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April 30, 1985

MEMORANDUM

FROM: Dean R. Tousley
ASSOCIATE ATTORNEY FOR THE
YAKIMA INDIAN NATION

TO: Recipients of YIN Comments on Draft Hanford EA

RE: Errata #2

The enclosed replacement pages correct typographical errors in the "Comments of the Yakima Indian Nation on the Draft Environmental Assessment for the Hanford Site, Washington under the Nuclear Waste Policy Act," dated March 20, 1985. Please duplicate these replacement pages for each copy of the YIN comments you have and use them to replace the same-numbered pages in the orginally-submitted comments.

All of these pages except the last one (Table 5) belong in Volume 1 of the YIN Comments. Table 5 replaces the table on page E-9 of Appendix E, in Volume 2. (Only the title of the second column is changed.)

Enclosures

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CHAPTER 3

Introduction

Many matters discussed in Chapter 3 of the Draft EA are also discussed in other chapters, most notably Chapters 6 and 7. Because of insufficient time and resources, many Yakima Indian Nation concerns which pertain to Chapter 3 are commented upon not here, but rather in our comments on Chapters 6 and 7.

YIN Comment #: 3-1

EA Section: 3.3.1.3.3 Flood potential

Page 3-65, paragraph 1

Statement of Issue: Using 50% breach of Grand Coulee Dam as probable maximum flood is not realistic.

Discussion: Basing the maximum flood potential of the area on a partial dam failure appears unrealistic. A complete failure scenario should be studied.

Recommendation: Show an analysis of a 100% failure of Grand Coulee Dam.

YIN Comment #: 3-2

EA Sections: 3.3.2.2 Alternative groundwater flow concepts
6.4.2.3.5 Site subsystem performance

Pages 3-91, 6-77 par. 3, 6-264, 6-265 par. 3

Statement of Issue: The choice of Alternative Flow Concept B is premature and provides longer travel times than Concepts C and D in light of EPA's definition of accessible environment.

Discussion: The calculated groundwater travel time estimates presented in the EA are based on the assumption that groundwater flow away from the repository is confined to the adjacent flow top. In this assumption, travel times are based on a distance to the accessible environment of 10 kilometers. However, vertical flow needs to be taken into account, as demonstrated by the available data, especially in light of EPA's definition of the accessible environment. As shown on page 6-264 of the EA, the accessible environment may be as close as approximately 2 kilometers, or 5 times less than is now being assumed.

A large megaton ground burst in the 200 areas (the Reference Repository location) could also be expected to damage physically the engineered waste repository facility and possibly change the hydrology of the overlying formations. The spread of plutonium, strontium, and cesium around the area would make further use, including corrective actions, impossible for an indefinite period into the future.

It is also noteworthy that the repository itself would become an attractive ground burst target, since the spread of radioactivity at the repository could render the weapons program facilities useless indefinitely.

Finally, it should be noted that the U.S. and, presumably, the Soviet Union have contingency plans for fighting limited and protracted nuclear wars. It is reasonable to assume that Hanford could be an attractive target under such circumstances. It is U.S. policy to limit the damage to the homeland in the event of a nuclear war. Construction of a repository at the 200 area at Hanford is incompatible with such a policy.

Also, according to the FY 1984-88 Defense Guidance, U.S. strategic doctrine asserts that, "[s]hould deterrence fail and strategic nuclear war with the U.S.S.R. occur, the United States must prevail and be able to force the Soviet Union to seek earliest termination of hostilities on terms favorable to the United States." (New York Times, May 30, 1982). Thus, it would be inappropriate to conclude that targeting Hanford facilities need not be considered in siting a waste repository because the U.S. and its inhabitants would not survive any nuclear exchange with the Soviet Union.

DOE has virtually conceded, by virtue of the screening guidelines (p. 6-20) purportedly intended to exclude sites subject to the effects of man-made hazards -- specifically encompassing "attractive military targets" -- that the Hanford site is unsuitable. If the guideline has any meaning at all, Hanford is the one site that should have been excluded.

In addition, while DOE concedes that "design basis accidents at nearby facilities could result in temporary disruption of repository operations or closure" (p. 6-23), it provides virtually no discussion of the nature of the accidents in question, the nature or degree of disruption that would ensue, the probability of such accidents nor what scenarios could cause repository closure. DOE asserts that the probability of such accidents is low (p. 6-23), 7-68-71) without providing any analysis whatever to establish how low it is. It is DOE's obligation to provide all of this information in order that the suitability of this site and its comparison with the other sites under consideration can be addressed in a rational manner.

YIN Comment #: 6-10

EA Section: 6.2.1.8.9 Transportation--Favorable Condition (7) Absence of Legal Impediments

Page 6-51

Statement of Issue: The DEA incorrectly takes credit for the absence of legal impediments to nuclear waste transportation for the Hanford Site, ignoring a Yakima Indian Nation ban on such transportation within the Yakima Indian Reservation.

Discussion: Transportation favorable condition (7) is "absence of legal impediment with regard to compliance with Federal regulations for the transportation of waste in or through the affected State and adjoining States". The DEA concludes: "Since no legal impediments with regard to waste transportation now exist within the State of Washington or adjoining states, this favorable condition is present for the [RRL]."

This conclusion is incorrect. Since June of 1979 the Yakima Indian Nation has had a complete ban on transportation of radioactive substances across its Reservation. *See* Yakima Tribal Council Resolution T-72-79, attached in Appendix G. Since there clearly is a legal impediment to waste transportation within the State of Washington, this favorable condition is not present. This oversight is especially egregious because the Hanford Site alone among the five candidates for nomination is given credit for this favorable condition. The other four sites are all denied credit for this condition on the basis of various enacted local transportation restrictions or bans--sometimes in cities in adjoining states--that are clearly no more valid than the YIN ban. There is no basis for the Hanford site to be singled out for favor with respect to this condition.

Recommendation: The Final EA should acknowledge that this favorable condition is "not present" at the Hanford Site.

YIN Comment #: 6-11

EA Section: 6.2.1.8.10 Transportation--Favorable Condition (8) Emergency Response Procedures

Page 6-52

Statement of Issue: The discussion of transportation accident response procedures ignores the implications of Yakima Indian Nation sovereignty and Reserved Treaty Rights, as well as YIN resolution not to cooperate in radiological emergency response plans which might involve evacuation.

YIN Comment #: 6-16A [NOTE: PREVIOUSLY, BOTH THIS COMMENT AND THE PRECEDING ONE WERE NUMBERED 6-16.]

EA Sections: 6.3.1.1.3 Geohydrology - favorable condition
6.3.1.1.11 Geohydrology - disqualifying condition
6.4.2.3.5 Site subsystem performance

Pages: 6-63 paragraph 2
6-81 paragraphs 2,4
6-267 paragraph 4

Statement of Issue: All of the factors that contribute to uncertainty in groundwater travel time estimates have not been considered.

Discussion: The Draft Environmental Assessment (EA) considers travel time analysis via the use of numerical simulation techniques. The EA states that "these numerical simulations represent the primary tools for predicting ground-water travel times". It follows then that the uncertainties of the predictions made by the simulators need to be quantified to be able to assess the site with some degree of confidence.

On page 6-261 the EA states that "The amount of uncertainty in a predicted travel time depends on how well the spatial variability of the hydraulic parameters and hydraulic gradients are known ...." This statement suggests that all of the uncertainty is associated with the data and that if the variability of the data base can be quantified, then the uncertainty of travel time estimates can be quantified. However, there are several other ways in which uncertainty is introduced into the prediction of groundwater travel times. The following discussion will examine these errors and discuss how they add uncertainty to the travel time estimates.

I. Numerical Error

Conventional finite element and finite difference techniques are subject to errors that are inherent in application of the numerical procedure, for example, roundoff error. In the preliminary uncertainty analyses of pre-waste-emplacement travel times of Clifton et al. (1984), a conventional finite element technique (Baca, et al., 1983) is used to solve the flow equation. A flow top with a domain of 10 km by 20 km is discretized into 200 1 km square elements. Using Monte Carlo analysis, the input parameters are treated as random variables which accounts for uncertainty in the input data.

When applying finite element techniques to real-world situations, numerical accuracy can be lost if not properly used. In the study by Clifton et al. (1984) an unquantified amount of numerical error is introduced by allowing the transmissivity

IV. Data Error/Spatial Variability

In the study of Clifton et al. (1984) the input parameters, transmissivity, hydraulic gradient, and effective thickness are treated as random variables. Transmissivity is assigned a log-normal probability distribution. However, hydraulic gradient and effective thickness are assigned uniform probability distributions. This means, for example, that for the regional gradient, any value between 10^{-4} and 10^{-3} has an equal probability of occurence. The problem here is that values outside of this range have a zero probability of occurance, which infers that the hydraulic gradient is explicitly known within the prescribed limits. Given this distribution for Case 2 (Clifton et al., 1984) a travel time of 86,000 years was determined. The gradient in Case 1 was set at 10^{-3}. Since the travel time varies directly with the hydraulic gradient, allowing the gradient to vary uniformly between the prescribed limits means that the calculated median travel time for Case 2 should be approximately 5 times that of Case 1 (since the median gradient is 5×10^{-3}). This result is seen when travel time increases from 17,000 years to 86,000 years from Case 1 to Case 2. This problem carries over into Case 3 when all three parameters are allowed to vary.

Great care must be exercised in assigning realistic and appropriate distribution functions to the input parameters. The travel time estimates are extremely sensitive to these parameters and improper input assignments will make the estimates meaningless.

V. Tortuosity/Travel Time

The travel time estimates of Clifton et al. (1984) are unrealistically high due to the use of tortuous pathlines in conjunction with the continuum approach. For each simulation, using random input parameters, a random hydraulic head field was calculated. Individual pathlines in each field do not follow straight lines but instead follow winding, tortuous paths. To calculate a travel time, one such pathline was traced until its linear distance from the starting point was 10 kilometers. The actual distance traveled was always greater than 10 kilometers, however. This causes the travel times to be much greater than if the calculation was based on a straight line distance. For example, in Case 3 a travel time of 81,000 years was calculated. The mean transmissivity was 0.153 square meters per day, the mean hydraulic gradient was 5.0×10^{-4}, and the mean effective thickness was 10^{-2} meters. Using these values and a straight pathline, a travel time of 3581 years is calculated. Clearly, Clifton et al. (1984) are overestimating the travel times. The use of tortuous pathlines must be justified.

<u>Recommendation:</u> Because groundwater travel time is a potential disqualifying factor in the DOE guidelines, all sources of error

YIN Comment #: 6-21

EA Section: 6.3.1.1.11.1

Pages 6-74, paragraphs 1 and 8
6-79, paragraph 1
6-80, paragraph 4

Statement of Issue: There is evidence indicating that the Hanford site may not qualify, based on short ground water travel times to the accessible environment.

Discussion: The stochastic ground water travel time analyses upon which rejection of the disqualifying condition is based (see EA pages 6-266 through 6-269) consider the likely pathway to be horizontal through the Cohasset flow top. In contradiction, the head data in well DC-20 (Hydrology Workshop, Silver Spring, Maryland, December 12, 1984) show evidence of a strong interconnection between the Cohasset and Rocky Coulee flow tops. Neutron logs and TV cameras indicate that the interconnection may be a function of the degree to which the Rocky Coulee flow interior is incompetent at this location. RHO stated at the December, 1984 workshop that they believed the interconnections to be due to rock character rather than poor packer seals. Of the total six flow interiors spanned by DC19, DC20, and DC22, one strong interconnection between flow tops exists. Although this does not constitute a legitimate sampling population from which any probabilistic judgments could be made, it does demonstrate the real possibility that a vertical pathway may provide the most direct access to the accessible environment.

Importance to EA Findings/Conclusions -- As stated in the EA on page 6-79, paragraph 2, to date, a conclusion on this qualifying condition is not possible. However, the comments implying the high probability of the site qualifying are without basis.

Recommendation: The vertical connection possibilities in the system, as well as the complex heterogeneities in the flow tops, must be assessed. The necessary extent of a valid sampling population to define the system and whether the sampling needed to reasonably define the system falls within the realm of practicality deserves further consideration. Delete the conclusion that there is a high probability of the site qualifying.

YIN Comment #: 6-22

EA Section: 6.3.1.1.8 Geohydrology, potentially adverse condition (1)

Page 6-76, paragraph 3

Statement of Issue: Thermal loading originating from the decay of nuclear waste will change the geohydrologic conditions surrounding the repository by increasing vertical groundwater flux.

Discussion:: Problem and Basis - The thermal loading from the decay of nuclear waste will increase groundwater temperatures in an area extending "several hundred meters" from the repository. As seen in Figure 6-5 on page 6-108 of the EA, the thermal loading at distances about 100 to 700 meters above and below the repository will increase with time (St. John et al., 1981, p. I-102).

The potential for thermal convection can be evaluated by calculating the thermal Rayleigh number (R) and comparing it with the established criteria for monotonic instability and the onset of convection in a porous medium. The thermal Rayleigh number is a dimensionless parameter that is calculated with the following equation:

$$(pi)2R = \frac{(alpha)\ B\ g\ k\ d^2}{(kappa)\ (nu)} \qquad (1)$$

where (alpha) is the thermal expansion coefficient of the water, B is the thermal gradient imposed by the heat generated by the decay of radioactive waste in the repository, g is the gravitational acceleration constant, k is the vertical permeability of the porous medium, d is the thickness of the porous medium, (kappa) is the thermal diffusivity of the water, and (nu) is the kinematic viscosity of the water. Substituting for k and (nu) with

$$k = \frac{K\ (mu)}{(rho)\ g} \quad \text{and} \quad (nu) = \frac{(mu)}{g} \qquad (2) \text{ and } (3)$$

where K is the hydraulic conductivity, (mu) is the dynamic viscosity of the water, and (rho) is the mass density of the water, equation (1) is reduced to

$$R = \frac{(alpha)\ B\ K\ d^2}{pi^2\ (kappa)} \qquad (4)$$

YIN Comment #: 6-24

EA Section: 6.3.1.1.11

Page 6-79, paragraph 1

Statement of Issue: The Hanford site should be disqualified on the basis that pre-waste-emplacement ground water travel times are reasonably likely to be less than 1000 years.

Discussion: Clifton (1984) describes the sensitivities of the results of travel time uncertainties to the correlation range. As noted on page 56 of Clifton (1984), the uncertainty increases as the correlation factor increases. What is not made clear in the EA is the fact that when the correlation range varies from 0-10 km, the median travel time increases as the correlation range increases. Varying the correlation range between the possible values of 0 to 10 km gives travel times from 7,150 to 30,000 years. A correlation range of 5 results in the 21,500 year median travel time presented in Clifton et al, 1984.

Since there is absolutely no basis for the choice of 5 km as the correlation range, the travel time estimates are biased by this choice of an arbritrary correlation range and may be overestimated by a factor of 2 to 3. Adjusting the travel time studies presented in the EA to account for a factor of three overestimation would reduce the median travel times for the three studies from 17,000, 81,000, and 86,000 years to 5,667, 27,000, and 28,667 years respectively. If this overestimation is considered in conjunction with the factor of 23 overestimation of effective porosity (see comment 6-27) it is fair to conclude that the three studies should have given median travel time results of 246, 1174, and 1246 years respectively. From this it can be stated that the site may be disqualified on the basis of a less then 1000 year travel time to the accessible enviroment.

Importance to EA findings--The EA findings are likely to be overestimating ground water travel times to the accesible environment by 20 to 30 times, which profoundly affects site rankings and strongly suggests that the site should be disqualified.

Recommendation: Disqualify the site on the grounds that the pre-waste-emplacement ground water travel times are reasonably likely to be less than 1000 years.

References:

Clifton, P.M., 1984. Groundwater Travel Time Uncertainty Analysis--Sensitivity of Results to Model Geometry, and Correlations and Cross Correlations Among Input Parameters, SD-BW-TI-256, Rockwell Hanford Operations, Richland, Washington.

Clifton, P.M., R.C. Arnett, and N.W. Kline, 1984. Preliminary Uncertainty Analysis of Pre-Waste-Emplacement Groundwater Travel Times for a Proposed Repository in Basalt, SD-BWI-TA-013, Rockwell Hanford Operations, Richland, Washington.

YIN Comment #: 6-25

EA Section: 6.3.1.1.11

Page 6-80, paragraph 4

Statement of Issue: The quote stating that ". . . in all probability, the Hanford site will demonstrate a pre-emplacement ground water travel time in excess of 1,000 years when fully characterized," is not supported by the data available for interpretation.

Discussion: The stochastic travel time analyses may be overestimating travel times by an order of magnitude or more for the following reasons:

1) the range of effective porosities for stochastic studies (EA pages 6-267 through 6-269 and Clifton, 1984) reflects the biases of RHO hydrologists;

2) the analysts charged with the task of evaluating independent hydrologists are including their own biases in the study;

3) consideration is given to series of lab test data which does not accurately reflect the flow structure at the megascale.

This overestimation implies that the stochastic analyses (pages 6-267 through 6-269) should have given mean values of between 740 years to 3740 years or less. The analysis would be performed using a median effective thickness based on a field derived effective porosity of a range of 1.6×10^{-4} to 2.7×10^{-4}, and an average flow top thickness of 8 m. A realistic variance should show a substantial probability of a pathway existing that does not satisfy to the 1000 year travel time condition.

Importance to EA Findings - The ground water travel time is a potential disqualifying factor if travel time from the disturbed zone to the accessible environment is less than 1,000 years.

Relevance to Regulations - The possibility of further characterization showing that travel times could be less than 1,000 years is not unlikely (960.4-2-1,d).

YIN Comment #: 6-26

DELETE--THIS COMMENT DUPLICATES COMMENT # 6-21.

YIN Comment #: 6-27

EA Section: 6.3.1.1.11 Geohydrology - disqualifying condition

Page 6-81 paragraphs 2,4

Statement of Issue: Reported travel time estimates are much lower than reported when effective thickness values measured in the field are used.

Discussion: In the travel time estimates of Clifton et al. (1983) and Clifton et al. (1984) three input parameters are used to calculate groundwater velocities to determine travel times. As discussed in these reports and in the EA the data base for these parameters is small.

In the study of Clifton et al. (1984) effective thickness is taken from the study of Loo et al. (1984). Loo et al. (1984) conducted a literature review and reported a range of effective porosity values for a typical basalt flow top of 10^{-4} to 10^{-2}. The validity of this range of values is questionable with respect to the Hanford site since it considered values from many different formations. However, two tracer tests have been conducted in the flow top of the McCoy Canyon flow and determined effective thickness values of $2X10^{-3}$ and $3X10^{-3}$ meters (reported on p. 3-89). It seems appropriate to rely more heavily on these values, even though they are not from the candidate repository flow top, since they are more representative of the basalt flows under Hanford than textbook numbers. It should be noted that this same rationale for using transmissivity values from a different flow top is given by Clifton et al. (1984).

In their model Clifton et al. (1984) use the mean of the range of values reported by Loo et al. (1984) to determine travel times for Case 1. The effective thickness value determined by Leonhart et al. (1982) of $2X10^{-3}$ meters corresponds to an effective porosity of $1.6X10^{-4}$. Using this value and a flow top thickness of 8 meters the calculated travel time would be approximately 550 years instead of 17,000 years. This was determined by direct ratio, since Clifton et al. (1983) reports that the groundwater travel time is directly proportional to effective thickness. The same argument holds for Cases 2 and 3, where shorter travel times would be calculated.

Recommendation: The estimated travel times are very sensitive to small changes in the input parameters. Considering the fact that travel time is a disqualifying condition, these input parameters should be chosen carefully. Actual effective thickness measurements from the Hanford site should be used, resulting in travel times that are much shorter than reported.

ground water movement is sometimes channeled along narrow intervals of the flow top instead of being averaged across the entire effective thickness. These intervals would have a higher hydraulic conductivity than the "equivalent" value used for the entire flow top. Therefore, velocities along these preferentiaal pathways may be higher than reported in the EA and consequently travel times lower.

Recommendation: The above points suggest that the continuum approach, using vertically averaged input parameters, may not yield realistic travel time estimates. The use of this modeling approach must be justified and the associated assumptions and simplifications fully explained.

References:

Clifton, P.M., R.C. Arnett, and N.W. Kline, 1984. Preliminary Uncertainty Analysis of Pre-Waste-Emplacement Groundwater Travel Times for a Proposed Repository in Basalt, SD-BWI-TA-013, Rockwell Hanford, Richland, Washington.

Freeze, R.A., and J.A. Cherry, 1979. Groundwater, Prentice-Hall, Inc.

YIN Comment #: 6-29

EA Section: 6.3.1.1.12

Page 6-85, paragraph 1

Statement of Issue: It is doubtful that RHO can characterize the site such as to reduce hydrologic system uncertainty to an acceptable level.

Discussion: Resolution of the geohydrology qualifying condition relies on being able to characterize the site. Given the extremely complex hydrologic nature of the site evidenced by extreme local heterogeneities, it is likely that compliance of the site with relevant regulations, even after site characterization, will not be possible to an acceptable degree considering reasonable time and budget constraints.

Recommendation: The Hanford site should be eliminated from consideration because characterization cannot resolve the uncertainty concerning the hydrologic system.

unit thickness (Leonhart et al., 1984).

As noted in Appendix D of Runchal et. al., the panelists were given the results of the field test (i.e., 1.6×10^{-4}) and then told, "The effective porosity is somewhat higher, however, because of the presence of highly conductive zones." Although porosity in the narrow high conductivity zone is underestimated by this method, this definition of effective porosity is consistent with field derived transmissivity values that are used in travel time calculations and are considered to be due to water transmission allocated over the whole flow top thickness.

If the effective porosity of the high conductivity zone is to be used in calculations, then the transmissivity should be divided by the thickness of the high conductivity zone to derive the hydraulic conductivity, which is not the case for the stochastic analysis.

By indicating that the effective porosity is somewhat higher due to the high conductivity zone, the questioner is biasing the experts answers in a manner that is inconsistent with the methodology used in travel time analysis. For an unbiased parameter estimation of effective porosity, the questions should have been aimed at estimating ranges of effective thickness (effective porosity multiplied by formation thickness) given the field tests and high conductivity zone thickness ranges for other Grande Ronde flow tops.

Relevance to Regulations - This favorable condition cannot be accepted as present on the basis of studies performed (see EA pages 6-266 through 6-269). There is no basis for considering the McCoy Canyon field test effective thickness range as unreasonably high. The use of a mean value that is one order of magnitude greater than that indicated in field tests (which, although sparse, are the most accurate data available) biases the stochastic analyses such that a favorable finding is virtually guaranteed. The biases also hide the potential for disqualification based on a travel time of less than 1000 years.

Recommendation: Until further field data results are available, the mean of an effective porosity range of 1.6×10^{-4} to 2.7×10^{-4} as derived from the field tests should be considered the median value for use in preliminary travel time calculations, and it should be concluded that the favorable condition is not present.

References:

Leonhart, L.S., R.L. Jackson, D.L. Graham, L.W. Gelhar, G.M. Thompson, B.Y. Kauchiro, and C.R. Wilson, 1984. Analysis and Interpretation of a Decirculating Tracer Experiment Performed on a Deep Basalt Flow Top, RHO-BW-SA-300 P, Rockwell Hanford

Operations, Richland, Washington.

Runchal, A.K., M.W. Merkhofer, E. Olmstead, and J.D. Davis, 1984a. Probability Encoding of Hydrologic Parameters for Basalt: Elicitation of Expert Opinions from a Panel of Five Consulting Hydrologists, SD-BWI-TA-010, Rockwell Hanford Operations, Richland, Washington.

YIN Comment #: 6-33

EA Section: 6.3.1.2.2 Geochemistry -- evaluation process

Page 6-87, Paragraph 3

Statement of Issue: The methods and procedures that DOE has used to determine radionuclide sorption are not valid for evaluating individual radionuclide behavior under repository conditions.

Discussion: To date, all DOE radionuclide sorption data has been measured in static, batch experiments. In this type of experiment, a single averaged K_d value is determined for all species of a radionuclide, even though, in general, each species has a distinct K_d value. The sorption ratios developed by batch tests will not account for particular species of a radionuclide which could move more rapidly than predicted by the averaged value. DOE claims that future testing (for example, using flow-through column experiments) will address this problem, however, they give no details of experiments, not even in the referenced subsection (4.1.2.6) on future plans.

Importance to EA findings/conclusions - DOE concedes that their present method of study has inherent inadequacies. The K_d values they have determined are not representative of specific radionuclide species, and therefore are not accurate for radionuclide release modeling.

Recommendation: Conclusions as to the behavior of individual radionuclide species cannot be made based on the present data; thus, the favorable condition cannot be considered present.

YIN Comment #: 6-34

EA Section: 6.3.1.2.3 Geochemistry -- favorable condition (1)

Page 6-89, paragraph 4

Statement of Issue: Information regarding radionuclide sorption has been incorrectly presented by DOE. Strong adsorption of radionuclides by basalt secondary phases has not been clearly

Flow-through column experiments should be considered as an alternative to static batch tests because equilibrium conditions would be easier to verify. Until the above are done, DOE should not conclude that the site has favorable geochemical conditions.

References:

Kelmers, A.D., 1984. Review and Assessment of Radionuclide Sorption Information for the Basalt Waste Isolation Project Site (1979 through May, 1983), NUREG/CR-3763, ORNL/TM-9191/V1.

Salter, P. F. and G.K. Jacobs, 1982. Evaluation of Radionuclide Transport: Effect of Radionuclide Sorption and Solubility, RHO-BW-SA-192 P.

YIN Comment #: 6-35

EA Section: 6.3.1.2.3 Geochemistry -- favorable condition (1)

Page 6-90, paragraph 1

Statement of Issue: Hydrazine is not an acceptable chemical reducing agent for geochemical sorption experiments. The conclusions regarding radionuclide sorption based on the current data are not valid.

Discussion: Hydrazine is used in BWIP radionuclide sorption experiments to simulate the reducing conditions which are expected in the repository. However, there are many reasons why hydrazine should not be used in the laboratory experiments (Kelmers, 1984), including:

1) The reaction between hydrazine and any reducible radionuclide is unknown, therefore the effective redox condition is unknown.

2) Hydrazine hydrate dissociates to release hydroxide anions, which likely affect the groundwater pH, so the pH is no longer representative of in-situ conditions.

3) Hydrazine could react with bicarbonate in the groundwater to form the carbamate anion, which may form radionuclide complexes.

4) Hydrazine is an aggressive chemical and attacked polycarbonate test tubes used in the BWIP tests, causing failure of the test tubes or brown-colored degradation products in the groundwater.

5) Hydrazine may alter or disaggregate clay mineral structures and change the secondary minerals in the

Discussion: At the ambient repository temperature in the Grande Ronde (approximately 65°C), the clay fracture fillings are predominantly smectite. Eberl and Hower (1976) showed that at 60°C, the mixed layer clay is initially 75% smectite and 25% illite. At 100°C, hydrothermal alterations result in mixed layer clays which are 20% smectite and 80% illite. Because illite has a low sorptive capacity, this conversion will result in reduced radionuclide retardation.

Importance to EA findings/conclusions - One of the favorable conditions regards the capability of the basalt primary and secondary phases to retard radionuclide transport. The DOE has not considered all the hydrothermal reactions possibly resulting from waste emplacement. The conversion of smectite to illite is inconsistent with the presence of the favorable condition.

Recommendation: Elevated temperatures can cause irreversible alterations of the fracture filling clays, thus reducing the sorptive capacity of the repository. Therefore the favorable condition (3) is not present at the site, and the DOE conclusion should be changed.

References:

Eberl D. and J. Hower, 1977. "The Hydrothermal Transformation to Sodium and Potassium Smectite into Mixed layer clays," Clays and Clay Minerals, Volume 25, pp 215-228.

YIN Comment #: 6-38

EA Section: 6.3.1.2.6 Geochemistry -- favorable condition (4)

Page 6-92, first paragraph

Statement of Issue: Solubility and sorption data for radionuclides do not constitute a sufficient basis on which to calculate accurate release rates.

Discussion: The DOE data on radionuclide solubility are not sufficient for calculating release rates. Solubility estimates by Early (1982) determine solubilities from thermodynamic tables at 25°C. Thus, the solubilities calculated are strictly applicable only at 25°C, and may vary greatly with temperature increases to 250-300°C. At elevated temperatures, thermodynamic data exists for only a few radionuclides, and much of it is estimated. However, thermodynamic parameters available for uranium and plutonium at 50 to 60°C indicate that solubilities of these radionuclides at the higher temperatures are approximately one order of magnitude greater than their respective solubilities at

25°C. Solubilities would likely increase even more at temperatures above 60°C.

Solubility determinations also show a strong dependence on Eh, by as much as 10 orders of magnitude. Since the Eh value has not been conclusively determined, solubilities of some radionuclides are not known to better than 10 orders of magnitude. During waste emplacement, the repository will be open to the atmosphere and oxidizing conditions are expected. The rate at which the system will return to the expected reducing conditions is not known. This further increases the uncertainty in the repository Eh, and thus the radionuclide solubilities.

Groundwater composition also greatly affects radionuclide solubilities. A study by Early (1982) showed that the range of observable compositions for Grande Ronde groundwater lead to calculated ranges of solubilities of two to three orders of magnitude for some radionuclides.

From the above limitations, it can be seen that the radionuclide solubilities for the repository conditions are not well known.

Importance to EA findings/conclusions - DOE currently believes that the solubility data supports the favorable condition. They have not considered all the limitations in the determination of radionuclide solubilities. Limitations in the thermodynamic data base, groundwater temperature, Eh, and chemical composition result in radionuclide solubilities defined at best within a range of two to three orders of magnitude. With this information, it is not possible to conclude that the favorable condition has been met.

Recommendation: Much more detailed thermodynamic measurements and solubility measurements need to be made for the radionuclides before reaching conclusions regarding the dissolution of the entire inventory. Solubility calculations must be relevant to the repository conditions.

References:

Early, T.O., G.K. Jacobs, D.R. Drewes, and R.C. Routson, 1982. Geochemical Controls of Radionuclide Releases from a Nuclear Waste Repository in Basalt: Estimated Solubilities for Selected Elements, RHO-BW-ST-39 P, Rockwell Hanford Operations, Richland, WA.

4) The effect of multiple speciation on the sorption information was not evaluated. Several radionuclides can exist as more than one solution species, due to multiple valences or complexes with other groundwater constituents. Each solution species may have a distinct sorption coefficient, and therefore BWIP batch tests, which calculate an average K_d value, may not account for a portion of the radionuclide which could move more rapidly than predicted.

5) The groundwater used in the sorption experiments was synthetic groundwater prepared to simulate the existing in-situ conditions. No consideration was given to the likely alteration of groundwater composition due to hydrothermal and radiolytic reactions with the engineered facility components. A change in groundwater composition can greatly affect the sorption behavior (Salter et al, 1981), since it can influence radionuclide speciation.

6) The BWIP sorption information is not adequate for several key radionuclides. For example, technetium is considered to be the most hazardous radionuclide in high-level waste (Barney and Wood, 1980). However, there has been no high-temperature data for technetium reported, and no sorption isotherms for technetium have been identified. Iodine, which is considered the second most hazardous radionuclide, is not expected to be adsorbed at all in the basalt environment, and therefore will not be retarded. Thus, for the two most hazardous radionuclides, DOE has not been able to meet the favorable condition.

Importance to EA findings/conclusions - The DOE has not shown experimentally that all radionuclides in the waste will have a distribution coefficient greater than 0.3 (mg/l), and thus will be favorably retarded. The EA even states that "several radionuclides ... do not adsorb in the basalt geochemical environment and will not be retarded." The DOE does not have sufficient basis to state that the favorable condition is met by the Hanford site.

<u>Recommendation:</u> The DOE must conduct sorption experiments under the conditions which they expect in the repository (i.e. reducing, high temperature conditions) before conclusions can be reached regarding radionuclide behavior. The use of hydrazine to simulate reducing conditions is not aceptable. Complete sorption/desorption experiments must be conducted for all radionuclides, and equilibrium conditions must be established, before conclusions can be reached. The use of flow-through reactors is recommended for determining distribution coefficients for multiple radionuclide species.

groundwaters is considered as a "condition that could affect the solubility...to the extent that the expected repository performance could be compromised."

Recommendation: Potentially Adverse Condition (1) of the Geochemistry section (DOE General Siting Guidelines, 10 CFR 960.4-2-2) is present at the Hanford site because of the high fluoride concentrations in the Grande Ronde Basalts groundwater. All references to this condition in the EA should be changed from "not present (NP)" to "present (P)".

References:

Cleveland, J.M., T.F. Rees, and K.L. Nash, 1983. "Plutonium Speciation in Selected Basalt, Granite, Shale, and Tuff Groundwaters," Nuclear Technology, Volume 62, pp. 298-310.

Early, T.O., G.K. Jacobs, D.R. Drewes, and R.C. Routson, 1982. Geochemical Controls of Radionuclide Releases from a Nuclear Waste Repository in Basalt: Estimated Solubilities for Selected Elements, RHO-BW-ST-39 P, Rockwell Hanford Operations, Richland, WA.

Long, P.E. and Woodward-Clyde Consultants, 1984. Repository Horizon Identification Report, Volumes 1 and 2, Draft SP-BWI-TY-001, WCC for Rockwell Hanford Operations, Richland, WA.

YIN Comment #: 6-41

EA Section: 6.3.1.2.8 Geochemistry, potentially adverse condition (2)

Page 6-95, paragraph 1

Statement of Issue: Organic compounds, at concentrations found in the Grande Ronde groundwater, will reduce adsorption of americium and neptunium in the far-field environment.

Discussion: In the EA, DOE states that the geochemical conditions of the Grande Ronde Basalts produces an environment favorable for the adsorption of radionuclides in the far-field. However, naturally-occurring organic compounds with high metal-binding capabilities are present in the Grande Ronde groundwater. Means (1982) found approximately 0.3 mg/l of fulvic acids in a single sample. DOE reports in the EA that "groundwaters from extensively pumped horizons usually have total organic carbon concentrations of less than 1 mg/l..." (p.6-94, paragraph 1). It has been shown by Boggs and Seitz (1984) that the adsorption of americium and neptunium by crushed basalts was reduced by 25 to 50 percent by the addition of 1 mg/l of dissolved organic carbon at 22 and 90°C.

Importance to EA findings/conclusions - The presence of organic compounds with high metal-binding capacities (such as fulvic acids) in the Grande Ronde groundwater will reduce adsorption of americium and neptunium, two important radionuclides in the waste inventory.

Recommendation: Potentially Adverse Condition (2) of the Geochemistry section of the DOE General Siting Guidelines (10 CFR 960.4-2-2) is present at the Hanford site because the concentrations of organic compounds found in the Grande Ronde groundwater will decrease the sorption of americium and neptunium by basalt. All references to this condition in the EA should be changed to reflect a status of "present (P)" instead of "not present (NP)."

References:

Boggs, S. Jr., and M.G. Seitz, 1984. The Influence of Dissolved Organic Substances on Sorption Behavior of Americium and Neptunium, ANL-83-84, Argonne National Laboratory, Chemical Technology Division, Argonne, IL.

Means, J.L., 1982. The Organic Geochemistry of Deep Groundwaters, ONWI-268, Battelle Memorial Institute, Columbus, Ohio.

YIN Comment #: 6-42

EA Section: 6.3.1.2.9 Geochemistry -- Potentially adverse condition (2)

Page 6-96, first paragraph

Statement of Issue: The organic content, fluoride content and colloids in the basalt groundwater are all factors that could adversely affect radionuclide sorption.

Discussion: The DOE recognizes that the above factors can have an influence on radionuclide sorption, but gives no details as to how studies will progress to evaluate their significance. Subsection 4.1.1.5 is referenced, but there are no details given.

Importance to EA findings/conclusions - Factors such as fluoride and organic content, and colloids in the groundwater could lead to decreased radionuclide sorption and therefore could constitute a potentially adverse condition.

Recommendation: DOE must definitely study the effects of these factors on radionuclide sorption, and should make known their plans of study, before conclusions can be made.

YIN Comment #: 6-43

EA Section: 6.3.1.2.10 Geochemistry, potentially adverse condition (3)

Page 6-96, paragraph 2

Statement of Issue: The evidence that supports non-oxidizing conditions in the repository are based on the reactions between observed solid phases and the absence of specific solid phases and/or dissolved species in the Grande Ronde groundwater. The evidence is based on the incorrect assumption that equilibrium conditions exist in the Grande Ronde Basalt.

Discussion: The use of reactions involving solid phases present in the Grande Ronde Basalt to make thermodynamic calculations of the Eh is not valid because it is unlikely that the basalt-groundwater system is in equilibrium at the low temperatures found in the Grande Ronde. The thermodynamic calculations are based on the assumption of equilibrium conditions. The four points cited in the EA as evidence of a chemically - oxidizing environment are challenged in the following:

1) The reaction between magnetite and secondary iron-bearing minerals has not been shown to be an effective buffer of oxygen fugacity in systems with temperatures below 400°C (Huebner, 1971).

2) Lack of hematite in the Grande Ronde Basalt is not a definite indicator of reducing conditions because reaction rates between magnetite, pyrite, other ferrous iron minerals and hematite are not well known at any temperatures (Barton and Skinner, 1967). Therefore, calculations or assumptions based on equilibrium conditions are not valid. In addition, Benson and Teague (1979) report the existence of a ferric iron phase, possible hematite, in the smectite clays, the primary fracture-filling alteration mineral in the Grande Ronde Basalts.

3) The coexistence of sulfide and sulfate is not shown in any hydrochemical data published for the Hanford site. The presence of sulfide in the Grande Ronde groundwater does not definitely indicate reducing conditions because the aqueous sulfur species equilibrate extremely slowly at temperatures less than 100°C (Ohmoto and LaSaga, 1982). Furthermore, Grandstaff et. al. (1983) concluded that the low sulfide:sulfate ratio in their experiments "may indicate that redox conditions are buffered to more oxidized values by the presence of spent fuel." The presence of methane coexisting with carbon dioxide is not a definite indicator of reducing conditions because reaction rates are expected be quite slow at the temperatures

expected in the repository. It is likely that both the hydrogen sulfide/sulfate and the methane/carbon dioxide speciation are not in equilibrium and the source of the sulfide and methane may be upwelling from deeper groundwaters (USGS, 1983; Burnham, 1983). DOE has not explored the effects of the deeper groundwaters.

4) As stated in the EA, Jantzen (1983) did achieve an Eh of -0.41 V at a pH of 8.44 at 60°C in a mixture of crushed basalt and deionized water. This experiment was designed to examine the ability of crushed basalt to impose reducing conditions in the near-field environment. When the experiment was conducted with a mixture of crushed basalt and simulated, deoxygenated Grande Ronde groundwater (GR3), the lowest Eh achieved was only about -0.1 V at a pH of 8.6 at 60°C. The Eh measured in these experiments was shown to be strongly dependent on the surface area/volume ratio (SA/V) of the crushed basalt. At greater SA/V ratios (finer mesh size of crushed basalt), Eh measurements were more reducing. To simulate the ability of basalt to influence the redox conditions of the groundwater in the far-field environment, uncrushed basalt (with a very low SA/V ratio relative to the crushed basalt) would be used. Such a basalt sample would not be expected to impose reducing conditions on the groundwater in this experiment.

Importance to EA findings/conclusions - The EA presents no evidence that establishes the existence of non-oxidizing conditions in the pre-waste-emplacement groundwater.

Recommendation: Because the EA has not sufficiently established the existence of non-oxidizing conditions in the groundwater at the Hanford site, Potentially Adverse Condition (3) of the Geochemistry section of the DOE General Siting Guidelines (10 CFR 960.4- 2-2) is considered to be present at the Hanford site.

References:

Barton, P.B., and B.J. Skinner, 1967. "Sulfide Mineral Stabilities," in H.L. Barnes, ed., Geochemistry of Hydrothermal Ore Deposits, Holt, Rhinehart and Winston, Inc., N.Y. pp.236-333.

Benson, L.V. and L.S. Teague, 1979. A Study of Rock-Water-Nuclear Waste Interactions in the Pasco Basin, Washington, University of California, Lawrence Berkeley Laboratory Report LBL-9677.

Burnham, J.B., 1983. "Basalt Waste Isolation Project Review by Pacific Northwest Laboratory's Review Team," (letter from D.E. Oleson to A.G. Fremling, November 29, 1983), 216 pp.

Grandstaff, D.E., G.L. McKeen, E.G. Moore, and G.C. Ulmer, 1983. "Reactions in the System Basalt/Simulated Spent Fuel/ Water." in Proceedings of the Materials Research Society Symposium Scientific Basis for Nuclear Waste Management, Boston, Ma, prepared for Rockwell Hanford Operations.

Huebner, J.S., 1971. "Buffering Techniques for Hydrostatic Systems at Elevated Pressures," G.C. Ulmer, (ed.), Research Techniques for High Temperature and High Pressure, pp. 123- 177.

Jantzen, C.M., 1983. Methods of Simulating Low Redox Potential (Eh) for a Basalt Repository, DP-MS-83-59X, E.I. DuPont de Nemours & Co., Savannah River Laboratory, Aiken, SC.

Ohmoto, H. and A.C. LaSaga, 1982. "Kinetics of Reactions Between Aqueous Sulfates and Sulfides in Hydrothermal Systems," Geochim. Cosmochim. Acta, Volume 46, pp. 1727-1745.

U.S. Geological Survey, 1983. "Review Comments by the U.S. Geological Survey on Site Characterization Report for the Basalt Waste Isolation Project," DOE-RL-82-3, (letter from J.B. Robertson, Chief, Office of Hazardous Waste Hydrology, to O.L. Olson, Project Manager, BWIP, May 6, 1983), 60 pp.

YIN Comment #: 6-44

EA Section: 6.3.1.3.3 Rock characteristics - favorable condition (1)

Page 6-99

Statement of Issue: This favorable condition is not met due to uncertainties in lateral variations in the Cohassett.

Discussion: Favorable Condition - "(1) A host rock that is sufficiently thick and laterally extensive to allow significant flexibility in selecting the depth, configuration, and location of the underground facility to ensure isolation."

The EA recognizes that this favorable condition is not present. Suggestions in the EA discussion of this favorable condition that significant lateral flexibility exists are not substantiated by evidence. Large variations in thickness of the flow components (e.g., flow top, colonnade, entablature, pillow zones) occur especially in the Umtanum, Rocky Coulee, and McCoy Canyon flows. These variations are observed within the Cohassett. The degree of variability of these components is unknown and would be difficult to characterize.

YIN Comment #: 6-54

EA Section: 6.3.1.7.4, Tectonics potentially adverse condition (1)

Page 6-129, paragraph 3

Statement of Issue: Several statements in the EA regarding this potentially adverse condition are inappropiate and should be deleted.

Discussion: Potentially Adverse Condition - "(1) Evidence of active folding, faulting, diapirism, uplift, subsidence, or other tectonic processes or igneous activity within the geologic setting during the Quaternary Period." The EA considers this potentially adverse condition to be present at Hanford. Several statements in the EA's discussion are not appropiate and should be deleted. These statements are summarized below.

1) The EA states that "deformation appears to be concentrated on the steeper limbs of anticlinal folds with little or no deformation occurring in synclinal troughs like the Cold Creek syncline". That deformation in synclines is less than observed in the anticlines (in the Yakima fold province) is not disputed. However, the degree of deformation in synclines is not known with any certainty (due to few surface exposures). Deformation in a syncline has occurred; there could not be bending associated with a synclinal fold without some deformation.

   The Cold Creek syncline is located at depth. Data regarding its overall shape are obtained from borehole data and geophysical means. There is no evidence to indicate with certainty the degree of deformation at depth in the Cold Creek syncline. The USGS notes that "... such faults (in fold axes) are as common in synclinal areas as anticlinal areas and could occur in the Pasco Basin, including the Cold Creek syncline and repository.... Unfortunately, most of these fault features occur as steeply dipping or narrow zones. Where they lie beneath the cover of younger sedimentary formations, they may be essentially (or completely) undetectable by geophysical methods.." (USGS, 1983, p.2). Caggiano and Duncan (1983) summarize thirty-three different tectonic conceptions of the Pasco Basin area. Some models include significant deformation within synclines.

   Therefore, the EA's statement "...with little or no deformation occurring in synclinal troughs like the Cold Creek syncline" is inappropiate because there is insufficient evidence to support it, and significant evidence contradicting it.

YIN Comment #: 6-59

EA Section: 6.3.1.7.11 Tectonics - conclusion on qualifying condition

Pages 6-136 to 6-137

Statement of Issue: In situ stress conditions are such that faulting on fracture and fault planes is likely to occur.

Discussion: The EA should note that the present in-situ stress regime is such that faulting is likely to continue, at least at present rates, and possibly increased rates.

Shallow earthquake swarms associated with reverse faulting have occurred with relative frequency in the Pasco Basin (Long and WCC, 1984, EA Subsection 2.1.1.3, Malone, et.al. 1975). There may exist a relation between the state of stress and the potential for reverse faulting such that high in-situ stresses may induce faulting.

Zoback and Hickman (1982) discuss the relationship of shallow reverse faults in regard to earthquakes at Monticello Reservoir, So. Carolina. The critical condition controlling the occurrence of such earthquakes is the ratio of the maximum effective horizontal stress (S_{hmax}-P) to the effective vertical stress (S_{vmax}-P) where P is the pore pressure. They show in eq. 2 (p. 6962) that the critical effective stress ratio on well- oriented faults or fracture planes is a function of the coefficient of friction of the rock, F, such that

$$(S_{hmax}-P)/(S_{vmax}-P) = ((2F + 1) * 1/2 + F) * 2,$$

F = 0.6 to 1.0 for all rocks (Byerlee, 1976).

Reverse faulting is "potentially imminent" (USGS, 1983, p.11) when the critical effective stress ratio ranges from 3.12 (for F =0.6) to 5.83 (for F =1.0). Based on measurements from Hanford, (provided in USGS (1983)), the mean value of (S_{hmax}-P/S_{vmax}-P) is greater than the critical value for F = 0.6. Therefore, the ambient stress state is close to one which would continue to cause reverse faulting on well-oriented fracture and fault planes.

Importance to EA findings/conclusions - The stress tensor for the Hanford region may be sufficient to cause earthquakes and/or faulting that could adversely affect the repository's isolation performance in the future.

Recommendation: The Hanford tectonic and seismologic character must be examined further to determine if the tectonic qualifying condition, favorable condition, potentially adverse conditions,

3) define the relationship between the the microscopic characteristics of the material and the macroscopic material behavior.

References:

Sagar, B., P.W. Eslinger, R.G. Baca, and R.P. Anantatmula, 1984. Probabilistic Modeling of Radionuclide Release at the Waste Package Subsystem Boundary of a Repository in Basalt, SD-BWI-TA-012, Rockwell Hanford Operations, Richland, Washington.

Fish, R.L., and R.P. Anantatmula, 1983. Preliminary Corrosion Models for BWIP Canister Materials, SD-BWI-TI-157, Rockwell Hanford Operations, Richland, Washington.

YIN Comment #: 6-67

EA Section: 6.4.2.3.3 Waste package subsystem performance

Page 6-243, paragraph 1

Statement of Issue: An average canister lifetime of 6300 years used in the Preliminary Performance Assessment may not be valid.

Discussion: The Preliminary Performance Assessment used a range of canister lifetimes which average to approximately 6300 years. As mentioned in earlier comments, thermal and lithostatic loadings may greatly reduce canister integrity. (The 6300 year value derives from corrosion failure only.)

Additionally, the NRC has asked BWIP to define how much "weight" is assigned to engineered barrier components in a performance assessment. It appears that BWIP has placed a high degree of confidence and weight on one waste barrier - 6,300 out of 10,000 years. The questions to be asked is "Will the NRC allow this much weight to be placed on the canister in the final analysis?" and "Is it valid for this analysis?". 10CFR60 states that the waste package must substantially contain the waste for 300 - 1000 years, with no mention of a longer time frame.

Recommendation: Redo the Preliminary Performance Assessment to reflect containment for 300 - 1000 years as opposed to 6300 years.

Relevance to Regulations - Inability to confirm the system guideline qualifying condition 960.4-1 that requires compliance with 40 CFR Part 191.

Recommendation: Complete documentation, verification, and benchmarking of EPASTAT.

References:

Sonnichsen, J., 1984. Basalt Waste Isolation Project Performance Assessment Plan, SD-BWI-PAP-001, Rockwell Hanford Operations, Richland, Washington.

YIN Comment #: 6-74

EA Section: 6.4.2.4.4 Performance of the total isolation system

Page 6-279 paragraph 2

Statement of Issue: Preliminary system performance assessment accounts for the combined performance of the three major repository subsystems but does not account for the error associated with transferring information between these subsystems.

Discussion: The multibarrier concept consists of three subsystems: waste package, repository seals, and the candidate site. The performance assessment for the proposed repository site combines performance evaluations for these subsystems. This is accomplished in a step-wise manner where the output from the innermost subsystem is used as the boundary condition for the adjacent subsystem, etc..

An important issue in determining the overall performance of the multibarrier system is how the errors within each subsystem are propagated when transfering data between subsystems. Nguyen and Lehman (1985) examined this problem in detail. Using the conventional one-dimensional transport equation they show how the uncertainty within each subsystem is propagated through the entire system. The uncertainty in the concentration exiting from the multibarrier system is not simply the additive combination of the uncertainties of the subsystems. Nguyen and Lehman (1985) find that the actual uncertainty is greater than the uncertainty calculated by the DOE performance assessment models due to differences in the spatial and temporal scales between the subsystems.

Recommendation: Before judgement can be made on the performance of the total isolation system, the type of error discussed above must be considered

that are acknowledged in the EA and discussed in YIN comment # 6-61, it is apparent that the possibility of such measures being required at Hanford is very real, thus, the condition is present. The only difference between the potentially adverse condition and the disqualifying condition is that the former is expressed in terms that extraordinary measures "could" be required, whereas the latter speaks of them being "likely" to be required. Conwequently, the disqualifying condition may also be present.

Recommendation: The Hanford site should either be disqualified based on this consideration, or at the very least, it should be heavily penalized. Certainly, Hanford should not be ranked equal to Davis Canyon, Deaf Smith, and Richton on this consideration. The hydrologic conditions at the other three sites are not nearly as adverse as those at Hanford.

YIN Comment #: 7-15

EA Section: 7.4.1 PREFERRED SITES FOR RECOMMENDATION FOR CHARACTERIZATION--INTRODUCTION

Page 7-120

Statement of Issue: DOE improperly declines to compare the sites on the basis of the system guidelines.

Discussion: The DEA states:

> Sections 7.2.2, 7.3.1.2, 7.3.2.2, and 7.3.3.2 explain, however, that the evidence is not sufficient to substantiate comparisons or to discriminate among sites on the basis of the system guidelines. In such a circumstance, the implementation guidelines allow comparisons to be made by considering collectively the technical guidelines in the postclosure and the preclosure sets.

As discussed in YIN comment # 7-16, the guidelines specify that "[c]omparisons between and among sites shall be based on the system guidelines, to the extent practicable...." 10 CFR § 960.3-1-5. In light of this requirement, DOE should meet a heavy burden to show that the evidence is not adequate to substantiate such comparisons before deciding to dispense with them.

The sections cited by DOE above do not meet this burden. In each case, DOE cites the large uncertainties of systems findings as the reason why it cannot do comparisons. However, the inability to compare the sites on the basis of the system guidelines does not follow from the uncertainties. If anything, the inherent uncertainties are less important for a comparative analysis than in the absolute analyses, i.e., whether the individual system guidelines are satisfied for each site. DOE

TABLE 5 HEALTH EFFECTS PER CURIE
(IMPLIED FROM EPA WORKING DRAFT #4)

RADIONUCLIDE	HEALTH EFFECTS/CURIE
CHAIN 1	
PU 240	0.1
U 236	0.1
TH 232	0.1
RA 228	0.1
CHAIN 2	
CM 245	0.1
PU 241	0.01
AM 241	0.1
NP 237	0.1
U 233	0.1
TH 229	0.1
CHAIN 3	
CM 246	0.1
PU 242	0.1
U 238	0.1
PU 238	0.1
U 234	0.1
TH 230	0.1
RA 226	0.1
PB 210	0.1
CHAIN 4	
AM 243	0.1
PU 239	0.1
U 235	0.1
PA 231	0.1
AC 227	0.1
OTHER RADIONUCLIDES	
TC 99	0.001
I 129	0.1
SN 126	0.01
CS 135	0.01
C 14	0.1
SR 90	0.01
CS 137	0.01