. While no wholly new, major issues are raised, as results of either policy decisions or new documents, the relative emphasis has changed in several areas. R

There is continuing concern over the sequencing of milestone documents called for in the Nuclear Waste Policy Act. In addition to the Mission Plan and the final EPA Standards of 40 CFR 191, now there is the MRS documentation which will be submitted to Congress. Each of these has the potential to affect the validity of conclusions in the final EA, and vice versa. The use of realistic program schedules by USDOE will allow these critical pieces of the total program to be reviewed by the states R and tribes, other federal agencies and the public in an orderly process, which was clearly the intent of the Act. The fact that over 2,000 responses to the Draft EA have been assigned to USDOE/Richland for response is a good indication of the importance reviewers attached to the EA. The greater its credibility, as perceived by reviewers, the fewer problems USDOE will face in the subsequent process of formal site characterization. R

Summary of Policy and Procedural Concerns

Ranking of Sites. The EA uses ranking methodologies (Chapter 7 and Appendix B) which are not contained in the siting guidelines. Throughout the comment period on the siting guidelines, the state of Washington and others had contended that the guidelines were too general to allow realistic site comparisons. Now we find that USDOE used ranking methodologies in the EA which are not even hinted at in the siting guidelines. The state of Washington believes that the criteria and methodologies for repository site selection should all be in the siting guidelines. The state believes that use of methodologies never adopted by regulation as major components of the site selection process is not supportable. At the least, the state believes that Chapter 7, which describes the ranking process, should contain references to explain the ranking procedures in greater detail.

The EA uses the approach of the Siting Guidelines (10 CFR 960.3-2-2-2) to nominate for site characterization a preferred site within each geohydrologic setting. Since the sites in Washington and Nevada were the only sites within their respective geologic media identified as potentially acceptable, the mere fact that they were identified almost guaranteed that they would be among the final five sites nominated. Furthermore, the original identification as potentially acceptable was done without the benefit of formal guidelines, and with little or no statutory guidance.

We are unable to reproduce USDOE's numerical scores for the five finalist sites, in spite of USDOE's statement to the Board (January 17, Olympia) that replicability was an advantage of a "simplistic" rating system. We need to know who the voters were, or at least their qualifications. Needed are the numerical weights assigned to system factors and the results of voting where it was employed. The final EA should contain detailed sensitivity analysis of the ranking system.

Failure to disclose the details of scoring would seriously undermine USDOE credibility when it says sites were selected objectively. We have repeatedly questioned USDOE about the pre-NWPA screening method and been told it was objective. Yet the draft EA, noting the RRL selection was pre-NWPA, does not provide data to substantiate either that decision or the nomination of Hanford from among the five sites on a reproducible basis.

EA Out of Sequence. The Act assumes that by the time the EA is issued, the Environmental Protection Agency will have adopted final release standards (40 CFR 191) and USDOE will have completed its Mission Plan. Now, with Monitored Retrievable Storage being proposed by USDOE, there is keen interest at the state level as to what the USDOE documents submitted to Congress will contain, especially as MRS affects transportation to, and timing of, a geologic repository.

Clearly none of these key documents is available today, but at least two of them will be by late 1985. In order for USDOE to produce a responsive EA and for the state to review it realistically, the date of final issuance should be moved back into the sequence specified in the Act, probably not sooner than early 1986.

Mission Plan. If the statutory sequence had been followed, USDOE would have prepared a "mission plan" for Congressional review explaining its plans for the whole high-level nuclear waste program before sites for the first repository were nominated. If this had been done, Congress and the public would have been able to review (and perhaps challenge) proposals for other important components of the program, including defense wastes. We believe that the Mission Plan should be submitted to and reviewed by Congress before any sites are nominated for the first repository.

EPA Standards. By January of 1984 the United States Environmental Protection Agency (EPA) was required to have adopted "standards for protection of the general environment from off-site releases from radioactive material in repositories". The siting guidelines of the Department of Energy repeatedly reference these EPA standards, although the EPA still has adopted no final standards. The state of Washington continues to believe that it is inappropriate to begin the site characterization process without the EPA standards. These standards provide part of the criteria which any repository must meet. EPA standards should be adopted before sites are nominated for formal site characterization.

EA - Comparative Evaluation. The state of Washington believes that the EA should contain, as required by law, a comparative evaluation of the Hanford site "with other sites and locations that have been considered". The draft EA's comparison of the Hanford site with just the other four nominated sites does not meet this criterion. Sites beyond those four have been, and continue to be, considered for a repository site. The Hanford site and the other sites being considered for the first repository were selected without a formal site screening process. The final EIS on the first repository will consider only the three characterized sites as alternatives.

The EA provides a convenient and appropriate opportunity to consider alternatives. It is vitally important to public confidence that we select one of the best, if not the best, sites for a repository. We certainly have no way of determining this if the sites are originally chosen without a screening process and then just compared with each other. The state of Washington believes that a "reasonable comparative evaluation" should be made of Hanford against all other sites and locations considered, including granite sites, for which there are data available.

Water Rights. The EA indicates no intention to secure water rights for repository characterization, even though water would clearly be needed. Rather, the EA asserts (p.6-59) that the federal government "owns" the necessary water rights. We disagree. The state believes that existing water rights for the Hanford Reservation may not legally be used for the purpose of characterizing or constructing a nuclear waste repository.

Transportation - Technical Issues. The treatment of transportation in the draft EA is inadequate on several points. First, risk and cost analyses were based on "nationally applicable unit risk factors" (5-53) and do not reflect risk data on probable routes to the potential repository sites. Consequently, distance is the key variable. Differences in topography, climate, and engineering design of both rail and highway routes can be expected to result in significantly different risk factors among sites. Such probable differences are not reflected in the EA. The decision to use generic unit risk factors is not sufficiently documented or defended. R

Second, the calculation of radiological effects of accidents is not adequately documented. Specifically, the basis for estimating the severity of accidents and the extent of radioactive exposure resulting from accidents is not adequately referenced. This deficiency in documentation assumes added importance in light of apparently conflicting estimates in previous transportation documents prepared by the NRC and Sandia National Laboratories. If, in fact, the consequences of accidents are more severe than assumed in the EA, the need to project accidents based on specific routes to the potential repository sites assumes increased importance.

Third, the EA fails to adequately explain the weighing of transportation relative to other siting consideration and the relative importance of local, regional, and national transportation policies and issues. This latter concern is highlighted by the relatively high ranking assigned to Hanford, despite the fact it displays the highest total life cycle cost and risk for transporting of waste (p.7-94, 95).

Fourth, a matter of considerable concern is the elimination of a major portion of the region, including Spokane, from analysis of transportation conditions. Calculations of radiological effects of both normal conditions (Table 5-14) and accident effects (Table 5-15) do, in fact, consider population densities along highway routes. However, key transportation concerns, including risk of accidents, weather conditions, and necessary upgrading, are not analyzed along these routes. The Spokane corridor is excluded from such analysis by the definition of "local" and "regional" R used in the EA (p.5-49). The result of this definition is the failure of the EA to address matters of obvious and considerable concern.

Fifth, the draft EA appears to significantly understate the volume of defense waste that will be transported to a commingled repository. Even if analysis deals only with the very limited amounts of defense waste scheduled for shipment to a commingled repository in the draft commingling report (DOE/DP-0020), review of the data in that report indicates that defense waste would constitute 43% of the waste packages transported to a commingled repository.

Sixth, the EA provides inadequate documentation for the assumption that approximately 70% of waste will be transported by rail and 30% by truck. The revised EA should explain both the basis of this assumption and its effect on the ranking of sites. In addition, the EA should directly address the potential use of barges for transport.

Finally, the final EA should describe current plans of USDOE to incorporate Monitored Retrievable Storage as an element in an overall waste management strategy. Because MRS will affect the pattern of transportation, the age and, therefore, radioactivity of fuel transported, and the feasibility of unit trains, analysis of these and other possible transportation impacts of MRS is required.

<u>Transportation - Policy Issues</u>. Several comments regarding transportation included in the previous overview statement have been incorporated in the revised technical comments. This section of the Overview is limited to comments on policy issues which go beyond the technical adequacy of the EA.

A cursory review of the draft EAs for Nevada and the two Utah sites shows the different ways in which a "region" is defined, as compared to the Hanford EA. In Nevada the region appears to extend to the state boundary, while in Utah a radius of 125 miles was employed. In the Hanford EA one defined region covers the area from the site to the nearest interstate highway, but in the discussion of radiological effects the region extends through Spokane.

It is difficult to understand how the nine potentially acceptable sites could be compared regarding risk and cost or regarding compliance with the guidelines in general when definition of a key determinant of impact, i.e., the region within which detailed analysis occurs, varies among sites.

Second, at least one potentially significant determinant of transportation costs, provision for physical security in transit, is considered at two sites (Lavender Canyon; Davis Canyon), but not at another (Hanford). Assurance must be provided that a basis exists to compare costs at one site with costs at another.

The technical comment of the Board on the Evaluation Process for Transportation emphasizes the need to consider costs and risks on a route specific, not generic, basis. The comment observes a need to expand the definition of "region" to include the Spokane corridor. While Spokane is included in the analysis of radiological effects of normal conditions and accidents (Chapter 5), the analysis is of questionable validity. In addition to a lack of information regarding the estimates of accident severity and radioactive material release (3.2.3.1(C)), the estimates of density along alternative routes in Chapter 5 (Table 5-13) appear inaccurate. Moreover, analysis is limited to a corridor 1 km on either side of the potential route.

As is noted in the technical comment, the condition directing consideration of cost and risk which permits consideration of the Spokane corridor (favorable condition #5) appears to play no significant role in the determination that the Hanford site meets the qualifying condition. In addition, the EA fails to explain the significance of favorable condition #5 in the comparison among sites. Despite having the highest transportation cost and risk (p.7-92, 7-95), the Hanford site is rated near the top of the potentially suitable sites (p.7-94). It is apparent that risk in the immediate vicinity of the repository site is the dominant consideration in the comparison among sites.

This disregard of potential risk to Spokane area residents is not acceptable to the Board. The EA should be revised to accurately and directly address transportation risk in the Spokane corridor and to incorporate such findings in the recommendation of repository sites. Potential impacts of transportation beyond the 2 km corridor and the potential for, and benefits of, bypassing Spokane need to be addressed. The weight assigned to the total risk of transportation to the Hanford site, including the risk in the Spokane area, should be defined and justified.

<u>Economic Risk Analysis</u>. The potential for economic damage from routine operation and unanticipated releases in transport to or operation of a waste repository should be a factor in nomination of sites for characterization. This conclusion reflects the state position that significant differences may exist among potential sites in terms of economic damages from such releases.

Our concern for such damages has been expressed to the Department for over a year. A subcommittee of the state Nuclear Waste Board negotiating a Consultation and Cooperation Agreement with USDOE identified the need for an economic risk analysis as a means to resolve conflict concerning liability. We understand that an economic damage analysis has been initiated by USDOE, but results will not be available under the current schedule prior to formal site nomination and the start of site characterization.

In requesting economic damage analysis in the final EA, the state observes that the Guidelines (960.5-2-6) specify as a potentially adverse condition the potential for major disruption of primary sectors of an area's economy. A disqualifying condition exists if the repository would significantly degrade or diminish water from major off-site sources. In view of the proximity of the Columbia River to the proposed site and the reliance of the region on the Columbia River for agriculture, transportation, recreation, fisheries and municipal water supply, the state finds the absence of economic risk analysis in the draft EA a major deficiency.

Such analyses should be based on a common methodology, but should be site specific and permit comparison among potential sites. Non-routine events should include a range of rates of release of radionuclides from the repository. While such events must be hypothetically possible, the probability of release need not be a factor in economic damage analysis. However, resources at risk near the repository and along transportation routes should be identified; the costs of decontamination, resource replacement, and repository evacuation or reconstruction should be estimated. To assist in the technical potential economic damage, the Board submitted the report of the Economic Damage Analysis Subcommittee to the R
Director of the Office of Civilian Radioactive Waste Management on April 10.

Emergency Response. The draft EA indicates that the favorable condition requiring that "plans, procedures and capabilities for response to radioactive waste transportation accidents...are completed or being developed" is present for shipments to Hanford (p.6-52). We question both the appropriateness of this as a guideline for site nomination and the specific conclusion. There has been no emergency response planning in Washington State in response to the possibility of a repository being constructed at Hanford. Existing response plans are based on limited shipments of radioactive material in the state, most of which is low-level R
waste.

While detailed response planning for repository operations does not appear a prudent expenditure prior to recommendation of a final site for the first repository, when such planning and program implementation appears appropriate, the state will insist that all costs to state and local agencies be fully paid by the Nuclear Waste fund authorized under the Nuclear Waste Policy Act. For this reason, we request attention to the statement within the EA that the state recognizes that state and local government have primary responsibility for responding to transportation accidents (p.6-52). This statement should be expanded to make clear that financial responsibility for accidents and for costs of emergency response planning and implementation rests wholly with the Department and will not be assumed by state or local government agencies.

Summary of Defense Waste Concerns

Low, intermediate and high-level wastes from defense operations since 1943 are an inherent part of the Hanford environment, and must be assessed on the same basis as climate, archaeology and ecological factors. These wastes are in varying states of containment, including wastes accidentally released to the soil and shallow aquifers and wastes in tanks which are not easily recoverable.

The Nuclear Waste Policy Act presumes defense wastes will be commingled unless the President, because of security or other concerns, decides otherwise. The decision has now been made. ' R

The commingling decision triggers NWPA provisions relating to consultation, funding, and the inclusion of defense wastes in environmental assessments and site characterization. Disposal of defense wastes in a repository will have implications on design, size, schedules and transportation and should, therefore, be addressed at appropriate locations throughout the final EA.

The dimensions of the needed analysis are multiple. One of the most critical problems is the effect of existing and anticipated defense waste losses to the measurable environment on geochemical/radiological monitoring of the repository. The most critical timeframe is not over the few postclosure decades, but out into near geological time: hundreds to thousands of years. If succeeding generations are unable to discriminate between sources of measured radionuclides in the land and water environments, and if original records are lost, then the burden on future generations becomes immense: they will have to assume a worst case and react accordingly. This would mean almost incalculable costs and losses of productive time to ensure a habitable and useful environment.

Almost as severe is the problem of total radionuclide loading of the Columbia River. The environment which has to be considered in the EA is not just the downstream sector, but the entire drainage basin. Other sources of radionuclides include (1) the naturally occurring mineral assemblages in rocks subject to erosion and leaching, (2) the uranium mines and wastepiles from existing and future mining operations, in a region which has already shown economic viability of uranium mining in competition with world sources, and whose rate of release after abandonment is greatly magnified compared to natural sources, and (3) the Idaho National Engineering Laboratory, both an operational and a residual source of radionuclides which includes long-lived transuranics and bioactive fission products.

The EA discussion should include a detailed description and evaluation of defense wastes in interim storage. It should include the basis for deciding what wastes will be transferred to a geologic repository, the legal basis for assigning any portion of existing wastes to permanent storage outside the geologic repository, the volume of defense waste in interim storage which will not be transferred to the geologic repository, and the implications of combined storage on radionuclide release over long timeframes. Most of these issues were raised in our formal response to the commingling report (Section 8, Nuclear Waste Policy Act). The Department should include an inventory of wastes lost to Hanford soils and the unconfined aquifer. Land requiring permanent posting, surface access restrictions or environmental controls should be identified to ensure protection of people and the environment. It is critically important that the Department include a section describing how existing defense wastes will affect long-term performance monitoring, after abandonment of Hanford as a site for nuclear activities.

The present draft EA considers none of these factors; it makes its assertions of safety and conformance against an empty slate, when just the opposite is the case. What the release standard of the 30th and 50th centuries will be is a mystery; the history since 1945 has been toward increasing conservatism as new effects and causes are discovered. The Columbia River will be there, and there will always be some total budget allowable for releases from a Hanford repository, which has to subtract from "background" loading. The EA is the appropriate vehicle for a full discussion of this difficult question, because it is the only vehicle short of a final EIS which asks the question, "What is the net impact on the Columbia River, and what is the impact of the proposed action?"

A third problem created by defense wastes at Hanford has to do with the apparently de facto conclusion of the federal agencies that commingling of defense and commercial high-level wastes is of nominal impact, simply an addition of 10,000 MTHM to a 70,000 MTHM design figure.

This is an inaccurate conclusion. It is apparent that defense waste commingling involves much greater volumetric capacity per Curie than spent fuel, and thus that the already difficult geologic problem (at Hanford) of finding and documenting a large volume of intact interior basalt flow rocks, to fit the preliminary geological and engineering assessments, could be exacerbated by an increase of as much as 70 percent in required volume. Underground development and construction is an art and science developed over many technical generations, but we find that there is little indication that these practical, rather straightforward considerations have been employed in the writing of the draft Commingling Report. The failure of the draft EA to include the impact of defense waste commingling on costs and cost allocation between civilian and defense sectors, on the practical difficulties of characterizing a sufficient rock volume, and on geohydrologic release scenarios constitute serious flaws. The final EA must correct this deficiency thoroughly and objectively. The fact that there will not be an opportunity for state review places a considerable burden on USDOE.

Summary of Geotechnical Concerns

Developmental Technologies. The Department must clearly identify where advances in technology are required to conduct environmental assessments. If experimental or developmental technologies are to be used, the implications of failure of such technology should be described. The nature of the reducing conditions of the groundwater is a potential major control on radionuclide transport, and the Department is still developing a new redox probe which is capable of functioning in the adverse repository environment. NRC has questioned the validity of laboratory tests which use hyrazine to simulate reducing conditions and new techniques may be needed. Blind shaft drilling of the size and to the depths projected would also be a developmental undertaking; the EA should describe contingency plans for an incomplete shaft or inadequate sealing.

Regional Geology and Tectonics. It is apparent, and concluded in the EA draft, that most of the questions of regional and local tectonism are unanswered or imperfectly understood. At the same time, Chapter 6 presents relatively favorable, or neutral, conclusions in these regards as to the specifics of the Guidelines of 10 CFR 960.

Most of the evidence and documentation in the EA is included in the Site Characterization Report dated November 1982; the principal change in the EA is withdrawal from some of the more optimistic statements in that document, but there has been little new data presented in spite of continued field and laboratory work. In particular, there is ambiguity between levels of confidence.

The Guidelines themselves are, in places, vague; and lack of site-specificity is continually troublesome. To the state of Washington reviewers, this situation is as much a procedural or interpretative error as anything else, to be dealt with at some other level. Our geologic concerns are quite specific, however.

Foremost is the apparent failure to utilize the existing evidence of geophysical anomalies which could be interpreted as faults in and close to the Reference Repository Location--the RRL. The Emerald Exploration seismic reflection re-study, commissioned by USDOE, indicates deep-seated anomalies at or near the RRL. Fully complementing this study is the Weston Geophysical aeromagnetic mapping project of 1978, produced for WPPSS Project 2, which upon our own and independent interpretation suggests that there is considerable deep faulting at or near the RRL. More subjective than the geophysical evidence is photointerpretation of aerial and satellite imagery, but both have produced consistent pictures of linear, geologic structure patterns and extensions which are also consistent with both field-mapped and geophysical lineations. Of essential significance is the fact that any confirmation of the photointerpretations in areas of thin cover means that there is some physical evidence at the surface of fault or shear movement in younger rocks; that the structures so defined are suspect of being capable of recurrent activity in the present or near future until better evidence has been obtained. ' R

A related observation is that the most minor near-surface movement on underlying faults, as measured in inches or centimeters in the past few thousand years, may indicate continual movement measured in meters and even hundreds of meters over the time since emplacement of the Columbia River basalts, a span of nearly 17 million years. Until the regional tectonic scene is well understood, the underlying deep faulting must be assessed as potentially providing vertical pathways of high groundwater permability and conductivity to the assumed discharge area of the Columbia River.

Except for the brief preclosure period of repository development, direct seismic hazard is of minor concern; a well-designed underground structure, fully backfilled, should withstand any reasonably conceivable ground motion in the Columbia Basin. The major concern we have today is that discrete and throughgoing, near-vertical groundwater pathways may exist at or near the RRL and yet be discounted in the EA on the basis of "no adverse evidence". The EA downplays adverse evidence of faulting at the repository horizon which exists in the literature, and instead relies to some extent on mean or average values for the ability of the basalts to conduct groundwater contaminated by radionuclides toward and into the Columbia River discharge areas. Even the reliance, in the EA and its supporting documentation, on averaged values for hydrologic parameters is specious when there exist orders of magnitude of numerical variability. Water will move along the path of least resistance, and the rock breakage and shattering due to movement on faults can create pathways which obviate any averaged values for unfaulted rock. ' R

<u>Geohydrology</u>. While the EA properly notes the unknowns and uncertainties in geohydrologic data, still it presents an overly optimistic picture in relation to the criteria of the Guidelines. We are concerned that the data supporting these conclusions represent judgments reached and recorded before the reappraisals which followed the Site Characterization Report of November, 1982. That is, there may still be a tendency to assume a favorable condition in the absence of negative data, instead of the more appropriate assumption that adverse conditions may exist until proven otherwise.

Some potentially adverse geohydrologic conditions given minimal treatment in the EA include pathways to the environment created by faults or shears which crosscut the basalt flows and interbeds; the effects of the thermal pulse on both buoyancy and solution capability of groundwater; the upward flow component that would exist if the site is in a regional discharge area; and the changes in flow direction and velocity which will be induced as deep aquifers are tapped for irrigation over not decades but centuries and millenia.

We believe the EA should reflect a more conservative and candid position by USDOE that emphasizes the fact that there is as yet no valid conceptual model of the geohydrology of the Pasco Basin, and that NRC's Site Technical Position 1.1 requires virtually a fresh start in data collection for even the close-in hydrology of the RRL.

Preclosure Rock Stability and Construction Problems; Seismicity and Structure. Relative to the rocks at the other candidate repository sites, the Hanford basalts at repository depth are hard, brittle and highly stressed, with stress applied anisotropically. Conditions exist for rock failure at various stages of development, with consequences for added cost and delay, for safety of men and underground facilities and for creation of groundwater pathways to horizons of greater conductivity than the dense flow interiors.

Blind boring of large-diameter shafts to this depth, in these rocks, has no direct precedent. While it may be accomplished, there are also possibilities that it will not, in which case alternative technology would have to be employed. The EA should specify the alternatives and their impact on costs and schedules, along with plans for permanently sealing any abandoned rotary boreholes.

While in-situ measurements will be required to characterize the rock mass at depth, that is, measurements taken from the exploratory shafts and underground test facility, the EA should address in greater detail what is already known or realistically inferred from geologic and geophysical data about the relationships of structure and seismicity to the stability of mined openings. We are concerned that the EA repeats the conventional thinking of the past, to the effect that there are no significant faults or shears at the RRL, and that the small earthquakes and microearthquake swarms observed at and near the RRL are random events in space, not associated with faults. The subsequent discovery of recent and presumably active faulting at Gable Mountain and the eastern end of Yakima Ridge, along with recent reinterpretations of aeromagnetic and reflection seismic surveys, makes the earlier conclusions suspect. At least some of the epicenters recorded in the period 1969 through 1984 in fact appear to align on geophysical anomalies interpretable as faults, and faults of small displacement measured in very young rocks at the surface must be assumed to represent increasingly greater displacement and rock disturbance with increasing age and depth.

Faults at and near the RRL do not necessarily disqualify the site, but they must be allowed for in conceptual thinking and they must be characterized in the exploratory workings. If faults or shears or shattered rocks are present, then three of the essential factors for rock failure or even rockbursts exist: brittle rock, high stress and structural discontinuity. The EA should carefully consider all the ramifications of this reasonably possible scenario.

Exploratory Shaft Construction. Concern has been expressed by the state of Washington during 1984 when revised plans of the Department of Energy called for the construction of two exploratory shafts during site characterization at the BWIP site, if the state were to be included as one of the final three states. Additional information indicated that the second shaft would be oversized beyond that necessary for safety in site characterization. That decision by USDOE apparently was based on a desire to speed up the construction time by getting a head start during the study phase, well before construction authorization by NRC.

At a Nuclear Waste Board meeting held in July, 1984, a representative of OCRWM stated that the Office would limit the shaft size to six feet in diameter, rather than the larger-sized shaft. However, the draft Environmental Assessment, on page 4-10 states that the program "would involve the drilling of two large-diameter (9.2 foot) holes". Explanation and justification for this unannounced change in the proposed DOE plan must be included in the final EA.

Geochemistry. The EA relies heavily on data compiled over the years by Hanford/Rockwell, and supplemented liberally with handbook values, to conclude that the general conditions are favorable for radionuclide retainment or retardation at depth. But the EA does not recognize the major effect of the November, 1984 Technical Position on radionuclide solubility testing, issued by NRC, which says in effect that the only acceptable values for solubility are those obtained at repository pressure and temperature, using realistic groundwater analogs and duplicating the actual pH and redox conditions. Thus, many or most of the earlier conclusions on favorable geochemistry, repeated in the EA, are now required to be reestablished in a long, costly and technically difficult series of experiments. Any changes in solubility values will then have to be cycled through the evaluative process and some important earlier conclusions may have to be withdrawn or amended.

The EA should note this change, and in places modify its statements to emphasize that its conclusions are not based on confirmed data of the type required by NRC, and that independent reviews by other federal contractor laboratories are suggesting that many values used in the 1982 SCR and the draft EA are incorrect, in some cases by several orders of magnitude. R

Human Intrusion; Natural Gas. The EA is inaccurate in two cases involving natural resources: the increased withdrawal of groundwater from the deep aquifers in future centuries, already noted elsewhere, and the probability that the search for natural gas could lead to drilling of the Cold Creek syncline.

USDOE's assumption that future exploration will be on anticlines is incorrect. The target is deep gas in early Tertiary sediments, considerably older than the oldest basalts, with the gas migrating from coal beds into stratigraphic as well as structural traps, with the basalt forming a caprock. Structure in the older rocks may well be largely independent of structure in the basalts, so that as improved geophysical techniques appear drilling may be anywhere in the basin. The current exploration for deep gas is on the anticlines mainly for reasons of economy; the basalts are thinner there. These inaccuracies should be remedied in the final EA.

APPENDIX A

Comment regarding the Draft Environmental Assessment received by the Board subsequent to March 19, 1985 for submission to U.S. Department of Energy.

A. Comment received from Legislators

1. Representative Jolene Unsoeld
2. Senator Mike Kreidler

B. Comment received from Local Governments

1. City of Vancouver
2. Public Utility District of Clark County

C. Comment received from Groups

1. Clark County Pomona Grange No. 1
2. Search Technical Services
3. National Association of Retired Veteran Employees, Inc.

D. Comment received from Individuals

1. Ruth M. Meneke
2. Nancy Kelly - Mizrahi
3. M.J. Szulinski
4. Wen-sen Chu
5. Lori Loranger
6. Gary Greene
7. Chilton Ryan
8. Cheryl Stewart
9. Allan H. Marcus
10. Amy Mickelson
11. Al Hanners
12. K. Smith
13. Connie Copeland

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TWENTY-SECOND DISTRICT

RESIDENCE
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OLYMPIA, WA 98502
206 866 8815

OLYMPIA OFFICE
HOUSE OFFICE BLDG
OLYMPIA 98504
206 786 7940

House of Representatives
STATE OF WASHINGTON
OLYMPIA

March 18, 1985

Comments -- Environmental Assessment
U.S. Department of Energy
ATTN: Comments -- EA
1000 Independence Avenue S.W.
Washington, D.C. 20585

To whom it may concern:

I am submitting these comments for inclusion with Washington State's comments on the Hanford Environmental Assessment for a High Level Nuclear Waste Repository.

First of all, I am outraged that the Department of Energy has demonstrated, through their refusal of a 30-day extension period, their desire to railroad their site selection onto the residents of Washington State even when they are unable to provide complete documentation proving that Hanford is the safest site. I believe that the posture of our state has been one where, for the good of the nation, we have been open and willing to consider a Hanford repository further. However, the DOE's response to the Governor's request has shown nothing but a blatant disregard for the health and well-being of those who would be most intimately affected. That action can only lead to further mistrust of the DOE, and to the belief, whether accurate or not, that the DOE might have skewed its site-selection process in favor of Hanford. As residents of Washington State, we have already experienced the ineptitude and lack of integrity of the Federal government in their mis-handling of hazardous - and **LEAKING** - military waste. To push forward without providing adequate responses to all of the issues raised only further proves our point that the DOE cannot be trusted.

As a result, I demand that further consideration of a Hanford repository be postponed until the DOE:

(1) acknowledges that the site is not necessarily one of the three safest choices;

(2) agrees to improve its ranking methods so that the basis for ranking can be evaluated;

(3) resolves technical issues including, but not limited to,:

* the problem of existing highly radioactive (and chronically leaking) defense wastes presently located on the Hanford site;

* the possibility that huge horizontal stress on deep layers of basalt rock at Hanford could create serious engineering problems, i.e., "the fracturing could presage explosive bursts of rock in a repository" according to Dr. Donald White in his 1983 report for the National Academy of Sciences;
* the difficulty of keeping a deep, open repository intact for 50 years or more before final closure.

In addition, I question the DOE's basis for selecting Hanford as one of the three sites to be characterized when that judgment was based in part on a 1982 Groundwater Flow Times Report that was severely criticized by scientific groups, and which triggered a reappraisal of that Hanford study.

Finally, the comment period should be extended until the DOE can provide a completed EIS statement which adequately documents their position so that a responsible review and definitive conclusions can be drawn. The siting of this repository presents many risks that need to be carefully evaluated, especially in the light of its impact on the Columbia River. To rush the selection process could result in not only an immediate danger to and loss of workers' lives, but could also hasten the leakage of hazardous radioisotopes into the Columbia River and the general environment which depends on that major waterway. Those dangers are too great and far-reaching to be taken lightly; future generations will be the ones who are affected by the good or bad decisions of today. As a result, it is my belief that no action should be taken without thorough and valid documentation.

Sincerely,

Jolene Unsoeld

Rep. Jolene Unsoeld
22nd District
House of Representatives
State of Washington

cc: Mr. Warren Bishop, Nuclear Waste Board
Mr. Max Power, Joint Legislative Committee on Science and Technology

Senator Mike Kreidler
Washington State Senate
22nd District

March 7, 1985

John Harrington, Secretary
U.S. Department of Energy
1000 Independence Avenue SW
Washington, D.C. 20585

Dear Secretary Harrington:

The U.S. Department of Energy's choice of Hanford as a potential disposal site for high-level nuclear waste is irresponsible. First, because the federal government has apparently assumed that Hanford is guilty (a good site) until proven innocent (a poor choice). Second, because our state is already accepting low-level nuclear waste from other states while both Nevada and South Carolina are gradually limiting the amount of such wastes that can be shipped in to their states. How much risk must Washington and Oregon residents be asked to live with, while the rest of the nation gets off with little or no long-term risks for its nuclear power refuse?

The problem of nuclear waste and its disposal will not go away, will not disappear neatly for us just because we decide to bury it in the ground. Our children, and their children, and many generations of children to come, will have to live with the consequences of the decisions we make. A rush to judgement designed to save the nuclear power industry from a storage problem of its own creation would be one of the most serious mistakes this nation ever made. Such a mistake would be, at best, extremely costly to undo. Most likely, it would be totally impossible to remedy. Think long and hard about this fact.

Washington residents recognize that this is an issue of national importance, not a regional problem; nuclear waste and its hazards will affect everyone in this country for a very long time. That is why we would not object to becoming a permanent respository for high-level waste, even more than our fair share of it, were it not for our firm belief -- based upon scientific facts, or, in the case of your initial site recommendations, the lack of facts -- that Hanford is unsuitable and dangerous as a storage site.

425 Public Lands Building • Olympia, Washington 98504 • (206) 786-7642

That is why I think the other states in this country should begin to take the problem of nuclear waste disposal more seriously and more personally, because this is a problem which affects all of us, now and in the future. It is a problem we will decide now and leave to our children to deal with after we are gone. In the past, it's been too easy for other states to leave the problem up to Washington, Nevada and South Carolina, those states which, until recently, have accepted all of the low-level waste, and with it, the responsibility.

Our appetite for even low-level wastes has decreased as incidents of leakage of radiation into the environment have steadily increased over the years. Each time we are told that the levels involved are "acceptable," even if that requires dividing the amounts over time or changing the standards to suit the contention that there is no danger.

Face it. Hanford simply is not the best site in the country for burying high-level nuclear waste. Hanford was chosen as one of three potential sites for high-level waste disposal because it is currently accepting the greatest amount of low-level waste in the country; not because geographically or geologically it is the best spot in the United States.

Judging by humankind's inability to safely process or store nuclear wastes, it would be foolish of Washington to reach out with bare hands and grab hold of a universal solvent. In accepting Hanford as a permanent burial ground, that is exactly what we would be doing.

Sincerely yours,

MIKE KREIDLER
State Senator

MK:ss

CITY OF VANCOUVER, WASHINGTON
City Hall, 210 East 13th St. - P. O. Box 1995
Vancouver, Washington 98668-1995

March 18, 1985

E.A. U.S. Department of Energy, ATTN:
E.A. 1000 Independence Avenue, S.W.
Washington, D.C. 20585

SUBJECT: NUCLEAR WASTE REPOSITORY SITE DECISION

The City of Vancouver. Washington, is located on the Columbia River directly north of Portland, Oregon. The city has a population of approximately 43.000 people, and we provide water services to almost 100,000 people in the urban area of Clark County. We rely totally on groundwater as a supply source for our municipal system. The majority of our water source, and our strongest well fields, receive a significant recharge effect from the Columbia River, and any contamination of that water would have disastrous effects on the entire urban area of Clark County.

We also view the Columbia River as a major recreational resource and currently have two city parks and one county park with river frontage within the city limits. Any contamination of the Columbia River would have obvious detrimental effects on the recreational capabilities of those parks.

There has been much information disseminated on the subject of a nuclear waste site in the upper Columbia River basin. The issue is complex and requires a great deal of analysis in order to come to a responsible decision.

We and all citizens must ultimately rely heavily on the technical analysis performed by the experts.

The Vancouver City Council urges a thorough study of the potential impact on the Columbia River before final decisions are made. This final decision should then be made based on sound technical data and not political expediency, especially since Hanford is an existing disposal site.

We also urge that the final plan require recycling of dangerous material to the maximum extent possible thereby minimizing the amount of material that will have to be stored for extended periods.

The Vancouver City Council opposes the designation of Hanford as a permanent site for the storage of nuclear wastes until the geological and technological questions are satisfactorily answered. We believe a quick "political" decision is not in the best interests of the residents of the City of Vancouver and Clark County.

Sincerely,

BRYCE SEIDL
Mayor

Copy

"A consumer-owned electric and water utility, established 1938"

Public Utility District of Clark County
P. O. Box C-005 • Vancouver, Washington 98668
(206) 699-3000 • Toll Free in Washington 1-800-562-1736

W. Bruce Bosch, General Manager

Board of Commissioners
Carol Curtis-Somppi, District 1
Paul Runyan, District 2
Jane Van Dyke, District 3

File

26 March 1985

Mr. Warren A. Bishop, Chairman
Department of Ecology
MS PV 11
Olympia, Washington 98504

Dear Mr. Bishop:

Subject: Resolution Opposing Further Consideration of The Hanford Site as a High-Level Nuclear Waste Repository

Attached is a copy of a Resolution passed and adopted by our Board on 19 March 1985 opposing further consideration of the Hanford Site as a high-level nuclear waste repository.

After a thorough review of existing studies and reports, the Board of Commissioners has concluded that any contamination of the Columbia River from the Hanford nuclear waste repository would impair, or render useless, a future water supply for Clark County PUD. Since no assurances have been made that such contamination would not occur, the District must go on record as opposing any further consideration of the Hanford Site.

Sincerely,

Carol Curtis-Somppi
President
Board of Commissioners

CC/kis
Attachment

RESOLUTION 3996

A RESOLUTION OPPOSING FURTHER CONSIDERATION OF THE HANFORD SITE AS A HIGH-LEVEL NUCLEAR WASTE REPOSITORY

WHEREAS, in 1983 the water utilities of Clark County completed a Coordinated Water System Plan which investigated future water supply requirements for Clark County and identified resources available to meet future demands. Well fields adjacent to the Columbia River and direct intake from the river were identified as two future resource options; and

WHEREAS, contamination of the Columbia River may seriously impair either the direct use of the river or wells which may receive a significant portion of their recharge from the river for future public water supplies; and

WHEREAS, the environmental assessment of the reference repository location, Hanford site, lacks sufficient assurances that radionuclides from the repository will not enter the ground water and subsequently the Columbia River; and

WHEREAS, radioactive contamination of the river could seriously impair the future water supplies of Clark County by rendering the river or well fields adjacent to the river useless as a future water supply,

NOW, THEREFORE, BE IT RESOLVED:

That the commissioners of Clark Public Utility District do hereby go on record as opposing further consideration of the Hanford site as a high level nuclear waste repository.

PASSED AND ADOPTED this 19th day of March, 1985.

President

ATTEST

Secretary

CLARK COUNTY POMONA
No. 1

8007 N. E. 72 Avenue
Vancouver, Washington 98665
March 14, 1985

U. S. Department of Energy
Attention: Environmental Assessment
1000 Independence Avenue, S. W.
Washington, D. C. 20585

Gentlemen:

The Clark County Pomona Grange No. 1, State of Washington, wishes to present its comments in response to the allowance of a period for public comment regarding permanent sites for high-level radioactive waste deposit.

Clark County, in Southwest Washington, is the home of over 6,000 Grange members. It is bounded on two sides by the Columbia River, which, historically, has been the life-blood of the area. Clark County is the gateway to the magnificent Columbia River Gorge, a natural, scenic wonder. Recent years have seen an unprecedented growth in population in this county, due in part to its livability. Projections indicate that the Columbia River should be the future source of drinking water for the public system. Anything affecting the Columbia River affects life in Clark County.

Being two hundred miles down the Columbia River from the Hanford Site, this county is aware of its inescapable vulnerability should any disaster occur there. Past incidents have taught us that errors will happen and that human judgment is not infallible. The use of the Hanford Site for storage of this magnitude would place our county in jeopardy and subject it to the danger of irrevocable loss of our people and our environment. We have no confidence in claims of permanent safety in this storage, and we are not willing to acquiesce to a decision whereby our very existence would be dependent upon man's judgment or the endurance of his manufactured storage containers.

Clark County Pomona Grange No. 1 strongly opposes the use of the Hanford Site as a permanent high-level radioactive waste repository. As residents of the area along the Columbia River drainage basin, we implore you not to place this potential for destruction upon the land that we love.

Sincerely yours,

Elizabeth M. Swanson
Master

cc: President Ronald Reagan
Sen. Slade Gorton
Sen. Dan Evans
Sen. Mark Hatfield
Sen. Robert Packwood
Rep. Don Bonker
Rep. Sid Morrison
Rep. Tom Foley

High Level Nuclear Waste Management Office
Please put us on your mailing list. thanks
EMS

SEARCH technical services
(509) 725-6666
STAR ROUTE BOX 17 DAVENPORT WA 99122

14 March 1985

U.S. Department of Energy
Attention: Comments--EA
1000 Independence Avenue, SW
Washington, DC 20585

REFERENCE: Technical Review Comment on
DRAFT EA: REFERENCE REPOSITORY LOCATION, HANFORD SITE, WASHINGTON, December 1984.
SEARCH : 5545

CONCLUSION: The Hanford Site fails the Geohydrology Disqualifying Condition and therefore should be eliminated from further consideration as a potential repository site according to DOE guidelines. Available data indicate a pre-waste-emplacement ground-water travel time from the disturbed zone to the Columbia River of 300 years.

BACKGROUND: According to DOE guidelines, potentially acceptable repository sites are first evaluated in the Draft Environmental Assessment (DEA) against 12 specified Disqualifying Conditions. If the Hanford Site is shown to fail any one of these Disqualifying Conditions, then the site is automatically eliminated from further consideration.

This Technical Review Comment evaluates the Hanford Site in regard to the Geohydrology Disqualifying Condition [1] which is defined as follows:

> **"A site shall be disqualified if the pre-waste-emplacement ground-water travel time from the disturbed zone to the accessible environment is expected to be less than 1,000 years, along any pathway of likely and significant radionuclide travel."**

In other words, Hanford is eliminated as a possible site if much of a sample of water placed where the repository would be situated would be expected to enter the Columbia River within the next 1,000 years.

Ideally, one would actually like to carry out the experiment of timing the spread of a suitably tagged water sample. But repository site selection cannot await a thousand-year demonstration of site qualification. Instead, one examines possible pathways and measures appropriate flow velocities to calculate an expected ground-water travel time to the accessible environment. If these measurements and calculations are performed properly, the calculated travel times should be close to the results which would be found from the actual experiment.

The scientific problem is to select the appropriate pathway of significant radionuclide travel and to assign appropriate flow velocities to the various legs of that pathway. The "travel time" along this critical pathway is the sum of the following: the length of each leg divided by the flow velocity along it.

Another technical term of interest is "hydraulic conductivity" which is the flow velocity divided by the "hydraulic gradient." A hydraulic gradient is the slope of an equivalent ground-water surface, which drives the flow. Our interest in these technical terms is that hydraulic conductivity is a physical property of a particular geologic structure, and the hydraulic gradient can be measured from bore-holes. Thus, the flow velocity of each leg of a critical pathway can be calculated as the product of the measured hydraulic conductivity and hydraulic gradient. Such calculations form the basis for travel time predictions.

This review assumes that the repository is emplaced within the Cohassett Flow of basalt at a depth of about 3,000 feet, Fig. 1 [2]. This review further represents that accessible environment to be the Columbia River which is about 60,000 feet to the east of the reference repository location, Fig. 2 [3]. Corresponding to these vertical and horizontal scales, any significant pathway

STRATIGRAPHY OF REFERENCE REPOSITORY LOCATION

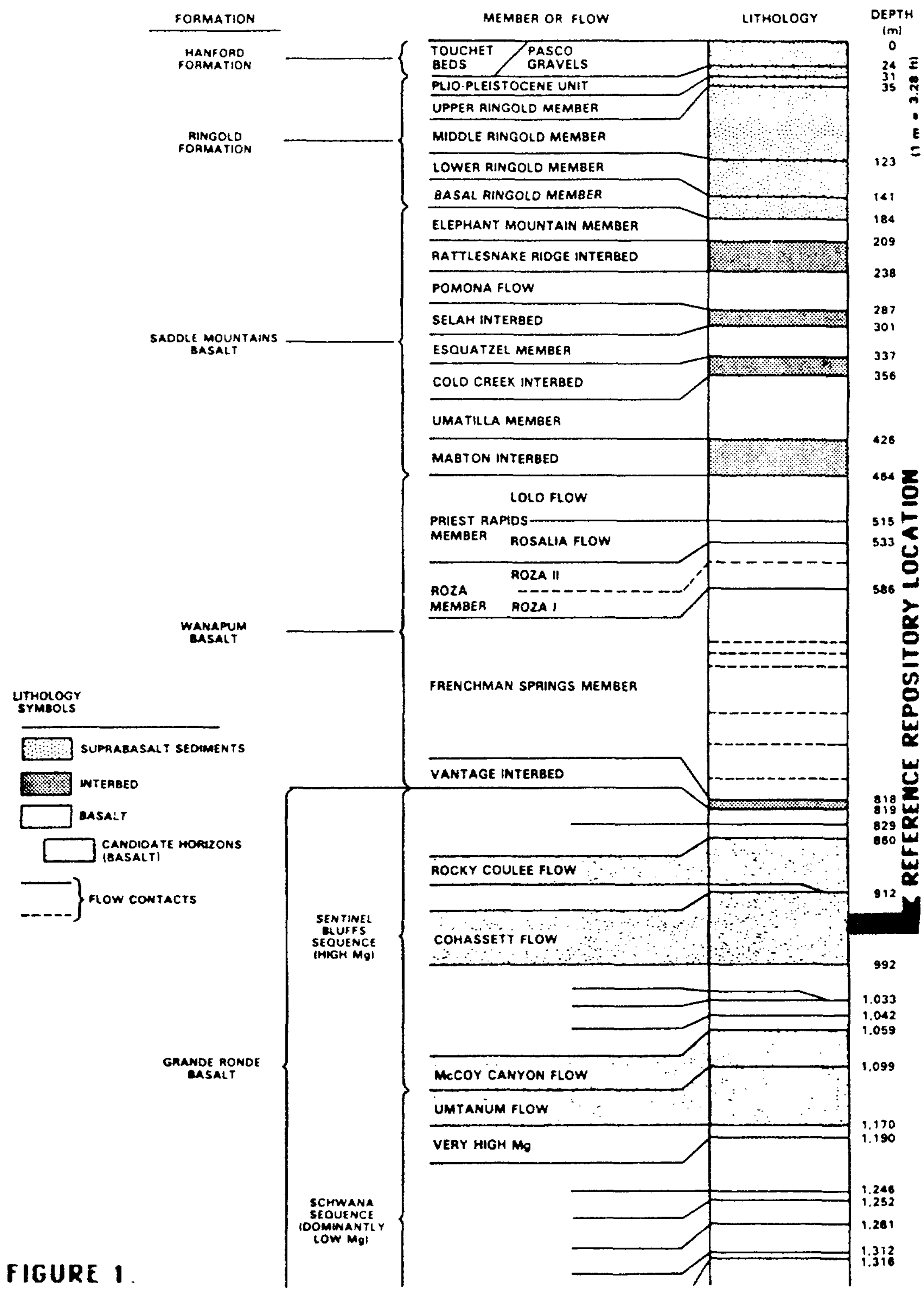


FIGURE 1.

SEARCH.

REFERENCE REPOSITORY LOCATION
WITH NEARBY EARTHQUAKE CENTERS SINCE 1969

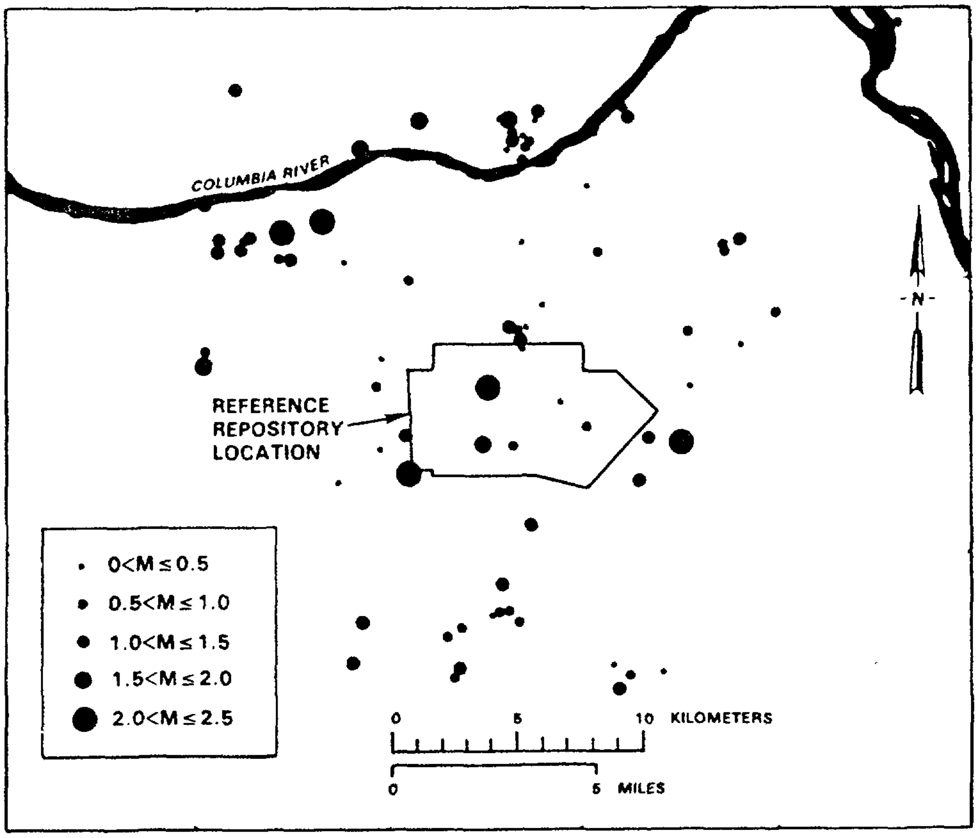


FIGURE 2.

connecting the repository to the Columbia River can be expected to have vertical and horizontal legs.

This review seeks vertical and horizontal structural pathways which can be expected to provide the least resistance to ground-water flow from the reference repository location to the Columbia River. With such pathways of least resistance identified, travel times are calculated from the available data for each leg, and the travel times are summed for the pathway. These calculated travel times must be less than 1,000 years in order for the Hanford Site to pass the Geohydrology Disqualifying Condition.

To obtain a rough idea of expected horizontal ground-water travel times in the area, one may examine the tritium plume released (beginning in 1944 or later) from the 200 East Area which lies just east of the reference repository location. The surface aquifer plume from the 200 East Area reached Well 699-2-3 in

21 years,

Fig. 3 [4]. The site map in Fig. 3 shows that Well 699-2-3 is about as far east of the 200 East Area as the Columbia River is east of the reference repository location. That is, this 21-year period is a crude estimate of the travel time which might be expected for the horizontal leg of a sedimentary pathway connecting the repository to the Columbia River.

Well 699-2-3 was selected for this travel time estimate because its tritium record is particularly simple: There is an abrupt breakthorough of tritium-bearing water in 1965, followed by an exponential increase in concentration, followed by near attainment of saturation concentration in 1976.

Although the horizontal leg of the surface aquifer, extending from 3,000 feet over the reference repository location to the Columbia River, has a travel time of only 21 years to breakthrough, there is no similarly conductive vertical leg connecting the repository

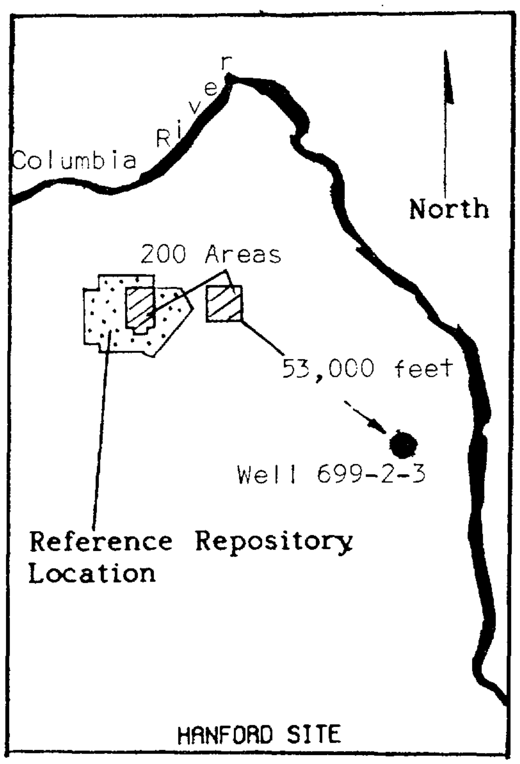
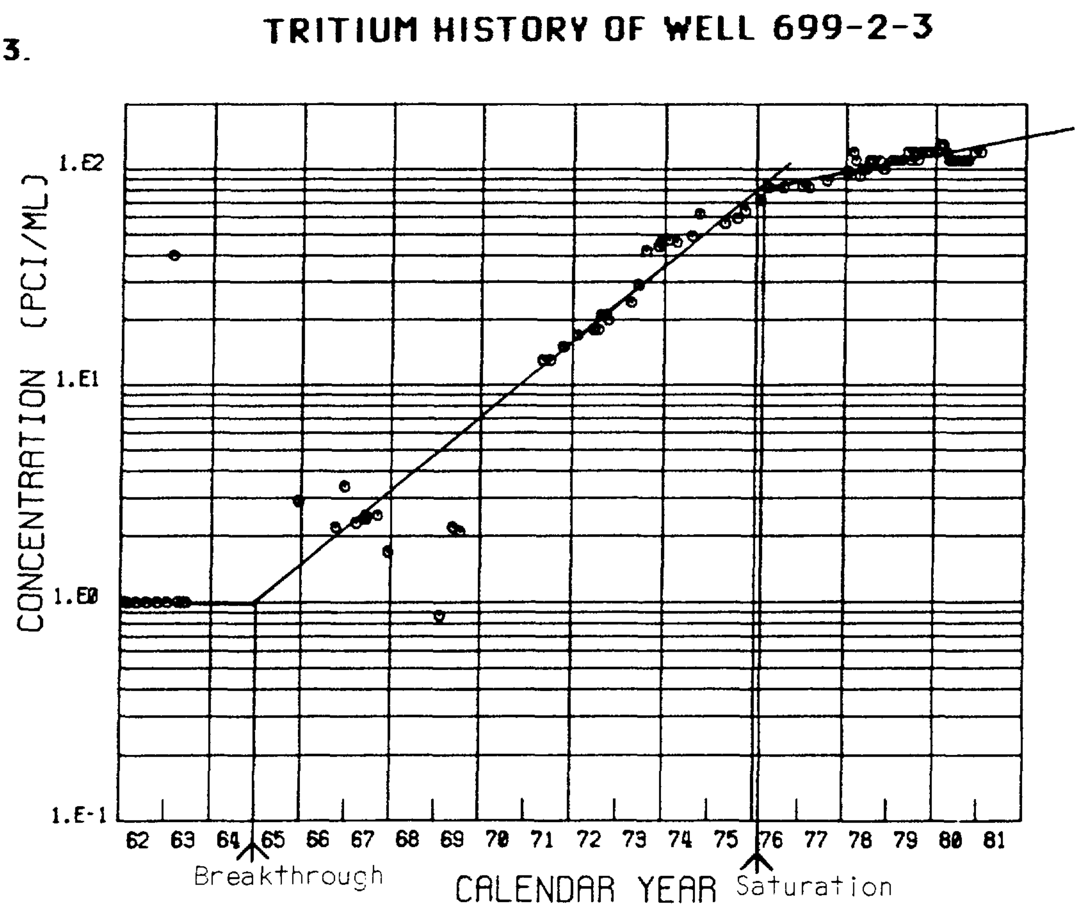


FIGURE 3.



SEARCH.

location to the unconfined surface aquifer in which the flow of Fig. 3 was measured. One may suspect that the presumedly local recharging of the deep aquifers at Hanford would imply reciprocal, upward flows to the surface aquifer as well. But any such pathways are not identified in the DEA. If such vertical legs do exist over the reference repository location, the travel time to the Columbia River might be as low as 21 years. However, in the absence of supporting data, the review turns to other, better identified pathways.

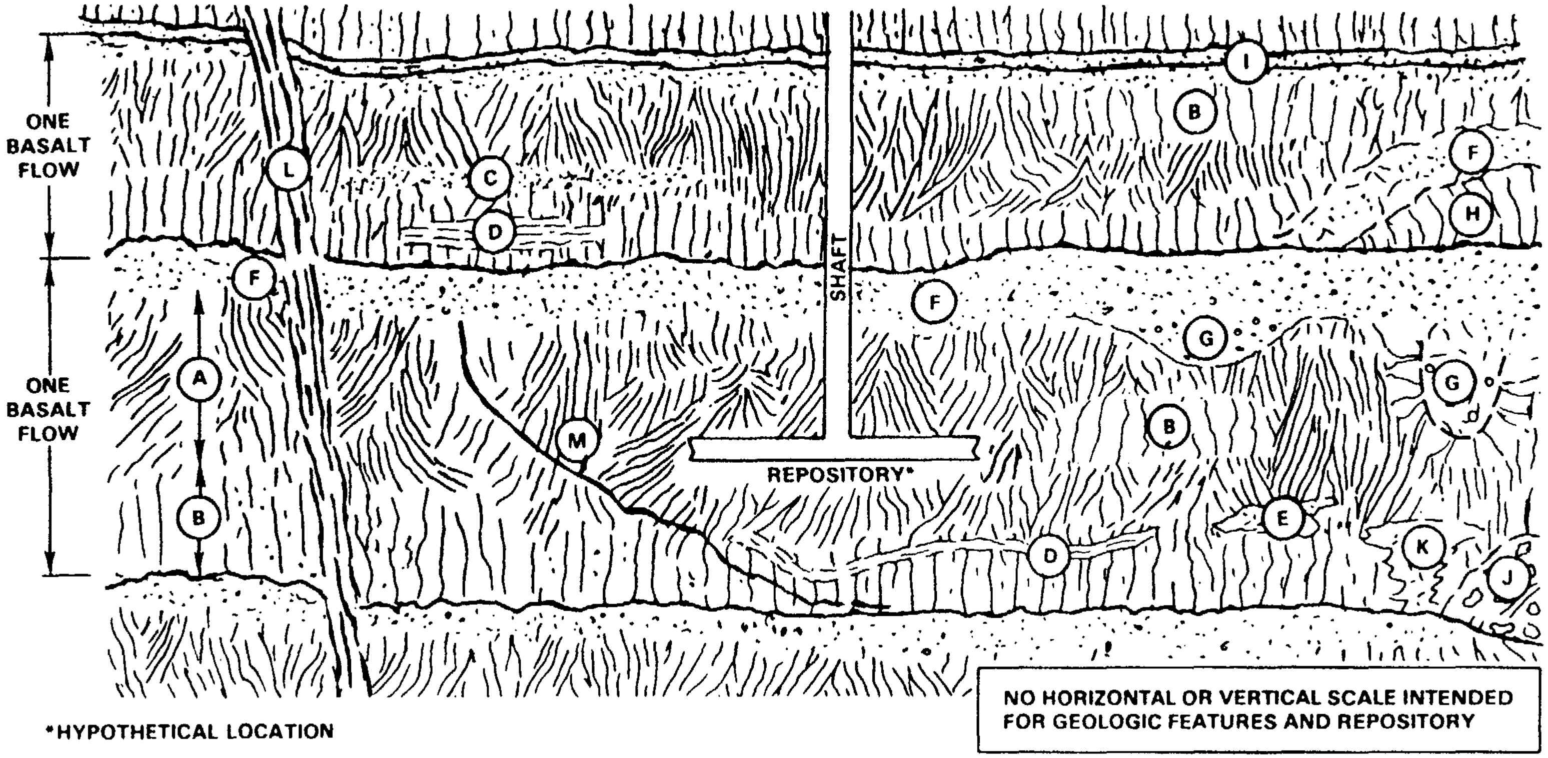
FLOW PATHS: This section identifies a ground-water pathway to the Columbia River, composed of one vertical leg and one horizontal leg. Then in the following section, the conceptual basis for this identification will be explored.

Begin with the observation that ground-water travels quite rapidly, horizontally, in sedimentary units such as the surface aquifer at Hanford. Thus, the stratigraphy of Fig. 1 may be reexamined for a sedimentary "interbed" which might have hydraulic conductivity similar to the surface aquifer but would not require such a lengthy vertical leg between the reference repository and that interbed.

Figure 4, taken from the DEA, provides a hypothetical, composite cross section of possible geologic features in a layered basalt sequence with the repository sketched [4]. This figure shows an interbed situated one basalt flow above the basalt flow in which the repository is located. Furthermore, Fig. 4 shows a major fault or fracture which connects the level of the repository with the level of the interbed. That is, Fig. 4 presents hypothetical vertical and horizontal legs of a pathway which might connect the repository to the Columbia River.

As a first step twoard evaluating this hypothetical pathway, the approximate scales of the reference repository [5] and the

GEOLOGIC FEATURES IN A LAYERED BASALT SEQUENCE



*HYPOTHETICAL LOCATION

FLOW INTERIOR DISCONTINUITIES

- A ENTABLATURE JOINTS
- B COLONNADE JOINTS
- C VESICULAR ZONE
- D PLATY ZONE
- E LOCAL FRACTURED ZONE

FLOW CONTACT

- F FLOW TOP
- G LOCAL THICKENING OF FLOW-TOP BRECCIA
- H FLOW TERMINATION
- I SEDIMENTARY INTERBED
- J PILLOW BRECCIA
- K SPIRACLE OR SPIRACLE-LIKE FEATURE

BEDROCK STRUCTURAL DISCONTINUITIES

- L FAULT OR FRACTURE ZONE, HINGE OF FOLD, OR SHEAR ZONE
- M LOCALIZED TECTONIC FRACTURE

FIGURE 4.

stratigraphy (Fig. 1) may be combined with the hypothetical geologic features of Fig. 4 to allow some appreciation of possible spatial relationships. Figure 5 is the diagrammatic result, with the repository shown in the Cohassett Flow which the DEA finds to be most geologically promising [6].

The striking feature of this scaling of the actual structures is the great horizontal extent--about 11,000 feet [7]--of the repository.

APPROXIMATELY SCALED CROSS-SECTION AND CRITICAL FLOW PATH FOR DEA PREFERRED LOCATION

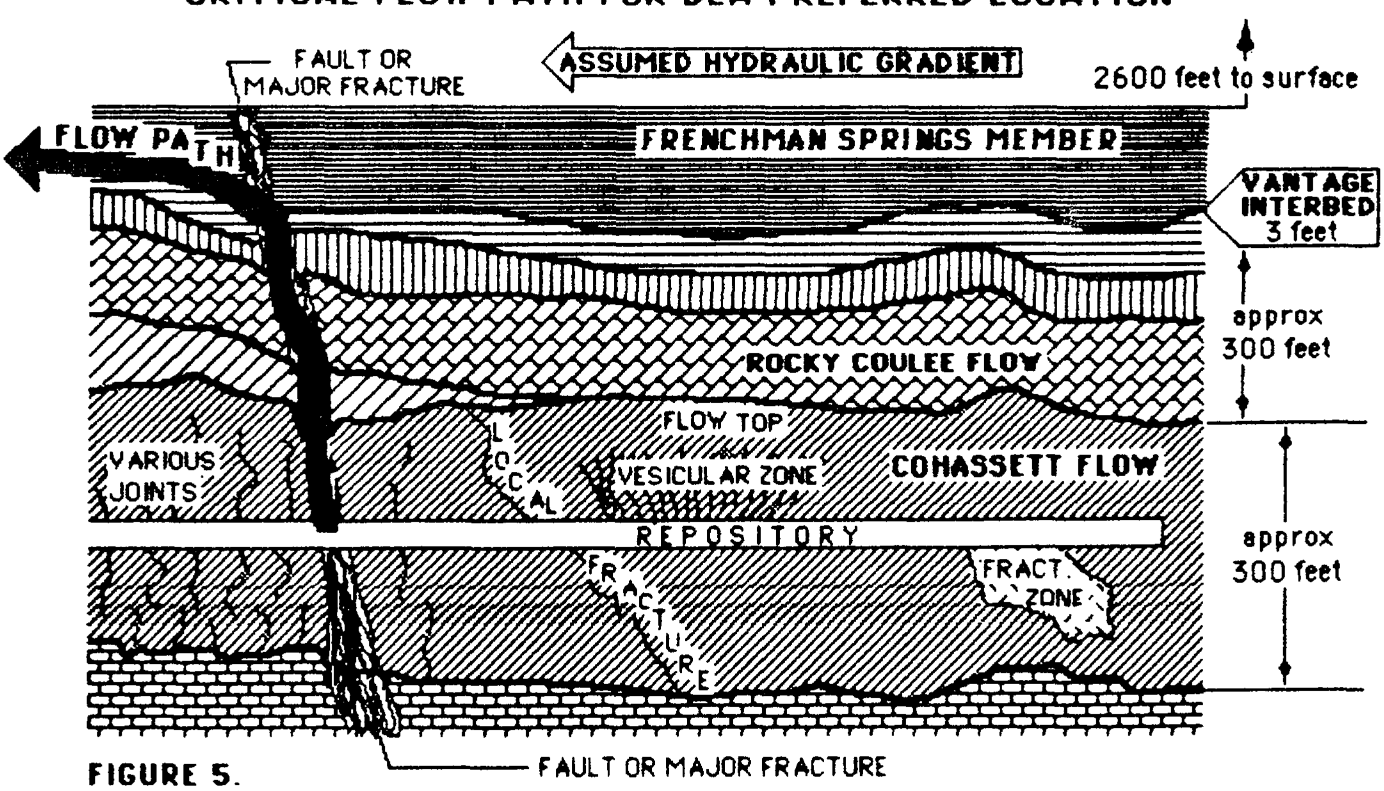


FIGURE 5.

Figure 5 shows this scaled repository to cross several vertical discontinuities in the Cohassett Flow. The most severe of these discontinuities, a fault or major fracture, is shown as connecting the repository to the Vantage Interbed, some 400 feet above it.

The next step is to estimate how likely it is that the 120,000,000 square-foot repository will actually intersect such a fault or major fracture. Three lines of inquiry suggest that such intersection is very likely: (1) One major discontinuity, the "Cold Creek Barrier," is already identified next to the reference repository location, in DEA Fig. 3-1. (2) General descriptions of Central Basin basalt outcropping [8] and easily made observations from roadways reveal major vertical discontinuities with horizontal scales much less than the repository scale. (3) General consideration of quasi-static plate failures suggests fracture spacing on the order of plate thickness, in this case less than 1,000 feet. On this basis, an arrow is drawn into Fig. 5 to depict the probable, significant flow pathway for the reference repository location in the Cohassett Flow.

Once the ground-water has reached the Vantage Interbed, rapid horizontal migration can be expected to expose that water to other vertical discontinuities over a wide area, allowing migration to other interbeds or the surface aquifer.

MODELING CONCEPTS: The evaluation of this repository-fracture-interbed-river pathway requires an understanding of both sampling and modeling biases. Consider an example which is more intuitive and familiar than ground-water flow:

Suppose that the steel-hulled S.S. Cohassett, shown in Fig. 6 has been torpedoed and that the captain asks a geologist (who happens to be aboard) to estimate the time before the ship will sink. The geologist probes the 88 plates on each side of the hull at random points to locate holes which would cause the ship to leak. Figure 6 shows the torpedo hole to have an area equal to about four plates, so the chance that any one probing of the hull will reveal the torpedo hole is only 4/176=2.3%.

SINKING OF THE S.S. COHASSETT

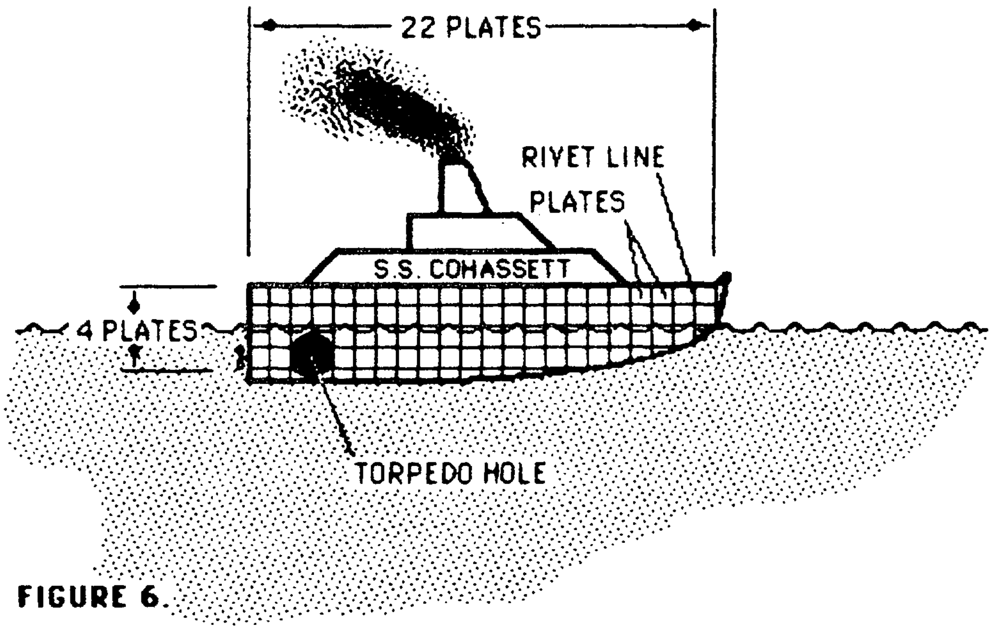


FIGURE 6.

Many random probings are required to achieve any confidence of finding the torpedo hole. For example, 10 random probings would have only a 21% chance of finding the hole. Even 50 random probings provide only a 78% chance of finding the hole. But if the geologist's probe does not enter the torpedo hole, his data can only reveal small rivet leaks which could not sink the S.S. Cohassett. That is, with a limited sampling program, the geologist is likely to report back to the captain that the Cohassett will not sink! The point of this example is that sampling programs underestimate the severity of leaks, whether into the S.S. Cohassett or out of the Cohassett Flow at Hanford. This inherent sampling bias is exacerbated as the number of samples is reduced. In the limit, there are no (reported) leaks if there are no samples taken.

> Now take the example a bit further. Suppose the geologist conducts 50 probings with the following outcomes: 42 probings reveal solid hull plates; 7 probings reveal slightly leaking rivets; and one probing reveals the torpedo hole. With the torpedo hole found, it can then be measured. The geologist can then calculate the sinking rate of the ship. But in order to do so, the geologist must recognize that the torpedo hole is **the only significant datum** he has.
>
> If instead the geologist applies usual data processing techniques to determine an "effective" hole size, he may be misled: The mean hole size is 1/50 of the torpedo hole size while the median and modal hole sizes are each zero. The point of this further development of the example is that usual data processing techniques may inadvertently bias the calculation toward unrealistically low leakage rates.
>
> From this example of the sinking of the S.S. Cohassett, the reader may appreciate the care that is necessary to assure that ground-water travel time from the repository location to the Columbia River is not grossly overestimated.

CALCULATION: With this awareness of biases toward exaggerated travel time estimates, the review proceeds to assignment of representative travel times to the legs of the repository-fracture-interbed-river pathway. The upward direction of flow in the vertical fault or fracture leg is supported by

> ...measurements across the deep basalts indicate either a slight upward gradient or essentially no gradient [9].

The upward flow is also driven by the buoyancy effect of ground-water heating by radioactive decay of the contained waste. This "chimney effect" depends on the extent of ground-water heating, which has not yet been characterized by DOE [10].

In lieu of final DOE characterization, leaching temperature studies for a variety of potential waste containment media suggest an expected temperature near 194^{o}F [11]. If ground-water ambient is about 54^{o}F, the leach water may be assumed to be heated 140^{o}F above ambient. Its density would then be decreased about 3.5% due to this heating. This would introduce a vertical hydraulic gradient of 3.5%. Applying this gradient to the only hydraulic conductivity data (10 feet/day) given for a (localized) fracture zone near the site [12], the travel time for the vertical leg of the flow path is calculated to be two years.

As an alternative model for the vertical leg travel time, consider a major structural discontinuity which exhibits an abrupt change in hydraulic head. The most extreme measurement for the area shows a "hydraulic head" drop of 500 feet [13]. (Hydraulic head is the hydraulic gradient multiplied by the distance over which it occurs.) If **either** this horizontal change in hydraulic head does not occur in each stratigraphic member **or** if the discontinuity is not exactly vertical, then an equal, local vertical head is developed. In the absence of other data, such a 500 foot vertical head may be presumed to apply to the 400 foot-high, assumed fault or fracture connecting the repository location to the Vantage Interbed. If this vertical hydraulic gradient of 500 feet/400 feet = 1.25 is multiplied by the above fracture conductivity (10 feet/day), the critical travel time up the fracture is calculated to be 50 days.

From either this model of a structural discontinuity or the previous model of buoyancy, one concludes that the vertical leg of the flow path can be expected to have a travel time which is trivial compared to the 1,000-year requirement of the Geohydrology Disqualifying Condition. Therefore, this required 1,000-year travel time must be provided by the horizontal leg if the Hanford Site is not to be disqualified.

The preview of this horizontal leg travel time provided by the tritium plume in the surface aquifer is not encouraging. However, one may still hope that travel times for interbeds above the Cohassett Flow might be drastically greater. Unfortunately, the only DEA data relevant to the horizontal leg travel time are the following:

> ...the hydraulic conductivities of <u>most</u> individual flow tops and interbeds range between approximately 10^{-4} and 10^{7} meter per second [=10^{4} to 10^{1} feet/year, emphasis added, 14]....

As the example of the sinking of the S.S. Cohassett demonstrated, "most" values are irrelevant for the calculation of leakage rate. The largest hydraulic conductivity paths generally dominate the leakage. Thus, one wants to know, What is the hydraulic conductivity of the interbed with the highest conductivity?

In the absence of a published value of this critical datum, a representatively large conductivity for an interbed may be estimated from the observation that hydraulic transmissivity data for the basalt-flow tops in the Grande Ronde Basalt are log-normally distributed. Then if one also applies this probability distribution to hydraulic conductivities for the 12 major stratigraphic features within 1,000 feet over the Cohassett Flow reference repository location (Fig. 1), the maximum feature conductivity--presumably of the Vantage Interbed--may be estimated. For this estimation, the meaning of "most" individual flow tops and interbeds is equated to 51% of those flow tops and interbeds. For the log-normal distribution, this 51% range corresponds to 0.69 standard deviations from the log-mean. Also for the log-normal distribution of hydraulic conductivities, the conductivity of the most conductive stratum of 12 strata is expected to occur at 1.39 standard deviations about the log-mean. Figure 7 diagrams the analysis. According to this calculation, the most conductive stratum of the 12 strata above the repository would have an expected hydraulic conductivity of $3X10^{5}$ feet/year. (If this extrapolation is incorrect, DOE will presumably publish data demonstrating that no interbed hydraulic conductivity measurements have values this large.)

LOG-NORMALLY DISTRIBUTED HYDRAULIC CONDUCTIVITIES

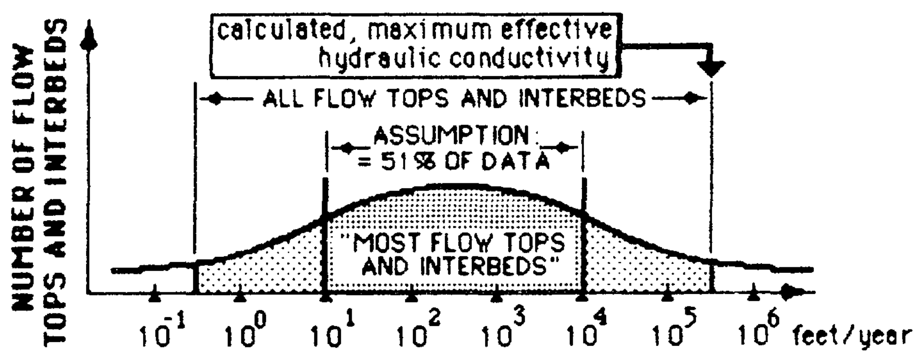


FIGURE 7.

The effective hydraulic gradient must also be determined in order to calculate the travel time for the horizontal leg of the interbed flow. The "deterministic regional hydraulic gradient" used in the DEA is 10^{-3} [16]. This is a factor of 10 greater than the regional average for the Cold Creek syncline [9]. Still, the use of this seemingly conservative value is justified from the same considerations as were explored in the "sinking of the S.S. Cohassett:" that is, the flow is expected to travel the shortest, high conductivity pathway to the lowest surface available (the Columbia River channel). Multiplying the effective hydraulic conductivity ($3X10^5$ feet/year) by the effective hydraulic gradient (10^{-3}), the effective flow velocity is obtained:

300 feet/year.

This is 17% of the easterly component of the breakthrough flow velocity to Well 699-2-3 in the unconfined surface aquifer, implying that the Vantage Interbed is expected to be much more compact than the surface aquifer. The 300 foot/year flow velocity implies a breakthrough travel time to the Columbia River of 60,000 feet / 300 feet/year =

200 years (to breakthrough).

Breakthrough, however, does not imply a significant release of radionuclides to the Columbia River. As Fig. 3 shows, the breakthrough concentration of radionuclides is negligible: The maximum concentration of radionuclides released to the Columbia River requires about 50% more time. That is, the expected travel time for significant radionuclide travel to the Columbia River is

300 years.

The ground-water from the repository disturbed zone is expected to emerge from one or more of the nearly 115 springs which enter the Hanford Reach of the Columbia River [17]. At least one of these springs is already demonstrated to be contaminated beyond Washington State drinking water standards [18].

SUMMARY: The 300-year travel time to the Columbia River predicted in this review is dramatically different from the DEA prediction of an 81,000-year travel time. This difference is attributable to the following:

This review and the DEA use different pathway assumptions. This review employs an interbed flow path on the basis that it is expected to be the most significant flow path. The DEA employs the basalt flow top that overlies the repository horizon on the basis that this "most direct groundwater pathway" is

> **one plausible hydrologic conceptual model** [emphasis added, 15].

This model is simply "assigned" to the Hanford Site. In other words, the conceptual basis for the DEA model makes no assumption that the model actually represents the travel time that can be expected nor does it even seek to identify "any pathway of likely and significant radionuclide travel," as required by the Disqualifying Condition.

Nonetheless, the DEA model formalism allows a calculation of probabilities according to that model, as carefully stated in the DEA:

> The cumulative distribution of ground-water travel times predicted by the ... model is shown in Figure 6-22....
>
> From this distribution, it is estimated that pre-waste-emplacement ground-water travel time has a probability of approximately 0.95 of exceeding 1,000 years [emphasis added, 20].

Notice that the DEA does not contend that the actual ground-water travel time is likely to exceed 1,000 years.

By careful reading of these DEA statements, one discovers that no technical disagreement between the result of this review (a 300-year travel time) and the DEA calculation (an 81,000-year travel time) exists: The former is an estimate of the condition of physical reality; the latter is a reported output datum of a mathematical model. One further understands the DEA summary statement that

> Based on current knowledge, obvious disqualifying conditions have not been identified that would result in rejecting the reference repository location from further consideration for a nuclear waste repository [emphasis added, 21].

The DEA has avoided identifying pathways of likely and significant radionuclide travel, thereby avoiding necessary elimination of the Hanford Site on the basis of the Geohydrology Disqualifying Condition.

Submitted as a public comment by,
SEARCH Technical Services

Norman Buske
Principal Reviewer

SEARCH.

DISTRIBUTION: Unlimited: Parties of interest.

REFERENCES AND NOTES

1. Draft EA: Reference Repository Location, Hanford Site, Washington [DEA], DOE/RW-0017, U.S. Department of Energy, Section 2.3.1.1 (1984).
2. DEA, Fig. 2-29 (p.2-58) is copied as Fig. 1.
3. DEA, Fig. 3-25 (p.3-56) is copied as Fig. 2.
4. The approximate extent of the ground-water tritium plume is shown in Fig. 7 of Environmental Surveillance at Hanford for CY 1982, PNL-4657, Pacific Northwest Laboratory, 24 (1983). Figure 3 is modified from Fig. 13 of Radiological Status of the Ground Water Beneath the Hanford Site, PNL-3768, Pacific Northwest Laboratory, 31 (1981).
5. DEA, Fig. 3-36 (p.3-84) is copied as Fig. 4.
6. DEA, Section 2.2.3.
7. Taken from the scale on DEA Fig. 5-5 (p.5-16). The 5,272-foot height of the underground facility suggested in this figure is assumed to be adjustable downward to fit within the basalt flow site.
8. See Roadside Geology of Washington, D.A. Alt and D.W. Hyndman, Mountain Press, 193-216 (1984) for an excellent introduction to the character of the basalt flows as well as a statement of concern about the radioactive wastes already in hydrogeological retention at Hanford. Another descriptive background is provided by Geology of the Grand Coulee, address before the Northwest Scientific Association, Spokane meeting, December 27, 1928, J.G. McMacken, if you can find a copy. Important structural discontinuities are usually identified and mapped by means of seismic surveys which have become extraordinarily well developed by the petroleum industry. A theoretical introduction is provided in Seismic Filtering, R. Van Nostrand, ed., Society of Exploration Geophysicists (1966). Detailed seismic evaluation of fractures is curiously missing from the DEA.
9. DEA, p.3-89.
10. DEA, p.6-262.
11. Twelve authors presented data for leaching from special containment media for high-level wastes in Scientific Basis for Nuclear Waste Management, S.V. Topp ed., North-Holland. Those authors were Stone, Spitsyn et al., Dosch, Welch et al., Vance et al., Staples et al., Campbell et al., Oversby and Ringwood, Boatner et al., Hayward and Cecchetto, Reeve et al., and Hermansson and Christensen.

The leaching temperatures (°F) they reported were as follows:

72, 77(2), 104(2), 140, 167, 194(8),
203(2), 212(2), 302(2), 392, 1112

The two lowest temperatures provided room-temperature references, and the highest temperature involved consideration of radiation effects. 8/12 of the authors employed 194°F.

12. DEA, p.3-86.
13. DEA, p.3-90.
14. DEA, p.3-88. No reference other than Strait and Mercer (1984) is provided for the 200 single-hole data upon which the quoted range is based. That reference, and the other references with "SD-" prefixes are not available to the public, according to Rockwell Hanford Operations.
15. Stochastic Analysis of Groundwater Traveltime for Long-term Repository Performance Assessment, RHO-BW-SA-323P, P.M. Clifton et al., Rockwell Hanford Operations, 5 (1983). DEA, p.6-265.
16. DEA, p.6-266.
17. Investigation of Ground-Water Seepage from the Hanford Shoreline of the Columbia River, PNL-5289, W.D. McCormack and J.M.V. Carlile, Pacific Northwest Laboratory, vii (1984).
18. A Gross Beta value of 88 pCi/L was reported in Hanford Reach Expedition Report, N. Buske and L.S. Josephson, Search Technical Services, apparently for Spring Designation 15-0 of [16]. That report used Public Health Laboratories Report No. 2308.
19. DEA, p.6-269, 6-271-272.
20 DEA, p.6-268.
21. DEA, p.2-64.

--+--

PRESIDENT SECRETARY-TREASURER

National Association of Retired and Veteran Railway Employees, Inc.

OFFICE OF THE GOVERNOR
MAR 18 1985

UNIT NO. 81

Presented to Dept of Energy at Public Hearing in Spokane City Hall 3 pm 3/13/85

Spokane Washington
March 13, 1985

Department of Energy
1000 Independence Avenue
Washington D.C. 20585

Public Hearing, Spokane Washington, 3/13/85: Re: Hanford Waste Repository, Alleged Enviormental Assessment:

Honorable Sirs:

My name is Leslie E. Downing, Citizen, Property Owner, Tax Payer and Legislative Representative for the National Association of Retired & Veteran Railway Employees, Unit No. 81. I am appearing in behalf of this group of Retirees for the purpose of opposing the Department of Energy's alleged RIGHT to designate Hanford Washington as a Repository for HIGH LEVEL NUCLEAR WASTES as is allegedly imposed by the Nuclear Waste Policy Act of 1982.

OUR OPPOSITION IS BASED ON THE FOLLOWING:

1. The Guidelines imposed by the 1982 Nuclear Waste Policy Act for the siting authority for the Department of Energy is ambiguous. (seeChairman Bishop's statement, State Nuclear Board, Waste, of March 7, 1985), and therefor should be challenged.

2. No independent study has been made to document whether or not these Life Threatening elements (e.g.Plutonium etc) or other Nuclear by-products with this horrendous RADIOACTIVE CAPABILITY is in the Sils or Water of Eastern Washington. This is a mandate before any licenses are granted to designate Hanford as a SITE.

3. It is proven and documented as fact that these RADIOACTIVE ELEMENTS and MATERIALS, that are by-products of these generating facilities (PUREX and WPPSS), are present in Washington and have resulted a marked increase in Lukemia, Lymphoma, Lung Cancer, Breast Cancer and in Infant and Fetal Mortality since 1940. (see Press Release Spokesman Review of 3/10/85).

4. The Department of Energy has not employed the services of the United States Geological Survey to document the needed comprehensive investigation of the Rock Formations and soil perculating capabilities that will be affected by the depositing of these High Risk Radioactive materials. This is needed before any license is granted. (see Press Release of 3/10/85, Spokesman Review).

NEXT PAGE PLEASE

HANFORD WASTE RESPOSITORY, ALLEGED ENVIORMENTAL ASSESSMENT HEARING, CONT'D:

5. The very people who are employed at these facilities in this Tri-Cities Area are by their presence in these plants, are at EXTREME RISK and may face CANCER and or other FATAL CONSEQUENCES, (see incident at the Hanford Z Plant on August 30, 1976 where employee Harold McCluskey suffered extreme radiation, as documented in the Spokesman Review on 3/3/85).

6. The Department of Ebergy has refused the extension of time requested by Gomenor Gardner in order that the State of Washington could make their own Enviormental Assessment of Hanford.

7. The Washington State Nuclear Waste Board made an in depth investigation of this Hanford Facility, comprising 18 months, and found that the D.O.E. study was INADEQUATE and announced plans to sue the federal government for not abiding by the guidelines in this selection of sites and the arbitrary selection of Hanford for this REPOSITORY. (see SPokesman Review of 3/10/85).

8. The Transportation of these HIGH LEVEL RADIOACTIVE MATERIALS from Eastern Facilities places the people in Eastern Washington at Extreme Risk, This Risk is present whether the movement is made by Rail or Highway. (see recent SPILL near Coeur D' Alene Lake Idaho on February 27, 1985).

9. HIGH LEVEL RADIOACTIVE WASTES must be disposed of at or near the sites that they originate thus eliminating the need for this CROSS-COUNTRY TRANSPORTATION. (see Press Release, Spokesman Review 3/5/85).

10. The people living in Eastern and Western part of Washington have documented OPPOSITION to the SITING of the REPOSITORY at Hanford. (see Press Release, Spokesman Review of 2/25/85).

What is obvious to we retirees, is that this NUCLEAR GENERATION FORMAT, whether it be for MASS ANIHILATION through STAR WARS WEAPONARY (PUREX) or for the production of MEGAWATTS of ELECTRICITY; has SPAWNED this alleged need for this STORAGE of these LIFE THREATENING NUCLEAR WASTES. Had the Billions already spent and continuing to be spent, been applied on more throrough RESEARCH, such as the NUCLEAR FUSION of GENERATION in the TOKAMAK REACTOR at Princeton University, (The reactor generates energy from ISOTOPES in SEA WATER); we perhaps woul d not be here pleading against this impossible LIFE THREATENING CONDITION today. We are outraged that this question of Nuclear Generation was not explored in this FUSION FORMAT. We ask that this Hanford SITING BE DENIED.

cc; Governor Gardener
State Representatives
Congresional Representatives
file

Respectfully Submitted,

L. E. Downing, Legislative Rep., N.A.R.V.R.E. 81

4204 W. Okanogan Ave
Kennewick, Wa. 99336
3-16-85

Dear Sirs:

I am opposed to the plan of creating a national nuclear waste depository at the Hanford site. The other nuclear reactor sites in this country should develop their own waste depositories. We do not need to be the "garbage pit" of the entire country.

Two things concern me!

(1) Transportation of the waste to the site - safely

(2) Possible contamination of the Columbia River due to leakage of the stored waste.

Sincerely,

Ruth M. Meneke

March 19, 1985

U. S. Department of Energy
Attention: Comments - EA
1000 Independence Avenue S.W.
Washington, D.C. 20585

As we rush to make decisions regarding the permanent disposal of high-level nuclear waste, can we please stop a moment to contemplate the reality that though certain natural resources are diminishing that threaten our materialistic and industrial way of life we fail to grasp the seriousness of the one natural resource that mankind cannot do without - WATER. If we continue to contaminate our groundwater, we won't live to see the day that oil, gas, uranium or coal run out. Considering recent revelations that uranium concentrations in groundwater beneath two long-abandoned waste sites at Hanford have unexpectedly increased 12-fold (Seattle P.I. March 8), several sections of the Draft Environmental Assessment lead me to believe that only a fool would tamper with these basalt formations and substantiate a belief that not only should Hanford not be chosen as a high-level nuclear waste repository, the site characterization should be cancelled.

I call your attention to the following pages of the EA: Pg. 4-22 (4.2.1.2.2 Ground-water impacts) Shaft drilling could potentially have two impacts on the ground-water flow system in the reference repository location relative to site characterization. First, shaft construction might interfere with the measurement of natural variations in baseline ground-water levels. Second, shaft construction might provide a vertical conduit for some ground-water mixing that otherwise would not have existed. Pg. 7-26 - The potential for thermally induced fracturing and for the dehydration of fracture material is present at the Hanford site, though it may occur only in areas near individual waste packages. Little information is available for determining whether this would be a problem under repository conditions of stress and temperature. Pg. 7-49 Exploration for natural gas is under way in ridges north and west of the Hanford Site, but the repository site lies in a synclinal trough that is structurally unattractive for exploratory drilling. However, because there is a potential for ground-water withdrawal for irrigation, this favorable condition (absence of commercially extractable resources) is not present at Hanford. Pg. 7-111 At the Hanford site, the potential for high-pressure permeable zones above and below the dense interior of the repository horizon would require special precautions to avoid such zones.

The potential for ground-water contamination and the site's close proximity to the Columbia River should be reason enough to eliminate it as a serious choice for a high-level nuclear repository; however, other factors also contribute to a conclusion that this site should not be considered.

Though cost should not be "the" determining factor in an issue of such importance, the reasons for Hanford being a more costly site do:

Pg. 7-106 - The hardness of the basalt, the fractures in it, and high in-situ stress conditions could make construction more difficult than in the other host rocks and may also create difficulties in waste retrieval.

Pg. 7-92 - As can be seen from the above table, the sites farthest from the major sources of spent fuel--namely, Hanford and Yucca Mountain--would incur the greatest transportation cost and risks.

Let's face it, Hanford is included in the list of finalists based on strong pluses in site ownership and control, offsite installations and operations, and socioeconomics. These factors are allowed equal importance in determining Hanford's overall desirability or lack of desirability as the factors that determined its last place status in ease and cost of siting, construction, operation and closure.

My survivalistic instincts for the qualitative future of mankind feel strongly that we do not place this nation's high-level nuclear waste repository in a site the farthest away from the major sources of waste in a non-homogenous rock formation supporting two major ground-water flows located six miles from a major river. Surely technology and human intelligence can work together towards a more stable solution to this most perplexing problem.

Nancy Kelley-Mizrahi
2739 - 36th Avenue S.W.
Seattle, Wa. 98126

cc: Governor Booth Gardner
State of Washington

Nuclear Waste Board
State of Washington

March 19,1985

U.S. Department of Energy
Attention: Comments--EA
1000 Independence Avenue,S.W.
Washington, D.C. 20585

Following are my comments on the "DRAFT ENVIRONMENTAL ASSESSEMENT--HANFORD SITE". I had originally planned a more comprehensive "Peer Review", but did become overwhelmed. The document does contain a monumental work on the Pasco Basin.

1. Alternatives are not discussed adequately. Discussion should include the pros and cons of the various storage modes, geologic media, and waste forms. Also pertinent is the future value of spent fuel and Storage vs. Disposal.

2. The original criteria for site selection, when the sites were first established, should be discussed in relation to repository criteria and requirements.

3. Consideration of other "contaminated" government sites should be discussed, e.g. Oak Ridge, SRP, Los Almos, INEL, etc.

4. In considering existing government sites, e.g. Hanford, acceptance by the local population should not be weighted too highly, in consideration of the fact that the evaluation horizon is 1000 to 10,000 years. Evaluation based on local acceptance could be very misleading.

5. Operation and receipt for 28 years and retrievability for 84 years is discussed- (Section 5.1); plans for retrieval are not discussed. Expected temperature during 28 years of operation; or for retrieval at the end of 84 years are not given. (My opinion is that you have got a problem! Comment also applies to other sites). Retrieval, considering initial operation of the repository in a storage mode, could be the most important requirement.

6. Using "Decision Analysis" (an Ordinal Dominance Analysis!?!?) to rank sites ranging in numeric value from 0.088 to 0.860! (Table 2-5). It is disturbing that the expert geologist and engineers would need systems analysts to help them make up their minds. Finding that there is a variability of sites on the Hanford reservation, in close relation to each other, suggests that the basalt is not uniform, or that better sites, in basalt, may exist outside of the reservation.

7. It is not clear if the best site for any basalt, or the best site on the Hanford Reservation, was the siting objective.

8. The relation of the proposed repository to the disposition of Hanford Defence Waste is not discused.

9. The roll of basalt in enhancing isolation is not discussed adequately. Why is basalt better than salt? Must the basalt be monolithic? If not how much fracturing or porosity is allowable? Geologic discussions appear to assume fracturing, but repository design appears to assume a dry work area. Will "Characterization" settle such an issue.

10. At the eight dry sites, burden of proof of integrity lies in postulating possible radionuclide transport mechanisms. At Hanford, with transport mechanism inherent in the repository system, integrity becomes a question of rate of transport.

11. Can any degree of "Characterization" successfully demonstrate that a basalt repository is feasible? Guidelines should be established for recognizing the end point of "characterization".

12. Based on a rather cursory review of all nine documents, it would appear that salt, probably the Paradox Basin, would provide the best repository. (It is likely that waste could be stored safely at all sites).

M J Szulinski

M.J.Szulinski
1305 Hains
Richland, WA 99352

(509) 946 8670

UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON 98195

Department of Civil Engineering
Environmental Engineering & Science, FX-10

March 16, 1985

Mr. Warren Bishop, Chairperson
Nuclear Waste Board
Department of Ecology, MS PV-11
Olympia, WA. 98504

RE : Comments on "Draft Environmental Assessment - Reference Repository Location, Hanford Site, Washington"

Dear Mr. Bishop:

The enclosed comments are brief because of the time constraint. I would need one month of full time effort to consume the massive materials presented in the document. I should also let you know that I am a strong opponent to the idea of deep burial of high level nuclear waste at Hanford or any place else.

The reason for my strong opposition to deep burial of high level nuclear waste at Hanford Site is quite simple: I do not believe anyone (within the Department of Energy or their consultants) knows about the actual physics of the site well enough to put such potentially dangerous and harmful materials there. Reading the title document did not change my mind a bit. I will use a simple example in the document to explain why. In Figure 3-8 of the document, we are presented with a constructed geological formation of a selected crosssection of the site from only three borehole data. I believe the actual formation is much more complex than the linear interpolation shown in Figure 3-8. It is cited in the document that more than 3,740 boreholes have been drilled at the site, I do not know what happened to those data, but I think it should have been a first step to construct a more reliable geological formation from those data by some geostatistical techniques. Then, I think that some kind of uncertainty and risk analyses of the site should have been conducted. What I am suggesting here is not an academic research that fits well in a technical paper, it is just a basic step toward better understanding of a complex natural setting.

I have not spent much time in reading the data regarding the birds, the reptiles, and the railroads. I have a very strong suspicion of the expected effects stated in the document. I urge you and your staff to take a very cautious approach in this matter. If possible, I would like to suggest that the document be reviewed by a team of independent scientists before any action is taken. If feasible, I can suggest a few top quality scientists and engineers (none of them live in the State of Washington) for you to contact.

Please give me a call at 206-545-7594 or 545-1024 if you have any question regarding my brief evaluation.

Sincerely yours,

Wen-sen Chu
Assistant Professor of
Civil Engineering

cc: Dr. William Funk
Dr. Eugene Welch

Booth Gardner
Governor

Andrea Beatty Riniker
Director

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

Mail Stop PV-11 • Olympia, Washington 98504 • (206) 459-6000

MEMORANDUM

March 15, 1984

TO: EA Public Comment File

FROM: Jerry Parker

SUBJECT: Telephone Conversation Re Proposed Nomination of Hanford

Lori Loranger expressed opposition to siting a repository at Hanford. She is concerned about contamination of groundwater and the Columbia River, which is near her home in Washougal, and about accidents in transport of nuclear material by truck, rail, and barge in the Columbia River Gorge to the proposed repository at Hanford.

Mrs. Loranger speaks on behalf of her family.

Lori Loranger
MP 017 R
Krogstad Road
Washougal, WA

JP:hlt

TO ALLOW A NUCLEAR WASTE DUMP TO BE LOCATED IN THE UPPER AREA OF THE COLUMBIA RIVER WATERSHED WOULD PROVIDE A FREE RIDE FOR THE TOXIC MATERIALS ACROSS THE STATE TO THE SEA, IF THE "IMPOSSIABLE" HAPPENS

NO!

GARY GREENE
GREENE LANE
SKAMANIA, WA 98648

RECEIVED
APR 2 - 1985
GOVERNOR'S OFFICE

March 19, 1985

EA Comments
Department of Energy
1000 Independence Ave
Washington, D.C. 20585

The history of the DOE and its' relation to the Rockwell Corporation is cause for concern. The 1982 "Site Characterization" written by Rockwell International for the DOE was described by USGS chief William Meyer as containing," a lot of, excuse me, bullshit."

Rockwell, the firm studying the site for the DOE, stands to make large profits if Hanford is chosen for the repository. Are their studies impartial? Are they biased? Why was a firm which would profit from an affirmative decision chosen to make the studies?

In 1981 DOE's Hydrology and Overview committee took Rockwell to task for saying the site was being studied because of its' " Favorable Geology."The memorandum said,"There is only one solid justification for studying this site and it is the socio-political fact that the land is a U.S. Nuclear Reservation, From a hydrogeological perspective, the Columbia River Basalt Group as a whole is not well suited for a high-level waste repository."

In considering the Hanford site, the issue of groundwater flow is crucial. The proposed dump is only six miles from the Columbia river, which was at one time, the largest Salmon hatchery in the world.

Geological Survey circular #779 states,"Given the uncertain state of our knowledge, the uncertainties assoctiated with hot wastes that ineract chemically and mechanically with the rock and fluid system appear very high... Although the geometry of a fracture system may be know in the vicinity of an unederground working, it seems difficult , if not unfeasible to know this in sufficiant detail at any distance from the few bore holes or workings likely to be permitted near a repository. In addition to natural fractures manmade boreholes in the vicinity of the repository as well as in the repository itself present problems. They must, even during hundreds of years, be considered as potential shrt-circuit pathways that could permit water flow from the repository horizon upward to shallow aquifers that may be utilized by man.

In refrence to Hydraulics the Survey states," Most of the requisite data are presently unavailable; most of the available data have such large error limits that their usefulness in predictive models is limited.Natural events such as earthquakes may affect a backfilled repository containing fluids very differently from the way in which they affect undisturbed rock; seismicity may itself be introduced by fluid pressures.However, unanticipated interactions have taken place in many engineering efforts whose component were presumably well characterized; the Appollo 13 near tragic explosion is a conspicuous example.... Long term prediction in the Biological and Earth Sciences is unavoidable and impossible to perform with high confidence limits because of the great complexity of possible interactions among processes, both identified and unidentified".

" In summary" the Geology Survey Circular says,"predictive models are an essential step in the selection and implementation of a radioactive waste repositoryand a radioactive waste management system.. However, some components of the models are inherently unpredictable at present and are likely to change at different times. In no sense, therfore, will these models give a single answer to the question of the fate of radioactive waste in geological repositories; rather they will provide a spectrum of alternative outcomes,each based on a set of uncertain assumptions about the future. Decision makers outside the earth sciences will have to evaluate thse uncertain predictions in the light of pressing social and economic concerns."

Defense Nuclear waste accounts for 98% of the total volume of all nuclear waste in this country . 2/3 of this is now stored at Hanford. 450,000 gallons of defense wastes have already contaminated groundwater draining into the Columbia river.If the military nuclear waste is to be stored on the same reservation with the high-level civilian wastes it will increase the size of the proposed repository by as much as 70%. Why has this question not been addressed?

For the above reasons it seems to me that it would be the gravest error to select Hanford as a high level nuclear waste dump.The people of Washington State have already stated by their ballots that they do not want imported nuclear waste in their state. Our new state motto should be, " DON'T DUMP ON US."

Sincerely,

Chilton Ryan

Chilton "Tope" Ryan

206 North 8 St.
Mt. Vernon,
Washington, 98273

Cheryl Stewart
1615 Judd St. SE, Apt. 41
Olympia, WA 98506

March 14, 1985

COPY

U.S. Department of Energy
Comments E.A.
1000 Independence Ave. SW
Washington, D.C. 20585

RE: Hanford Draft E.A.

Dear Sirs:

Hanford, Washington should not be placed in the top three candidate sites for two reasons: first, DOE has not been able to characterize the ground water regime and thus cannot guarantee that the Columbia River is not threatened, and second, there is not sufficient thicknesses in any of the flows to safely isolate the high level nuclear waste for the period of time indicated.

Let me elaborate more on the second point. In a letter (enclosed) dated December 21, 1979 by Frank A. Spane, Jr., Ph.D., Senior Hydrologist for Rockwell International to Dr. Paul A. Whitherspoon of Lawrence Berkeley Laboratory, University of California, Dr. Spane, Jr. states that Hanford is a good candidate site because the basalt flows are greater than 200 feet thick (thus indicating 200 feet is a safe and preferred minimum). Dr. Whitherspoon's contention at that time was that it was much less than 200 feet.

Subsequent drilling showed that Dr. Witherspoon, not Dr. Spane, Jr. from Rockwell International, was correct. Now, DOE/Rockwell have stated in the draft E.A. (pages 6, 154 and 155) that only a minimum of 70 foot thickness is needed.

It is my contention that it was expedient for DOE/Rockwell to reduce the minimum thickness of 200 feet in 1979 to 70 feet in the draft E.A. just so the Hanford site would qualify.

In my opinion, it hardly seems ethical that the company who will ultimately get the construction contracts should be setting minimums in order to reap the profits at the public's expense. Shouldn't that be determined by independent professional engineers, geologists and hydrologists not affiliated with DOE or its contractors?

As far as is apparent to me, the findings from the independent sector have always been shelved and ignored when they refute Rockwell's claims and only included when in agreement. One good case in point is the report by Dr. Donald White of the U.S. Geological Survey submitted in June 1983 and only acknowledged on February 13, 1985 after public pressure.

My last question is: "Are we merely going through the motions with all the public input and studies while in actuality Hanford was the site permanently and privately selected as far back as 1976? If your answer to this is no, please explain why professional, independent studies which prove the site dangerous are not addressed and answered in DOE's draft E.A.? Could it be because Rockwell International compiled the information and data provided by their tests and their people?

Sincerely,

Cheryl Stewart

cc: Washington Nuclear Waste Board ✓

Enclosures

OUTGOING LTR. NO.			
INCOMING LTR. NO.			
ACTION			
REPLY DUE			
DIST:	LTR.	ENCL.	APPR.
Bartholomew, D.C.			
Bellofatto, M.			
Brand, R.K.			
Carey, J.M.			
Cockeram, D.J.			
Deju, R.A.	X		
Donahue, J.W.			
Freeman, R.A.			
Fritch, P.J.			
Gimera, R.J.			
Gruhn, R.S.			
Hammond, R.D.			
Heine, W.F.			
Kinzer, J.E.			
Oglestree, L.R.			
Pitts, G.G.			
Roecker, J.H.			
Sahler, G.H.			
Salina, C.M.			
Shaw, M.P.			
Sparks, T.E.			
Weil, V.R.			
Wodrich, D.D.			
Central Files			
Leggestoff RL	X		
Brown DJ	X		
Beeecson RE	X		
Evans GC	X		
Gephart RE	X		
DATE 12-28-79			

54-6000-117 (R10-78)

Rockwell Hanford Operations
Energy Systems Group
P.O. Box 800
Richland, WA 99352

Rockwell International

December 21, 1979

In reply refer to letter #R79-3723

Dr. Paul A. Witherspoon
Head, Earth-Sciences Division
Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720

Dear Dr. Witherspoon:

I have been asked by Dr. Raul A. Deju to review and comment on your letters to Dr. Colin Heath, dated October 26, and November 23, 1979. After reviewing the letters, I have concluded that there are several points which are brought out which do not fully portray (i.e., based on recently available data) the subsurface hydrogeologic conditions of basalt formations at Hanford. Items within the letter which I will briefly address are:

1. Subsurface geometry and permeabilities of basalt interflow zones;
2. Thickness and vertical fracturing of individual basalt flows;
3. Representativeness of ground-water samples collected from existing research wells; and
4. Hydrology test program at Hanford.

Item 1

The broad or generalized description given of basalts being layer-cake in nature separated by porous and permeable zones which are filled with moving ground water is not entirely accurate for basalts at depths being examined as potential repository horizons. Previous investigations by LBL (Apps, et al., 1979) and RHO (Deju and Fecht, 1979) and on-going studies by RHO and RHO subcontractors indicate that interflow zones generally possess low hydraulic conductivities ranging primarily between 10^{-5} to 10^{-10} cm/sec. Because of the low permeabilities present, ground water within these basalt interflow zones is expected to move very slowly under normal hydraulic gradient conditions.

Item 2

The thickness of Columbia River Basalts varies considerably between individual basalt flows, with thicknesses ranging from a few tens to over 400 feet. The important consideration here, however, is that basalt horizons which are being examined for potential repository siting are greater than 200 feet thick; not less than 200 feet as indicated in the letter.

The point raised that basalts are vertically fractured and may establish vertical pathways for unacceptable offsite migration of radionuclides, is probably not tenable. While it is recognized that parts of certain basalt flows (e.g. colonnade) may exhibit vertical fractures under surface conditions, they are usually closed or sealed in basalt flows at depths being considered for a repository. Recent studies by LBL (Benson, 1979) and RHO (Ames, 1976, and Long, 1978) indicate that considerable secondary mineralization and alteration has taken place within basalts of the Grande Ronde Formation. Long (1978), for example, in his examination of core recovered from a research borehole at Hanford, indicated that over 86 percent of all fractures were healed.

Geochemical studies by RHO indicate that ground water within the basalts is supersaturated with a number of mineral species, including: calcite, amorphous silica, chalcedony, and a variety of zeolites and clay minerals. The hydrological implication from these studies is that deposition of selected secondary minerals in the fractures has significantly lowered the permeability of the fractured geologic horizons through which the ground water has moved for long periods of time. Younger, shallower formations are undergoing a sealing process at this time as ground water moves through the fractures.

<u>Item 3</u>

Rockwell has long recognized the problem of collecting representative ground-water samples from existing wells at Hanford. Beginning in fiscal year 1978, RHO adopted new procedures for the collection of representative samples. Results have been dramatic. From FY 1978 to present greater than 90 percent of all samples collected have acceptable ionic balances (Σ anions - Σ cations / Σ cations $\leq$5%), and can be used reliably in geochemical interpretations. In comparison, only 20 percent of samples collected before this period had acceptable balances. A brief description of procedures utilized in the sample collection process is presented below:

- Isolation of sample horizon within the borehole, by means of a dual packer assembly;
- Extensive development of the horizon utilizing air-lift or other pumping techniques;
- Monitoring of selected water-quality parameters to assess the representativeness of the ground water pumped;

- Sampling of ground-water horizons utilizing submersible or argon-lift pumps;
- Proper sample preparation; i.e., filtration, preservation, etc., at the time of collection; and
- Immediate laboratory analysis of major ionic and trace element content.

Zones selected for sampling are isolated within the borehole by means of a dual packers assembly. In order to guarantee isolation and the integrity of the sample, the pressure response between, below, and above the packers is monitored to assess the potential for leakage around packer seats. This procedure was initiated at Hanford in fiscal year 1979.

Once the packer assembly is set, extensive development of the horizon utilizing the air-lift pumping technique is used prior to sampling. RHO has determined through the field-testing program that the greatest ground-water production in small diameter boreholes is provided by air-lift pumping. An added advantage to developing a horizon with this technique is that the geologic interval is not overly stressed as would be expected by extensive swab development techniques. Over stressing would cause alteration of hydraulic properties for the geologic interval and would adversely affect concurrent or future hydraulic testing.

Selected water-quality parameters are monitored during development to assess representativeness of ground-water samples. These parameters include pH, temperature, electrical conductivity, major anions, and total organic carbon. As you mentioned, tritium is a useful parameter in evaluating sample contamination; this is largely after-the-fact information however. A useful parameter to monitor existing research boreholes during development and sampling is total organic carbon. Since these boreholes were drilled largely with organic based polymer muds, this parameter can be very useful in evaluating contamination within the sample.

Extensive cross-aquifer communication between existing open boreholes and surrounding areas does not appear to be supported by available data. Prior to the FY 79 field testing program, RHO staff were concerned about obtaining reliable samples from the existing open DC boreholes. Subsequent fluid velocity and temperature profiles within these wells, however, indicated that very little circulation was taking place within the boreholes. This was due in part to the density of drilling fluid left in the boreholes, and the low hydraulic gradient and permeabilities of basalts encountered at depth.

As a precaution for future work, however, RHO is planning to place packers within the existing research boreholes at selected horizons to minimize borehole circulation. This work will be done following the completion of geochemical sampling activities in FY-80.

Item 4

We agree that the hydrology at Hanford is complex and requires additional definition. Rockwell has designed programs to answer the critical hydrological questions concerning the basalt at Hanford as a suitable repository media. Questions concerning Pasco Basin hydrology will be addressed by developing models and interpreting data obtained from drilling, testing and sampling of research boreholes within and outside the Hanford Site.

For questions specifically concerning the suitability of basalt as a repository media, an exploratory shaft and hydrologic test plan is being proposed and examined for a candidate site. In-situ hydrologic tests have been proposed for the exploratory pilot hole, shaft, and for laterals and drifts emanating from the shaft.

Rockwell has reviewed the LBL test plan and preliminary results from testing at Stripa. We want to establish a meaningful dialogue with LBL for possible advisement on the hydrologic tests to be conducted if an exploratory shaft is sunk.

Dr. Deju has asked me to invite you and your staff to receive a full briefing on our hydrology program here at Hanford. We can either arrange this briefing to take place in Richland or at LBL at your convenience. Such a meeting can be used to initiate a more thorough dialogue between the two organizations. Please advise me when and where it would be convenient to set up such a meeting. Feel free to contact us if you have questions or would like further clarification on my review comments of your letters to Dr. Heath.

Very truly yours,

Frank Spane

Frank A. Spane, Jr., Ph.D.
Senior Hydrologist

FAS/jl

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Ames, L.L., 1977, Hanford basalt flow mineralogy (in press).

Apps, J., Doe, T., Doty, B., Doty, S., Galbraith, R., Kearns, A., Kohrt, B., Lons, J., Monroe, A., Narasimhan, T., Nelson, P., Wilson, C.R., Witherspoon, P., 1979; Geohydrologic studies for nuclear waste isolation at the Hanford Reservation; Lawrence Berkeley Laboratories Earth Science Division Berkeley, California.

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Long, P.E., 1978, characterization and recognition of intraflow structures, Grande Ronde Basalt; Rockwell Hanford Operations, BWI-LD-40, Richland, Washington.

Personal Communication

Dr. Paul A. Witherspoon, Head of Earth Sciences Division, Lawrence Berkeley Laboratory letter correspondence, October 26, 1979 to Dr. Colin Heath, Director of the Division of Waste Isolation, Department of Energy.

Dr. Paul A. Witherspoon, Head of Earth Sciences Division, Lawrence Berkeley Laboratory, letter correspondence, November 23, 1979 to Dr. Colin Heath, Director of the Division of Waste Isolation Department of Energy.

Dept. of Pure & Applied Mathematics
Washington State University
Pullman, WA 99164-2930
March 17, 1985

Environmental Assessment Comments
Department of Energy
1000 Independence Avenue
Washington, DC 20585

To Whom It May Concern:

The following comments extend and amplify earlier comments that I submitted to the Washington State University ad hoc committee on the Draft Environmental Assessment of the Hanford High-Level Nuclear Waste Reference Repository Location. I thought it useful to submit these additional remarks directly to DOE.

My comments fall into three categories:

I. Statistical criteria reported in the DEA are often inappropriate to the needs of risk assessment. Hazards should be reported as probabilities.

II. A complete review of the technical work on groundwater travel times and radionuclide releases could be obtained only from various supporting documents. The analyses appear to be technically competent and in some aspects quite innovative. However, they exhibit more sensitivity to mathematical and statistical assumptions than is made evident in the DEA. The DEA should report these sensitivities and their implications in more detail.

III. The mathematical tools could have been used to identify how much data might be required to resolve various issues, which data might be most sensitive and thus determine how the experiments in the characterization experiments could be optimally designed. There does not appear to be any systematic use of theoretical studies to help determine whether the characterization experiments are adequate.

In the next pages I will provide detailed comments on these topics. I am a Professor of Mathematics and Statistics at Washington State University and Coordinator of Mathematical/Statistical Consulting at the WSU Computing Center. My primary area of research is in environmental health and toxicology. However, I have done extensive research in spatial statistical analysis in connection with lunar and planetary surfaces. I also have a general interest in energy facilities siting, having served as the Executive Secretary of the Power Plant Siting Advisory Committee of the State of Maryland from 1974 to 1977.

I hope these remarks are of use to you. Please contact me if any further comments are needed.

Yours very truly,

Allan H. Marcus

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I. CRITERIA FOR RISK ASSESSMENT

1. PRESENTATION OF PROBABILISTIC CRITERIA

The DEA makes a determined effort to deal with uncertainties in knowledge about important geological, geohydrologic, and geochemical parameters. The most effective presentation of the combined uncertainties would be in the form of probabilities of various adverse outcomes. These are implicit in some of the cumulative distribution function plots e.g. Figs. 6-16, 6-20, 6-22 to 6-28, but an explicit estimate, e.g. Pr{Groundwater travel time < 1000 years} (which I will denote P(1000 years) from now on) with confidence limits, would be helpful. 1000 and 10,000 years are obviously necessary criteria levels, but it may be useful to approximate the very low tail of the c.d.f. The calculations below show that although many of the input parameter distributions are assumed to be lognormally distributed (e.g. transmissivity), the travel time (t.t.) c.d.f. cannot be reconstructed from a median and logarithmic standard deviation i.e. is not lognormal. Since these c.d.f.s are empirical, based on simulations, would it not be more useful to show them as step functions? This might give more of a feel of the variability in extreme t.t.

2. USE OF STOCHASTIC UNCERTAINTY ANALYSIS OF GROUNDWATER TRAVEL TIMES

The mathematical models and their computer implementation appear quite competent and the supporting documents cleared up many of my questions about the statements in the DEA. (I reserve the right to change this assessment as we have more opportunity to try out the models). The Supporting Documents provide a frank and detailed assessment of some of the limitations and uncertainties in the models and in the estimated travel times (abbreviated t.t. hereafter). None of these limitations have been reported in the DEA, a serious omission.

3. EFFECT ~~OF~~ VARIABILITY ON GROUNDWATER TRAVEL TIME ESTIMATES

DRAFT ENVIRONMENTAL ASSESSMENT, pp. 6-267 to 6-270. The median estimate of the travel time may be less useful than the estimate of the probability that travel time will be less than a certain small criterion value. I will here use 1000 years as an illustration. Three models are described in more detail supporting document SD-BWI-TA-013: (i) Transmissivity random and lognormal; (ii) Both transmissivity and regional hydraulic gradient random; (iii) Transmissivity, hydraulic gradient, and effective thickness are all random. Models (ii) and (iii) have much longer median travel times M, and are also have higher estimated standard deviations s of $\log_{10}$(travel time) than does model (i). If the travel times were approximately log-normally distributed, then the probability that travel times are < 1000 years could be calculated using the standard Gaussian or normal probability integral F by the formula

Pr(travel time < 1000) = F((log(1000)-log(M))/s). The table below compares these estimates with the probability estimates directly from the empirical c.d.f. (Figure 9 in SD-BWI-TA-013, which greatly enhances the comparison; see Fig. 6-22 in the DEA). If the model (iii) has the highest median groundwater travel time, it also has the highest risk of a short travel time. This appears to be a consequence of the extra random variation.

Model	Median M, years	s (log t.t.)	z *	F(z)	Prob(t.t.<1000)
(i)	17,000	0.71	-1.733	0.0415	0.015
(ii)	86,000	0.77	-2.512	0.0060	<0.005

(iii) 81,000 0.96 -1.988 0.0234 0.036 * z = {log(1000 years) - log(M)}/s. Figure 9 is attached. One can also read off P(10,000 years) from the three models as, respectively, 0.42, 0.10, and 0.17. These probabilities appear not low, by usual risk assessment criteria, in spite of the long median travel times.

4. INDEPENDENT MODES OF FAILURE

An issue in the risk analyses is the assumption of independent modes of failure. This problem is implied in the captions to Figure 6-19 (p. 6-253) describing the cumulative release of all radionuclides at the waste package subsystem boundary: "Assumes no correlation between performance of individual containers." This assumption is formally embedded in the Poisson failure model (p. 6-249). Yet there are many possible modes of simultaneous failure of multiple containers, e.g. the disruption scenarios on p. 6-281 (Table 6-34). An assessment of fractional radionuclide releases under non-catastrophic scenarios with simultaneous failures of containers and possibly other systems would be useful.

A similar problem arises in connection with the analyses of catastrophic events, particular the effect of a 50 percent breach of Grand Coulee Dam (why only 50 percent?). If the failure occurs as a result of a major tectonic or seismic event, it seems likely that other dams on the Columbia and Snake Rivers would also be breached. Has this been assessed?

II. TECHNICAL COMMENTS ON SUPPORTING DOCUMENTS

1. TIMELINESS OF SUPPORTING DOCUMENTS

It was not possible to adequately review the ground water travel time analyses in the DEA without the following BWIP Supporting Documents. They were all released in the interval January 11-16, 1985 (see list below). It might have been more appropriate to allow the release date of the DEA to be moved up to the release date of all essential supporting documents. They are:

- Effective Porosities of Basalt. ... SD-BWI-TI-254. Rel. 11 Jan. 1985.
- Preliminary Uncertainty Analysis of Pre-Waste-Emplacement Groundwater Travel Timesfor a Proposed Repository in Basalt. SD-BWI-TA-013. Rel. 14 Jan. '85
- Groundwater Travel Time Uncertainty Analysis--Sensitivity of Results to Model Geometry, and Correlations and Cross-Correlations Among Inputs. SD-BWI-TI-256. Released 14 January 1985.
- Calculation of Groundwater Travel Time: A Comparison of Simple Hand Methods With More Complex ... Methods. SD-BWI-TA-014. Released 16 Jan. 1985.
- Probabilistic Modeling of Radionuclide Release at the Waste Package Subsystem Boundary of a Repository in Basalt. SD-BWI-TA-012, Rel. 14 Jan. 1985.

2. WORST CASE ANALYSES

The use of spatially distributed parameters is quite admirable, but it must be acknowledged that there is a wide divergence of opinion about the parameters of these distributions as well. A clearly identified analysis of plausible "worst-case" parameters would be helpful.

3. THE ASSUMPTION OF SPATIAL ISOTROPY IN-LOG-TRANSMISSIVITY

One assumption whose sensitivity was not tested was the form of the covariance function for the log-transmissivity field simulation. The function used for C(r) in SD-BWI-TI-256 (p. 20, eqn. 16) is not the only possible choice e.g. three-dimensional Markov correlation. I'm not sure that this C(r) even allows the existence (in mean square) of a differentiable transmissivity field. In any case, there is a strong assumption that the covariance is isotropic in space. I think the theoretical implications of this assumption need to be investigated. Spatially anisotropic covariance functions may be more appropriate for describing vertical geological layering. Even within layers, the horizontal covariance structure may be anisotropic, with a long correlation range in the principal direction and with a shorter range or possibly quasi-periodic structure orthogonal to this direction. A very strong vertical anisotropy in hydraulic conductivity was elicited by expert opinion (SD-BWI- TA-013, p. 12). This would have an effect somewhat equivalent to modelling "pipes" of relatively high transmissivity scattered at random in the basalt flow, and would reduce the meandering of water pathways, thus reduce t.t. Other possibilities: Layers with high vertical transmissivity may have low horizontal transmissivity, and layers with low vertical transmissivity may have high horizontal transmissivity. It should not be excessively difficult to explore these possibilities mathematically, given the progress to date on such codes as PORFLO and MAGNUM.

4. DETAILED COMMENTS ON SD-BWI-TI-256, TRAVEL TIME UNCERTAINTY

A. EFFECTS OF ZONE SIZE (pp. 44-46).

The simulations with zone sizes of 0.5, 1, 2, and 5 km can be extrapolated linearly in median M (mislabelled "mean", I think) and log. std. dev. s, to zone sizes of 0.1 and 0 km. I get approximately M = 24,550 years and s = 0.88 at 0.1 km, M = 25,120 years and s = 0.89 at 0 km. This allows the following estimates of the probability that t.t. < 1000 years. Define z = (log(1000) - log(M))/s.

Size	M years	s	z	F(z)	Prob (t.t.<1000)
0	25120*	*0.89	-1.573	0.0578	
0.1	24550*	*0.88	-1.580	0.0570	
0.5	23500	0.86	-1.594	0.0554	
1.	21500	0.81	-1.645	0.0500	0.02
2.	18000	0.73	-1.720	0.0427	0.03
5.	16000	0.50	-2.408	0.0080	<.002

Note: * linear extrapolation.

It is clear that within the context of the model, the smaller zones lead to higher risk probabilities. An "eyeball" estimate of the probabilities from the c.d.f.'s on p. 45 is shown in the last column. The effect of zone size on pathline meandering is much larger (p. 46 attached).

B. SENSITIVITY TO DOMAIN OF MODEL SIMULATION (p. 51).

The sensitivity is appreciable to what is, after all, an artefact of the computational limits of simulation. "The width of the model domain has a noticeable effect on the distribution of pathline tortuosity factors (fig. 26). {see attached}. ... As the width of the model domain increases, the distribution of tortuosity factors indicates that the pathlines, on the average, meander more through the flow field. ... In a wider domain, the streamlines will meander and tend to avoid the subregions of relatively low transmissivity. This causes shorter travel times, on the average, in the wider domains." This effect is not discussed in adequate detail in the DEA.

C. SENSITIVITY TO CORRELATION RANGE OF LOG-TRANSMISSIVITY.

See Figure 27 attached. The "eyeball" estimate of Pr(tt.t. < 1000 years) can be read as about 0.015 for a 2 km correlation range, about 0.03 for 10 km correlation range, and 0.30 for an extremely long correlation range. Since the correlation range is not actually known (even within the context of a spatially isotropic model), the risk implications can vary over an uncomfortably large range. Note how much more informative are the actual probabilities. Since they have already been calculated, they should be reported.

D. SENSITIVITY TO CORRELATION BETWEEN TRANSMISSSIVITY AND EFFECTIVE THICKNESS

See Figure 29 attached. When effective thickness is assumed log-normal and correlated with log-transmissivity, both median and log std. dev. of t.t. are affected, but the effect on Pr(t.t.<1000) is much larger. Furthermore (p. 61) "If a symmetric probability distribution, such as normal, was used [for effective thickness] in this analysis, the median travel times would be less than the travel times calculated in this section."

5. TECHNICAL COMMENTS ON SD-BWI-TI-254, EFFECTIVE POROSITIES OF BASALT

A. SUMMARY OF EXPERT OPINIONS (p. 36)

It is clear that any simple summary of the 10th, 50th, and 90th percentiles of these highly divergent opinions is likely to be incomplete. The divergence of opinion is itself an important element in assessing the uncertainty of the input into the computer models and might be reported in the DEA. See also Table 6-1.

B. DISTRIBUTION OF APPARENT POROSITY (Appendix A, pp. 45-67).

Lognormal probability plots would be very helpful. Even though the sample sizes are small, some of these don't look at all lognormal to me. Some of the histograms suggest a mixture of subpopulations; if this is the case, it would be very helpful to estimate the fraction of the data that comes from samples with unusually high porosity. See attached. The methods for testing the distribution are well known (SD-BWI-TA-013, 35-38).

6. TECHNICAL COMMENTS ON SD-BWI-TA-012, RELEASES FROM PACKAGE SUBSYSTEM

A. CONTAINER CORROSION MODEL (pp. 13-16).

The primary assumptions are embodied in equations (1)-(3). The derivation of these results is contained in earlier supporting documents (SD-BWI-TI-159 and RHO-BW-SA-330) that I have not yet reviewed. The evidence for the power-function form of the relationship between corrosion thickness d and exposure time t in an air-steam environment is potentially quite important. In particular, the estimate of the empirical exponent b (no confidence limits given) is 0.15 to 0.25 in the model. This says that the corrosion rate increases relatively very slowly with increasing duration of exposure to an air/steam environment. That may be correct, but some physical justification for the formula and an extended discussion of its significance is called for, in my opinion. The linear form for corrosion thickness in an aqueous medium seems more plausible.

The assumption of a uniform corrosion rate for each container may be largely responsible for the relatively small spread in simulated failure times, in spite of the effort to build in additional sources of random variation by use of an assumed distribution of input parameters. (The methodology appears correct and useful, as far as it goes). I suspect that there is a much more important source of random variation that has been overlooked. Waste container packages will not fail uniformly. Some point in the package will likely fail before the others, and the radionuclide content of the container will then be accessible through the initial breach. Thus some form of "first-passage time probability" model may be more useful than a uniform corrosion rate model for predicting waste package failures. Additional failure modes such as pitting and microcracking (see p. 37) could then also be incorporated using "competing risk" methodologies that are used in epidemiology and in reliability theory.

B. INDEPENDENT FAILURES

The assumption that waste container packages fail independently of each other is made explicit on pp. 12 and 26 and would normally be acceptable. However, as each container is breached it may contribute to the environmental stresses suffered by the surviving containers. For example, on p. 14, equation (1), the corrosion rate in an air-steam environment increases with increasing temperature explicitly, and implicitly may depend on related thermal and chemical conditions that are affected by the failure of an adjacent package. In aqueous conditions described by equation (3), earlier saturation (smaller t\s°) leads to increased corrosion rate due to elevated surface temperatures. Thus the survival of the remaining containers will be progressively reduced by each additional failure. The consequences of this should be explored, as the effect may be quantitatively significant. Probabilistic modelling using Markov processes may be feasible here, as the simulations might be expensive!

C. ACCURACY OF SIMULATIONS

The statistical results of the simulations should be reported with their confidence limits, since only 200 replications of each model seem to have been carried out. The effects of this on the convolutions for radionuclide release (equations 9-11) may be hard to work out. I was favorably impressed with the use of sophisticated statistical methods (e.g. kernel density estimation) to deal with the novel and difficult statistical problems encountered. If the simulations are so expensive that only a modest number of replicates is affordable, the determination of confidence limits is also non-standard. The BWIP investigators may wish to investigate relatively model-free interval estimation techniques such as the jackknife or the bootstrap (see e.g. B. Efron, The Jackknife, the Bootstrap, and Other Resampling Methods, SIAM Monograph No. 38) (Can't find an exact reference -- this is close).

III. THE USE OF MATHEMATICAL MODELS IN DESIGNING CHARACTERIZATION STUDIES

In spite of the preceding criticisms, the mathematical models and the statistical and computational methods developed for groundwater travel time studies are quite powerful and potentially quite useful. They have not, at this time, been adequately used to address the key issues in selecting a site for further characterization. The models won't answer questions about uncertainty: Data is needed. But the models can help to decide what kinds of data are likely to be most important, and how much data is needed to resolve the uncertainties. There is hardly anything in Chapter 4 of the DEA to suggest that the very considerable uncerainties about transmissivity, porosity and effective thickness revealed by these analyses will be resolved by the characterization studies. In particular, I would like a clear connection made between components of the experiment and the following issues: (i) Anisotropy of transmissivity and porosity (or effective thickness) fields; (ii) Shape of the spatial covariance and its correlation range (ranges in each direction); (iii) how many boreholes etc. and where located so as to reduce the estimated uncertainty of Pr(t.t.<1000 years) to some specified confidence limit. These are standard questions in the statistical design of experiments, but it is not clear that they have been addressed. In view of the quality of work already expended in the analyses, I trust it would be possible to work constructively with BWIP staff on these issues.

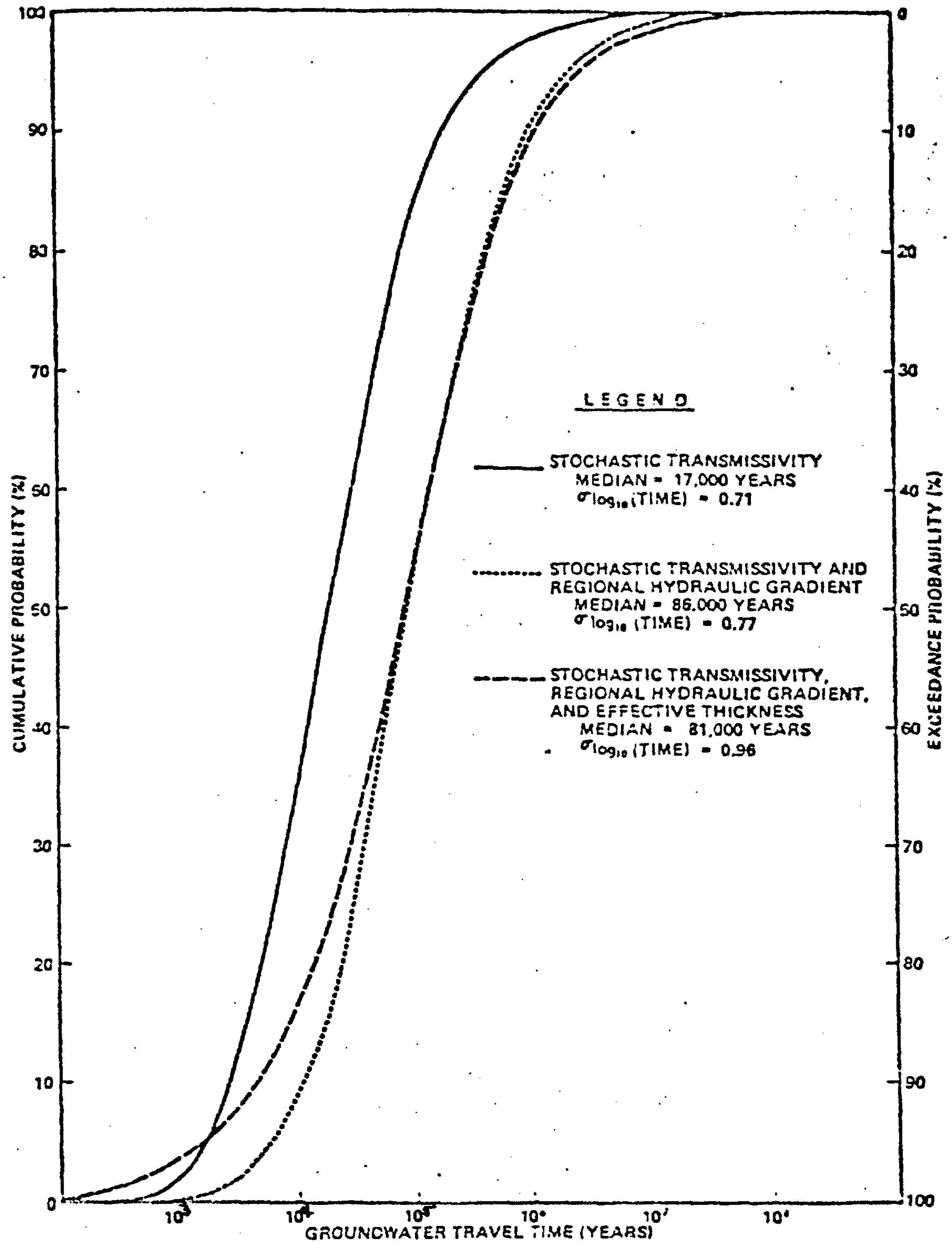

FIGURE 9 - Sensitivity of Groundwater Travel Times To Variations in Effective Thickness and Regional Hydraulic Gradient

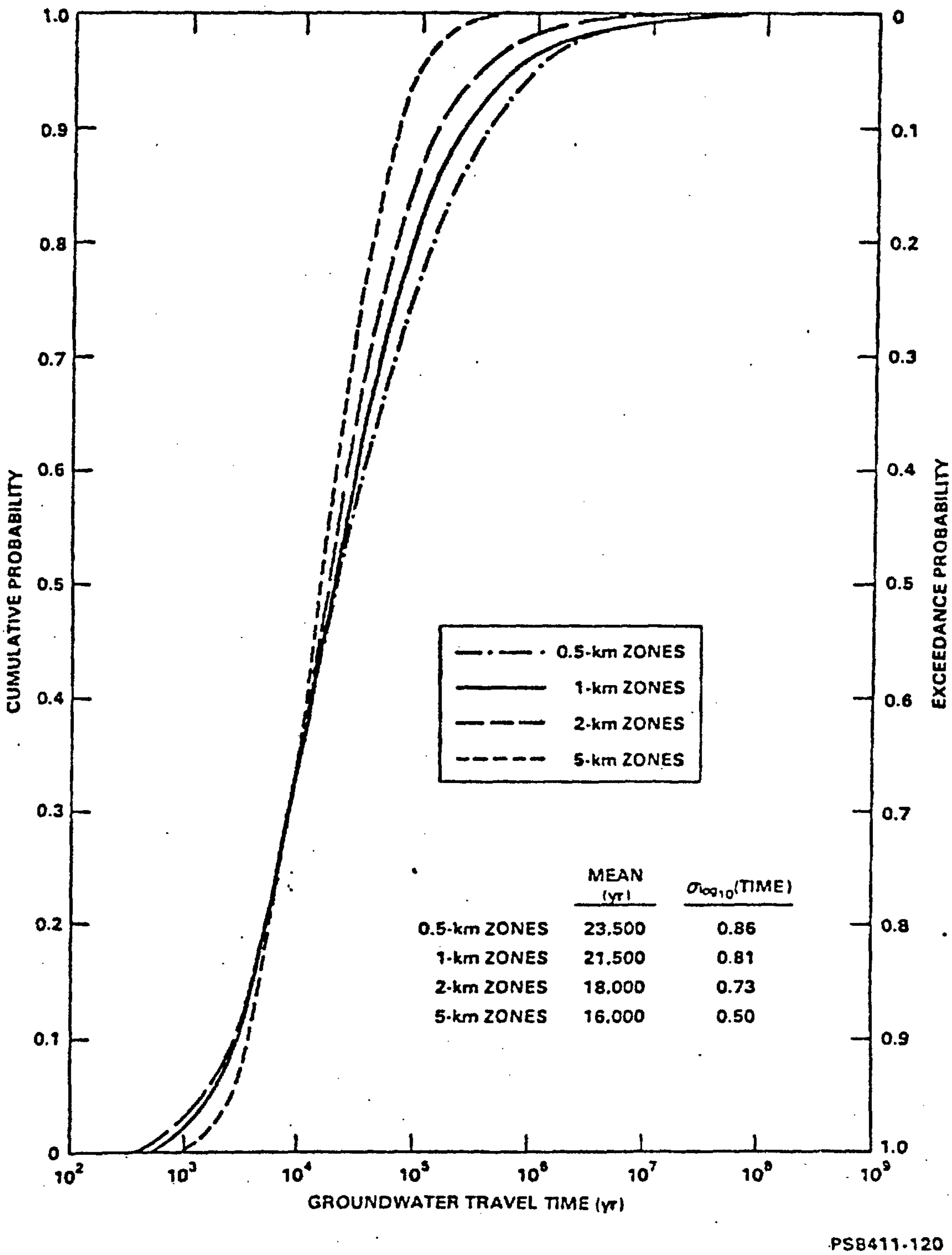

FIGURE 23. Distribution of Groundwater Travel Times from Models with Different Parameter Zone Sizes.

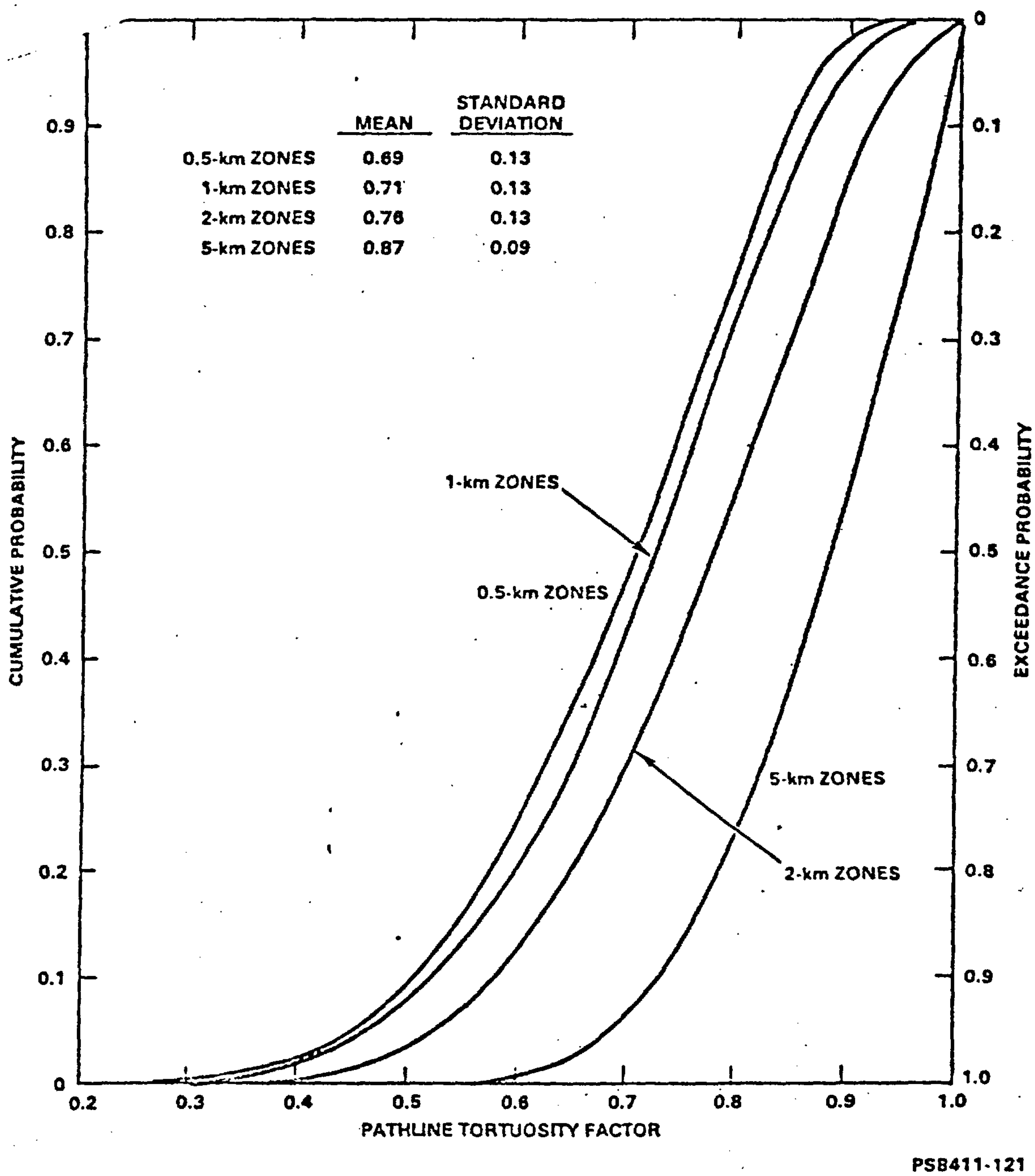

FIGURE 24. Distribution of Pathline Tortuosity Factors from Models with Different Parameter Zone Sizes.

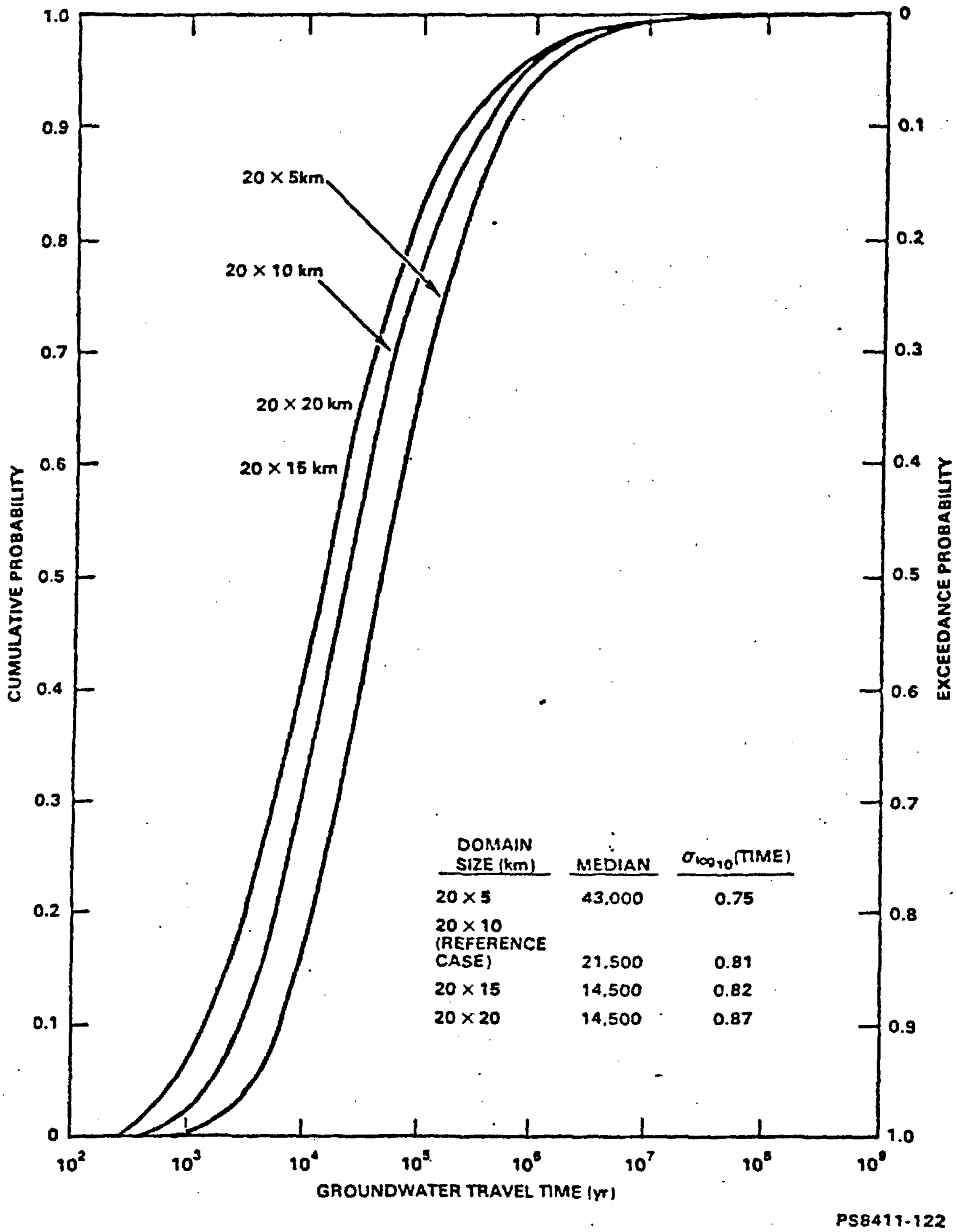

FIGURE 25. Distribution of Groundwater Travel Times from Models with Different Domain Widths.

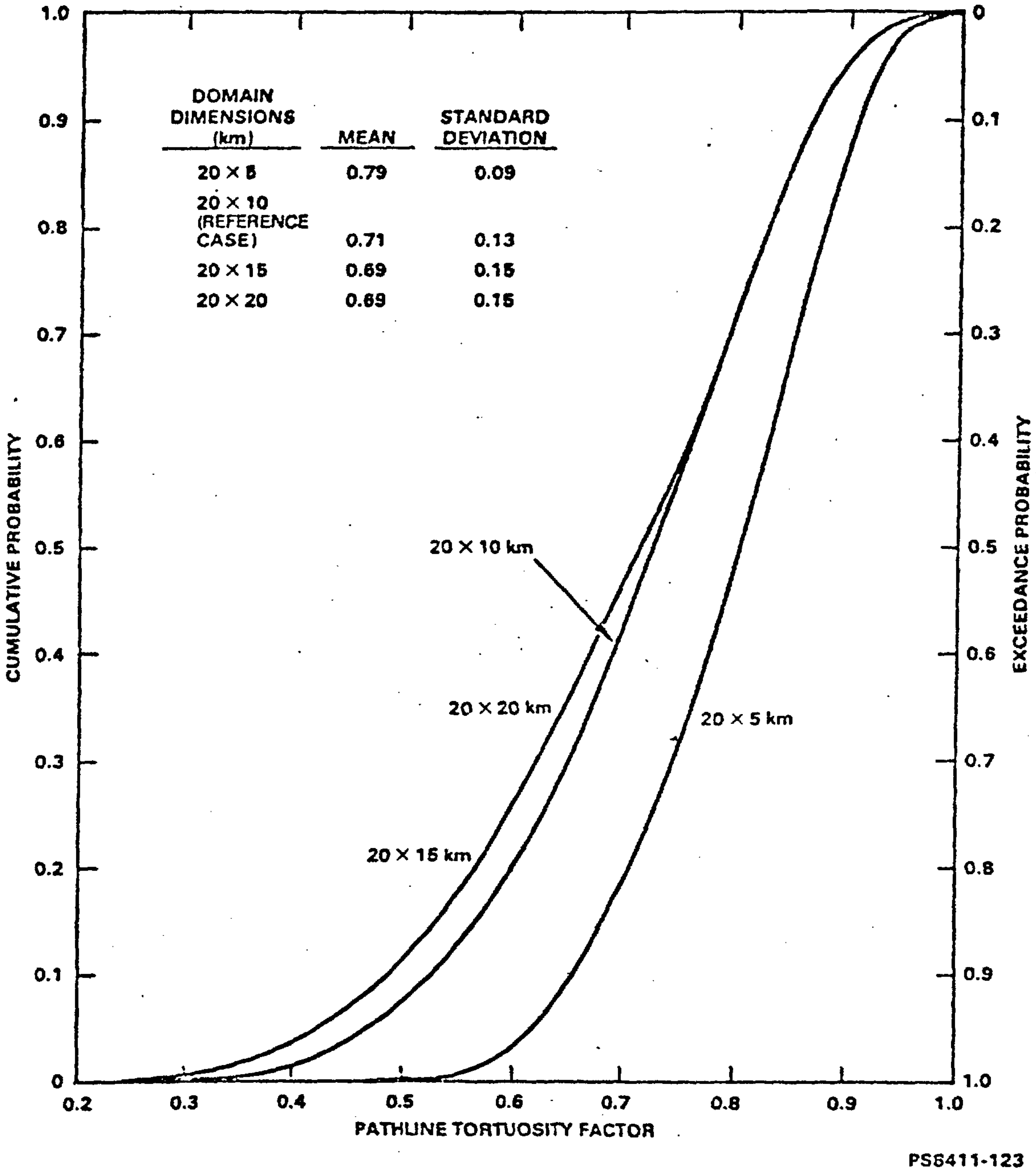

FIGURE 26. Distribution of Pathline Tortuosity Factors from Models with Different Domain Widths.

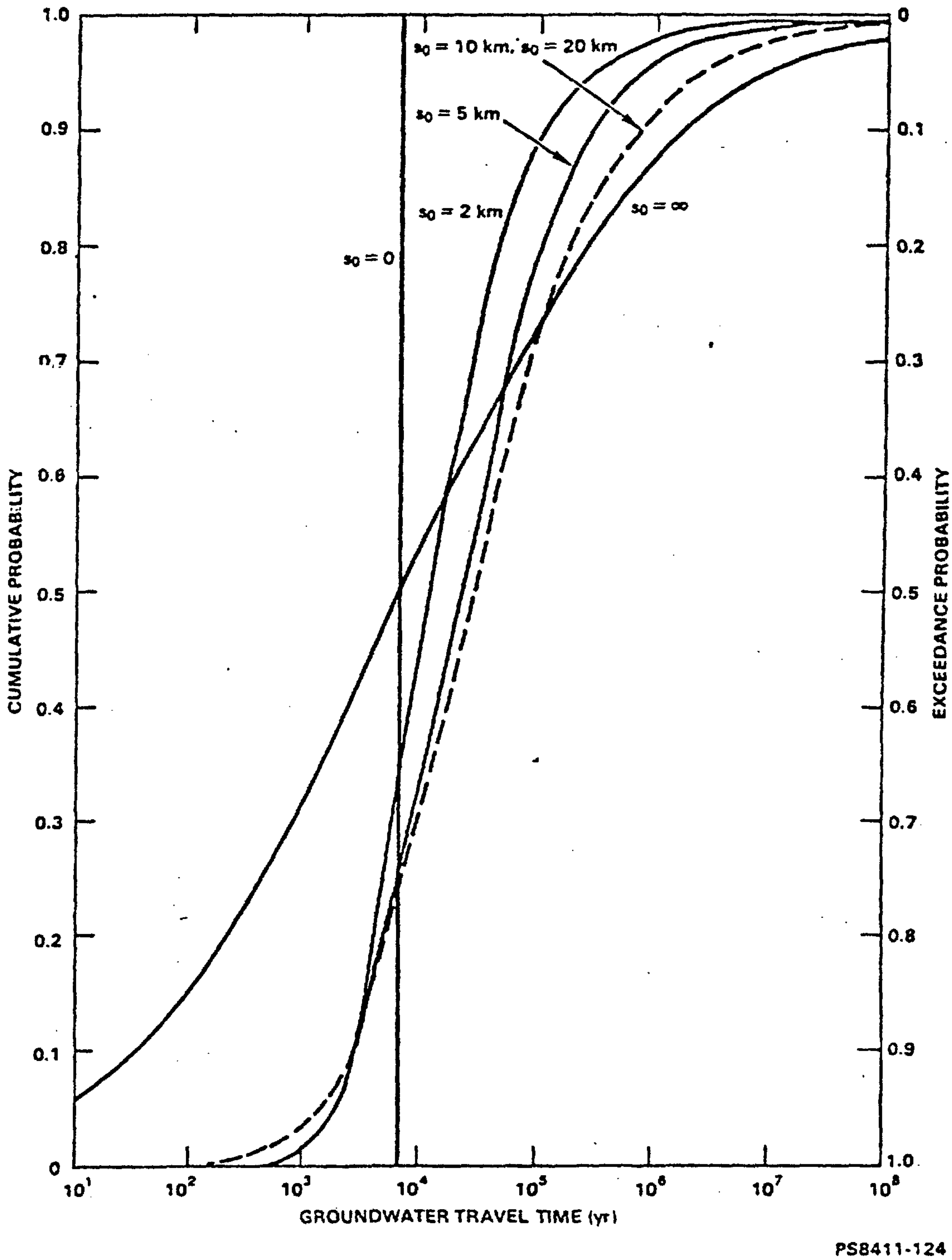

FIGURE 27. Distribution of Groundwater Travel Times from Models with Different Log-Transmissivity Correlation Ranges.

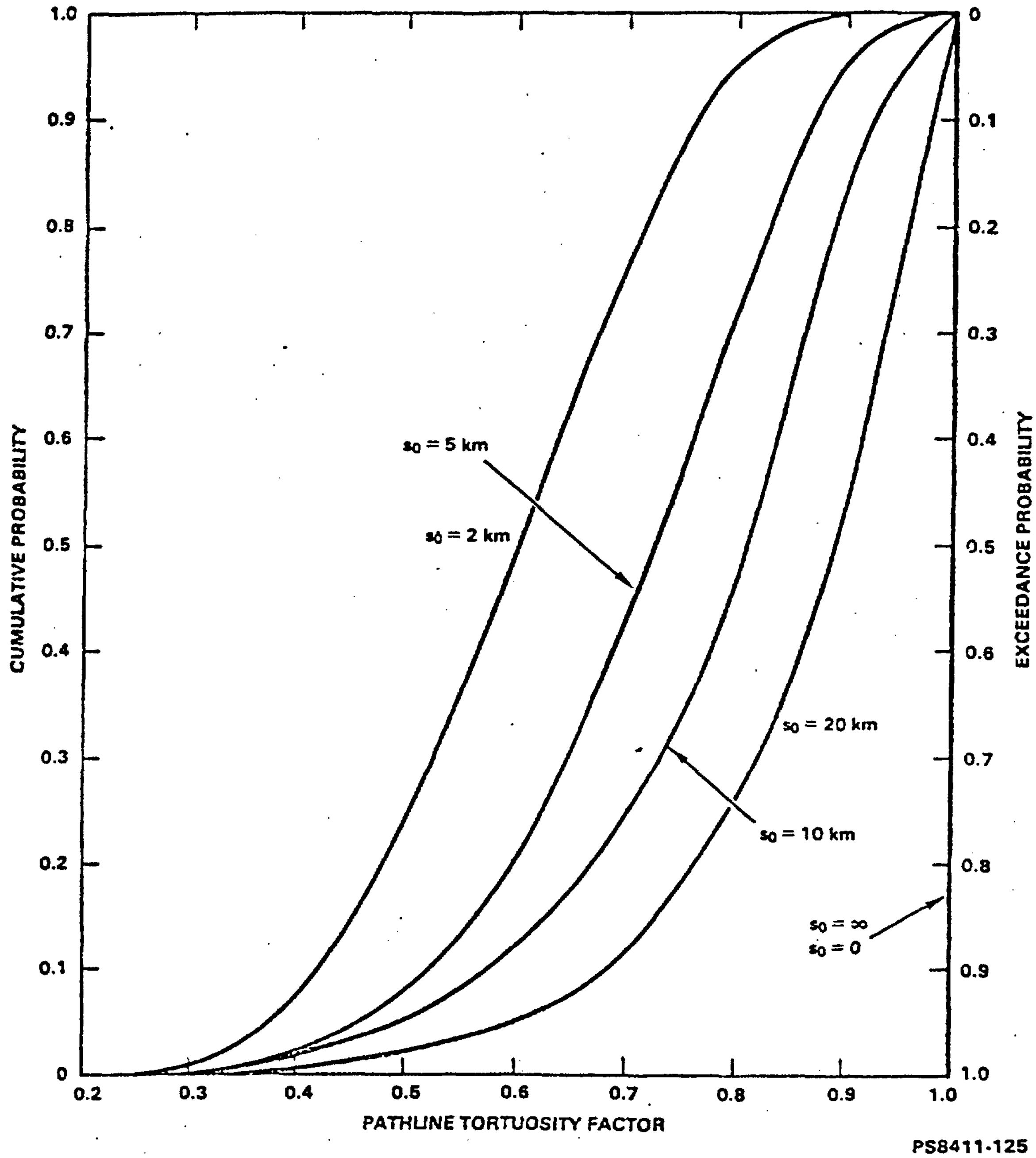

FIGURE 28. Distribution of Pathline Tortuosity Factors from Models with Distribution Log-Transmissivity Correlation Ranges.

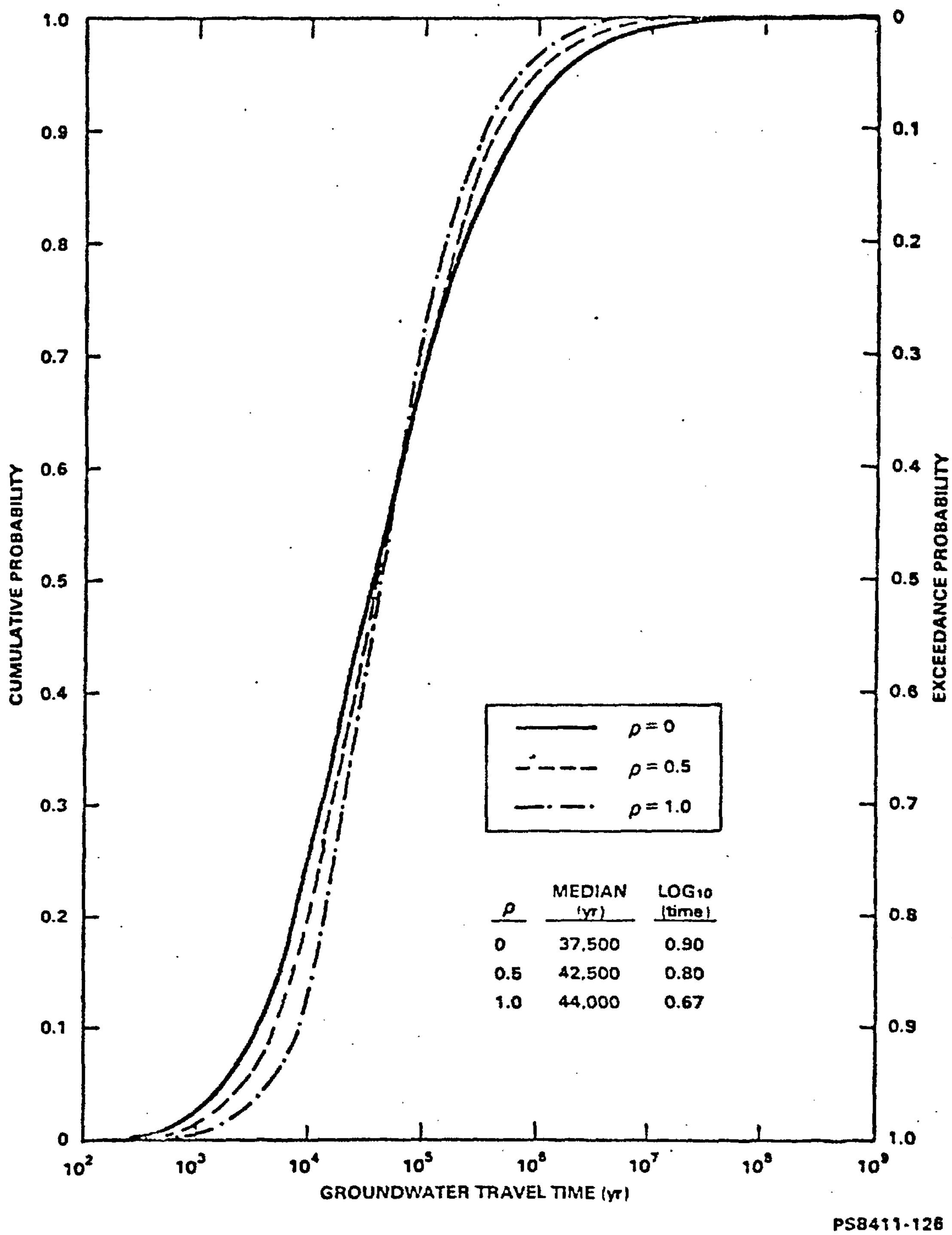

FIGURE 29. Distribution of Groundwater Travel Times from Models with Different Cross Correlations between Transmissivity and Effective Thickness.

TABLE 5-2
SUMMARY OF EXPERT OPINION ON CUMULATIVE PROBABILITY
DISTRIBUTIONS OF COHASSETT FLOW TOP AVERAGE EFFECTIVE POROSITY

EXPERT	DISTRIBUTION VALUE		
	10 Percentile	Median Value	90 Percentile
Mega Scale			
A	3.0×10^{-6}	1.0×10^{-4}	4.0×10^{-3}
B	2.5×10^{-3}	2.0×10^{-2}	9.0×10^{-2}
C	1.0×10^{-4}	2.9×10^{-3}	4.0×10^{-2}
D	1.2×10^{-4}	3.1×10^{-3}	3.0×10^{-2}
E	1.6×10^{-2}	3.5×10^{-2}	7.0×10^{-2}
F	3.1×10^{-4}	7.1×10^{-3}	4.0×10^{-2}
G	1.2×10^{-3}	3.7×10^{-2}	2.0×10^{-1}
H	3.9×10^{-2}	8.9×10^{-2}	2.5×10^{-1}
Mean	7.4×10^{-3}	2.4×10^{-2}	9.1×10^{-2}
Median	7.6×10^{-4}	1.4×10^{-2}	6.5×10^{-2}
Macro Scale			
A	3.3×10^{-7}	1.0×10^{-4}	5.0×10^{-2}
B	1.0×10^{-3}	1.9×10^{-2}	1.2×10^{-1}
C	1.0×10^{-5}	9.5×10^{-4}	3.7×10^{-2}
D	4.5×10^{-5}	1.8×10^{-3}	3.0×10^{-2}
E	6.0×10^{-3}	2.5×10^{-2}	8.5×10^{-2}
F	1.9×10^{-4}	6.8×10^{-3}	6.2×10^{-2}
G	6.0×10^{-4}	2.8×10^{-2}	2.2×10^{-1}
H	3.0×10^{-2}	1.0×10^{-1}	3.5×10^{-1}
Mean	4.7×10^{-3}	2.3×10^{-2}	1.2×10^{-1}
Median	3.9×10^{-4}	1.3×10^{-2}	7.3×10^{-2}

Source: Runchal, et. al. (1984a)
Runchal, et. al. (1984b)

Mega Scale - 100 to 1000 meters
Macro Scale - 1 to 10 meters

Note: Alphabetical order listing of experts are different than order as listed in Table 5-1.

TABLE 5-3
SUMMARY OF EXPERT OPINION ON CUMULATIVE PROBABILITY DISTRIBUTIONS
OF COHASSETT DENSE BASALT INTERIOR AVERAGE EFFECTIVE POROSITY

EXPERT	DISTRIBUTION VALUES		
	10 Percentile	Median Value	90 Percentile
Mega Scale			
A	1.6×10^{-6}	1.0×10^{-5}	6.5×10^{-5}
B	1.4×10^{-5}	9.0×10^{-4}	7.5×10^{-3}
C	8.5×10^{-6}	1.6×10^{-4}	3.0×10^{-3}
D	4.5×10^{-6}	7.2×10^{-5}	1.6×10^{-3}
E	8.2×10^{-4}	1.9×10^{-3}	7.6×10^{-3}
F	2.2×10^{-4}	2.0×10^{-4}	7.2×10^{-4}
G	2.2×10^{-7}	1.0×10^{-5}	1.3×10^{-3}
H	3.0×10^{-3}	9.8×10^{-3}	2.5×10^{-2}
Mean	5.1×10^{-4}	1.6×10^{-3}	5.9×10^{-3}
Median	1.1×10^{-5}	1.8×10^{-3}	2.3×10^{-3}
Macro Scale			
A	2.1×10^{-7}	9.0×10^{-6}	5.0×10^{-4}
B	1.0×10^{-5}	1.0×10^{-3}	1.3×10^{-2}
C	3.0×10^{-6}	1.0×10^{-4}	4.0×10^{-3}
D	3.0×10^{-6}	1.0×10^{-4}	4.0×10^{-3}
E	1.6×10^{-4}	2.5×10^{-3}	1.5×10^{-2}
F	1.1×10^{-4}	2.0×10^{-4}	1.0×10^{-3}
G	1.1×10^{-7}	8.2×10^{-6}	3.0×10^{-2}
H	2.5×10^{-3}	9.8×10^{-3}	4.4×10^{-2}
Mean	3.5×10^{-4}	1.7×10^{-3}	1.4×10^{-2}
Median	6.5×10^{-6}	1.5×10^{-4}	8.5×10^{-3}

Source: Runchal, et. al. (1984a)
Runchal, et. al. (1984b)

Mega Scale - 100 to 1000 meters
Macro Scale - 1 to 10 meters

Note: Alphabetical order listing of experts are different than the order as listed in Table 5-1.

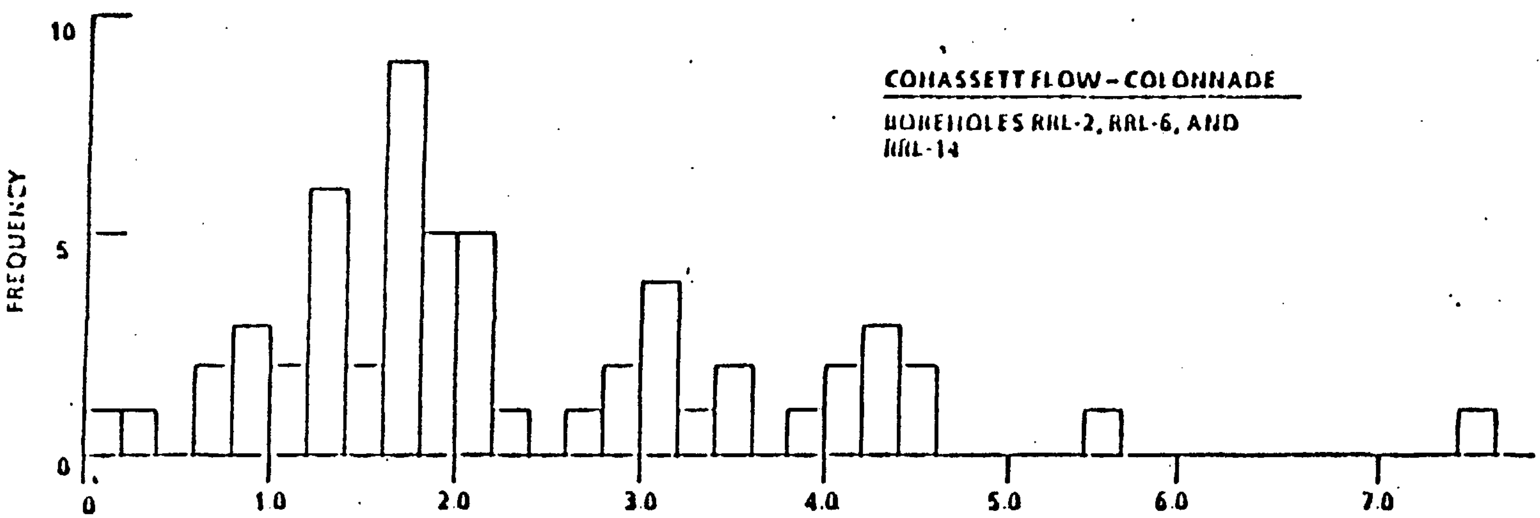

FIGURE A-4b. APPARENT POROSITY (%) OF CORE FROM 58 LABORATORY DETERMINATIONS.

PS85-2032-4

March 22, 1985

The Honorable Booth Gardner
Governor of Washington
State House, Olympia, Washington 98504

Dear Governor Gardner:

Enclosed are written comments which I submitted to the Department of Energy regarding the Draft Environmental Assessment of the Hanford site which is being considered as a location for the repository for commercial high level radioactive waste. I am sending these to you for your review.

Sincerely,

Amy Mickelson

Amy Mickelson

RECEIVED
MAR [illegible] 1985
GOVERNOR'S OFFICE

March 15, 1985

Comments-- EA
U.S. Dept. of Energy
Attention: Comments -- EA
1000 Ondependence Ave, S.W.
Washington, D.C. 20585

After reviewing the Draft Environmental Assessment, Reference Repository Location, Hanford Site, Washington, I submit the following questions and comments:

1. LAND OWNERSHIP

Sec 1.2.1 Site Sreening (pg 1-6) States:

" Screening of sites in basalt and tuff was initiated when DOE began to search for suitable repository sites on some Federal lands where radioactive materials were already present."

A DOE Basalt Waste Isolation Project (BWIP) fact sheet (8404) states:

" Beginning in 1976, the Federal government started a search for sites with geologic and hydrologic characteristics suitable for long-term nuclear waste storage. Screening for sites was based on a twofold approach. The first approach called for surveying areas underlain by salt. This is because salt has the ability to isolate waste and support the construction of underground facilities. The second approach was to evaluate government lands already dedicated to nuclear activities. Hanford, underlain with basalt, is in this second category."

Both Hanford and the Nevada Test Site were looked at as potential repository sites, not because they were underlain by rocks of suitable characteristics, but because the federal government owns the land.

If the DOE has made the decision to select mined geologic repositories as the preferred means of nuclear waste disposal, because deep underground storage with suitable geologic and hydrologic characteristics is the safest method to keep these long-lived radioactive materials away from the (human) environment, then I feel that the Dept. of Energy should be looking at sites with suitable geology, not at who owns the land.

And that geologic, hydrologic, and transportation factors should be weighted heavier than land ownership.

2. HANFORD SELECTED BEFORE GUIDELINES WRITTEN

Section 2.2 (pg. 2-39) states:

" Note that the reference repository location was selected before criteria was developed by the National Waste Terminal Storage Program (the predecessor to the Civilian Radioactive Waste Management Program) or the development of General Siting Guidelines required by the Nuclear Waste Policy Act of 1982."

By stating this, the DOE is saying that the guidelines were written to fit the site, not that the site was selected because it met requirements of the General Siting Guidelines.

3. CRYSTALLINE ROCK

Section 2.2 (pg 2-38) states:

" Two primary factors led to the selection of the Hanford Site for exploration and screening to determine its suitability. First, the Hanford Site is situated in the center of a region covered by one of the largest (200,000 sq. km., 78,000 sq. mi) crystalline rock types in the U.S., the Columbia River Basalt Group. "

If the DOE has made a decision to defer investigations and screening of crystalline rock types until the second repository, why then is the DOE looking at Hanford, a crystalline rock type? Or rather, why aren't other crystalline rock sites, such as those in granite, being looked for the first repository?

4. ELIMINATION OF CERTAIN SITES

Figure 2-21 (pg. 2-43) is a map showing subareas within the Pasco Basin. It also shows areas which were eliminated during site screening. Page 2-41 states that areas were eliminated in screening process because of " fault rupture, floodind, ground failure, erosion denudation, hazardous facilities, induced seismicity and site preparation costs."

This map (Figure 2-21) shows a dog bone shaped region south of Gable Mt. and Gable Butte which according to the key says it was eliminated during site screening.

What exactly was the reason that this dog bone shaped piece of land eliminated?

And if this area was eliminated, then why was it included for further study shown on the Maps - Fig. 2-23 and Fig. 2-24 ?

5. CANDIDATE SITES H. J, K

Three additional candidate sites were chosen whose boundaries were superimposed on portions of the original sites. See fig. 2-25.

Section 2.2.1.2 (pg. 2-46) states:

" Because of the linear trendings resulting from geophysical studies in the Cold Creek syncline (Meyers & Price, 1981) , the boundaries of the seven candidate sites were re-evaluated. For ease of comparison with previous work, the original candidate site boundaries (A thru G) were maintained and three additional candidate site boundaries were superimposed on portions of the original seven sites (but outside of the influence of the more prominent geophysical lineaments). These additional sites were designated H, J, and K (Fig. 2-25) . "

This explanation is not very clear. Plaese give a detailed explanation, in lay persons terms, of how all of the boundaries for candidate sites H, J, and K were chosen.

6. SITING OF SURFACE FACILITIES

Figure 2-28 is a map of the Reference Repository Location which shows two areas (in white) which are suitable for the siting of surface facilities.

Figure 3-31 is another map which shows two areas within the RRL (Reference Repository Location) proposed as repository surface support facilities. Since the maps are not to the same scale, it is difficult to see where the proposed facilities shown on Fig. 3-31 would be if overlain on to Fig. 2-28. But eyeballing the Northern most proposed facility on Fig. 3-31, it appears that this proposed location is right in the middle of the 200 W area; an area eliminated from siting surface facilities on Fig 2-28.

Please explain this contradiction. It would be very helpful if the map (Figure 3-31) were shown in the same larger scale as the map (Fig. 2-28).

Does this have any relation to the map (Pg. 3) of a Rockwell/DOE publication, "Radioactive Waste Management at Hanford", which shows a mining facility approx. in the middle of the 200W area?

7. POPULATION DENSITY

Section 2.3.6.1 Disqualifying Conditions (pg. 2-69) states:

" A site shall be disqualified if:

2) Any surface facility of a repository would be located adjacent to an area 1 mile by 1 mile having a population of not less than 1,000 individuals as enumerated by the most recent U.S. Census."

How was the population density of 1,000 people/ mi^2 decided upon?

Does the population density somehow relate to a radiation exposure level expected from the surface facility?

Is 1,000 people or less an acceptable risk population for receiving what ever the expected dose level is?

Or is this population density chosen because a repository is not wanted in the populous East where most of the reactors that generate this waste are located?

8. WATER LEVEL RISE IN AQUIFERS

Regarding the Columbia Basin Irrigation Project, Section 2.1.4.2 (pg. 2-36) states:

" After irrigation commenced in 1952, the upper confined acquifers of the Columbia River Basalt Group experienced a water-level rise. Water levels in typical wells drilled onto the basalt acquifers underlying the Columbia Basin Irrigation Project have increased as much as 6 to 12 meters (20 to 40 ft) per year (DOE, 1982). This water level rise is due to leakage of excess irrigation water from overlying unconfined aquifers across rock formations and probably along well casings and in open boreholes. "

With the increased agricultural growth projected, won't increased irrigation cause the water levels in the aquifers to rise even more?

8. Continued

If the levels of these near aquifers were to rise, couldn't the aquifers be contaminated by radioactive materials already in the soil on the Hanford Reservation, as these radionuleids perculate down through the soil?

9. COLUMBIA RIVER FLOOD POTENTIAL

Although evaluations (see Fig. 3-30, pg. 3-66) of flooding due to a 50% breach of Grand Coulee Dam were made,

" no determinations were made with respect to breaches greater than 50% at Grand Coulee Dam or to failures of dams upstream of Grand Coulee." (pg. 3-65)

Will Grand Coulee Dam be there after 10,000 years? 100,000 years? If the radioactive wastes will be around this long, why wasn't a scenerio of a complete failure of Grand Coulee Dam evaluated? I feel one is necessary in the Final EA.

10. COLD CREEK FLOOD POTENTIAL

Section 3.3.1.3.5 discusses the flood potential of Cold Creek. Figure 3-31 (pg 3-68) shows a map of the probable maximum flood in the Cold Creek area. The proposed exploritory shaft is in this maximum flood plain.

The effects of flooding of the drilling operation are not discussed, nor are the effects of flooding on the exploritory shaft. Please address these.

Section 3.3.1.3.5 also mentions that analysis of a 100 year peak stage flood was also done. It states that 100 year flood waters

" would not reach the area considered for repository support facilities and such floods would be of short duration. " (pg 3-67)

No map was shown for this possibility. Please add a 100 yr flood plain map of the Cold Creek area, and not at such a reduced scale as the map on Figure. 3-31.

11. AREAS LEASED TO THE STATE OF WASHINGTON

Fig. 3-38 (pg. 3-95) is a map of the land use on the Hanford Site. A section of land between the 200E and 200W areas is leased to the state of Washington. This map shows that half of the leased land is within the reference repository location.

How can this be? I thought all of the RRL was land controlled by the Federal gov't. Please explain this. Has the state of Washington given up their lease?

Page 3-94 states:

" The State also retains fee title to a section of land for use as a proposed hazardous waste disposal site. "

Is this the same section of land between the 200E & 200W areas that is shown in Fig 3-38? Will a hazardous waste disposal site be in conflict with operation of a high level radioactive waste repository?

12. WIND

Section 3.4.3.1 does not discuss the effects of high elevation winds. Fig. 3-42 addresses 50 foot wind data. These high level winds need to be discussed.

13. RADIOACTIVE MATERIALS DISTURBED BY MINING OPERATIONS

Section 4.2.1.3.2 does not address radioactive particles already on the ground at the RRL (from other Hanford operations) which will be picked up by the wind as a result from the ground being disturbed by the mining operations (example- site preparation). The effects of this dispersal should be discussed in the Final EA.

14. CAPACITY OF THE FIRST REPOSITORY

Section 5.1 (pg.5-1) states:

" The amount of waste emplaced in the repository shall not exceed 77,000 tons of heavy metal until such time as a second repository is in operation. "

The Dept. of Energy and its contractors have been giving the public the impression the first repository will be capable of only accepting this 77,000 tons and nothing more. But according to the NWPA 82 the repository can accept more. Is the DOE just going to keep on accepting wastes at the first repository, once the second one is in operation?

What is the Capacity of the first repository?

15. SURGE STORAGE CAPACITY

Section 5.1 (pg. 5-2) states:

" Surge storage capacity equivalent to waste receipts for a 3-month period (i.e., 100 metric tons (110 tons) equivalent for Phase I operation and up to 750 metric tons (825 tons) equivalent for Phase II operation) will be provided. Such capacity would assist in minimizing the impact of interruptions in repository operations. The storage facility would be capable of storing the waste as received from offsite as well as the waste packages prepared onsite. "

Nothing more abouth this surge capacity is mentioned. More detailed information is needed. Is this above or below ground tempory storage? What type of facility is this? Pools? MRS? Dry Storage? What type of radiological effects can be expected from these wastes sitting and waiting to be entombed?

16. DESIGN REQUIREMENTS FOR 1982 CONCEPT

If the 1982 design concept for the repository has been updated, why is mentioned in such great detail in this draft document?

17. WHITE REPORT

I request that the DOE indicate where the National Academy of Sciences, National Research Council's report entitled, " A Study of the Isolation System for Geologic Disposal of Radioactive Wastes"(June, 1983) is referenced in the Draft Environmental Assessment- Reference Repository Location, Hanford Site, Washington?

Mr. Larry Fitch of Rockwell's BWIP program stated at a presentation at Gonzaga University's Environmental Law Caucus on February 23, 1985, that the unpublished report , " Backround Paper for Assessment of Basalt Lava Flows, Hanford Washington " by Donald E. White is referenced in this National Academy of Sciences report. And that the NAS report is referenced in the Draft EA.

White's report indicates problems of Hanford's basalt such as rock bursting, high temperatures and hot groundwater. Quoting from White's recommendations:

" The geologic and some hydrologic aspects of BWIP (excluding geochemical relations) are unfavorable enough to raise serious questions about its eventual suitability as repository. Most of these questions can either be resolved or intensified, perhaps fatally, prior to major construction committments. "

Mr. Fitch also stated that the White Report was not included in the NAS report because it was too long. White's report is only 29 pages long. Is this too long of a document to include?

I just want to know that White's report was looked at during the process of evaluating the Hanford site for the Draft EA. And if not, I request that White's report, " Background Paper for Assessment of Basalt Lava Flows, Hanford, Washington " be submitted and evaluated in detail in the final EA.

18. HEAT, HIGH WATER, AND ROCK INSTABILITY AT HANFORD

I request that " Heat, High Water, and Rock Insability at Hanford A Preliminary Assessment of the Suitability of the Hanford, Washington Site for a High-Level Nuclear Waste Repository " by Dr. Ajun Makhijani and Kathleen Tucker, Esq. (February 1985, Health and Energy Institute) be evaluated for the Final Environmental Assessment.

19. EA PREDATES GUIDELINES

The DOE published final Siting Guidelines for the Recommendation of Sites for Nuclear Waste Repositories. These guidelines were published on December 6, 1984 in the Federal Register (10 CFR Part 960).

In the Federal Register it states that the effective date of these guidelines is January 7, 1985. (see enclosed sheet from the Federal Register)

The Draft Environmental Assessments were released on December 20, 1984, and supposedly written in accordance to these final guidelines. (Page 3 of the executive summary of the Hanford Draft EA.)

If the Final Gidelines weren't effective for another 19 days, how are these draft environmental assessments even valid?

19. EA PREDATES GIUDELINES- Cont.

I am not asking that the testimonies and comments be discounted, because I know that alot of hard work and research has gone into many. I am only asking that the DOE should be held accountable for following the spirit as well as the letter of the law.

20. A BIGGER PROBLEM

If the DOE is looking at spending upwards to 1 billion dollars for site characterization at just one site, and the President (according to the NWPA of 1982) must select a minimum of three sites; and he could choose all nine. There is the potential of spending three to nine billion dollars in site characterization alone.

Once the site has been selected, the EA suggests that an " estimated repository life-cycle cost is roughly 10 billion dollars. " (pg 6-51)

But a repository that this Draft EA addresses is just for spent fuel (and wastes from commercial reprocessing, and possibly defense wastes). The next big important question which needs to be answered is what is the safe containment (entombment) of the equally as radioactive major components of nuclear power plants (piping, reactor vessel, containment vessel etc). Spent fuel is just a small percentage of the total volume of contaminated parts of a nuclear power plant that we will have to find a final burial ground for. And what will that cost be? We are just now looking at the tip of the iceberg.

21. IF MAJOR FLAWS FOUND DURING SITE CHARACTERIZATION

I suggest that there be a requirement in the Nuclear Waste Policy Act of 1982 that makes it manditory for site characterization work to stop right away if something is found that would disqualify the proposed site. Not after all the Money has been spent.

22. EXTENSION OF COMMENT PERIOD

I request that there be a 90 day extension to the comment period for the Draft Environmental Assessments.

23. COLUMBIA RIVER

It seems inconceivable to me that one would even consider placing a repository in close proximity to such a major river system as the Columbia River. Why was there no guideline that no repository beplaced in proximity to any body of water? Water is the pathway for these radioactive particles to reach the living environment and affect the food chain.

24. REFERENCE LIBRARIES

I was appalled to find that no mention was made in the Draft EA as to reference availability. It was not until March 13, 1985, at the public hearing in Spokane that I picked up the DOE booklet, " Background Information on the Draft Environmental Assessment (Washington, 1985- DOE/RL-85-1). Page 16 of this document gives names and addresses of libraries around the Northwest where references cited in the Draft EA were being made available. Had I not picked up this document, I would not have known this. I presumed the references were only available in reading rooms in Richland, WA and Lacey, WA

24. REFERENCE LIBRARIES- Cont.

which has been the case in the past. I request that in the future library references be given in any DOE document. I also request that this library reference list be put in the Final EA. There is no excuse as to why it was not in the Draft EA.

I also request that a Dept of Energy " Reading Room " be established in Spokane, WA.

25. INDEX

The Draft EA should have had an index. Subjects are difficult to find when one wants to refer to them. An index needs to be included in the Final EA.

26. BETTER ORGANIZATION OF CHAPTERS

The Draft EA is very difficult to read and comprehend thoroughly since one has to spend much time jumping back and forth between chapters to read about the same subject. I suggest that a subject be discussed in detail once, and that all the information about that subject be presented in one chapter. The present organization follows what is requested in the Nuclear Waste Policy Act of 1982, not what is logical and makes sense.

27. WHY PUT THE WASTES UNDERGROUND

The Nuclear Waste Policy Act of 1982 states that a deep underground repository is the choice that has been made. I can see the rationale of wanting to secure these radioactive wastes somewhere away from the human environment. And supposedly deep under the ground in a geologically suited location, one won't have to worry about it 10, 000 years down the line. Even 100, 000 years. But it seems a short sighted decision when one thinks in terms of geologic time. How can one be absolutely sure that the location chosen will remain the same. The earth is constantly changing. It always has and always will.

Another aspect of putting the wastes in one location away from the region where it was generated, is that once that once the spent fuel is gone from the area the people there no longer have to be concerned about it. It is no longer their problem (out of sight out of mind) and those people will probably never hear about the waste again. But the spent fuel is everyones responsibility. And the only way to keep it so is to keep the wastes (I suggest above ground dry cask storage) near where the wastes come from in the first place. Near the site of the nuclear power plants. This way the local people will not forget about the wastes. The spent fuel will be in the news- a concern of the local community, a concern of the utility and its customers. People will drive by it. People will see it. People will have to maintain their responsibility for the waste.

Then maybe one day technology may have advanced so that we can find a way to dispose of the radioactive wastes permanently- possibly neutralize it, or maybe sending the waste to the sun will be feasible.

29. CLOSING

I would like to conclude my comments with the following quote:

" This we know. The earth does not belong to man; man belongs to the earth. This we know. All things are connected like the blood which unites one family. All things are connected.

Whatever befalls the earth befalls the sons of the earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself. "

(from a speech Chief Seattle gave in 1854 to mark the transferral of ancestral Indian lands to the federal government.)

Sincerely,

Amy Mickelson

Amy Mickelson
E. 2810 18th Ave.
Spokane, WA 99203

cc: Governor Booth Gardner
Congressman Tom Foley
Senator Dan Evans
Senator Slade Gorton

Copy to: Nuclear Waste Board

→ Sen. Harold Zoltz

3005 Plymouth Drive
Bellingham, WA 98225
March 4, 1985

Barry Zoltz

Hanford High Level
Nuclear Waste
Reference Repository

Secretary of Energy
Department of Energy
Washington, D.C.

I am writing to comment on the Environmental Assessment of the Reference Repository, Hanford Site, Washington; and to express my concern about the potential movement of nuclear wastes by groundwater to the surface, especially in and about the damaged zones around the access shafts, and thus the lack of adequate long term geological containment of those wastes as mandated by the Nuclear Policy Act of 1982 to protect public health and safety.

I am a geologist who was employed by a major oil company for 37 years in geological and management positions. I have studied and handled the underground containment and movement of fluids--oil, gas, and water--throughout most of the non-communist world, and that includes considerable experience with fractured reservoirs which has a direct bearing on my evaluation of the Environmental Assessment of the fractured basalts at Hanford. I do not work for and have never been employed by a defense contractor, the Department of Energy, the U.S.G.S. or the State of Washington. Thus, I am qualified to speak.

The Hanford Nuclear Waste Repository: A Flawed Start

The Nuclear Policy Act of 1982 declares that the Federal Government has the responsibility of protecting public health and safety (Att. #1). The Department of Energy, which has been assigned the responsibility of protecting the public from high level nuclear wastes, conceeds that long term protection of health and safety is a most important consideration (Att. #2), and further, that the only realistically plausible movement of nuclear wastes from a deep underground repository would be by groundwater.

Yet the Hanford high level nuclear waste repository, if selected, would be in a basalt aquifer through which it is acknowledged that groundwater is flowing, an aquifer being drained by irrigation wells and by the Columbia River. The DOE Environmental Assessment of December 20, 1984, gives Hanford's rank among the reference repositories as last in geohydrology and rock characteristics, and second to last in tectonics (See Att. #3). How is it possible that a site with geological conditions so adverse to public health and safety ever came to have any consideration as a geological repository for nuclear wastes? And how, then, could the Hanford site move up from a low overall rating to become one of the three top reference repositories?

We are speaking of "geological containment" and surely, I feel, no responsible geologist--one who is not a "hired gun"--would make such a recommendation. But where should one turn? For a second opinion, I turned to the governmental body I most respect in geological matters, the United States Geological Survey. I said, "I don't think basalts with fresh water flowing through them are the place to dispose of nuclear wastes."

And Harry Turtellot, Assistant Chief Geologist of the USGS located in Denver said, "I agree with you."

"Did you ever rank theoretical geological sites in accordance with appropriateness for geological containment of nuclear wastes? For example, in what kind of geological conditions is little or no water present; in what kind of rocks is there little or no movement of groundwater; and in what kind of rocks do fractures, if they occur, quickly heal?

And Harry Turtellot replied, "That is not the kind of question that would have been asked of us."

The DOE tells us that selection of a repository site in basalt began on the basis of land use with a recommendation of the Comptroller General of the United States and a House resolution to search for repository sites on Federal lands where radioactive materials were already present (Att. #4). Who did the principal site characterization of the Hanford basalt? Rockwell, the contractor already working there. And after an expenditure of some $300 million, demonstration that Hanford site is safe still has a long, long way to go.

Now the Hanford site has been pushed into one of the three sites recommended for further site characterization by political policy decisions, not by the merit of geological containment of nuclear wastes. When the DOE Site Characterization of 1982 left Hanford near the bottom of the list, the Environmental Assessment of 1984 was published and Hanford was moved up to one of the top three by changing the weighting factors, not by changing the facts.

Further, as the DOE has done significant site characterization in only three kinds of rocks, (only one site in basalt [Hanford], only one site in tuff [Yucca Mountain], and several sites in salt) a policy decision that each of the three sites recommended for further site characterization must be in a different kind of rock automatically insured that Hanford msut be one of the chosen three.

Deep Groundwater Travel Times through Geological Formations

With the geology unfavorable at Hanford, the DOE and others have been trying to salvage Hanford as a nuclear waste repository by calculating the time for groundwater at the repository to reach the accessible environment. The shotgun scatter of calculated times (att. #5) is to be expected considering the inadequacy of hydrological data. Here is a summary from comments by Donald White, Ph.D., of the USGS:

1. The vertical flow of water in faults and fractures is significant but inadequately known.

2. There are irregular and unpredictable changes in hydrological heads. Extensive drilling to map these changes could threaten the integrity of the repository.

3. Where the deep groundwater is discharged is inadequately known.

My comments are several. In my 37 years in the oil business I have dealt with the production of oil and gas from fractured reservoirs in quite a few fields, and I have never known anyone to accurately predict the production from a field or a well from the fractures themselves. Flow rates always were determined from tests of the wells. I believe that calculations of flow rates of groundwater in fractured basalts have a common problem: the fractures are not and will not be sufficiently well known for accurate calculations.

As the repository would have an area of several square miles, we should take seriously Donald White's warning that extensive drilling to map the hydrological details could threaten the repository itself. Oil field experience is replete with examples of fluids from one geological zone moving through channels created by well bores to other geological zones. We must remember that Band-Aid attempts to make a bad situation better not uncommonly only make things worse.

Lack of knowledge about where deep groundwater is discharged is dramatized by the DOE Environmental Assessment of December 20, 1984, itself. Attachment #6 from the E.A. shows a southerly gradient in hydrological head. Attachment #5, also from the same E.A., shows that ~~almost all~~ some the calculations of groundwater travel times~~, including the latest by the DOE,~~ are based on flow to the north. Of course, water does not flow by averages and assumptions; it travels in the finite complex paths glossed over and omitted from the E.A. Surely those omissions do not inspire confidence that the DOE calculations have any sound basis.

Groundwater Travel Times Via Paths Created by Repository Shafts

I consider the greatest threat of the Hanford repository to the health and safety of human beings to be potential leaks of radioactive materials from the repository along the edges of the entry shafts after they have been plugged and the repository is in the post-closure stage. These shafts, 15 feet in diameter and to be among the largest drilled vertical holes in the world, would be drilled through highly fractured basalt (att. #7 and #8). The rocks at the edge of the shafts would be disturbed (att. #9). Moreover, irrespective of the original hydraulic gradient, there will be a hydraulic gradient upward due to thermal effects from the emplaced waste (att. #10 and #11).

Yes, there would be an attempt to seal off upward flow of water by the use of "grout curtains" about the entry shafts by squeezing cement into the rocks (att #9); and yes, this technique has been used in dams. But dams commonly leak and so do similar cement seals in oil field wells.

The damage in the rocks around the entry shafts in the basalt will be more extensive than in rocks around oil field well bores. Oil wells not only have smaller diameters, they are drilled under the pressure of heavy mud that supports the rocks about the holes. The entry shafts to the repository will be very much larger and open to the atmosphere; as a result, there will be "rock bursts" as the original pressures in the rocks are relieved.

In spite of simpler conditions in oil field practice and in spite of a great deal of oil field research, leaks of cement seals are so common that a significant portion of a typical annual oil field budget is earmarked for remedial work. In common oil field practice, radioactive tracers are used to indicate where the cement went; sometimes it goes up, sometimes down, and sometimes outward but not necessarily uniformly. Pressure testing is carried out to find out whether an effective seal has been created, but only time tells how long that seal will last.

The DOE Hanford Environmental Assessment of December 20, 1984, gives 10,000 years as the time of release of radionuclides from the repository seals. And what is that figure based on? Not much, it turns out, other than meeting the guidelines. Witness the 7 qualifiers used in just 2 pages of the E.A.--assumed, suggested, estimated, etc. (att. #11). Need I say more to confirm that the mandate of the Nuclear Policy Act of 1982 to protect public health and safety is not being fulfilled?

<u>Flaws in the DOE Hanford Environmental Assessment of Dec. 20, 1984</u>

1. It is not unbiased; it rationalizes the political decision to place a nuclear waste repository on Federal lands.

2. Omits unfavorable facts.

3. Treats subjects out of context; does not adequately integrate them.

4. Does not meet the minimum guidelines for scientific consideration: Calculations and the basis for conclusions are not adequately explained and are not reproducible by others.

5. Written in legal double negative prose to absolve the DOE and put the burden of proof on the public.

It is said that the DOE had no obligation to issue the E.A. of December 20, 1984, and that has been construed to absolve the DOE of responsibility for flaws. But as surely as the DOE issued the E.A. to influence people, the flaws in the E.A. must be exposed to public opinion and the political process the DOE sought to influence.

Yours truly,

Albert J. Hanners

Albert J. Hanners

ATTACHMENT NO. 1

FROM NUCLEAR POLICY ACT of 1982

Sec. 111.(a)FINDINGS.--The Congress finds that:

(1) radioactive waste creates potential risks and requires safe and environmentally acceptable methods of disposal;

(2) a national problem has been created by the accumulation of (A) spent nuclear fuel from nuclear reactors; and (B) radioactive waste from (i) reprocessing of spent nuclear fuel; (ii) activities related to medical research, diagnosis, and treatment; and (iii) other sources;

(3) Federal efforts during the past 30 years to devise a permanent solution to the problems of civilian radioactive waste disposal have not been adequate;

(4) while the Federal Government has the responsibility to provide for the permanent disposal of high-level radioactive waste and such spent nuclear fuel as may be disposed of in order to protect the public health and safety and the environment, the costs of such disposal should be the responsibility of the generators and owners of such waste and spent fuel;

ATTACHMENT NO. 2

FROM DOE 10CRF PART 960, 1984

The postclosure guidelines govern the siting considerations that deal with the long-term behavior of a repository--that is, its behavior after waste emplacement and repository closure. These are the considerations most important for ensuring the long-term protection of the health and safety of the public.

ATTACHMENT NO. 3

DOE Hanford E.A. of Dec. 20, 1984

Table 7-21. Rankings of sites for each technical guideline in the postclosure set[a]

Geohydrology

1. Davis Canyon, Deaf Smith, Richton
2. Yucca Mountain
3. Hanford

Geochemistry

1. Hanford
2. Davis Canyon, Deaf Smith, Yucca Mountain
3. Richton

Rock characteristics

1. Davis Canyon, Richton
2. Deaf Smith
3. Hanford, Yucca Mountain

Climatic changes

All sites equal[b]

Erosion

All sites equal[b]

Dissolution

1. Hanford, Yucca Mountain
2. Davis Canyon, Deaf Smith
3. Richton

Tectonics

1. Deaf Smith
2. Richton
3. Davis Canyon
4. Hanford
5. Yucca Mountain

Natural resources

1. Yucca Mountain
2. Hanford
3. Davis Canyon, Deaf Smith
4. Richton

Site ownership and control

All sites equal[b]

[a]The listing of more than one site for any particular rank indicates a tie.

[b]All sites are ranked equal if the evidence for a technical guideline is insufficient to discriminate among sites at this time.

Table 7-22. Rankings of sites for each technical guideline in the preclosure set[a]

GROUP 1: RADIOLOGICAL SAFETY

Population density	Site ownership and control	Meteorology	Offsite installations and operations
1. Yucca Mt.	1. Hanford	1. Yucca Mt.	1. Davis Canyon
2. Davis Canyon	2. Deaf Smith, Richton	2. Hanford	2. Richton
3. Hanford, Deaf Smith	3. Yucca Mt.	3. Deaf Smith, Richton	3. Deaf Smith
4. Richton	4. Davis Canyon	4. Davis Canyon	4. Hanford
			5. Yucca Mt.

GROUP 2: ENVIRONMENT, SOCIOECONOMICS, AND TRANSPORTATION

Environmental quality	Socioeconomic impacts	Transportation
1. Hanford, Yucca Mt.	1. Hanford	1. Deaf Smith, Richton
2. Deaf Smith	2. Yucca Mt.	2. Yucca Mt., Hanford
3. Richton	3. Richton	3. Davis Canyon
4. Davis Canyon	4. Deaf Smith	
	5. Davis Canyon	

GROUP 3: EASE AND COST OF SITING, CONSTRUCTION, OPERATION, AND CLOSURE

Surface characteristics	Rock characteristics	Hydrology	Tectonics
1. Deaf Smith, Hanford, Yucca Mt.	1. Yucca Mt.	1. Yucca Mt.	1. Deaf Smith, Richton
2. Richton	2. Davis Canyon, Richton	2. Davis Canyon, Deaf Smith, Hanford, Richton	2. Davis Canyon
3. Davis Canyon	3. Deaf Smith		3. Hanford
	4. Hanford		4. Yucca Mt.

[a]The listing of more than one site for any particular rank indicates a tie.

ATTACHMENT NO. 4

FROM "DOE 10CRF PART 960," 1984

The selection of sites in basalt and tuff began on the basis of land use: the DOE began to search for suitable repository sites on some Federal lands where radioactive materials were already present; this approach was recommended by the Comptroller General of the United States (9) and a House resolution (10). Although land use was the beginning basis for this screening of Federal lands, the subsequent progression to smaller land units was based primarily on evaluations of geologic and hydrologic suitability.

ATTACHMENT NO. 5

DOE Hanford E.A. of Dec. 20, 1984

Table 6-3. Summary of ground-water travel time estimates from previous modeling studies.

Study	Purpose of study	Ground-water travel-time distance and (or) direction	Ground-water travel time
Los Alamos Technical Associates, Inc., and Intera Environmental Consultants, Inc. (LATA, 1981)	Initial estimates of ground-water movement from hypothetical repository	Northward, 12 km (7.5 mi) to the Columbia River	33,000 yr
Pacific Northwest Laboratory (Dove et al., 1981)	Demonstration of numerical modeling capability	Northward, 12 to 16 km (7.5 to 10 mi) to the Columbia River	13,000 to 17,000 yr
Rockwell Hanford Operations (Arnett et al., 1981)	Estimate ground-water travel times from reference repository location	Southeast, 32 km (20 mi) to beneath the Columbia River	30,000 yr
U.S. Nuclear Regulatory Commission (NRC, 1983c)	Sensitivity of ground-water travel times to variation of model inputs	10 km (6.2 mi) from hypothetical repository	20 to greater than 40,000 yr
Rockwell Hanford Operations (Clifton et al., 1983)	Probabilistic estimation of ground-water travel times	10 km (6.2 mi) within flow top of host rock	Median ground-water travel time of 17,000 yr (see Subsection 6.4.2.3.5)
Rockwell Hanford Operations (Arnett and Sagar, 1984)	Evaluation of deterministic approaches for ground-water travel time calculations using a preliminary measured effective thickness value	10 km (6.2 mi) within flow top of host rock	3,600 yr
Section 6.4.2 of this environmental assessment (Clifton et al., 1984b)	Probabilistic estimation of ground-water travel times	10 km (6.2 mi) within flow top of host rock	Median ground-water travel time of 81,000 yr (see Subsection 6.4.2.3.5)

ATTACHMENT NO. 6

DOE Hanford E.A. of Dec. 20, 1984

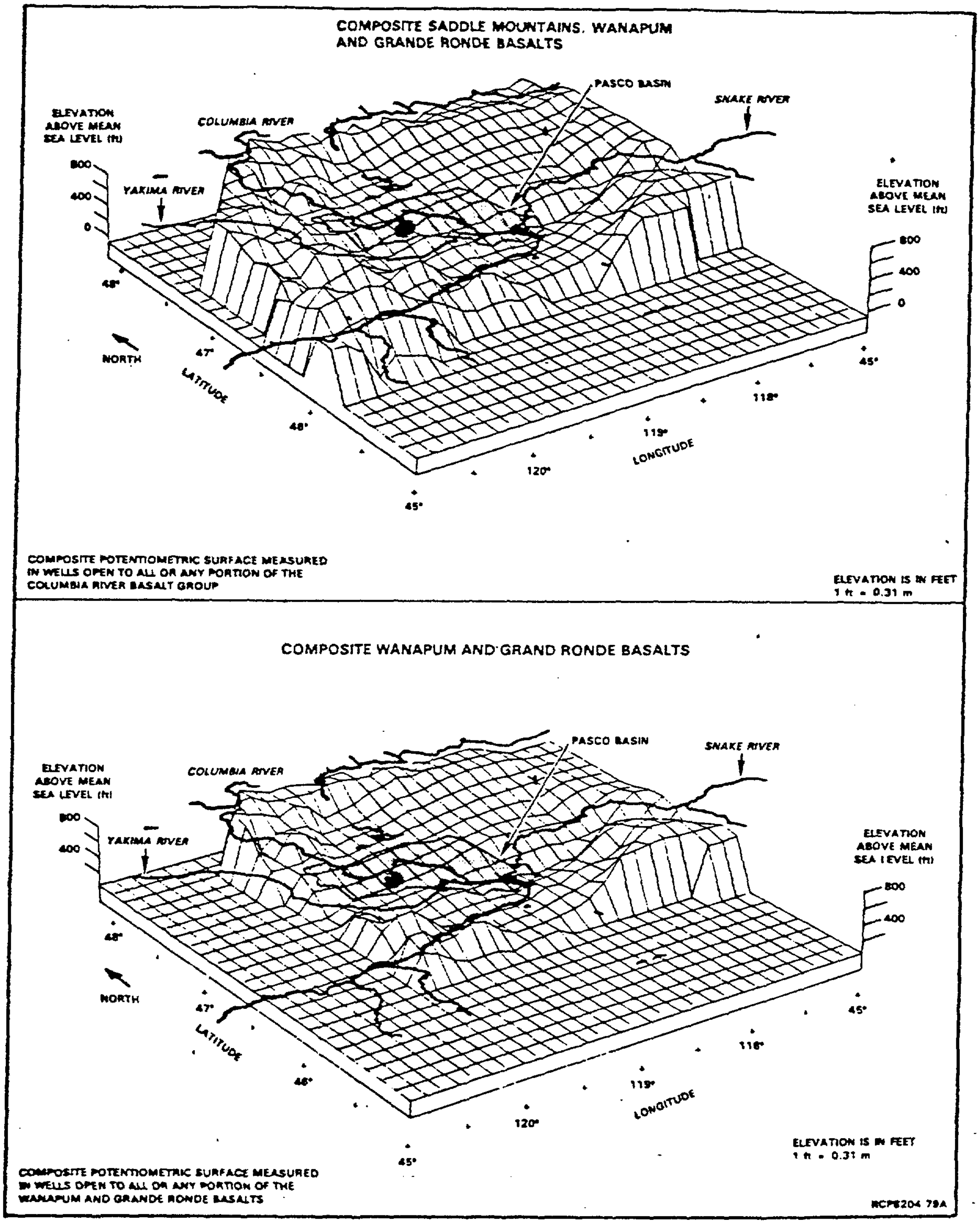

Figure 2-16. Three-dimensional perspective views showing the regional potentiometric surfaces for various strata within the Columbia River Basalt Group.

ATTACHMENT NO. 7

BASALT IN THE HANFORD VICINITY

Photo not included

ATTACHMENT NO. 8

DOE Hanford E.A. of Dec. 20, 1984

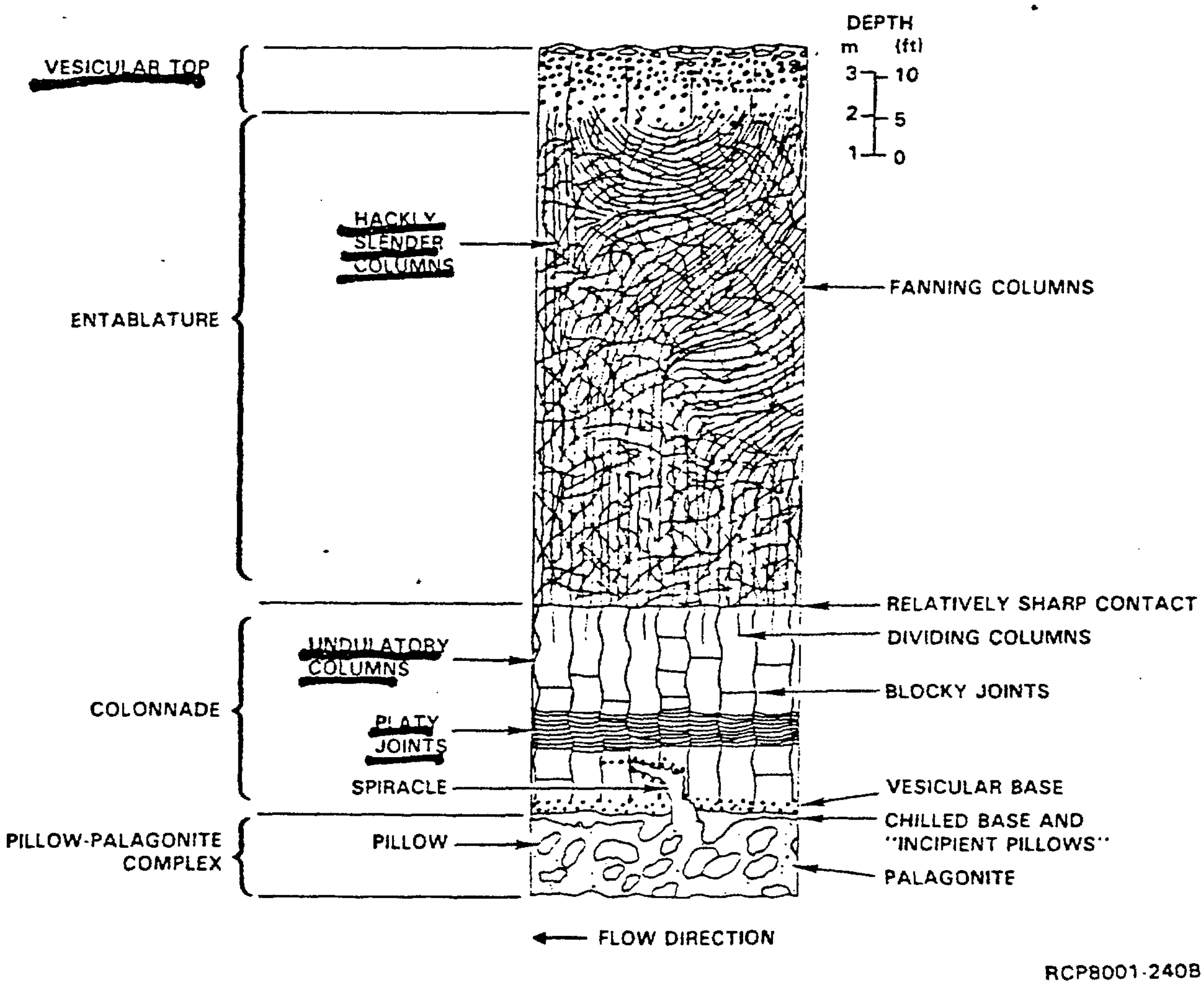

Figure 2-3. Cross section of a typical flow in the Columbia River Basalt Group illustrating, in idealized form, jointing patterns and other structures (from Swanson and Wright, 1976).

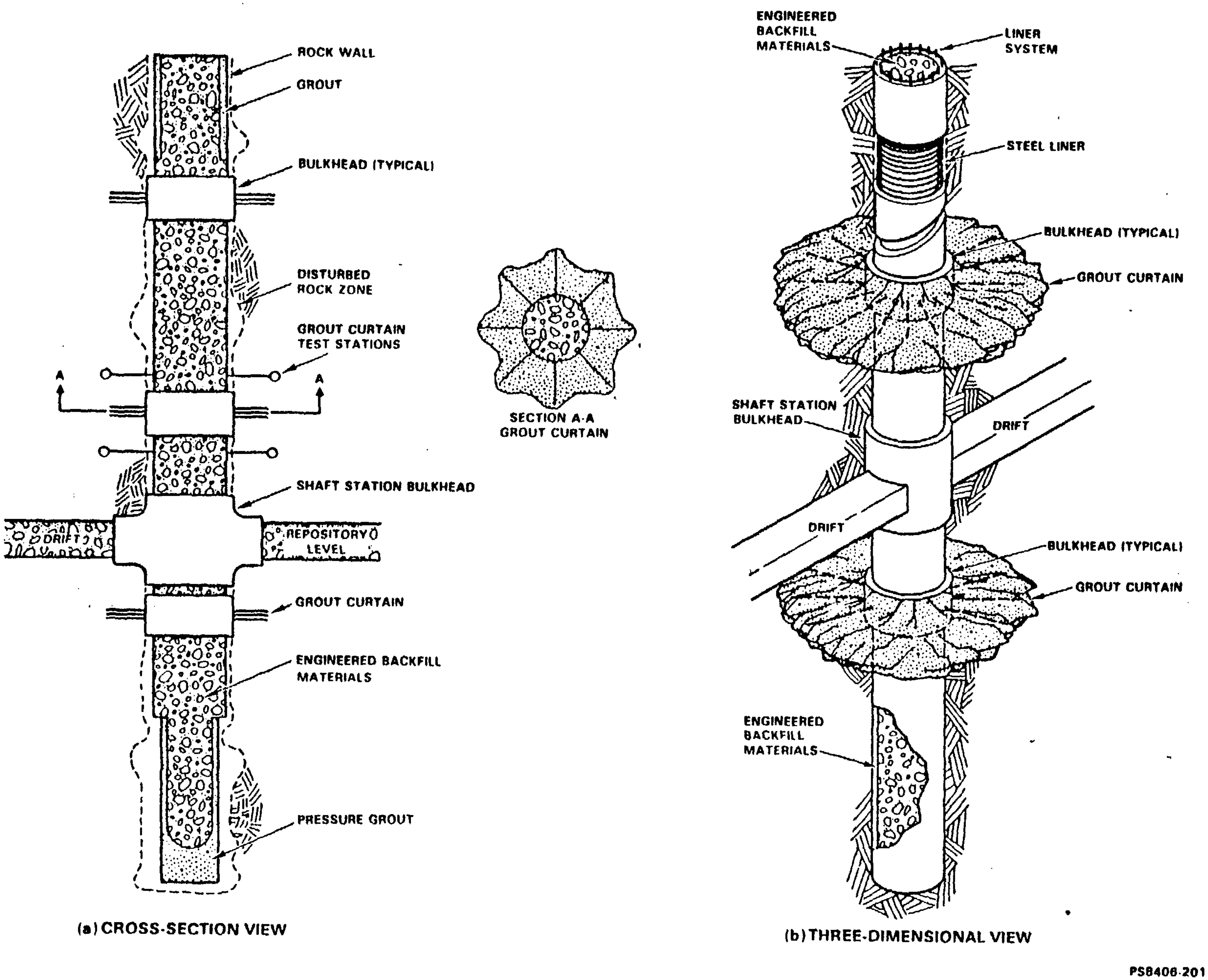

Figure 6-4. Conceptualized shaft seal design: (a) cross-section view; (b) three-dimensional view.

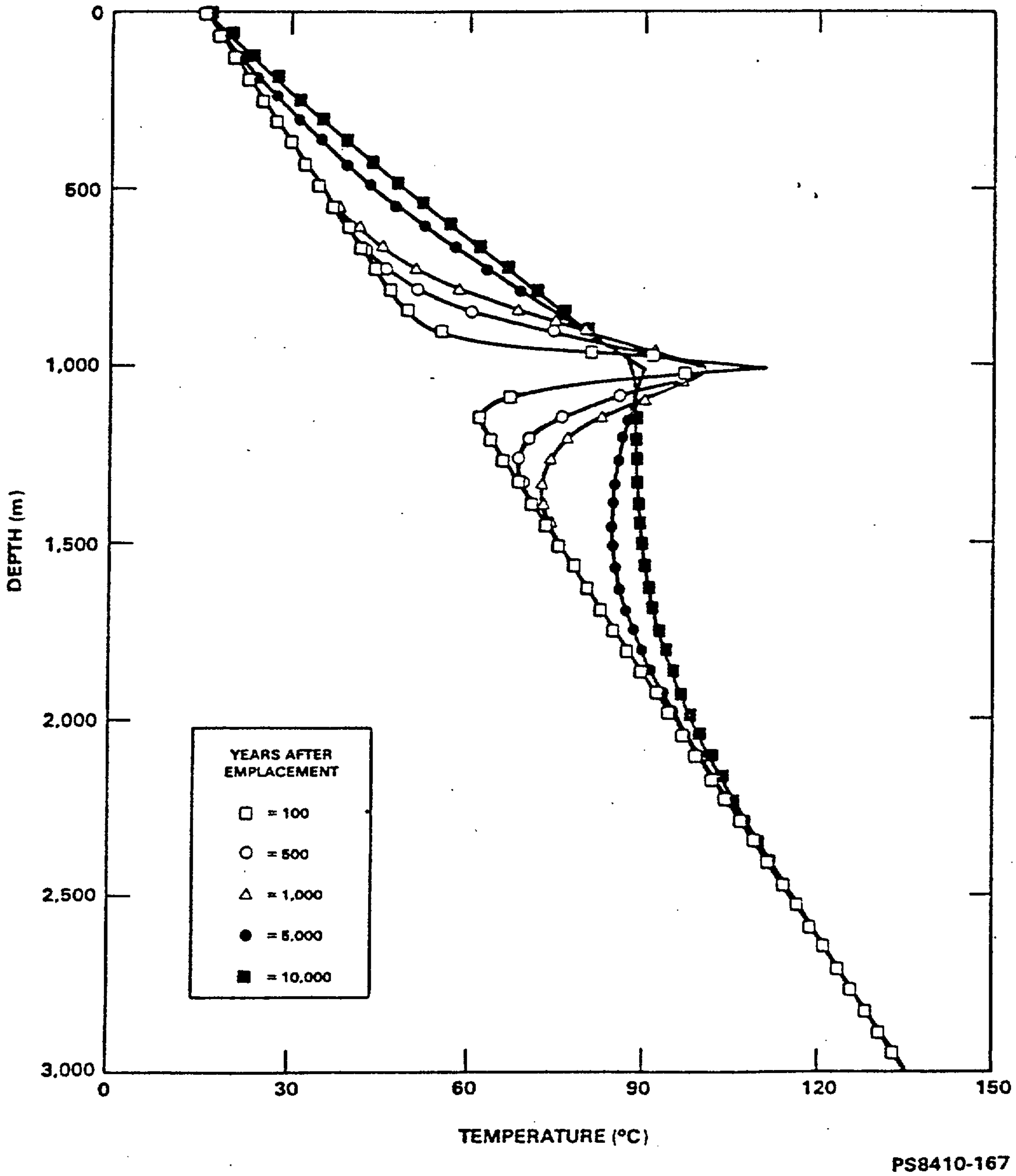

Figure 6-5. Temperature profile for a repository in basalt with areal thermal loading density of 8.2 watts per cubic meter (taken from St. John et al., 1981, p. I-102).

ATTACHMENT NO. 11

DOE Hanford E.A. of Dec. 20, 1984

The calculation of radionuclide release from the repository seals subsystem is based on a conceptual model. Release from the repository seals subsystem was calculated at an arbitrary boundary located at the intersection of the vertical access shafts with the Vantage interbed at the top of the Grande Ronde Basalt, a distance of approximately 133 meters (436 feet) above the emplaced waste. This analysis conservatively assumes that 10 percent of the contaminated ground-water flow is through the repository seals subsystem pathway, and 90 percent through the site subsystem. A three-dimensional analysis of flow pathways for a repository in the basalt (Golder, 1983a) estimated that only approximately 0.1 to 2.0 percent of the vertical ground-water flow entering the repository area would move laterally and enter the vertical shafts at the repository level. Approximately 0.2 to 6.5 percent of the ground water would flow across the repository area and could traverse the emplacement horizon and then enter the vertical shafts by indirect pathways (Golder, 1983a). Similar three-dimensional ground-water flow simulations (Cottam, 1983) have also suggested that less than 1 percent of the total ground-water flow through the repository is likely to enter the repository seals subsystem pathway. Since these calculations were based on limited data on rock characteristics, the more conservative value of 10 percent was used for purposes of predicting the contribution of the repository seals to cumulative radionuclide release at the accessible environment.

Radionuclide migration along the repository seals subsystem pathway is assumed to be through the damaged annulus of rock around each opening, rather than through the backfill material placed in the openings at permanent closure. This assumption is believed reasonable because, for the relative ranges of hydraulic properties (hydraulic conductivity and effective porosity) expected for the damaged rock and backfill, ground-water velocity will be greater through the damaged rock zone than through the backfill. The calculation of ground-water travel times through the repository seals subsystem was based on Darcy's law, which relates ground-water velocity to effective porosity, hydraulic conductivity, and hydraulic gradient. The hydraulic gradient near the repository is in a vertical direction, due to thermal effects from the emplaced waste. Thus, the magnitude of the hydraulic gradient will decrease with time, approaching the natural hydraulic gradient after long time periods. Therefore, the radionuclide release rate and ground-water velocity through the shaft are also time-dependent, and were modeled as such.

Radionuclide release at the intersection of the vertical shafts with the Vantage interbed, that is attributable to radionuclide migration through the repository seals subsystem, was calculated using the probabilistic computer code REPSTAT (Sonnichsen, 1984). In this analysis, the cumulative release output from the waste package subsystem analysis (see Fig. 6-18) is used as input to the repository seals subsystem analysis. The magnitude of the radionuclide release rates predicted by the CHAINT-MC (Baca et al., 1984b) computer code, as well as the parameters affecting radionuclide travel time, were treated as random rather than discrete variables. Probability distributions were then assigned to these variables to represent uncertainty. A Monte Carlo sampling technique was then used to select values from the distributions as inputs to mathematical models for calculation of release and transport of radionuclides. The output of these computer simulations is a cumulative probability curve for total radionuclide release at the Vantage interbed, which is constructed from the spectrum of predicted releases.

The probability curves for the mean release rate (see Fig. 6-18) generated by the CHAINT-MC computer code were approximated by mathematical functions in REPSTAT (a cubic function for the portion of the curve depicting releases prior to the time of peak release, and an exponentially decaying function for the portion of the curve depicting releases after peak release). The magnitude of these curves is proportional to the mean radionuclide solubilities for the uniform probability distributions indicated in Table 6-27. Therefore, the magnitudes of the fractional release rates were varied for each Monte Carlo sampling trial in REPSTAT according to the ratios of the radionuclide solubilities sampled from the uniform probability distributions (see Table 6-27) to the mean radionuclide solubility values corresponding to the release rate curves in Figure 6-18.

Radionuclide travel time is calculated for average path lengths to the designated release boundary (Vantage interbed) from each of ten panels that collectively represent one quadrant of the repository. In this analysis, radionuclide retardation is conservatively assumed to be unity for all radionuclides (i.e., radionuclide travel time is equal to ground-water travel time). The cumulative radionuclide release at the Vantage interbed during 10,000 years is calculated for each panel, and then summed for all ten panels to yield the cumulative release during 10,000 years for one quadrant of the repository. The cumulative release for the repository is then conservatively assumed equal to four times the release for one quadrant. This approach is conservative because, for likely hydraulic gradient vectors, only one quadrant can be expected to contribute to transport of radionuclides towards the vertical shafts. This calculation is repeated for parameters governing release rates and with radionuclide transport rates randomly sampled from the probability distributions of parameter values (Tables 6-27 and 6-31), for 1,000 Monte Carlo trials.

Data set for repository seals subsystem. The data used in this preliminary performance assessment of the repository seals subsystem are given in Table 6-31. Cumulative probability curves for cumulative radionuclide release were generated for median hydraulic conductivities of 10^{-10}, 10^{-9}, 10^{-8}, 10^{-7}, and 10^{-6} meter per second (approximately 10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}, and 10^{-1} feet per day) in the damaged rock zone (see Subsection 3.3.2.1) (Cottam, 1983).

Results. The probabilities for cumulative radionuclide release from the repository seals subsystem are shown in Figure 6-20. The vertical axis of the graph is the probability that the cumulative release of all radionuclides at the subsystem boundary (during 10,000 years) is less than or equal to the value on the horizontal axis (expressed as fractions of the U.S. Environmental Protection Agency limit).

5401 35th Avenue, S.W.
Seattle, Washington
98126

May 6, 1985

U.S. Department of Energy,
1000 Independence Avenue, S.W.,
Washington, D.C. 20585

Dear Sirs:

I am an environmentalist.

I am concerned to the point of being uneasy about things I know are going on. We have enough problems here in Washington to cope with, without being asked to take all the radio active waste, from all the states, for all time to come. We have bottom fish that have developed cancerous tumors from the commercial wastes that are dumped into the Duwammish River. We have salmon spawaning streams that are filling up with silt and debris washing down from the mountains where trees have been cut down, and now to have all the radioactive waste of the whole United States dumped in our ground at Hanford, is something we don't want to take on. It will have to go somewhere, but I don't believe any other State is going to welcome it either.

I lived for seven years in England at a place called Sherwood Farm, but the old Sherwood Forest is no more. Completely cut down. I believe the parts of Africa that are starving once had many trees, and Spain, once had forests, and now is so hot only grapes and olives grow there. This is surely a more fragile planet than people used to think, and it seems to me if we keep pushing more and more abuse on it, we may reach the point of no return in the very near future.

In the 50's, I think it was, Denver had many small earth quakes, one after the other. A geologist had a theory that at Rocky Flats north of Denver, the waste water they were pouring down deep drilled holes was lubricating the rock layers and causing them to slip. When they stopped that practice, the earthquakes stopped, I believe. It isn't possible , I'm sure , for anyone to know exactly what is going on deep underground, perhaps to our eternal detriment.

April 11 th I sent a letter to our Governor Gardner, and to Senator Gorton, and Senator Evans, and to Representative Mike Lowry, stating my feeling that a safe, stable, and certainly available place to store our country's radio active stuff would be in caves or cupboards blasted outof the granite of the Rocky Mountains. I feel this way because I know it could be done, (examples: Norad command center in Cheyenne Mountain near Colorado Springs, and the Eisenhower Tunnel under Loveland Pass west of Denver,) and granite must be one of the most dense materials on earth, so there couldn't be much shifting or percolating. And there surely is an abundance of sheer mountains so isolated they can't be used for anything else.

I feel this idea has some little bit of merit. Thank you for listening.

Respectfully yours,

K Smith

Ms. Connie Copeland
2235 Franklin
Bellingham, WA 98225

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May 3, 1985

High-Level Neuclear Waste Management Office
Department of Ecology
Mail Stop PV-11
Olympia, Washington 98504

Dear Sirs:

Thank you for your request for comments on the use of the Hanford site as a repository for high-level nuclear wastes.

I strongly oppose the use of the Hanford site as a repository and support all efforts made by the state to prevent Washington from becoming a "dumping-ground."

Thank you Governor Gardner -- and the staff of the High-Level Nuclear Waste Management Office. Your efforts are critical to the future of Washington.

Sincerely,

Connie Copeland

Connie Copeland

CC/sm