COMMENTS

OF THE

U. S. NUCLEAR REGULATORY COMMISSION

ON THE

U. S. DEPARTMENT OF ENERGY'S

DRAFT ENVIRONMENTAL IMPACT STATEMENT

RELATED TO

DISPOSAL OF HANFORD

DEFENSE HIGH-LEVEL, TRANSURANIC

AND TANK WASTES

(DOE/EIS-0113)

PUBLISHED MARCH 1986

## GENERAL COMMENTS

It is stated in the DEIS (p. i) that the purpose of the EIS is "to provide environmental input into the selection and implementation of the final disposal actions for high-level, transuranic and tank wastes located at the Hanford Site." The document goes on to state that the DEIS is "both a programmatic EIS intended to support broad decisions with respect to the disposal strategies for the Hanford waste" and "an implementation EIS intended to provide project specific environmental input for decisions on moving forward with certain disposal activities" (p. xiii). The DEIS further indicates that following publication of the Final EIS, the DOE "will begin selection of a Hanford Defense Waste final disposal strategy which will be documented in one or more Records of Decision. The DOE may decide to proceed with implementing certain parts of the strategy while delaying final decision on other parts pending further research and development" (p. xiii). This approach makes the review of the document difficult because it is unclear which areas will receive additional research and development and how the results of these research and development efforts will be factored into the decision-making process. The DEIS indicates that further NEPA review is anticipated to support certain other specific activities prior to their implementation but the document does not indicate which activities this would apply to, what the additional review would consist of, or when it would occur. The NRC staff recommends that the Final EIS clearly identify which decisions will be postponed pending completion of additional research and development, when these activities are likely to be completed, and the type of NEPA review that is anticipated.

The NRC agrees with DOE that several areas require additional research and development prior to making decisions concerning the disposal of the Hanford wastes. These include: (1) characterization of the wastes in the single-shell tanks; (2) long-term performance of the protective barrier system; (3) geochemical characteristics of the site; and (4) development of analytical capabilities for projecting waste transport. Each of these is discussed below.

### Characterization of single-shell tank wastes

The DEIS notes (p. 3.5), and the NRC staff agrees, that additional characterization of wastes in the single-shell tanks will be necessary to provide more detailed information about waste inventories. The NRC recommends that the wastes also be characterized, to the extent practicable, by their sources in fuel reprocessing operations. If, for example, certain tanks contain wastes from the operation of the first cycle solvent extraction system, then these wastes would clearly be considered as high-level wastes. However, if some of the tanks contain predominantly incidental wastes such as cladding removal wastes or organic wash wastes, and if the radionuclide concentrations in these wastes are comparable to other low-level wastes, these wastes might not be properly classified as high-level wastes.

After the completion of the waste characterization program, the NRC recommends that the selection of a disposal alternative be made on a tank-by-tank basis. Information presented in Appendix A (Tables A.4 and A.5) of the DEIS suggests that a large fraction of the total curie inventory of single-shell tank wastes may be contained in only a few tanks. If this is accurate, a substantial fraction of the total radionuclide inventory could be retrieved at only a small fraction of the cost presented in the DEIS. Furthermore, if some or all of the tanks with large inventories are in sound condition and do not leak, wastes could be retrieved by sluicing, further reducing the cost of waste retrieval.

In summary, the NRC agrees that additional waste characterization should be completed in order to (1) properly classify wastes as high-level or non-high-level, and (2) permit selection of a disposal alternative which is most appropriate for each tank of waste.

Long-term performance of protective barrier system

As noted in the DEIS (p. 1.14), the protective barrier and marker system is the key to effectively isolating from the environment wastes that are disposed of near-surface. Two of the three disposal alternatives that are considered in the DEIS (i.e., the in-place stabilization alternative and the reference alternative) rely heavily on the capability of the proposed protective barrier system to minimize water infiltration and to reduce the likelihood of plant, animal, and human intrusion. Indeed, it is the view of the NRC that near-surface disposal of many of the Hanford wastes would likely pose unacceptable risks to public health and safety unless substantial protection is provided by such barriers. The DOE acknowledges (DEIS, p. M.2) that a specific barrier design has not yet been determined. The DEIS further notes that the DOE will conduct a NEPA review of the final specific barrier to evaluate its anticipated performance as designed and its performance under perturbed conditions. This review is to be based on actual laboratory and field data. The NRC encourages the DOE to conduct these further studies to resolve uncertainties with respect to the effectiveness of the barriers. Our detailed comments list some of the aspects of barrier design and performance which should be addressed in these studies.

Geochemical characteristics of the site

The DEIS is replete with statements that indicate a lack of geochemical data for the site. The DOE acknowledges (DEIS, p. 0.7) that the absence of this data precludes a more rigorous analysis of the environmental effects of the proposed alternatives. It is recommended that sufficient data be available to support the analyses of environmental impacts presented in the DEIS before decisions are implemented.

Development of analytical capabilities for projecting waste transport

The DEIS recognizes that the linear distribution coefficient (Kd) modeling approach is a potential technical limitation in modeling efforts because it combines several geochemical processes into a single empirical parameter. The DOE indicates that additional development work is being pursued on the models. As indicated above with regard to the geochemical characteristics of the site, it is recommended that sufficient model development be completed to support the estimates of environmental impacts set forth in the DEIS before decisions are implemented.

Finally, the NRC agrees with the position stated in the DEIS (p. 6.11) that to the extent that any decision based on the DEIS (and subsequent final environmental statement) requires defense high-level waste to be placed in a facility which is authorized for the express purpose of subsequent long-term storage, such a facility would have to comply with any applicable licensing requirements of the NRC. Notwithstanding any comments presented here, NRC may (1) incorporate into any license that may be issued at a later date conditions that may reflect a more restrictive position than that taken in these comments; or (2) deny a license for activities at a proposed facility.

## DETAILED COMMENTS

### DISPOSAL OF TRU WASTES WITH CONCENTRATIONS BELOW 100 NCi/GM

The NRC staff is concerned about disposal of wastes with TRU concentrations below 100 nCi/gm (e.g., Section 3.3.1.4, paragraph 1). Disposal of such wastes may require better protective measures than are evidenced in this DEIS. For example, NRC's analyses in support of 10 CFR Part 61 showed that Class C wastes, including wastes with TRU concentrations between 10 and 100 nCi/gm, must be disposed of using a stable waste form and the disposal facility must either permit emplacement at least 5 meters below the ground surface or must include an engineered intruder barrier. The staff encourages the DOE to consider the results of the Part 61 supporting analyses when developing disposal concepts for such wastes. (The staff notes that, for other projects, the DOE has committed itself to comply with the 10 CFR Part 61 performance objectives for disposal of low-level wastes. See, for example, the Proposed Finding of No Significant Impact, Disposal of Project Low-Level Waste, West Valley Demonstration Project, West Valley, New York, April 1986.)

### PROTECTIVE BARRIER AND MARKER SYSTEM

#### Appendix M, Preliminary Analysis Of The Performance Of The Protective Barrier And Marker System

The NRC staff recognizes that substantial research and development of barrier concepts remains to be completed before a decision can be made to implement either the in-place stabilization or the reference alternative. The following concerns regarding the design and performance of barriers should be considered during DOE's future barrier research and development efforts.

Overall Barrier Design

The barrier design shown in Figure M.3 of Appendix M is based on construction of a multilayer capillary (or "wick") barrier that is intended to reduce deep drainage. The key to this design is a layer of very coarse gravel or rock with an overlying revegetated layer of fine-textured soil. Under ideal conditions this multilayer design can minimize infiltration rates by trapping fluids in the uppermost soil layer and subsequently removing soil moisture through evapotranspiration. Such a cover is only effective to the extent that hydraulic pressure within the wick is insufficient to cause a breakthrough into the pervious layer beneath the wick. If breakthrough occurs the pervious layer must direct water horizontally so that it will not migrate further down toward the waste. In order to do this, the base of the pervious layer must have adequate slope, probably greater than 5 percent. Such a slope is not apparent in the barrier design of Appendix M.

It should be noted further that a wick design should be based on extreme precipitation events rather than average annual precipitation. Wetting fronts and subsequent breakthrough are likely to occur during storms with infrequent return periods. Given the time period during which this barrier must be effective, it is prudent to design it for a storm with a very low recurrence interval (e.g., 1000 yr, 24 hr storm).

The DEIS also states that the barrier would restrict penetration by plants and animals into the waste, because of the rock and absence of moisture beneath the wick. The staff is concerned, however, that even shallow burrowing within the upper soil layer (down to the rock) could impair the effectiveness of the wick as a moisture barrier. The DOE should investigate means for preventing or minimizing burrowing within the barrier.

Potential for Erosion

It appears that little or no consideration has been given to the potential for erosion of the soil cover of the protective barriers due to the occurrence of local intense precipitation. Several long-term stability investigations performed for the NRC staff indicated that the most disruptive natural phenomena affecting long-term stabilization are likely to be wind and water erosion (Nelson et al., 1983; Young et al., 1982; Lindsey et al., 1982; and Beedlow, 1984). These studies also indicated that wind and water erosion can be mitigated by a rock cover of reasonable thickness and that the size of the rock chosen for the protective cover will normally be controlled by a design precipitation or flood event.

The NRC staff considers it very important that adequate erosion protection be provided to prevent the occurrence of sheet erosion and the initiation of gully erosion. Gully erosion, once initiated, can cause extensive damage to any soil cover, such that previous assumptions regarding infiltration, biotic intrusion, erosion, and releases of radionuclides may no longer be valid.

On the basis of NRC staff experience with long-term stabilization in arid regions of the western United States, it is very unlikely that the proposed vegetative cover will provide adequate protection to prevent the occurrence of gully erosion (Nelson et al., 1983). In general, a rock cover is usually needed to provide such protection. A mixed rock/soil cover might provide similar protection while also allowing growth of a vegetative cover. The NRC staff recommends that such a protective cover be considered. To address various uncertainties and provide for a conservative design basis, it would be prudent for the DOE to design the rock cover for an occurrence of localized intense precipitation as previously discussed.

Long-Term Stability

The performance of the barrier shown in Figure M.3 of Appendix M is dependent on the overall structural integrity of the barrier system and on the maintenance of interlayer textural differences. It is not known whether these factors can realistically remain stable over a time scale of 10,000 years. Even if structural integrity of the barrier can be maintained over this time scale, downward infiltration of fine-grained soil materials into voids of the gravel layer could compromise the barrier effectiveness by altering textural differences in the capillary barrier. This could occur through gradual settling or minor subsidence of the protective barrier after construction. (The structural stability of waste tanks is of particular concern in this regard.) Other mechanisms for altering textural differences would include biogenic activity (discussed above), and liquefaction of the base of the soil cover if it is near saturation and experiences significant seismic accelerations.

It is noted that overall deterioration of the capillary barrier would be accelerated by any physical rupture of the barrier, as perhaps induced by vibratory ground motions or by the intrusion of man. Such a physical rupture would allow direct influx of runoff and precipitation through and beneath the barrier. In that event, contaminant transport within the vadose zone beneath the protective cover could be increased significantly.

In summary, the NRC staff considers that many uncertainties remain unresolved regarding long-term performance of a capillary barrier. Substantial additional research and development of barrier concepts must be completed before a preferred alternative can be selected for actual disposal of wastes.

Volume 2, Foreword, page xxxiv, paragraph 2

The assumption that the single-shell tanks remain integral for 165 years is both arbitrary and unsubstantiated. As stated in the DEIS: "an arbitrary assumption has been made that none of the tanks provides a barrier after the year 2150. This is equivalent to assuming the tanks provide a barrier to significant levels of vapor-phase transport of moisture for another 165 years."

The DEIS goes on to state that there are "no data to suggest that significant releases from the solid waste form are currently occurring." This may indeed be correct. However, there are data which show that releases have occurred from these tanks in the past. Based on historical difficulties with the integrity of the single-wall tanks, the highly soluble waste form they contain, and the lack of data supporting the integral tank assumption, it would be prudent to assume that properly backfilled tanks will provide only the structural stability necessary to inhibit slumping, collapse, or other failure of the disposal site. While the proper backfilling of tanks is necessary for structural stability, it will not significantly inhibit water infiltration or radionuclide release.

Appendix M, Section M.4, Reduction in Risk of Inadvertent Intrusion Through Passive Institutional Controls, page M.12, paragraph 1

The Final Environmental Impact Statement on 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste" (NUREG-0945, 1982), indicates intruder pathways dominate the potential health effects from commercial low-level radioactive waste disposal. Appendix R (p. R.1) of the DEIS recognizes a similar effect, in that "scenarios involving contact with or intrusion into waste...predict significant adverse or fatal consequences to those ignoring warnings and intruding into the wastes." However, the DEIS puts considerable reliance in the passive institutional controls described in Appendix M to avoid the intruder problem. The arguments supporting reduction in the risk of inadvertent intrusion are very weak: "The risk reduction factors presented here are based solely on the author's judgment; at present there are neither empirical nor theoretical models upon which these risk reduction factors can be based."

The Final EIS should provide a stronger basis to support the effectiveness of the proposed barriers as a deterrent to inadvertent intrusions.

Appendix M, Section M.4, Reduction In Risk of Inadvertent Intrusion Through Passive Institutional Controls, page M.11

This section presents factors by which the risk of human intrusion into wastes is estimated to be reduced by different protective means. When more than one means is present, these factors are then multiplied together to obtain an overall risk reduction factor.

The NRC staff considers that failure of some of the protective means (e.g., boundary markers and monuments) might result from the same primary cause (e.g., evolution of the language so that the meaning of the markers and monuments would no longer be understood). The potential for such "common-mode failures" indicates that multiplication of the individual protective factors to obtain an overall risk reduction factor is not appropriate. The method for combining the individual protective factors should accommodate the possibility that a single primary cause might render two or more of the protective mechanisms ineffective.

REGULATORY

Volume 1, Foreword, page v, paragraph 7

The NRC staff is concerned about the long-term cumulative effects of all ongoing and reasonably foreseeable waste disposal activities at the Hanford Reservation. The defense wastes, which include high-level and transuranic wastes, are already present and in need of permanent disposal. As stated on page v of the Foreword, the scope of the DEIS excludes low-level radioactive wastes in liquid and solid disposal sites at Hanford. Also excluded are wastes generated by the decontamination and decommissioning of surplus or retired facilities (post-1983). It is stated that those operations will be the subject of other National Environmental Policy Act (NEPA) reviews.

It is not clear why the DOE evaluated the environmental impacts of defense waste disposal alternatives without consideration of the cumulative effects of all existing and reasonably foreseeable activities. On page vii of the Foreword it is stated that, if the BWIP site were to be selected as a candidate site for repository development, a corresponding EIS would be written to support that site and to address cumulative impacts of that and other reasonably foreseeable activities on the Hanford Site. Why does the Defense Waste DEIS differ in that cumulative effects of all current waste disposal activities at Hanford are not addressed?

Section 3.4, Comparison of Impacts From Alternatives, pages 3.33-3.65

The DOE's proposals for permanent disposal of defense wastes at Hanford may pose special problems with respect to the NRC's current and future reviews and licensing decisions involving BWIP as a candidate site for the high-level waste geologic repository. For example, the DOE is required to develop a Performance Confirmation Program for BWIP to provide data that indicate, where practicable, whether subsurface conditions encountered and changes resulting from construction and waste emplacement are within limits assumed in the licensing review and that natural and engineered systems and components are functioning as intended.

Some of the actions proposed in this DEIS could potentially make a BWIP Performance Confirmation Program more difficult to design and carry out. For example, the barriers proposed for in-place stabilization of wastes may reduce infiltration to the unconfined aquifer system, potentially altering groundwater flow conditions. The Final EIS should include, in the discussion of impacts, possible effects of the proposed alternatives on licensability of a high-level waste repository at the BWIP site.

Section 6.6, Resource Conservation and Recovery Act, pages 6.10 and 6.11

In this section the DOE suggests that all of the waste covered in the DEIS is byproduct material and therefore not subject to subtitle C of the Resource Conservation and Recovery Act (RCRA). Throughout the text, however, the DOE acknowledges in numerous instances that the waste contains materials that are considered hazardous, dangerous and/or toxic by the EPA. In section 6.6 the DOE appears to be relying on a legal interpretation of authority rather than a technical analysis of hazard to make the conclusion that RCRA does not apply. Since no final determination has been made concerning the EPA and/or primary state authority regarding the disposal of this material, it would seem prudent that the DOE at least consider the impacts of the prescriptive disposal and monitoring requirements that would be mandated by RCRA.

HYDROLOGY

Section 4.4.1, Surface Waters, page 4.12, paragraph 2

The flood analyses and information provided in the DEIS indicate that facilities may be exposed to a potential flood threat from Cold Creek, since portions of the site may be flooded by a 100-year flood. It therefore appears that the requirements of Executive Order (E. O.) 11988, "Floodplain Management", have not been addressed. This E. O. requires, among other considerations, that the hazards and impacts associated with siting in a floodplain be identified and evaluated. Accordingly, an outline of the procedures involved in this decision-making process should be provided, and compliance with E. O. 11988 should be discussed.

Section 4.4.1, Surface Waters, page 4.12, paragraph 2

Results of flood studies in the Cold Creek watershed (Skaggs and Walters, 1981) indicate that a potential for flooding of portions of the site exists. As proposed, it appears that several facilities may be placed in an area of the Cold Creek floodplain, which could be inundated by several feet of water.

Based on an examination of the Skaggs and Walters report, it appears that the magnitude of flooding on Cold Creek may be underestimated. The Probable Maximum Flood (PMF) was estimated in the report to have a magnitude of 55,000 cubic feet per second (cfs) at the site where the drainage area is about 86 square miles. Review of historic flood data for arid regions of Washington and Oregon with similar climates and weather patterns indicates that a flood of this magnitude has occurred on a stream with a drainage area of about 13 square miles, located less than 150 miles from the site.

In recognition of the fact that the Cold Creek basin could have different flood-producing characteristics from the stream that produced the historic maximum discharge, it is nevertheless important that the PMF represent an upper bound of flood potential for a particular stream. It appears that this upper bound is not well-defined for Cold Creek.

In addition, maximum water levels will be increased as a result of increased PMF discharge and may also be increased by site location in the flood plain. The amount of increase in water level due to flood plain constriction has not been discussed in the DEIS. On the basis of topographic and cross-sectional examination of the site area, surface facilities may be subject to flooding and may constrict the flow area in the flood plain. This may increase the water levels associated with major floods; this increased level and its potential impacts should be discussed in the Final EIS.

Section 4.4.2, Groundwater, page 4.18, Figure 4.8

Isoheads indicate a potential for migration of waste from the 200-W area to the existing commercial low-level waste facility situated near the southwest corner of the 200-E area. This may adversely impact groundwater monitoring activities associated with that facility.

Appendix R, Section R.7, Other Surface Flooding, page R.92, paragraph 1

Disposal alternative #2, and in some respects alternatives #1 and #3 (page ix, Executive Summary), present disposal scenarios similar to the burial of high-level waste in a shallow land disposal site. All or some of the high-level and low-level wastes would remain at shallow depths below the ground surface. Consequently, the waste may be subject to near-surface natural phenomena.

The draft EA for the proposed disposal of high-level wastes at Hanford concluded, and the NRC agreed, that proglacial catastrophic flooding associated with the melting phase of glaciation would not likely occur during the 10,000-year isolation period. However, other consequences of either significantly warmer or cooler climatic trends could result in adverse environmental conditions at the Hanford Site. For example, future climatic

variations may cause increased sediment loads in the Columbia River and its tributaries, resulting in possible channel migrations. These possible adverse conditions are discussed in major comment #2 of NRC's comments on the draft EA for Hanford (NRC, 1985a) and should be considered in the defense waste Final EIS.

Appendix S, Section S.2, Radionuclide Releases to Accessible Environment, page S.6, paragraph 2

From discussions in the DEIS, it is unclear whether the drier-climate scenario is considered representative of either the Holocene (recent) climate at Hanford or of conditions drier than at present. Assumed log-normal probability density functions for annual groundwater recharge were described for both drier and wetter climate scenarios over the next 10,000 years. The drier climate scenario was assumed to have a median annual recharge of 1.5 cm, whereas the value for the wetter climate scenario was assumed to be 5.0 cm.

If it is intended that the drier climate scenario is representative of recent conditions, what is the basis for the assumed median annual recharge of 1.5 cm? On pages 4.19 and 4.20 it is stated that the annual average recharge from precipitation on the 200 Areas plateau has not been established to date, but two sets of lysimeter measurements are expected to resolve this question within 4 to 5 years. It was also stated that DOE expects that the value will lie within the range of 0.5 to 5.0 cm/yr based on data to date.

In summary, with regard to future climate scenarios, the Final EIS should contain a discussion that more clearly defines and differentiates between the terms "drier" versus "wetter." Also, more information should be included about uncertainties in assumed values for ranges and median values of future annual recharge for the Hanford Site.

Appendix S, Section S.5 Results, page S.24, paragraph 3

It is stated that the composite release-ratio/probability curves show that the in-place stabilization and disposal alternative and the reference alternative meet the EPA standard at the 99.9 percentile. This conclusion is not adequately supported.

Specifically, over the next 10,000 years, it is assumed that a drier climate scenario is nine times more probable than a wetter climate scenario (0.9 vs. 0.1; combined probability = 1.0). No basis for this assumption is given and no relevant references are cited in the appendix. This assumption biases the results of the composite release curves (Figure S.10) in favor of a drier climate with its implications of reduced recharge, infiltration, and contaminant transport. The rationale for assigning such a high probability to dryer climate scenarios should be explained in greater detail.

GEOCHEMISTRY

Appendices O, P and Q, Transport and Attenuation Modeling

The DOE recognizes that the total $K_d$ (distribution coefficient) modeling approach is a "potential technical limitation" in modeling efforts (DEIS, Vol. 3, p. O.15) which has "come under severe criticism recently" (DEIS, Vol. 2, p. xxxii) because it combines complex geochemical processes into a single empirical parameter. This methodology is used, however, because of the "limited data base" at Hanford (DEIS, Vol. 2, p. xxxii). It is the NRC staff's position that the lack of data for more complex models and codes is not, by itself, a sufficient basis for using simplifying models and assumptions. Rather, the DOE should also demonstrate that the simplified models and assumptions are sufficiently realistic (or conservative) to support the decisions to be made using them. The DEIS states that the DOE is developing more complete and advanced transport and attenuation models (DEIS, Vol. 3, pp. O.15, P.3). The DOE should use these new models to evaluate the accuracy of the simpler Kd modeling approach.

Areas of concern pertaining to the DEIS modeling methodology include the following. The DOE does not show that the Delegard and Barney (1983) $K_d$ values are directly applicable to the transport and attenuation models in the DEIS. The Delegard and Barney (1983) study illustrated the effects of certain waste components on the sorption properties of Hanford soils under specific laboratory conditions, but did not attempt to duplicate the ambient and expected site geochemical conditions at the Hanford Site. Delegard and Barney (1983) state that their $K_d$ values are valid only within the range of their test conditions and that slight changes in waste composition can change migration rates by a factor of 13 to 40. Kelmers (1984) notes that in measuring laboratory $K_d$ values it is "essential that test materials and conditions duplicate those to be encountered in the field situation being evaluated." It appears that this criterion is not met.

The contaminant transport assessment calculations do not account for all factors which can influence contaminant retardation. Changing site geochemical conditions due to spatial variation in groundwater or soil chemistry (DEIS, Vol. 3, pp. O.35, Q.9, V.9) or to the introduction of contaminants (DEIS, Vol. 3, p. O.37) will change the sorption characteristics of the Hanford Site. Kinetics of sorption-desorption reactions are not accounted for, nor is mass action competition for sorption sites. Additionally, the effect of naturally occurring organic material, which may be important in sorption and transport processes at Hanford (Toste and Myers, 1986), has not been examined. To perform a thorough transport assessment at the Hanford Site, the DOE should examine the impact of changing geochemical conditions on contaminant retardation and assess the effect of those geochemical processes not accounted for by their current methodology.

Limitations in the Hanford geochemical data base also limit the DOE to the use of contaminant release models that do not explicitly account for solubility limits as dictated by the current and expected site geochemical conditions

(DEIS, Vol. 2, pp. xxxi and xxxii; Vol. 3, pp. P.1, P.11). Release concentrations used in the DEIS are described by the DOE as being conservative estimates on the basis of data available in the literature (DEIS, Vol. 2, p. xxxii). Future release models, which the DOE states will take into account waste form release characteristics (DEIS, Vol. 3, p. P.18), should be incorporated into future impact assessment calculations.

Appendices O and U, Hanford Site Geochemical Conditions

The DEIS does not demonstrate that the ambient geochemical conditions and the composition of the tank waste have been adequately characterized to allow realistic transport assessments of contaminants at the Hanford site. To develop valid transport models and use accurate values for parameters in these models, the site geochemistry must be carefully examined and characterized. Since the DOE repeatedly cites the lack of site geochemical data (DEIS, Vol. 3, pp. O.7, O.8, O.15, U.4, and others) and uncertainty as to the composition and speciation of the tank waste (DEIS, Vol. 2, p. xxxv), the DOE should demonstrate that the site geochemical conditions are known well enough to ensure that the models and model parameters used in the impact assessment calculations are reasonable and conservative.

Appendix P, Section P.1.4, Diffusion-Controlled Release Beneath a Protective Barrier, page P.7, bullet 4

The DOE states that prior releases of contaminants (e.g., tank leaks, crib disposals, well injection) are not included in transport simulations because "most are not categorized as high-level or transuranic (TRU) waste," and those that are high-level or TRU are of negligible quantity. The DOE should take into consideration prior releases of contaminants in the transport calculations since these wastes are components of the current site geochemical conditions. Because these wastes will continue to be transported, their effects on the transport and attenuation of other contaminants (i.e., future releases of defense wastes) and their contribution to waste concentrations at site boundaries should be assessed.

Appendix V, Site-Monitoring Experience

The DEIS includes a brief discussion of current and former environmental monitoring activities at Hanford. Examples of localized contamination problems (cribs, trenches, etc.) are discussed in detail, while larger-scale contaminant plumes receive little mention. The large-scale movement of these plumes has been studied at Hanford for decades, and much has been learned about contaminant migration in the unconfined aquifer system. Some of this valuable information should be incorporated in the Final EIS. At a minimum, additions to the Final EIS should include available maps that show, for various times, the shapes and movements of various contaminant plumes known to exist in the unconfined aquifer system. This would include constituents like nitrate, tritium, I-129, Ru-106, Co-60, and Tc-99. These types of mobile contaminants show considerable promise in the continued study of flow paths for contaminant migration in the unconfined aquifer system at Hanford. The Final EIS should include a discussion of the role of large-scale contaminant plume behavior in evaluating the environmental impacts of future defense waste disposal operations.

Appendix V, Section V.5, Reverse Wells, page V.29, paragraph 2

The DEIS states that "the zone of [radiologic] contamination around the 216-B-5 reverse [injection] well appears to be [chemically] stable, with no apparent further migration of radionuclides." Results are shown for Cs-137, Sr-90, and Pu-239,240. However, a previous DOE investigation indicated that there was some evidence of contaminant migration beneath the well site, the source of which was uncertain. The following was reported by Smith (1980):

> Gamma logging showed that sediments distributed over a broad area and located just above the basalt surface were contaminated with low-level gamma contamination. Examination of previously collected gamma logs indicated that a possible source of this contamination could be the BY cribs located [approximately] 900 m north of the reverse well. This work also indicates that the contamination may be moving in a southeasterly direction.

Smith (1980) also recommended that the broad contamination plume at the basalt surface should be investigated as to its distribution, source or sources, radionuclide identity and concentrations, and that a monitoring plan be developed if required. This study showed that the position of the water table and the type of sediment to which waste solutions are discharged are important factors for controlling radionuclide distributions. The study also recommended the use of stainless steel well screens for monitoring wells. Anomalous beta activity was present on rusted portions of corroded well casings and was believed to have produced some erroneous radionuclide analyses.

This is the only reverse well for which contaminant migration has been characterized, and one could not thereby conclude that the results are statistically significant. Because of aquifer heterogeneities and the chemical variability of fluids originally injected into various reverse wells, it may not be reasonable to extrapolate these results to other reverse well locations. It is noted that zones of contamination appear to extend beyond the maximum depth of penetration of the monitoring wells. It would be useful to know to what depth contaminants may have penetrated basalts at the base of the unconfined aquifer. Previous researchers at Hanford have presented some evidence for deeper contamination. Brauer and Rieck (1973) noted the presence of I-129 in groundwater obtained from well 699-10-E12 P. The sampled aquifer was believed to be confined, and it was suggested that there had been some contamination of the groundwater since the early 1940's.

The presence of varying concentrations of contaminants that were released to the unconfined aquifer system over the last four decades provides a unique opportunity to better understand in situ solute behavior and geochemical retardation processes. Given this unique opportunity, the DOE should plan additional in situ characterization studies of this type as a means of better supporting modeling studies of contaminant transport in the unconfined aquifer system.

GEOLOGY

Section 3.3.2.5, In-Place Stabilization and Disposal Applied to Previously Disposed-of TRU-Contaminated Soil Sites, page 3.24, paragraph 1

This section states that a geophysical survey of the liquid waste sites with high subsidence potential will be completed to characterize them and to identify grout-injection points. Further discussion of the feasibility and adequacy of subsidence control should be provided in the Final EIS.

Section 4.0, Affected Environment, page 4.2, Figure 4.1

Figure 4.1 provides the general locations of the defense high-level and transuranic wastes. Figure 4.1 indicates that waste disposal occurred in the 200-W, 200-E, and 300 Areas and in the Wye Burial Ground. The DEIS should more precisely identify all waste locations at Hanford. It is further recommended that the Final EIS include additional information regarding the geohydrology, geochemistry, and geology (e.g., geomorphology, stratigraphy, and structure) of specific waste disposal areas to better characterize these sites. For example, the potential for contaminant migration in the vadose zone beneath a given disposal site cannot be reliably determined without an evaluation of actual, site-specific soil moisture characteristics and curves of pressure head versus hydraulic conductivity.

Section 4.3, Seismicity, page 4.10, paragraph 4

The existence of faulting and the possibility of fault reactivation in the waste disposal areas has not been adequately addressed. The general guideline in 10 CFR 61.50(a)(9) may be of use in discussing the potential and significance of faulting in these areas.

The referenced draft EA for Hanford (DOE, 1984) presented a generally favorable view of the tectonic setting and possible effects of tectonics on waste isolation. In the NRC's major comment #4 on the draft EA (NRC, 1985a), this view was considered to be inadequately supported by the data and analyses presented. The statements made by the NRC staff regarding the reference repository also apply to the waste disposal alternatives of this DEIS.

Section 4.3, Seismicity, page 4.10, paragraph 4

A series of sub-vertical clastic dikes has been observed (NRC, 1985b) in the trench walls at the U.S. Ecology Low-Level Waste Disposal Area, which is located in close proximity to the 200-E Area. The dikes cut across, but do not appear to offset the sand and silt strata in the trenches. They taper upward and extend from below the base of the trench to within 8 to 10 feet of the surface. They are approximately 2 to 3 feet wide at the base and several inches wide where they are truncated or pinch out near the ground surface. The dikes, which occur in other areas of the Hanford Reservation, may be related to fissuring caused by ground motion resulting from seismic activity. The

fissures were apparently filled by movement of water-saturated sediments under hydrostatic pressure, which are susceptible to liquefaction.

The presence of these clastic dikes may have significant implications for shallow land burial of low-level and high-level wastes. In the 500 to 10,000 year periods of isolation required for low-level and high-level wastes, respectively, there is a possibility that fissuring may again occur or that existing fissures may be reopened as a result of seismic activity. Existing fissures may also provide avenues for groundwater migration. The probability of occurrence as well as the significance of these fissures should be addressed. Additionally, the possible existence of these dikes within the waste disposal areas should be determined.

Section 4.7, Land Use, page 4.30

The DEIS does not address nor does it provide information on the potential for the existence of natural resources in the defense waste areas. 10 CFR 61.50 (4) requires that, for the near-surface disposal of low-level wastes, areas known to contain natural resources should be avoided. While the disposal of defense wastes is not subject to 10 CFR Part 61, the reasons for avoiding such areas remain valid. The Final EIS should provide an evaluation of natural resources, including hydrocarbon and mineral resource potential at the proposed site. This is particularly relevant in view of a natural gas discovery within sediments underlying the basalts in the Saddle Mountains area of the Hanford Reservation by Shell Oil Company (NRC, 1985a).

Appendix O, Section O.1, Stratigraphy Beneath The Hanford 200 Areas, pages O.2-O.5

The principal units that comprise the unconfined aquifer system at Hanford are discussed in Appendix O. Little information is provided on the topic of paleogeomorphology at Hanford. This topic may be of importance in developing a better understanding of flow and transport in the unconfined aquifer system.

Brown et al. (1962) provided geologic interpretations that accounted for the apparently rapid dispersal of tritium in the unconfined aquifer system at Hanford. They noted that the contaminants appear to be following old Columbia River channels incised into the eroded upper surface of the low-permeability Ringold Formation sediments. These channels are filled with more recent deposits (Hanford Formation) that have permeabilities approximately two orders of magnitude greater than in the underlying Ringold strata. It appears that the relative subcrop elevation of the Ringold Formation with respect to the water table thereby exerts considerable influence over groundwater flow paths. This may account for the observed branching (anomalous macrodispersion) of contaminant plumes migrating away from the 200 East Area. This information should be considered when interpreting the results of groundwater surveillance at Hanford and in the continued development of a groundwater monitoring program.

ENVIRONMENTAL

Several of the NRC's detailed environmental comments on the DOE's draft Environmental Assessment are applicable to the DEIS. The comment numbers are E-1, 3-30, 4-3, 4-5, 5-10, 5-11 and 6-38. These comments should be considered in preparing the Final EIS.

## REFERENCES

Beedlow, P. A., 1984. Designing Vegetation Covers for Long-Term Stabilization of Uranium Mill Tailings, NUREG/CR-3674 (PNL-4698), U. S. Nuclear Regulatory Commission, Washington, D. C.

Brauer, F. P. and H. G. Rieck, Jr., 1973. I-129, Co-60, and Ru-106 Measurements on Water Samples from the Hanford Project Environs, BNWL-SA-4478, Battelle, Pacific Northwest Laboratories, Richland, Washington.

Brown, D. J., R. E. Brown, and W. A. Haney, 1962. Appraising Hanford Waste Disposal by Integration of Field Techniques, HW-SA-2707, General Electric Company, Hanford Atomic Products Operation, Richland, Washington.

Delegard, C.H. and G. S. Barney, 1983. Effects of Hanford High Level waste Components on Sorption of Cobalt, Strontium, Neptunium, Plutonium, and Americium on Hanford Sediments, RHO-RE-ST-P, Rockwell Hanford Operations, Richland, Washington.

DOE, 1984. Draft Environmental Assessment: Reference Repository Location, Hanford, Washington, Office of Civilian Radioactive Waste Management, U. S. Department of Energy, Washington, D. C.

Executive Order No. 11988, "Floodplain Management", May 24, 1977, 42 F.R. 26951

Kelmers, A.D., 1984. Letter Report: Draft Analysis of Conservatism of Radionuclide Information Measured by Batch Contact Sorption/Apparent Concentration Limit Isotherms, L-290-3, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Lindsey et al., 1982. Long-Term Survivability of Riprap for Armoring Uranium Mill Tailings and Covers, NUREG/CR-2642 (PNL-4225), U. S. Nuclear Regulatory Commission, Washington, D. C.

Nelson et al., 1983. Design Considerations for Long-Term Stabilization of Uranium Mill Tailings Impoundments, NUREG/CR-3397 (ORNL-5979), U. S. Nuclear Regulatory Commission, Washington, D. C.

NRC, 1982. Final Environmental Impact Statement on 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," U.S. Nuclear Regulatory Commission Report NUREG-0945, Volumes 1-3

NRC, 1985a. NRC Comments on DOE Draft Environmental Assessment for the Hanford Site, Division of Waste Management, U. S. Nuclear Regulatory Commission, Washington, D. C.

NRC, 1985b. Trip Report to Richland Low Level Waste Disposal Facility and Hanford Reservation, Washington, June 25-26, 1985 (memorandum from Jose J. Valdes to Malcolm R. Knapp, July 31, 1985).