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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 26 1985

OFFICE OF
EXTERNAL AFFAIRS

Mr. Ben Rusche
Director, Office of Civilian
Radioactive Waste Management
Department of Energy
Washington, D.C. 20585

Attention: Comments - EA

Dear Mr. Rusche:

In accordance with its responsibilities under Section 309 of the Clean Air Act and the Nuclear Waste Policy Act of 1982, the U.S. Environmental Protection Agency has reviewed the nine Environmental Assessments (EA) for the characterization of nine sites in six states for possible future use as nuclear waste repositories. These sites are the Vacherie Dome (LA), Cypress Creek Dome (MS), the Richton Dome (MS), Swisher County (TX), Deaf Smith County (TX), Lavender Canyon (UT), Davis Canyon (UT), Yucca Mountain (NV), and Hanford (WA).

EPA appreciates the very difficult task that DOE has undertaken and believes that you have done a commendable job in assembling a great deal of information about the nine potential repository sites. DOE has presented this information in a workable framework for decisionmaking. We also commend DOE for its decision to publish Draft and Final Environmental Assessments for public comment, thereby assuring maximum coordination on this very complex issue.

We recognize that the DOE site comparison process is subject to numerous interpretations and that there are many possible variations for carrying out such comparisons. While we have no fundamental disagreement with the approach selected by DOE, we do have a number of specific concerns with the implementation of that approach. These concerns are discussed in detail in the enclosed specific comments for each site and can be summarized as follows:

First, we believe there is important baseline information that is missing or otherwise not fully accounted for in the initial rankings of the sites. We are concerned that this may have lead to an understatement of the site-to-site differences in both the pre and post closure rankings.

BWIP 1313
NNWSI 611
SALT 1002

Second, we are concerned with the relative importance that was given the various technical guidelines during the ranking process. Although the Environmental Assessments place slightly greater emphasis on the post-closure guidelines than on the preclosure guidelines, we believe that the difference in emphasis is too small. The site ranking should give a more substantial precedence to the postclosure set of guidelines. In addition, we believe that, among the technical guidelines related to postclosure performance, the Environmental Assessments should give greater emphasis to those guidelines which most strongly affect long-term isolation. Instead, the EAs give equal consideration to each of the postclosure technical guidelines. This gives factors like climatic changes, erosion, and tectonic activity -- which are very unlikely to have any significant effect on waste isolation at these sites -- equal status with such critical factors as geohydrology and geochemistry.

The details supporting these issues and suggestions for improving the analyses in the final EAs are given in our enclosed specific comments. If you have any questions concerning these comments, please let me know or call Dr. W. Alexander Williams (382-5909) of my staff.

We appreciate the opportunity to review these documents and look forward to reviewing the final EAs.

Sincerely,

David E. Davis, Acting Director
for Allan Hirsch
Director
Office of Federal Activities

Enclosures

General Comments of the U.S. Environmental Protection Agency
on the Environmental Assessments for Characterization of
Nuclear Waste Repositories

Differences in Geohydrology and Rock Characteristics

Table 1 summarized the Draft Environmental Assessments' estimates of groundwater travel time to the accessible environment for the five sites considered for comparative ranking: Hanford, Yucca Mountain, Deaf Smith County, Davis Canyon, and the Richton Dome. As indicated in the Table, EPA has two observations regarding these travel times. First, for both of the nonsalt sites, we are aware of many travel time estimates that are lower, including those prepared by the Nuclear Regulatory Commission. Furthermore, EPA has assumed substantially faster groundwater travel estimates in the generic performance assessments of basalt repositories that have been done to support development of 40 CFR 191. These less optimistic estimates reflect the uncertainties in the basic geohydrological parameters and models for groundwater flow for basalt and tuff.

On the other hand, the Draft EAs assume a Darcy flow model (porous media) for groundwater flow through salt to arrive at travel time estimates for the three salt sites. We know of no reason to assume that groundwater flows through undisturbed salt deposits as if the salt was a porous media, and the corresponding travel time estimates for the salt sites appear to be related to a decision to do comparative travel time calculations. If groundwater flows normally through salt formations at all, the travel time estimates in the EAs are probably substantially underestimated. On the other hand, anisotropic or abnormal flow at the salt sites may exist; the possible presence of abnormal conditions complicate flow time estimates.

Table 2 continues the geohydrology comparison by considering groundwater flow rates past the repository horizon before repository construction. The approximate calculations for basalt and tuff are based on geohydrological data presented in the EAs. Table 2 also indicates how a repository containing high-level waste might interact with the characteristics of the geologic media to affect these groundwater flows. The conclusion of this comparison is that, under actual repository conditions and barring catastrophic failures, only the Hanford site appears to have the potential for substantial groundwater flows past the emplaced radioactive wastes. In discussing the geochemistry guideline, DOE acknowledges this observation on page 7-21: "At Yucca Mountain and the salt sites, the potentially adverse condition [for geochemistry] is not found because so little water is expected." (emphasis added) We believe this comparative finding is particularly important because groundwater flow is by far the most likely pathway for long-term release of these wastes to the environment.

A final issue relative to geohydrology is whether the groundwater sources close to the repository site contain enough water of adequate quality to potentially support a significant number of groundwater users. This is important because the presence of groundwater provides the only viable mechanism for transporting radionuclides from the repository to people. Furthermore, the presence of groundwater might attract people in the future. This would not only increase the population density around the repository but the presence of groundwater might lead people to inadvertently disturb the emplaced waste.

Relative Emphasis on Postclosure and Preclosure Guidelines

As the Department of Energy (DOE) was developing the general guidelines (10 CFR 960) that are the basis for the Draft Environmental Assessments (EAs), EPA recommended that "the Guidelines most important to long-term environmental protection should be the primary basis for site selection" and that "guidelines related to relatively near-term concerns should receive much less emphasis."

Although it is most easily seen in the "utility estimation ranking method" of aggregating the ratings -- where postclosure and preclosure guidelines were weighted in the ratio of 51 to 49 -- it is clear that all three methods of aggregation used in Chapter 7 treat postclosure and preclosure guidelines approximately equally. This approach is not consistent with the intent of giving meaningful precedence to the postclosure guidelines in the rankings.

Relative Importance of Guidelines Within the Postclosure Set

Finally, EPA believes that those guidelines that have the most significance to long-term isolation of these wastes should be given greater consideration in the comparative evaluation. Geohydrology should be the most important criterion, since migration through groundwater is the greatest threat that these wastes present to the environment. Geochemistry is important, since it can compensate for less than optimum geohydrology -- but it should be less important than geohydrology itself. If the geohydrological conditions at a site do not provide significant amounts of groundwater, then geochemistry will not be a significant factor. Rock characteristics are important because they affect the media's long-term response to the stresses imposed by a repository, as indicated in Table 2. For example, the tendency of salt to plastically deform to close fractures enhances its potential to keep the wastes isolated from groundwater. Beyond these three guidelines, the only other that might receive special emphasis is Natural Resources, because such resources could attract inadvertent human intrusion into a repository if markers and records are not completely effective. The remaining five guidelines in the postclosure set should receive comparatively less emphasis because they are much less likely to affect long-term isolation of the wastes.

Transportation Issues:

The discussion of transportation modes is inconsistent, describing all modes, but only discussing highway and rail transport in any depth. Other modes and the reason they are not considered should be discussed. Barge transportation may be appropriate for those sites near waterways.

Editorial Comments:

The basic format of the EAs is good but leads to redundant information spread between different chapters and sections. We recommend that cross-references be put into the different chapters and the repetitive material be deleted.

The nonstandard double page format is extremely inconvenient. We recommend that the final EAs be reformatted into a standard format.

Table 1: GROUNDWATER TRAVEL TIME COMPARISONS

Site	Estimate from Environmental Assessments	EPA Comments
Hanford	17,000 to 86,000 years	Substantial uncertainties in the data and models used for these estimates. Many other estimates, including those in generic EPA analyses, are shorter --e.g., a few thousand years or less.
Yucca Mountain	25,000 to 55,000 years	Substantial uncertainties in the data and models used for these estimates. Significantly shorter travel times may be possible.
Davis Canyon	130,000 to 160,000 years	EA assumed Darcy flow, which is not expected in salt formations. If normal groundwater flow occurs at all, travel times are likely much longer than this. If anisotropic conditions exist, travel time could be much faster.
Deaf Smith	87,000 to 361,000 years	EA assumed Darcy flow, which is not expected in salt formations. If normal groundwater flow occurs at all, travel times are likely much longer than this. If anisotropic conditions exist, travel time could be much faster.
Richton	more than 107,000 years	EA assumed Darcy flow, which is not expected in salt formations. If normal groundwater flow occurs at all, travel times are likely much longer than this. If anisotropic conditions exist, travel time could be much faster.

Table 2: GROUNDWATER FLOW COMPARISONS

Site	EPA Assessment of Pre-Emplacement Flow Through Repository	Probable Effects of Loaded Repository on Groundwater Flow Through Repository Horizon
Hanford	small, less than 1,000 cubic meters per year[1]	Thermal stress effects on host rock and larger gradients due to thermal buoyancy are likely to increase this pre-emplacement flow substantially, perhaps by several orders of magnitude.
Yucca Mountain	small, less than 1,000 cubic meters per year [2]	Heat from emplaced waste is likely to evaporate water percolating through unsaturated zone, reducing flow to nearly zero for a long period of time. No mechanism to increase the pre-emplacement flow is known.
Davis Canyon	very small, approaching zero	Plastic flow of salt is likely to compensate for thermal stress effects, preventing creation of significant groundwater flow, although presence of some non-salt interbeds might complicate this process.
Deaf Smith	very small, approaching zero	Plastic flow of salt is likely to compensate for thermal stress effects, preventing creation of significant groundwater flow, although presence of some non-salt interbeds might complicate this process.

Richton	very small, approaching zero	Plastic flow of salt is likely to compensate for thermal stress effects, preventing creation of significant groundwater flow, although presence of some non-salt interbeds might complicate this process.

NOTES: 1 Estimated using a hydraulic conductivity within the basalt flow of 10^{-10} meters per second, a gradient of 10^{-3} meter per meter, and a repository cross section on the order of 10^{7} square meters.

2 Estimated using a flux of 1 mm/year, a porosity of about 0.1, and a repository cross section on the order of 10^{7} square meters.

U.S. Environmental Protection Agency

Detailed Comments on the

Davis Canyon and Lavender Canyon Sites, Utah

SUMMARY

The close proximity of the Paradox Basin Sites to Canyonlands National Park presents a conflict unique to these two potentially suitable sites. Increased noise, dust, night light interference, and visitor use conflicts along the only park access road are significant problems with these sites. The State of Utah has indicated that a PSD permit will likely be required, however, characterization activities will violate Class I particulate emissions in the Park. These and other conflicts appear to directly conflict with the Congressional intent in preserving the Park unimpaired for future generations. If DOE readjusts the site rankings, this incompatibility with the adjacent National Park should be given additional emphasis.

A number of geological features are adjacent to these sites which raise significant questions on the geologic stability of the area. These features include breccia pipe collapse structures, geo-pressured zones in the salt interbeds, active faults, and active salt slips. In view of these nearby features and the difficulty in assuring the lack of interference by similar features near the sites, characterization of these sites would be exceedingly difficult. DOE's ability to firmly establish that all applicable criteria can be met for these sites will be more costly and technically burdensome than other sites.

The remoteness of the Utah sites includes a lack of community infrastructure to support characterization activities, therefore socio-economic impacts would be greater for these sites than any other.

Air, Water, Noise and Night Light Impacts

Air resources

Air resources in the vicinity are remarkable for their currently pristine conditions. The average annual particulate concentration in the area is less than 21 ug/m3. Oxides of sulfur and nitrogen are not present except in very minor amounts due to some long distance transport from industrial activity in California. The visibility in the region often exceeds 100 miles and long distant views of the La Sal and Abajo Mountains are popular among tourist photography. The light sandy arid soils at these sites readily generate fugitive dust when the stabilizing cryptogramic organisms are the least bit disturbed. Cryptogramic communities are the slow growing combination of algae, fungus, and bacteria that stabilize the sand.

The modeling of TSP emissions indicates violations of the 24-hour National Ambient Air Quality Standards (NAAQS). Both the primary and secondary 24-hour standards would be exceeded off-site adjacent to the Lavender Canyon and the Davis Canyon sites. Annual estimates of TSP emissions were not provided. Annual concentrations of NOx were predicted to be below the NAAQS. These annual average impacts were derived from short-term values using Larsen's transform. The Larsen transform method provides an approximate estimate for environmental assessment purposes, however, it is no longer an EPA-approved method for regulatory analyses.

The environmental assessments contain little detail in the modeling, emission factor assumptions, and emission data. The air quality analysis was performed with the ISCST model for the short-term low-level emissions. An ISCST model was selected for its ability to calculate deposition of total suspended particulates or TSP. This method is appropriate for ground level TSP sources and vehicular-generated oxides of nitrogen (NOx). This modeling procedure, however, does not adequately account for the effects of elevated buoyant-point sources such as the concrete batch plants and diesel turbines. The emissions from these buoyant-point sources may affect the lower surrounding elevation areas even though stable night-time conditions may suppress ground level emissions.

The ISCST modeling performed only analyzed low wind speeds during stable and neutral conditions. Higher wind speeds and the associated high emission potential for fugitive TSP emissions during neutral conditions should have been analyzed. This is to determine the effect from the higher emission rate and the greater distances that air borne fugitive TSP will travel before settling.

The assumption used for the emission rates and efficiency of controls are not included in the environmental assessment. Since watering of roads will occur to reduce fugitive dust, credit was taken in the modeled emission rates for road wetting reduction. There is no reference, however, to the control efficiency claimed nor of the uncontrolled emission rate factors of unpaved roads. There was no analysis of the cement plant emissions. Emissions from the turbines show high TSP (about 22 pounds per day) which indicates fuel oil firing yet SO2 emissions are not evaluated. There is no indication if the internal combustion engines were modeled at 100 per cent load. When internal combustion engines are not operated at full load, CO emissions increase

rapidly while NOx emissions decrease. Therefore, unless the internal combustion engines operate at full load continuously, it is likely that significantly higher CO emissions will result.

DOE recognizes that additional on-site meteorological data should be obtained to predict the air quality effects. The close proximity to the National Park and the difficulty in defining worst case conditions using predictive models, require the use of on-site surface and upper meteorological data. We recommend that this data be obtained and analyzed.

Surface and Groundwater Resources

Surface water resources are limited in the area to the ephemeral flows in Davis and Lavender Canyons both of which join the larger perennial stream in Indian Creek. Indian Creek does not contain a fishery or aquatic resources of regionally significant value, however, the small pools in Indian Creek provide swimming recreation in an otherwise desert terrain. The lower portion of Indian Creek has been designated as a wilderness study area by the Bureau of Land Management. Indian Creek should be protected from large increases in sedimentation which could fill the small swimming holes. Salt loading to both Indian Creek and the main Colorado River should be avoided where economically practical and feasible. The effects to Indian Creek and the Colorado River from properly designed and operated salt and salt-contaminated waste disposal piles would be inconsequential. The effects upon salinity in Indian Creek and to the Colorado from a discharge of overflow from the salt mud pits could be noticeable but would not create any significant effects.

Groundwater in the area is limited in use since production rates are low. The National Park Service operates two wells for potable water at the Park entrance and at Squaw Flats Campground. These wells are completed in the Cedar Mesa Sandstone and the top of the Elephant Canyon Formation. The Cedar Mesa aquifer and the upper portion of Elephant Canyon aquifer are classified as Underground Sources of Drinking Water (USDW) under the provisions of the Safe Drinking Water Act. The USDW includes all of the Cedar Mesa Sandstone and that portion of the Elephant Canyon Formation containing water less than 10,000 parts per million total dissolved solids.

Noise Issues

The ambient sound level in the area is at the lower range of detectable sound -- less than 20 dBA. The area is marked by a noticeable absence of industrial sounds and the current noise intrusions are limited to occasional recreational vehicular traffic.

EPA is concerned that the noise impact analysis in the Environmental Assessment focuses primarily on annoyance as a function of sleep disturbance and speech interference, and not enough on the audibility or detectability of noise associated with development and operation of the waste repository. In primitive areas such as Canyonlands National Park and the Wilderness Study Areas nearby, audibility must be the prime criterion for evaluating

the noise impacts of man-made activities. In 1977, the National Academy of Sciences Committee on Hearing, Bioacoustics and Biomechanics (CHABA) stated that for ". . . critical land uses requiring special consideration, the hourly average sound level (Lh) due to the new intruding noise should not be allowed to be higher than 5 dB below the existing hourly average sound level." ("Guidelines for Preparing Environmental Impact Statements on Noise," 1977). The minimum hourly Leq measured in the study area (presumably in the Park) was 20 dBA. Thus, an hourly Leq of 15 dBA is correctly used in the Environmental Assessment as the audibility threshold.

The Environmental Assessment discussed the 15 dBA Leq in the preliminary evaluations of audibility in Chapters 4 and 5, but fails to analyze the extensive impact and incompatibility of construction, transportation and industrial noise with the legislative purposes and values of the park. For example, Section 4 of the Environmental Assessment indicates that under worst case assumptions, 14% of the total annual number of Park visitors would be within audible range of machine noise during the site characterization phase of the project. This estimate does not include blasting noise, helicopter noise during exploration or transportation noise. Looking at traffic noise, the Environmental Assessment estimates that traffic on State Highway 211 will increase from about 45 vehicles a day to 500 or more daily round trips (1000 + vehicles), including 26 heavy truck round trips. Despite all of these impacts, the Environmental Assessment suggests that areas outside the 35 Ldn contours are not expected to be affected by noise from the repository. Actually, the public will hear traffic and machinery noise, blasting and possibly helicopter overflights while visiting Canyonlands and nearby undeveloped primitive areas.

The expectations of many Park visitors include getting away from people and the noises of civilization to enjoy what the U.S. Forest Service defines as semi-primitive and primitive recreational opportunities ("Predicting the Impact of Noise on Recreationalists", April, 1980). These semi-primitive and primitive environments are characterized by natural sounds and the absence of man-made sound intrusions, especially those propagated over large distances. The Forest Service goes on to say that in the most primitive areas, "mechanical . . . sounds are inappropriate."

Because of this conflict between visitor expectations and the mandate of our national parks and wilderness areas on the one hand, and machinery and industrial noise on the other hand, the projected audible noise impacts from the repository appear unsuitable for the environment of Canyonlands National Park.

Night Sky Observation

One amenity of the area as a result of the absence of a nearby industry or community is the clear night sky. With infrequent cloud cover, night-time observation above the horizon is usually unaffected by interfering refraction from illumination sources. The predicted effect from the repository glow is roughly equivalent to the interference of a full moon except the amount of sky impaired is less than that of the full moon. In addition to causing a perceptible glow in the night sky, the light from characterization activities

is predicted to cause interference with the viewing of some stars and the Milky Way galaxy. Magnitude six stars which compose a large portion of the Milky Way, would be obscured in the eastern half of the sky. The high intensity illumination at the proposed sites would also reflect from the high canyon walls and become visible from major scenic vistas; particularly the Needles Overlook recreational area. (See "Impacts of a Proposed Nuclear Waste Facility on the Night Sky in Canyonlands National Park", Systems Applications, Inc, February, 1985, prepared for the National Park Service.)

Permits Needed

NPDES Discharge Permit

National Pollutant Discharge Elimination Permit (NPDES) issued under the authority of Section 402 of the Clean Water Act, (1972 as amended) would be needed for the planned discharge of overflow from the salt mud holding pits. During characterization activities, 6.5 acres of lined pits are necessary to hold the large volume of salt-saturated muds. We would expect that these ponds would be located outside the probable maximum flood area within the canyon or that the outside edges of these impoundments would be protected from flood erosion. Overflows from these pits would be directed to an evaporation/retention pond. According to the environmental assessment, water will be discharged from the evaporation/retention pond only if it meets applicable discharge standards. Under the provisions adopted by the Colorado River Salinity Forum for discharges into the Colorado River, EPA is obligated to review NPDES permit applications to determine if economically practical measures to reduce salt loading have been considered. Under these procedures, Region VIII analyzes any point source capable of discharging over one ton of salt per day to determine if economically practical means are available for further salt reduction. Permit procedures require applications 180 days before the expected discharge and a public notice of availability of the permit and opportunity for public comment.

UIC Permit

An Underground Injection Control (UIC) permit issued by the Utah Department of Health would be needed for the proposed underground disposal of saturated brines and brine muds. EPA has delegated its authority to administer the UIC program under the Safe Drinking Water Act to the Utah Division of Oil, Gas and Mining for oil and gas-related injection activities (Class II wells) and to the Department of Health for industrial, municipal, and other injection activities (Class III, IV and V wells). (Class I wells cover hazardous waste injection which is prohibited under the delegated Utah program.) Although the disposal of brine wastes is a common practice in the oil and gas industry in Utah, it is important to note that the planned disposal of brine from this action is not related to oil and gas activity and therefore would not be considered a Class II well. The significance of this is that an operating Class II brine waste injection well is not permitted for brine waste disposal from other activities. Class V wells are normally authorized by rule under the UIC program except in situations where the

injection has the potential for endangering an underground source of drinking water. Given the salinity of the waste, a permit would most likely be required. Several existing brine injection wells are in operation in nearby Lisbon Valley but additional permitting would be required by the Department of Health to convert such wells for the planned disposal. Permit requirements emphasize assurance of mechanicl integrity of the well and protection of Underground Sources of Drinking Water which are aquifers containing less than 10,000 pars per million total dissolved solids.

PSD Permit

It is possible that CO emissions could be greater than 250 tons per year and therefore possibly subject to the Prevention of Significant Deterioration (PSD) process if so determined by the State of Utah. Given the unusually long construction period of five years for characterization activities, the normal exclusion for temporary sources may not apply. If the State of Utah declares the facility a PSD source, this will trigger the baseline increment analysis process. The Class I 24-hour TSP increment is 10 ug/m3. The DOE air quality analysis shows, even with the limitations noted previously, a concentration of at least 25 ug/m3 extending two miles into the National Park. All planned mitigating measures are accounted for in the modeling analysis and there is little opportunity for addition source control, therefore a violation of the Class I short-term TSP increment at Canyonlands National Park will be difficult to prevent.

Waste Rock Disposal

Page 4-4: The use of either synthetic or clay liners is appropriate to prevent salt migration into the subsurface. Salt will crust over if a wetted surface is maintained on an undisturbed pile. However, pile disturbance will continue as the material is placed on the pile by truck or conveyor. To minimize the particulate emissions, close attention to salt pile wetting will be necessary.

Page 4-61: For the purposes of environmental protection of surface and ground waters, the waste salt and salt-contaminated rock will be removed from the site and disposed elsewhere. Table 4-18 indicates that this waste material will transported over 160 miles to a permitted landfill either in Grand Junction, Colorado, or Farmington, New Mexico. Once at either of these sites, the waste salt material must still be contained in a manner to protect surface and ground waters. Since state authority and Federal authority under Subtitle C of the Resource Conservation and Recovery Act will require a suitably engineered facility for this disposal, there is no apparent environmental advantage to remove these salt wastes and still be confronted by similar problems of isolating the material from surface and ground waters. In addition, the estimated 4476 truck loads necessary to transport this material will further aggravate traffic problems on the narrow access road into the park. EPA believes alternatives for salt and salt-contaminated rock disposal should include on-site disposal.

Site Use Conflicts With Canyonlands National Park

Failure to cite Congressional purposes for Park designation

Significant adverse effects of characterization activities include increased air emissions, noise interference, and night light effects within Canyonlands National Park. The draft environmental assessment does not appropriately describe the values Congress intended to provide by designating Canyonlands National Park. In establishing the National Park in 1964, the Congressional enabling legislation states that the area was set aside to preserve "superlative scenic, scientific, and archaeologic features for the inspiration, benefit and use of the public." (78 Stat. 934). Congressional records describing the area state: "Nowhere else is there a comparable opportunity to view a colorful, exciting, geologically significant wilderness from above, and then get down into its midst -- and still not lose the atmosphere of remote wilderness." (House of Representatives Report Number 1823, 88th Congress). Congressional reports also mention areas outside the park boundaries, particularly noting that the Six Shooter Peaks are among features which the Congress anticipated to be "landmarks for centuries to come." (Senate Report Number 381, 88th Congress). The proposed site at Davis Canyon is at the base of South Six Shooter Peak. At the time Congress was considering park designation, there was considerable debate on the possibility of extending the boundaries of the park from "rim to rim" including the land between Newspaper Rock and the present park boundaries. One reason this did not occur was that the only competing land uses known at the time were grazing and unsuccessful uranium exploration. As a matter of historical prospective, it is important to note that the first Mormon pioneers in the area in the 1890's were particularly impressed with the majesty of the Six Shooter Peaks. The first drawings of the area depict these prominent landmarks as central features of the remote and nearly inaccessible area.

Since the environmental assessment does not fully describe the values protected by the park, the document fails to analyze protecting these values in a consistent and adequate manner. Consider for instance, that the night lighting effects analysis correctly compares the night sky observation interference to the important pristine wilderness conditions enjoyed by park visitors. However, the noise analysis focuses primarily upon speech and sleep interference and not upon the conflict presented by this major industrial activity in this currently pristine wilderness.

Conflicting social values between wilderness preservation and industrial use

The environmental assessment states on page 5-81 that "Canyonlands could lose some tourists who would have come for a wilderness experience at the park. The project's presence may have an adverse effect on visitors who seek a wilderness experience adjacent to the proposed site." The effects within the park are not the only effects park visitors will notice. Visitors may also avoid park visits because the access to both the repository and the park is along the same narrow corridor adjacent to Indian Creek. Currently, the access road from State Highway 163 is used exclusively to visit either the State Park at Newspaper Rock, Canyonlands National Park, or the adjacent

recreational lands administered by the Bureau of Land Management. Visitor awareness of effects within the park are important but of potentially equal importance to a park visitor is an awareness of industrial activity along the same access road into the park.

The final environmental assessment must include a more complete description of the values Congress intended for preservation is this remote canyon area. Revisions to the environmental assessment should include an analysis of the multiple values preserved within and near the sanctuary provided by the park and the likely conflict that visitors will observe by locating a repository near the entrance to the National Park.

Air Quality Impacts on the National Park

The modeling of TSP emissions indicates violations of the 24-hour National Ambient Air Quality Standards (NAAQS). Both the primary and secondary 24-hour standards would be exceeded off-site adjacent to the Lavender Canyon and the Davis Canyon sites. The modeling only analyzed low wind speeds during stable and neutral conditions. Higher wind speeds and the associated high emission potential for fugitive TSP emissions during neutral conditions should have been analyzed.

If the State of Utah declares the facility a PSD source, this will trigger the baseline increment analysis process. The Class I 24-hour TSP increment is 10 ug/m3. The DOE air quality analysis shows a concentration of 25 ug/m3 extending about two miles into the National Park. All planned mitigating measures are accounted for in the modeling analysis and there is little opportunity for additional source control. Therefore, a violation of the Class I short-term TSP increment at Canyonlands National Park will be difficult to prevent.

Night sky observaton interference with park and wilderness values

The predicted effect from the repository glow within the National Park is roughly equivalent to the interference of a full moon except the amount of sky so impaired is less than that of the full moon. In addition to causing a perceptible glow in the night sky, the light from characterization activities is predicted to cause interference with the viewing of some stars and the Milky Way galaxy when seen from Squaw Flats Campground. The high intensity illumination at the proposed sites would also reflect from the high canyon walls and become visible from inside the park as seen from the upper end of Davis and Lavender Canyons.

Need to monitor groundwater in the Park

The boundary of Canyonlands National Park is one thousand feet west of the proposed Davis Canyon Geological Repository Opertions Area. The probable direction of ground water is in this same direction; west-southwesterly flow for the lower hydrologic unit and northwesterly flow for the upper hydrologic unit. The conventional pattern to locate monitoring wells around such a setting is to include multiple well locations in the down gradient direction and fewer well locations up gradient. As noted in EPA comments on

deficiencies in the planned characterization studies, the proposed drilling pattern for the Davis Canyon is not consistent with this conventional pattern since only one of the five well locations is west and down gradient. DOE acknowledges the scarcity of data on the regional geologic system and the large distances between existing deep borehole locations. It is therefore likely that information needed for geologic interpretations can only be obtained by borehole locations inside the park. The final environmental assessment should specifically state whether drilling activities in the park are essential.

Effects of heat-induced uplift

The draft enviromental assessment provides a prediction that waste heat would create and uplift the surface of up to one meter decreasing gradually over a two or three mile radius. The ground water supply for Squaw Flats Campground and the park maintenance grounds is provided by the weakly producing Cedar Mesa sandstones. The few springs that emerge from the Cedar Mesa Formation also provide essential wildlife habitat. Groundwater within this upper hydrologic unit may be fracture-controlled and is likely to be affected by any additional fissuring. An uplift even of this small magnitude could alter these ground water resources. These potential effects should be analyzed in the final environmental assessment.

Potential conflicts with the "controlled area"

Since EPA's nuclear waste standard has not been promulgated, we agree it is difficult to specifically define the "controlled area." The exact location of the "controlled area" is also dependent upon information obtained during characterization and cannot be shown at this point in the process. Even though the exact location of the "controlled area" cannot now be developed, the final environmental assessment should definitely address whether the Davis Canyon site would be disqualified if the "controlled area" includes lands within the National Park.

Mitigation of Characterization Impacts

Fugitive dust control

As noted in the discussion of air quality impacts on the National Park, particulate emissions are predicted to exceed the primary and secondary NAAQS and short-term Class I increment in the park. Particulate emissions are also expected to impair visibility to some extent inside the park. Additional fugitive dust control would help reduce these concerns and is a likely area for additional mitigation techniques. Chemical soil binders in addition to the planned road wetting could further reduce road dust sources. A complete cover over the salt and salt-contaminated rock piles would further inhibit dust emissions. The extreme aridity of the area requires that fugitive dust control be a constant, continous activity.

Additional noise control

Noise reduction could considered in the purchasing and placement of major diesel engine locations. Noise control requirements similar to those used by the General Services Administration for construction sites should be written into the construction contracts. These requirements define pre-established sound level limits. If field measurements indicate that the established limits are being exceeded, the contractor is required to cease operating the particular piece of equipment and repair it or replace it with equipment which complies with the established limits. (Handbook of Noise Control, Harris, 1979, pp. 31-3 & 31-4) Mitigation will needed to be developed for the large generators and other pieces of stationary equipment located at the repository site. Noise barriers around these facilities could be constructed from the waste rock available once characterization begins. Carpooling, vanpooling and busing of workers into the site should be required to reduce the amount of traffic noise and congestion. The acoustic blankets mentioned in the Environmental Assessment for reducing the propagation of blast noise should be required. In short, every effort should be made to keep the noise from the Repository confined within the project boundaries in order to protect the special character of Canyonlands National Park and other nearby primative recreational areas.

Infrared security lighting

Twenty-four hour security lighting has been shown to interfere with the park visitors ability to clearly see the eastern portion of the night sky. Given the isolation and lack of access roads into the area, perhaps security lighting areas can be reconsidered and eliminated if determined to be non-essential. The use of alternative light sources, such as infrared equipment, should be considered to further minimize night light effects.

Non-discharging salt mud pits

As currently planned, the large salt mud pits associated with shaft sinking could discharge during a major storm event. Such planned discharges to water of the United States require NPDES permit approval issued by EPA Region 8. These discharges could effect the limited biota in Indian Creek and would increase the salt loading on the Colorado River. While such an impact would be minor, the location of an adequately designed overflow structure could prevent such discharges and the saline water could be used for salt pile dust control or used on roads to control fugitive dust.

Engineered facility for salt disposal on-site

As previously noted, the transport of salt and salt contaminated rock away from the sites increases the noise and traffic problems along the narrow canyon route. Transporting these wastes elsewhere and subsequent disposal in a landfill still requires an engineered landfill constructed to meet the provisions of Subtitle C of RCRA. Temporary storage on-site is to include an impermeable liner of either synthetic material or clay. The installation of a permanent cover over a properly engineered landfill could complete the permanent placement of these non-hazardous wastes. Alternative landfill designs and landfill locations less distant from the sites should be further evaluated. Alternatively salt could be used for road salt purposes.

Geological Suitability

Page 18: The environmental assessment notes that the ground water travel pathway is expected to be downward, away from the surface, because of the downward hydrologic gradient at the site. Consideration must be given to the possibilty for ground water flow vertically upward due to the apparent geo-pressured zone which may exist within the middle hydrological unit (test interval 14).

Page 2-15: The Rock Characteristics guideline (960.5-2-9(d)), is summarized in Table 2-4 and indicates that potential hazards to personnel during repository construction, operation, and closure include gas pockets, brine pockets, and water flow. The environmental assessment concludes such potential hazards have either not been found to date at the sites or can be mitigated by proven mine safety and engineering practices. Has DOE considered the occurrence of such hazards at other nearby mining operations in the Paradox Formation? Near Potash, Utah, the mining history includes methane gas explosions and rapid mine flooding. This mine had several methane explosions during the late 70's which resulted in shifting recovery techniques from conventional room and pillar excavation to in-situ recovery. Paradox Formation wells were allowed to flow into the mine and the mine was flooded in a two week period rather than the predicted six month period due to unexpected high flow rates from these wells. This should be noted in the environmental assessment.

Page 3-36: In the discussion of dissolution in Lockhardt Basin, there is no discussion of the presence and role of breccia pipes. Breccia pipe are collapse structures initiated by faulting or by cavern collapse which are propogated upwards by dissolution of salt removed by ground water flow. This phenomenon has accured at Lockhardt Basin where over 20 breccia pipes have reached the surface. These upwardly migrating collapse structures have traversed entirely through the Paradox Basin section, a distance of over 5000 feet.

Page 3-36: Section 3.2.5.1 indicates that seismic data was used to identify faults in the northern part of Davis Canyon. It would be useful to include a map showing the location of the seismic lines used in this evaluation. There should also be an indication as to whether all the available private seismic data was used in this analysis. If not, any additional data within 20 miles of the site should be purchased and analyzed, if available.

Page 3-40: The seismicity data of the Paradox Basin from 1962 to 1983 (Section 3.2.5.2) should be analyzed to determine if there are any statistically supportable seismic trends in the region other than the Colorado River linement. Figures 3-21 and 3-22 show at least one seismic belt between the river and the site with several trends that may run perpendicular to the river. The seismic discussion should be expanded to discuss the possible relationship between the regional structure (faulting, fracturing, etc.) and the seismic activity. Some information on lineation of major surface fractures features should be discussed. A map showing fracture traces from as many locations as possible should be included.

Page 3-50: The discussion on salt dissolution and collapse in the Lockhardt Basin does not address a major issue. Are there areas of dissolution which have not collapsed? There should be some additional data and discussion which better addresses this issue. It is possible that high precision gravity surveys in the site area would show the presence of collapsed features at depth which have no surface exposure. The difference in the density of the collapsed feature and the host rock should be sufficient to show up as a gravity anomaly. Seismic surveys run so that several lines intersect is a more reliable means of detecting such features. A single seismic line may not have sufficient resolution. A preferable option is to run both seismic and gravity surveys to allow for cross correlation.

Page 3-54: The section on rock characteristics should be expanded to include estimates of the fracture gradients of the various units listed in Table 3-1. If no actual fracture test data is available from oil test wells in the area, estimates should be obtained using the data on Poisson's ratio and the formation pressure data. A method for such estimates has been proposed by Anderson, et al. in the Journal of Petroleum Technology (November, 1973). Fracture information is needed to evaluate the ability of the formations to fracture during thermal expansion of the repository site.

Page 3-71: The environmental assessment indicates that concentrated and overpressurized brines have been encountered in the Paradox Basin. However, the environmental assessment states that "all of the reported occurrences are away from Davis Canyon and from stratigraphically deeper zones." However, Interval 14 in Borehole GD-1 appears to show a geopressured zone with a potential head to elevation 5575. It is not clear why this data point is considered unrepresentative solely because of low recovery rates. How was it determined that the samples were not valid? The data collected on these zones should be presented with a discussion which qualifies their validity. Some data from other oil test wells should also be presented.

Page 3-72. Water chemistry from the upper hydrological unit shifts from $CaCO_3$ to NaCl-type brines in the lower part of the section. Among the interpretations suggested for the sodium chloride concentrations is that salt dissolution may have occurred or is continuing in the area. (McCulley, et.al. 1984.) Since salt dissolution and its attendant potential for collapse-induced changes in permeability could alter the characteristics of the upper hydrologic unit, what studies are planned to ascertain the source of NaCl in these waters? EPA suggests that efforts be made to identify if a geochemically discernable differences can be used to answer this fundamental question.

Page 3-129: The Tables presented in the groundwater section of Chapter 3 show wide variance in the existing hydrologic data. For example, Table 3-11 indicates a mean permeability of 2.5 millidarcies for the Middle Hydrostratigraphic Unit whereas Table 3-13 shows values of 0.0035 to 0.0001 millidarcies for the Paradox and Pinkerton Trail Formations, respectively.

Page 3-133: Table 3-12 shows one static reservoir pressure value (Upper Paradox) which is listed as questionable because of its inconsistency. In fact, there area several values which may be inconsistent such as test

intervals 6, 7, 17, 11, and 10. These results and their significance should be discussed in more detail. As an aid to understanding the regional system, a table showing all the drill stem estimates of permeability and shut in pressure results for oil test wells in the area should be included and discussed. This should include data from the Lisbon Valley field. Leadville permeability in the Lisbon Field has been recorded as high as 1100 millidarcies. If possible, the additional data should be used to verify the results at GD-1. Of special note is the need for additional data to verify that the Pinkerton Trail and Molas Formations are likely to be unfractured in the vicinity of the sites. An examination of the logs of some of the oil test holes should provide some insight on porosity and, perhaps indirectly, permeability.

Page 3-139: The discussion on page 3-139 indicates that the Leadville Limestone has permeability ranging from $2x10^{-2}$ to $2x10^{-3}$ millidarcies. This is not borne out by Table 3-12 which shows values from 1 to 25 millidarcies. In addition, communication with oil experts familiar with the area indicates that the Leadville has values of permeability in excess of 1000 millidarcies. This discrepancy needs to be clarified.

Page 3-141: Discharge areas are not shown on Figure 3-40 for the Lower Hydrostratigraphic Unit (as identified in Figure 3-39 for the Upper Hydrostratigraphic Unit). Is any discharge from the lower unit believed to occur in the vicinity of the site? In 1966, a USGS reconnaissance survey mapped a saline spring in Dark Canyon (25 miles southwest of the site) as a discharge from the Leadville Limestone. This should be shown in figure 3-40. Additional study efforts should consider the potential for faulting between the site and Dark Canyon which could provide an avenue for flow in the Leaville to move to the surface. Given the sparsity of the data and its variability, the use of the average parameters does not appear to be statistically supportable.

Page 3-143: The environmental assessment provides estimates of groundwater flow rates in the strata above and below the repository rock using the concept of average linear velocity assuming Darcian flow conditions. This is not a reasonable approach given the fracturing apparent in these strata (see pages 3-131 and 3-137) and the variability of solution features. Many of the assumptions made in the analysis are neither conservative nor worst case.

Page 3-144: Based on the data problems previously cited, the validity of the ground water flow analyses is questionable. This figure is titled "Hypothetical" ground water flow rates as it should be, but we do not believe this is a conservative or "worst case" estimate.

Page 4-2: The section on the engineering design borehole (4.1.1.1) does not provide sufficient details on the types of logs to be run on the test holes. It is important that the following logs be run as a minimum:

a. Dual induction log
b. Density-nuetron log
c. Caliper log

d. Fracture finder micro-seismogram
e. Dip log
f. Temperature log

The fracture finder log and the dip log are very important since they help identify fracture zones which could provide water flow. This will also provide data which can be used in verifying the surface seismic results. The exploratory drill hole should also have drill stem tests run in selected zones. Any salt zone in the Paradox Formation which shows signs of dissolution must be tested. The tests should be run long enough to obtain an adequate water sample. All samples should be tested for the stable and unstable isotopes particularily oxygen ratios, carbon ratios, sulfate ratios, and dueterium. If any major water zones are encountered in the Paradox, the borehole should ultimately be completed in that zone so that a sample can be obtained without the use of partial completions. The comments relating to the exploration borehole also apply to the section on the stratigraphic confirmation boreholes.

Page 4-15: Five drilling sites are planned for characterization of the lower hydrostratigraphic unit at the Davis Canyon site. However, based on the potentiometric surface of this unit and the locations of these drilling sites shown on figure 4-4, only one site (DC-1) is planned down gradient of the proposed repository site. This borehole is proposed between the outer boundary of the controlled area and the eastern boundary of Canyonlands National Park. Such limited investigation down gradient of the site is not sufficient to adequately characterize the local geologic setting surrounding the site. Additional boreholes further down gradient (and thus within the National Park) are necessary to detect geohydrologic variations in the local geologic setting. Similarly, the drilling program for the upper hydrostratigraphic unit shown in Figure 4-3 suffers from the same limitations. Note that the hydrologic investigations proposed for characterizing the other proposed repository sites provide for more conventional locations of boreholes with at least three well sites down gradient. (See Figures 4-1 and 4-3 of Swisher County Environmental Assessment; Figure 4-1 and 4-4 of Deaf Smith County Environmental Assessment; Figures 4-3 and 4-4 of Vacherie Dome Environmental Assessment; Figure 4-3 of Cypress Creek Dome Environmental Assessment; Figure 3-7 of Reference Repository Location, Hanford Site Environmental Assessment; and Figure 4-3 of Richton Dome Environmental Assessment.)

Page 4-16: Section 4.1.1.1.7 indicates the limited coring will be conducted in the hydrologic/geologic borehole. There is no discussion about how core zones will be selected. The data from the stratagraphic boreholes should be used to predict the depth of potential core zones. All zones which may have dissolution or major porosity should be cored and a drill stem test run. The coring should begin above the zone of interest.

Page 4-19: There is no discussion of the need to establish the mechanism and rate of advance of the collapse breccia pipe structures in Lockart Basin. In order to understand the historical dissolution at Lockhart Basin, a portion of the field work should be devoted exclusively to investigation of the breccia pipes in this locale. As discussed elsewhere, this should include extensive seismic and gravity serveys. Such work should be tied together by stratographic boreholes. Important questions include: did faulting within the Leadville

precede breccia pipe formation, could cavern collapse induce a breccia pipe; and what rate of groundwater flow is necessary for breccia pipe advance?

Page 4-20: Given the thickness of the Paradox Basin, we question whether truck-mounted vibrators or 5 pound explosive charges will provide sufficient energy for effective 3-D seismic surveys or regular seismic line surveys. Resolution is especially important in defining the base of the Paradox Formation. The lack of resolution would make it difficult to locate small faults in the Leadville which could influence dissolution of the salt. Common practice in seismic efforts used for oil exploration is to use a shot hole about 100 feet deep with at least a 50 to 100 pound charge.

Page 4-27: The schedule for the geotechnical field activities should be modified slightly. The gravity survey and the seismic surveys should be run prior to the final site selection of the stratigraphic confirmation boreholes. The data obtained from the seismic and gravity work should be analyzed and the results used for final selection. This information should also be used in selecting the hydrologic test wells. The schedule for drilling the exploratory shaft is unclear. It is essential that all the borehole and geophysical data be collected and anlyzed prior to construction of the shaft.

Page 4-29: The proposed 50 miles of seismic lines may not be adequate to define the subsurface structure sufficiently to determine if salt dissolution is a potential problem. The proposed lines (Figure 4-4) do not extend much beyond the site boundary. Given the possibility that dissolution features may be present at depth with no surface expression, the seismic coverage should extend from the site into the Lockhardt Basin area. If there are existing seismic lines north of the site, it would only be necessary to run sufficient lines to provide continuous coverage between the site and the basin. In addition to the continuous seismic lines, several star patterns capable of detecting subsurface domes should be continued north of the site.

Page 4-71: The planned intinsive field investigation for groundwater sampling appears limited to standard chemical analyses. No mention is made of the need to determine the age of these ground waters and their possible origin using established stable and unstable isotope techniques. The Office of Nuclear Waste Isolation reported for the first quarter of 1984 that springs sample near Cataract Canyon were to be sampled for Chorine 36 isotope analysis. EPA later learned this work was cancelled before its completion. Such pertinent data should have been provided in the environmental assessments. The isotope work can serve as an aid in estimating the regional flow rates and the origin of the water. Of special interest are the isotopes of Chlorine (Cl^{36} and Cl35), Sulfate (S34 and S32), Carbon (C14 and C13), Oxygen (O18 and O16), dueterium and tritium. If this data is not available, new samples should be obtained and analyzed and the results incorporated into this document.

Page 5-35: The environmental assessment notes that while post-closure monitoring requirements have not been established by the Nuclear Regulatory Commission (NRC), licensing requirements would include groundwater monitoring

following site closure. The close proximity of Canyonland National Park, especially its location downgradient at the most likely direction of ground water flow, presents serious limitations to post-closure monitoring activities.

Page 5-36: The environmental assessment describes a thermally-induced uplift of three feet after 1000 years in the site area decreasing within a 2 or 3 mile radius around the site. This uplift could affect the shallow ground water resources which supply the National Park's Squaw Flat Campground because of fractures caused by the up lift and resultant changes in flow patterns. This is a potential adverse affect to the Park not addressed in the environmental assessment. The potential for water flow associated with fractures should be evaluated using pressure head data from existing test holes. The potential for fracturing should be evaluated using rock mechanics analysis of cores from GD-1.

Page 6-81: The environmental assessment notes that at the Waste Isolation Pilot Project (WIPP) site in New Mexico, where the bedrock has both primary and secondary permeability, it was shown that porous medium theory and transport models were not satisfactory in calculating mass transport and travel times. In the next paragraph, the environmental assessment indicates that at the Gibson Dome sites, where primary and secondary openings occur, groundwater flow rates and travel times are calculated assuming Darcian conditions (i.e., a porous medium). Given the experience at the WIPP Site, this approach is neither realistic nor conservative.

Page 6-81: The environmental assessment notes that ground water flow out of Salt Cycle 6 would require a "drastic alteration of existing conditions". For instance, breccia pipe collapse as previously discussed, present a plausible drastic alteration that could lead to radionuclide escape along a more permeable pathway. Dissolution along the minor clastic parting lenses with the Paradox Formation is another potentially drastic alteration. The environmental assessment should define plausible "drastic alteration" mechanisms and the presence of such mechanisms in the area.

Page 6-81: It is stated in the environmental assessment that flow in interbeds above the Leadville is not expected because "likely discharge points, e.g., in the Colorado River, are upgradient from repository and lower levels." It is possible that there is hydologic connection between this zone and the Elephant Canyon Formation along a fracture plane?

Page 6-82: The environmental assessment notes that flow through and travel times in the Elephant Canyon Formation above the repository are not considered because an unrealistic assumption would be required that future conditions are altered to permit upward flow into the Elephant Canyon Formation. Given the small differences in head between the hydrostratigraphic units at the site, the potential exists for travel of ground water upward through the over pressured zone. When analysing the hydraulic head information, a reported head value of 5575 feet for increment 14 of GD-1 was not considered representation and was disregarded (see ONWI 491).

Page 6-185: It is indicated in the environmental assessment that interbeds in the salt may have a significant transmissivity and provide a potential conduit for ground water. What is the lateral extent of such interbeds? Is it possible that the Monument Uplift anticline has induced the pressure in these interbeds?

Page 6-106: The environmental assessment notes the rate of advancement of dissolution. Similarly, the environmental assessment should provide information on the rate of eastward migration of the grabens in the Needles Fault Zone.

Impacts if Site is selected for Repository

Waste Rock Disposal

The draft envionmental assessment concludes that for the purposes of envronmental protection of surface and ground waters, the waste salt and salt-contaminated rock will be removed from the site and disposed elsewhere. Table 4-18 indicates that this waste material will transported over 160 miles to a permitted landfill either in Grand Junction, Colorado, or Farmington, New Mexico. Once at either of these sites, the waste salt material must still be contained in a manner to protect surface and ground waters. There is no apparent environmental advantage to remove these salt wastes and still be confronted by similar problems of isolating the material from surface and ground waters. In addition, the truck transport necessary to remove this material will further aggravate traffic problems on the narrow access road into the park. EPA believes that alternatives for salt and salt-contaminated rock disposal should include on-site disposal. Alternatively, there may be a commercial market for the sale of the salt for road usage.

Transportation Risks

If either of the Davis or Lavender Canyon sites were selected as a repository location, the transportation options in to the canyon country will include high risks due to unstable soils and landslides. Crossing the Colorado River will be necessary either in Moab or further down river. Landslide activity, although infrequent, can dislodge enormous amounts of rock potentially permanently closing a transportation corridor. The relative risks between sites under consideration should be better defined and the detailed options for waste transport routes should be disclosed in a regional transportation study for each site.

Site use conficts with the National Park

Page 4-1: The environmental assessment states that it is not known precisely how much land is needed for the controlled area, until site characterization is completed, and data collected in those studies are evaluated. How is the suitability of the site affected if the controlled area overlaps with the dedicated lands of Canyonlands National Park? Would the site be disqualified? As required by 10 CFR 60.121, the controlled area must be located in and on lands that are either acquired lands under the jurisdiction and control of DOE, or lands permanently withdrawn and reserved for its use.

During periods of blasting for construction of the Repository, 7.6% of annual Park visitors or 50% of the daily visitors would be able to hear the explosions. If the rail corridor is built, virtually all daily visitors or 15.4% of all annual visitors would hear the blasting. Noise from repository activities would be largely audible over the life of the project in eastern sections of the park such as Peekaboo Springs.

Page 4-27: The environmental assessment does not identify a decision point in the characterization process where acquired information is assessed to determine where characterization activities should proceed. The environmental assessment does not address whether the results of environmental studies conducted to further identify park affects, including meteorology, air pollutant modeling and noise studies will be evaluated for acceptability prior to shaft construction.

Page 6-6 and 6-7 : The environmental assessment indicates that the controlled area could extend 10 kilometers in any direction from the underground operations area. The environmental assessment should address the apparent conflict of the controlled area and dedicated lands of the Canyonlands National Park.

Page 6-83: The environmental assessment admits that, "In characterizing the geohydrologic system, the ability to do this readily may be complicated by the presence of Canyonlands National Park." The environmental assessment indicates that further testing could show a need to conduct drilling activities in Canyonlands National Parks in order to resolve hydrologic issues with the site. Would the need to drill in Canyonlands National Park to properly characterize the site also disqualify the site? This situation should be clarified in the environmental assessment.

Geological Issues

Calculations of the hydrologic regime for the Gibson Dome area is reported to include various tectonic, climatic, and geomorphic perturbations. However, these analyses assume Darcian flow conditions with only primary porosity and changes in head analyzed. Secondary permeability and the formation of breccia pipes have not been considered. Therefore, the pertubations evaluated by this method are neither conservative nor worst case.

According to the estimated costs of characterization, it appears that the Davis and Lavender Canyon sites will incurr significantly higher costs to complete all necessary studies. The suggestions for addtional studies made in these comments, if adopted by DOE, would further increase these costs. Given the uncertainties of the geologic setting and the difficulty in defining the presence or absence of geologic anomalies that could effect licensing critieria, Davis and Lavender Canyon sites should be considered difficult to characterize and potentially difficult to demonstrate full compliance with all the licensing criteria.

Site suitability of the Davis and Lavender Canyon sites will remain uncertain since the salt bed has been subject to dissolution at nearby Lochardt and Beef Basins, there is salt slip operating at the Needles fault

zone which could advance these block faults eastward, there is secondary permeability in both the upper and lower aquifer systems, there is a potential for cavern collapse into the Leadville Limestone potentially propogating a migrating breccia pipe, and there is the possibility of over pressured zones in the middle aquifer unit to create upward flow. Under these conditions, we are concerned that the site characterization process could uncover an unsuitable critieria; in which case the enormous public expenditure would be for nought.

Mineral and Resource Conflicts

Page 3-109: The discussion in Section 3.2.8.2.2 indicates that the potash encountered in borehole GD-1 is too deep for conventional mining. There should be some discussion on the possibility for the use of in-situ mining techniques to mine potash near GD-1. This method is used elsewhere in the basin on a commercial basis. This could result in mined out zones with associated collapse within 4 miles (or less) of the site. In particular, the potash in Salt Cycle 13 and Cycle 18 may have sufficient thickness to be economically mined with in-situ techniques. This could bring mining up to the edge of the site. The potential for economic in-situ mining should be discussed in more detail. This may require a much larger area for the DOE "control area" that is presently being considered.

Effect of EPA analysis on DOE's ranking and rating criteria for site selection

Page 3-143: The environmental assessment provides preliminary estimates of groundwater flow rates in the strata above and below the repository rock using the concept of average linear velocity assuming Darcian flow conditions. This is not a reasonable approach given the fracturing apparent in these strata (see pages 3-131 and 3-132) and the variability of solution features. Compliance with DOE guideline 960.3-1-4-2 requires the use of assumptions that would tend to underestimate the ability of a site to meet the qualifying conditions (i.e., a conservative analysis). The intent of this quideline was to require realistically conservative assumptions, such as the presence of fractures, that allow reasonable decisions to be made in the face of uncertainties (49 CFR 47728). Many of the assumptions made in the analysis are not conservative, nor worst case.

Page 6-83: Guideline 960.4-2-1(b)(3) describes the favorable condition which applies to sites that have stratigraphic, structural, and hydrologic features such that the geohydrologic system can be readily characterized and modeled with reasonable certainty. The ground water flow rates presented in the environmental assessment have been determined assuming Darcian flow conditions. Such a modeling approach is not appropriate given the variability in the formations and the potential for secondary pemeability. Therefore, a more complex modeling approach must be utilized. We suggest that several ranges of permeability be used including the maximum values. This should include the development of a geochemical model designed to assess the effect of flow rate on water quality. Further, to identify the presence of all discrete stratigraphic continuities caused by fracturing, folding, or faulting requires detailed 3-D seismic surveys, high resolution gravity survey, extensive drilling, and complex geochemical studies. For example, the

Leadville Limestone contains near-vertical solution caverns which have been observed near outcrops in the Grand Canyon. Finding such structures would be very difficult using surface seismic surveys. Therefore, in order to accurately assess the geohydrologic regime with reasonable certainty at the site, complex modeling and expanded data collection activities will be required. We conclude that the favorable condition is not present.

Page 6-83: The environmental assessment notes that, "In characterizing the geohydrologic system, the ability to do this readily may be complicated by the presence of Canyonlands National Park." The environmental assessment indicates that further testing could show a need to conduct drilling activities in Canyonlands National Park in order to resolve hydrologic issues with the site. Such drilling would interfere with the designated purposes of the National Park system to preserve the lands in their present state for future generations.

Page 6-83: EPA disagrees with the statement that the relative simplicity of stratigraphic, structural, and hydrogeologic features in the site vicinity makes the task of characterizing and numerically modeling the ground water system appear to be relatively straightforward. We disagree that a site bounded by two major dissolution features, major fault traces including a basin basement fault within 2 miles of the site, with three (3) different hydrologic units, with various potential dissolution mechanisms not yet well understood is not straightforward.

U.S. Environmental Protection Agency

Detailed Comments on the Deaf Smith County, Swisher County and Vacherie Dome Sites

Deaf Smith County Site

A. The Site

Figure 3 on page 10 should include a map of Deaf Smith County showing the orientation of the geologic cross-section relative to the proposed site. This information would be helpful and would strengthen the EA.

On page 2-8, the EA discussed differentiating factors between the possible repository site locations. One other very important factor that should also be considered is the Ogallala aquifer. This aquifer is a unique underground resource which is used to supply groundwater to "prime" agriculture lands and to a major livestock production area. This factor should be included in the section describing the physical setting.

B. Water Quality

The EA should define and identify the surface and groundwater monitoring programs to be implemented before, during and after all three phases of the repository. This information should be included in the Final Assessment.

At present, there are no classified stream segments in the Deaf Smith County Repository site location. However, it should be recognized that general water quality criteria apply to all unclassified streams and must be maintained through appropriate effluent limitations during all phases of the project. This should be noted and addressed in the water quality impact assessment Section of the EA.

C. Waste Salt Disposal

It is stated on page 12 that waste salt and residues will be removed to an off-site licensed landfill. However, Section 5.1.3.4 (pp. 5-31 thru 5-33) implies that off-site (surface) disposal is only one of six disposal options under consideration. Thus, this Section implies that no decision has been made. This Section needs clarification.

Also, Section 4.1.3.4.4 lists "commerical disposal" among the other options for disposing of the waste salt from the excavation. This is not an option per se and should be deleted from the listing. Selection of this "option" would seem to transfer the authority to decide on the disposal option to the contractor. If this is anticipated, it should be discussed in the Final Assessment.

D. Ogallala Water Supply

Table 4-3, page 4-28, is unclear regarding the total water demands of the exploratory shaft project. Due to the fact the area is projected to be water short by 1990, the question of how significant the impact of the repository on competing demands for water should be addressed. Also, the total water demand of the entire project should be quantified. These concerns should be clarified in the Final Assessment.

The assessment indicates groundwater resources are currently being used at rates greater than natural replenishment. Page 3-140 states that in 1980 the withdrawal rate was about 69 times greater than the estimated recharge. It is further stated that future water shortages are projected. Thus, the use of water from the Ogallala in the disposal of 0.5 million tons of excess salt per year as described in this Section should be considered a significant long-term impact on an already diminishing resource. These impacts and concerns should be more fully addressed in the Final Assessment.

Page 5-145 states that the magnitude of the repository's effect on the aquifer is relatively small in comparison to the current rate of use. However, since current water use is greatly exceeding the replenishment of the system, any additional use will be significant. This Section appears to conflict with prior Sections (i.e., Section 5.1.3.4.3). These discrepancies should be clarified in the Final Assessment.

The EA states that the localized water table may be drawn down during shallow borehole characterization tests. In view of the projected water shortage, we suggest these tests not be conducted during drought conditions and be scheduled with the current water demand and weather conditions in mind.

E. Contaminating the Ogallala

The EA states on page 43, that windblown salt may enter playa lakes and ephemeral streams. If so, there may be need to conduct other studies to determine: 1) the degree to which windblown salt will enter runoff which subsequently infiltrates the unconfined Ogallala; and 2) the potential for deterioration of water quality due to infiltration. Also, the Final EA should identify the measures that will be taken to prevent and/or minimize infiltration of windblown salts into the Ogallala.

The probability of contamination of the aquifer from leakage of nuclear waste during operation, and decommissioning phases of the project is not addressed. The associated risks should be fully evaluated in the Final Assessment.

The EA indicates that during construction there is a possibility of brine contamination, which may cause a 10% increase in salinity over the current salinity values in the aquifer. The assessment should evaluate the impact of this 10% increase and identify the basis for a reasonable and acceptable determination. This assessment information should be included in the Final EA.

F. Tests

At-depth testing of the mechanical response of the salt to the excavation, of the thermomechanical response of the salt, and of brine migration toward a heat source, are planned (Section 4.1.2.3.3). We question whether all of the results of such tests will be valid indicators of post-closure performance many hundreds of years into the future. This is because of the great difference in static load pressure that will exist in the two situations. In particular, it is clear that thermomechanical stresses in the vicinity of the open shafts cannot be realistically simulated because such stresses are easily relieved by deformation (compression) of the shaft. Several years or decades post-closure, we would expect that static pressure would return to near its natural state. We believe this simulation problem should be fully explored and discussed in the Final EA.

G. Dissolution

The qualifying and disqualifying conditions for dissolution (Section 7.3.1.6) rely heavily on whether or not dissolution has occurred in the past, during the Quaternary Period. During the past several hundred years, however, dissolution rates may have been altered significantly by technological man, who has drilled countless exploratory boreholes all over the country, many of which were not plugged adequately, or not plugged at all, when they were abandoned. This point should be fully addressed in the Final Assessment. (We note that DOE indicates that additional studies are required, "on the potential adverse effects of nearby oil and gas boreholes", in connection with natural resource exploration (page 7-52) but this seems to be oriented toward existing known and future boreholes, not possible existing unknown ones near the site).

H. Ground Motions

On page 3-86, it is mentioned that small oil fields are controlled by faults in east-central Oldham County. This reference is unclear, as is the potential effect or risks associated with faulting in the vicinity of the repository site. This concern needs to be clarified in the Final Assessment.

Subsidance and uplift are discussed in Section 5.2.1.3, and either of these effects are concluded to be possible, with surface movement in the range of 1 to 1.5 foot. It is concluded that this will not significantly affect surface drainage gradients or goundwater flow patterns nor cause major discontinuities in the salt or overlying sediment ..." However, the effects of these ground motions on the integrity of the shaft seal plugs (Section 5.1.4) was not evaluated. The impact on seal integrity should be fully addressed in the Final Assessment.

I. Other Comments

In Section 5.2.2.2.1, the statement is made that repository shaft construction "... will not require the use of drilling muds". However, in Section 2.1.2.2.2 the statement appears that mud circulation will be used, "during deeper drilling", all the way to the final depth of 2,590 feet, along with the development of a 10 foot deep, 6.6 acre mud pit. This discrepancy should be clarified.

The EA should identify the projected life expectancy of the shaft liner and the waste packages which will be buried in the boreholes. Also, the Final Assessment should discuss and substantiate the use of the freeze collar and wall as proven technology.

We note that figure 3-42 on page 3-105 is missing the seventh impoundment, Lake Tanglewood, which is listed in Table 3-15 on page 3-106. Please make the necessary corrections.

Beyond receipt of the transport vehicle, the EA indicates casks will be washed down in a separate decontamination wash bay as necessary. The Final Assessment should identify the fate of the contaminated wash water and any required treatment.

The life expectancy of the retention pond's liners should be identified. Also, the parameters, and the frequency of monitoring done to insure noncontamination of the surrounding area, including ground and surface waters should be discussed.

Table 5-48 should include a depth of shaft measurement.

On page 4-112, the dose rate of .0017 millirem per year is given as, "about 0.02 percent of ambient" but should be 0.002 percent of ambient. Please make the necessary changes.

On page 5-38, we were unable to find the (Maxwell at [sic] al., 1980) reference listed in Sec. 5.7. This should be clarified.

Swisher County Site

We found that this site had a similar (like) geohydrologic setting to the Deaf Smith County site and encompasses virtually the same physiographic, stratigraphic, structural style, and groundwater flow characteristics as the Deaf Smith site. About the only discriminating factor was remoteness of the sites from highly populated areas. Thus many (if not all) of the above stated comments on the Deaf Smith site are applicable to the Swisher site.

Vacherie Dome Site

On page 6-9, the population density in the Vacherie Dome area is characterized as "low" even though it is nearly the same as the national average of 64 persons per square mile. Since proximity of the site to densely populated centers is evaluated under a separate item, defining the national average as low here does not allow the identification of sparsely populated non-urban areas. This should be clarified.

On page 6-40, authority for regulation of the Underground Injection Control program in Louisiana is listed as belonging to the Department of Environmental Quality. This is incorrect. The program is administered by the Office of Conservation, Department of Natural Resources.

On pages 6-196 to 6-210, the discussion of brine migration toward the waste package does not address the fate of the brine as it enters the 0.8 inch annulus between the waste package and the borehole. At the elevated temperatures expected for the waste packages, the water may evaporate before contact with the package. Precipitated salt would gradually close the annulus from the outside. If this is so, the annulus should be engineered so that the waste package avoids any contact with the brine. Discussion on this matter should be included in the Final Assessment.

U.S. Environmental Protection Agency

Detailed Comments on the

Nevada Test Site

Hydrogeology Comments

The Nevada Test Site (NTS) has been the subject of intensive hydrogeological studies since the advent of the first underground nuclear tests in the mid-1950's. As stated in Section 3.3, there have been numerous investigations of the hydrogeology of Yucca Mountain as part of the overall NTS characterization. EPA recommends that a further literature search be conducted to include more recent papers that have been published on Yucca Mountain. EPA's Regional Groundwater Office has prepared a listing of reports that may be beneficial to the assessment of the site (see attached bibliography).

The Draft Environmental Assessment (DEA) indicates that groundwater is primarily transmitted by fractures in Tertiary tuffaceous volcanic rocks to the deep carbonate and valley-fill aquifers in the western part of the NTS. However, no mention was made of the mixing between the deeper aquifers. A model for groundwater flow, based on test well data, should be included in the FEA. In the discussion, DOE should:

1. Clarify the direction of the local and regional ground water flow.

2. Examine well data for fluctuations in water quality parameters which indicate potential fracture flow from the study site to wells in the ground water basin. Tritium has a radioactive half-life of 12.5 years and is usually not detectable 50 years after the water enters a ground water system. Detection of tritium, therefore, indicates rapid movement of "young" water through the groundwater system.

3. Discuss mixing between these aquifers which may transmit radionuclide-contaminated ground water from one aquifer to another.

4. Address potential impacts to ground water resources, over the life of the project, that recharge municipal and agricultural water supplies in southern Nevada.

5. Discuss the potential for contaminated ground water to impact Well J-13 since it is a possible water source for the repository facility. Section 3.3.2.1 indicates that the water table slopes toward Jackass Flat, south-southeast of Yucca Mountain (p.3-28) where Well J-13 is located.

6. Discuss ground water along the three major fault zones, Solitario Canyon, Ghost Dance and Bow Ridge, as well as the minor faults shown in Figure 2-15 (p. 2-44) and Figure 5-5 (p. 5-10).

7. Discuss recharge potential during intense thunderstorm activity. Recharge through permeable media, such as fractured tuffaceous rock, may exceed annual potential evapotranspiration rates during such events. This was not included in the evapotranspiration model.

Geology Comments

Yucca Mountain is in a National Oceanic and Atmospheric Administration (NOAA) Zone 3 Seismic Risk area which is listed as a "major risk" area (NOAA Seismic Risk Map; Algermissen, 1969). The DEA indicates that "earthquakes near Yucca Mountain should be considered possible."

1. The FEA should include information on the earthquake focal depth in the Earth's crust for those events that were located close to the Yucca Mountain site (Figure 3-9, p. 3-20). Information of this nature will be useful for assessing the nature of seismic activity in the vicinity of the project site.

2. The FEA should evaluate the possibility of the large regional fault complex, the Walker Lane-Las Vegas Valley Fault complex (Figure 3-4 and p. 3-14), impacting the Yucca Mountain site over the life of the project.

Water Quality Comments

1. Based on the projected growth of support communities in the vicinity, the FEA should discuss impacts on sewage capacity (p. 3-76, 3-77 and 5-101) and possible locations of new facilities. Impacts on future municipal, industrial and agricultural water resource needs (Section 5.4.3) should include a discussion of potential ground water overdraft.

2. The FEA should describe the proposed berm design for containing contaminated water from the rock storage pile. This design should include a system to detect leaks in the lining of the berm.

Radiological Comments

The hazards encountered from the naturally occurring radionuclides will essentially be the same as an underground mine. The DEIS should discuss appropriate measures to limit exposure to naturally-occurring radionuclides within the repository envelope and other structures of the site. DOE should consider exposure controls for underground and surface personnel at the repository. EPA suggests that existing guidance be used to achieve adequate protection. Additional controls should be employed if exposure levels increase.

General Comments

All continuing and proposed studies indicated in Section 4.1.3 and p. 6-193 must be completed before the Draft Environmental Impact Statement (DEIS) stage of the selection process so that the results may be evaluated by the appropriate reviewing agencies.

Benson, L.V. 1983. Chemical composition of groundwater and the locations of permeable zones in the Yucca Mountain area, Nevada. USGS Open-File Report 83-854. 19pp.

Carr, W.J. 1974. Summary of tectonic and structural evidence for stress orientation at the Nevada Test Site. USGS Open-File Report 74-176. 53pp.

Claassen, H.C. 1973. Water quality and physical characteristics of Nevada Test Site water-supply wells. USGS Open-File Report 474-158. 145pp.

Claassen, H.C. 1983. Sources and mechanisms of recharge for groundwater in the west-central Amargosa Desert, Nevada: A geochemical interpretation. USGS Open-File Report 83-542. 61pp.

Clebsch, A., Jr. 1961. Tritium of ground water at the Nevada Test Site, Nye County, Nevada. USGS Professional Paper 424-C: 122-125.

Dinwiddie, G.A. and J.E. Weir, Jr. 1979. Summary of hydraulic tests and hydrologic data for holes UE16d and UE16f, Syncline Ridge area, Nevada Test Site. USGS Report 1543-3. 20pp.

Dudley, W.W., Jr. and J.D. Larson. 1976. Effect of irrigation pumping on pumping desert pupfish habitats in Ash Meadows, Nye County, Nevada. USGS Report 927.

Fenske, P.R. and C.L. Carnahan. 1975. Water table and related maps for Nevada Test Site and central Nevada test area. Desert Res. Inst., Water Res. Center, No. NVO-1253-9. 18pp.

Mifflin, M.D. 1968. Delineation of groundwater flow systems in Nevada. Desert Res. Inst., WRC, Technical Report Series H-W, No. 4. 89pp.

Naff, R.L., G.B. Maxey, and R.F. Kaufmann. 1974. Interbasin groundwater flow in southern Nevada. Nev. Bur. Mines Geol., Report 20. 28pp.

Noble, D.C. 1968. Silent Canyon volcanic center, Nye County, Nevada. In: Nevada Test Site, E.B. Eckel (ed.), GSA Memoir 110: 65-75.

Rush, E.F. 1970. Regional ground water systems in the Nevada Test Site area, Nye, Lincoln, and Clark Counties, Nevada. Water Res. Reconaissance Series Report 54. 25pp.

Thordarson, W. 1983. Geohydrologic data and test results from Well J-13, Nevada Test Site, Nye County, Nevada. USGS Report 83-4171. 57pp.

Wells, P.V. and C.D. Jorgensen. 1964. Pleistocene wood rat middens and climatic change in Mohave Desert: A record of juniper woodlands. Sci. 143(3611): 1171-1174.

Winograd, I.J. and D.D. Doty. 1980. Paleohydrology of the Southern Great Basin, with special reference to water table fluctuations beneath the Nevada Test Site during the late Pleistocene. USGS Open-File 80-569. 91pp.

U.S. Environmental Protection Agency

Detailed Comments on the

Mississippi Sites

A. Geological Consideration

The EA's for the Mississippi Salt Basin (Richton Dome and Cypress Creek) indicate that DOE has concluded that the Richton Dome is the preferred site in the Gulf Interior Region. Therefore, the following review of the lengthy detailed documents is directed to the Richton Salt Dome.

The presence of saline water that appears to occur at relatively high attitudes in wells near the Cypress Creek and Richton Salt Domes may indicate dissolution of salt around the domes or upward movement of saline water around the flanks of the domes. Emphasis on describing the physical and chemical characteristics of the geohydrologic system and on determining the rate and direction of groundwater movements is important.

Evidence for dissolution exists for both salt dome sites. Topographic lows over Cypress Creek Dome indicates that dissolution may be progressing more rapidly than vertical movement of the salt. The potential adverse conditions from dissolution could effect hydraulic interconnection leading to a loss of waste isolations.

These factors are significant because transport by groundwater is considered to be the principal mechanism by which radionuclides migrate to he accessible environment.

As stated in the EA, the principal concern is that the dissolution of the host rock might create new pathways for radionuclide migration to the surrounding geohydrologic system. The sites with salt as the host rock are most vulnerable to dissolution, and effects of salt dissolution on waste isolation will be an important consideration in evaluaitng a site in salt.

Other siting issues at Richton Dome shows siting concerns presently center on the geologic stability (tectonic and salt tectonic) and hydrologic suitability (characteristics of the regional groundwater flow system) of Richton Dome and vicinity. Tectonic concerns of regional uplift and faulting and salt tectonic concerns related to salt dome movement and dissolution have been addressed in site characterization studies. It is not clear from the EA that they have been resolved with a sufficient level of certainty in order that the Richton Dome be a preferred site.

Chapter 3 hypothesizes that some faults in the area have had movement during the past 2 million years (Quaternary Period). Some faults are close to and one abuts Richton Dome. Information about Quaternary movement on these faults will have to be obtained prior to repository selection.

Water supply data needed for proper evaluation has not been provided. Water well inventories within a fifteen mile radius of the domes should be undertaken. Projected population and industrial growth with accompanying water needs should be determined. The projected increase in the number of irrigation wells should also be determined.

With the exception of one test well, no site-specific data have been gathered to estimate values of various site parameters. Hydrogeologic conditions at each dome site differ and valid travel times cannot be determined without site-specific data. On this basis, the determination of 1.63 million years travel time to the accessible environment is premature. Uncertainties exist about the size, shape and caprock characteristics of Richton Dome. The nature of the salt-caprock interface are poorly known. These raise questions regarding the hydrogeologic characterization of the Dome and possible pathways for movement of radionuclides or salt dissolution. Additional uncertainties are raised about the possible effects of oil/gas exploration or extraction of oil/gas or groundwater from sediments surrounding the Dome.

B. Other Issues

We recommend that Table 6.2 (pg. 6-24 for both EPA's), under the column entitled, "Compliance Demonstrated/Actions Planned" for "Floodplain/ Wetlands," should reference that jurisdictional determinations of wetlands subject to Section 404 of the Clean Water Act should be coordinated with the U.S. Army Corps of Engineers, Mobile District (Mr. Art Hosey, Chief of Assessment and Monitorting Section of the Regulatory Branch: 205/694-3781 or FTS/537-3781). Dredge and fill permits may be required for site construction and bridging. Consultation with the U.S. Fish and Wildlife Service, as indicated in Table 6.2, is also important (Natural Wetlands Inventory), but does not replace consultation with the Mobile District relative to Section 404 jurisdictional determinations.

- Although extensive noise modeling is presented in the Richton and Cypress Creek EA's, we offer the following specific comments:

  * Ambient noise levels were assumed in the EA's. While ambient levels may be low representative, actual noise monitoring data should preferably he measured at representative sites. Although the EA's indicate that such surveys are planned (pg. 5-65, Richton; pg. 566, Cypress Creek), such survey data would have been a more accurate baseline than the assumed data apparently used for the modeling analyses presented. Ambient measurements should also incorporate or separately measure/represent any common noisy events such as Camp Shelby military maneuvers (Cypress Creek), as opposed to estimating the levels of such noise events (pg. 4-101, Cypress Creek).

* Noise data are presented using the Ldn descriptor, which is appropriate since an Ldn standard (55 dBA) was used. All data, however, should be A-weighted, so that the example on p. 4-103 (Cypress Creek) regarding a C-weight Ldn valuer, should be converted. In addition to the Ldn descriptior values, which are averages, instaneous measurements (actual or from the literature), which were presumably used in modeling, could be listed for major intrusive sources of noise such as blasting. This would be useful in addition to the attenualtion distances from noise sources prsented in the EA. The magnitude of the impact on receptors within the attenuation distance should be presented, as described below.

* The impacts of project noise should be documented in terms of the number and kinds of human occupied receptors elevated 5-9 dBA, 10-14 dBA, and 15 dBA or greater, with those receptors increased to a resultant noise level above the Ldn 55 dBA threshold level (within the Ldn 55 dBA contour) being indicated. Presentation of actual data for ambient and predicted levels for those receptors elevated to values above the threshold, would be beneficial. Receptors affected by noise generated through the operation of the facility (on-site the facility and attendant on-site activities such as operation of highway and railroad lines as well as offsite drilling areas) should be documented. Those affected temporarily by noise generated throgh facility construction should be preferably documented. A summary table for such receptors, if any, would be helpful to the review agency and public.

* Both subject EA's suggest that populations are sparse in these areas. References to the presence or absence of receptors within the attenuation distance of noise sources are also numerous. However, several citations are made to 1947 (Cypress Creek) and 1967 (Ricton) USGS maps, which should be updated through reconnaissance, aerial photos, or current maps to reflect present populations or to verify 1947/1967 data. Also, the noise impact on affected residences should be determined, as described above, as opposed to just modeling the noise attenuation distance.

* Mitigation of noise should be considered if noise impact criteria (as previously defined) occur. We recommend coordination with appropriate agencies and mitigative methods such as those presented on page 5-70 in both EA's. We also approve of retaining vegetative buffers as suggested on page 5-66 (Richton) and page 5-68 (Cypress Creek) to attenuate noise levels as well as for visual and aesthetic purposes.

U.S. Environmental Protection Agency

Detailed Comments on the

Hanford Site, Washington

Major Findings and Conclusions

The discussion of the site identification and screening process does not clearly justify the selection of the Hanford site on the basis of the information presented. Land uses at or near the RRL include low-level radioactive waste disposal, HLW storage/disposal, spent fuel reprocessing, plutonium production (all in the 200 Areas) and reactor operation (nearby in the 100 Areas). All these uses contribute to the background radiation, and complicate environmental monitoring programs. These uses and previous designation of the site as "areas of the Pasco Basin eliminated during the site screening" raise questions relative to the selection that need to be addressed.

Environmental Setting

Several major concerns that should be addressed were identified relative to the geologic and hydrologic setting of the Hanford site: 1) the DEA oversimplifies the complexity and uncertainties about groundwater flow for evaluation of the flow system in the reference repository location and effects of repository operation; 2) more information is needed for seismicity and subsurface faulting which affects the evaluation of repository integrity; 3) data is insufficient relative to groundwater use in the Pasco Basin (depths, pumpage, and use of wells); 4) the description of near surface conditions (soils) needs more information to properly assess leachate infiltration and potential soil movement by wind; and 5) the discussion of surface hydrology requires more information for evaluating water quality.

The DEA should provide adequate information on the existing and past land use, particularly in the 200 Areas, which could conflict with repository construction and operation.

The DEA should discuss the effect of Mt. St. Helens on the area, and the potential for other volcanic eruptions. This information is important to evaluate any future impact of an eruption and resulting ash fall and the effect on high-level waste transport and repository construction and operation.

Environmental Consequences

Major concerns relative to geohydrology, tectonics, and rock mechanics were identified: 1) more consideration should be given to the structural implications of earthquakes and subsurface faulting for repository integrity; 2) the potential complications that could arise from variation in thickness of high-quality rock in the basalt flow are underestimated and questions surrounding the ability to locate a large enough area of high-quality rock within one flow need more detail; and 3) uncertainties about the thermal effects of the spent fuel on groundwater flows and travel require more attention.

Potential conflicts over natural resources, including surface and groundwater and natural gas are insufficiently addressed.

The discussion of surface water and aquatic ecosystem impacts should be expanded relative to site characterization and repository construction and operation. The DEA does not sufficiently address the potential effects of downstream contamination nor impacts of radionuclides on aquatic ecosystems.

The discussion of transportation impacts is limited by the narrow definition of the "region." The radiological risks, impacts of increased traffic on the transportation system, or population exposure cannot be realistically evaluated under this limitation.

Mitigating Measures

The discussion of mitigating measures should be expanded. Mitigating measures are discussed for some impacts (e.g., safety, site characterization) and not for others, and what discussion exists lacks detail. In addition, mitigating measures are interwoven with the general discussion of impacts throughout the DEA, making it difficult to evaluate their adequacy and appropriateness. Mitigating measures should be consolidated in one section and the discussion expanded.

Mission Plan

This document is generally consistent with the Mission Plan. However, the discussions regarding surface water quality and aquatic vegetation and wildlife are inadequate in terms of Mission Plan issues. Adequate baseline data to predict potential impacts on wildlife and habitat are nowhere in evidence; and no adequate data base for surface water quality can be established from the information presented.

Some information is presented in a subjective manner. For example, this subjectivity is seen in the selective presentation of some pertinent data. Analysis of the groundwater travel time for the geohydrology postclosure technical guideline (Section 6.3.1.1.11.1, p. 6-79 to 6-83), various studies of travel time are presented, corresponding to entries in Table 6-3 (p. 6-64), among which is a study by Arnett and Sagar (1984). In Table 6-3 the time of travel determined in this study is indicated as being 3,600 years, a value which would lead to a negative conclusion for the first favorable condition. In the text (p. 6-81), however, no travel time is given (even though all the other studies do have travel times presented) with the comment that the study concluded that a different procedure (a stochastic method) should be used instead.

The DEA requires additional editing to correct errors in referencing sections of the document. Some sections are incorrectly cited; others are cited which do not appear in the EA. For example,on page 6-132, para.3, the reader is referred to Section 4.1.2 for a discussion of the current plan for seismic surveillance which does not appear in that section. Also, on page 6-240, para. 3, the reader is referred to subsection 6.4.3.7.4 which is nonexistent. Some unpublished documents are referenced, making it difficult to check data bases.

Comments on the Executive Summary

The statement that "evidence does not demonstrate that a repository would have an adverse effect on the fisheries in the Columbia River" (paragraph 5) has not been supported in the DEA. No other reference to fish or fisheries has been documented. Adequate evidence should be presented to demonstrate whether there could be an effect in the Columbia River and its fisheries.

Nomination Decision Process

Page 2-18: This section focuses on the Columbia Plateau in the State of Washington. During the 1960's and 70's, on the Columbia River, the amounts of radionuclides from the Hanford reactors contained in bed sediments were generally much higher downstream than upstream and proportional to the amount of fine grained bed sediments. The river has been cleaned up considerably since 1972 to background levels of radiation. Still, any radioactive contamination of the Columbia River on the Hanford Site would be carried to downstream users. More discussion is needed in the DEA to identify the downstream reaches and those potentially-impacted user groups. Travel times of downstream Columbia River flow between selected reference points would be a useful addition.

Page 2-32: The NRC Issue-Oriented Site Technical Position (Draft Sept. 1984) 5.1.5.4.1 talks of fluid injection in the 200 West Area. Such activities should be described here.

Page 2-41: As shown in Figure 2-21 (page 2-43), the reference repository and the alternate repository are in areas that had previously been designated by surface screening as "areas of the Pasco Basin eliminated during the site screening." The elimination of this area during the second round of more stringent surface screening obviously is based on its relationship to the 200 West Area and 200 East Area (page 2-41). The 200 West Area has a number of potentially hazardous locations that could be disrupted during surface and subsurface construction activities. It is not clear why the reference repository and alternate sites were chosen when they also encompassed the 200 West and 200 East areas.

Page 2-35: Potential vertical conductivity of contaminated groundwater could impact existing and future deep water wells. Figure 2-19 shows that few of the water wells in the Pasco Basin are very deep (more than 300 m). Their locations could be shown on a map along with some indication of the depths, pumpage, and use, since they are the ones most likely to be impacted if contaminants spread. While predictions of long-range groundwater consumption are difficult, if not impossible, there is a place in the environmental characterization for some estimate of future groundwater usage (e.g. Will there be a shift back to groundwater as the Columbia reservoirs silt up?). Such assessments are important because of the effect groundwater pumpages may have on hydraulic gradients and thus on groundwater travel times.

Pages 2-45, 2-53, and 2-54: Figures 2-22, 2-26, and 2-27 do not clearly define the relationship between the proposed repository and previous uses of the 200 West Area. The 200 Areas contain a series of low-level radioactive disposal sites, high-level waste storage/disposal, spent fuel reprocessing and plutonium production; and reactor operations are contained in the nearby 100 Areas. Surface activities of the reference repository could conflict with the current use of some of this area.

The Site

Pages 3-1 to 41: The description of the site is generally adequate to assess the environmental effects of site characterization in regard to waste rock disposal. Additional information about soils (i.e., near surface conditions) should be provided in order to better assess leachate infiltration. The surficial strata are so permeable at the Hanford Site that infiltration into the fluviatile deposits is a certainty without fluid control. It can be assumed that leachate interception systems will be installed as part of the barriers proposed (p. 4-21), but this is not made clear.

Page 3-10: The DEA goes into considerable detail on the stratigraphy of the Columbia River Basalt Group but does not state that the whole basalt sequence is transected by an unconformity and that the basalts are buried in a terrain of moderate relief. Even though the Rattlesnake Hills well penetrated over 10,000 feet of basalt without reaching their base, this doesn't prove that similar conditions occur beneath Hanford. The configuration of the sub-basalt unconformity in the Pasco Basin is important to a holistic understanding of the hydrology of the area.

Some reference should be made in the stratigraphy section to strata below the Grande Ronde Basalt, and especially sub-basalt layers. While the material at these depths may not be as well understood as it is above the candidate horizons, there is a possibility of effect on a repository from below that should not be dismissed a priori.

Page 3-54: The description of seismicity of the RRL as "relatively low in comparison to the moderate seismicity of the Columbia Plateau region..." is misleading based on data presented in Figures 2-9, 2-10, 3-24 and 3-25 in the DEA.

Shallow earthquakes (Figure 3-24, page 3-55 and Figure 2-10, page 2-16) appear to be situated in clusters away from the site but some of these clusters are swarms whose multiple events should not be given the same weight as those events that are more dispersed in time. Deep seismicity (Fig. 3-25, page 3-56), appears to be more randomly distributed (there is no wider-area map for the deeper seismicity) and a wider view (Fig. 2-9) indicates a somewhat high seismicity in the general area (100 km diameter) of the RRL compared to the rest of the area.

A graph of the probability distribution of the micro-earthquakes detected within a given distance, using a reasonable extreme value transformation, would be useful for the appreciation of their recurrence intervals. More consideration (perhaps by using two separate graphs) should be given to the biasing of the data due to non-independence of earthquakes in swarms.

Page 3-58: Gaged streamflow calculations for the Pasco Basin between Priest Rapids and McNary Dams leave 8 million acre-feet of average annual outflow unaccounted for, without figures for evaporation loss. The associated surface water volume error band "prevents quantitative evaluation of groundwater flow into the Columbia River from being made." It must be recognized, however, that in many arid regions the water can leak through the bed and banks of the channel to recharge the groundwater at depth. The large error band associated with surface water volume passing through the Pasco Basin should be reduced by further investigation to determine the relationship of groundwater flow between the Hanford Site and the Columbia River. Once the direction of current groundwater flow in the aquifers at various levels is determined, speculated changes should be projected among changing climatic conditions to determine if radiation could be introduced into the Columbia River in the future.

Page 3-61: There appears to be an inconsistency in flood discharge magnitude figures for the December 1933 flood. In para. 1, the December 1933 flood discharge magnitude is 1900 cubic meters per second (cms) (67,000 cubic feet per second). The December 1933 flood referred to in the second paragraph, measured at Yakima, had a magnitude of 2,400 cms (83,000 cfs). This inconsistency brings into question the recurrence interval estimated at 170 years for the 1933 flood event and the lands susceptible to a 100-year flood.

Potential contamination effects associated with maximum surface runoff from the reference repository location into Cold Creek have not been accounted for in the first catastrophic flood situation described (the most likely to occur or reoccur).

Page 3-94: A more detailed description of present and past use of the site and nearby facilities, particularly in the 200 West Area, should be included in this section. Figures 3-38, 3-40, and 3-46 and the base map (e.g., on Figure 3-5) give some indication of previous use, but this use is not detailed in the text. It is also essential that on maps of sufficient scale, the proposed location of the surface facilities should be indicated; presently this information is only shown in Figure 3-46. Figures 3-23, 3-33, and 3-41 should show the reference repository location.

Page 3-96: The discussion concerning aquatic vegetation and wildlife should reference in detail "the program to protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River" by the Northwest Power Planning Council. The 54-mile section of the Columbia River from Priest Rapids Dam through the Hanford Reach has been identified as extremely valuable to natural production of chinook salmon and steelhead. The Mission Plan requires baseline data regarding wildlife and habitat adequate to predict potential impacts.

Page 3-97: The discussion of existing levels of background radiation for aquatic resources, especially the Columbia River, should include more detail in the DEA (Mission Plan, Vol. II, Issue 3.1.4). Aquatic impacts of radionuclide contamination from the repository at Hanford cannot be ascertained without adequate baseline data of pre-existing environmental conditions, e.g. type and level of radionuclides.

Page 3-105: The DEA should describe in more detail existing surface water quality and trends as addressed in the Mission Plan (Vol. II, Issue 3.1.2, page 1-17). Physical and chemical surface water quality measurements are not presented or addressed in discussions of repository siting, construction, operation, closure or decommissioning. Mitigation measures for significant adverse environmental impacts in affected areas are therefore also not addressed. An adequate data base for surface water quality should be established from the DEA.

Expected Effects of Site Characterization Activities

Pages 4-7 to 9: The methodology for determining the hydraulic effect of the major geologic structures on groundwater flow is treated inadequately. The discussion should include a timetable and studies which go to the structural scale. Hydraulic testing beyond the immediate vicinity of the repository is required to assess long-term flow patterns. The site characterization activities should also address the need to determine the configuration of the sub-basalt unconformity.

Pages 4-10 to 12: The discussion of the chosen shaft drilling procedure should include a description of the liner thickness and suggest geophysical methods to investigate for voids.

Page 4-19: Potentially, dewatering that may be necessary to allow construction of the underground facilities will have the greatest effect. One concern, which is not addressed in the DEA, is that breaking into the pervious zones may cause high inflows of water and may wash out from those fissures the very infill material which is assumed to provide long-term isolation protection to the repository. Other effects may be the initiation of seismicity (probably low-magnitude) as rock masses shift to accommodate new directions of stress from pore pressures. If dewatering effects in the rock mass extend far enough, it is possible that even greater effects will occur at the decommissioning of any underground facility (characterization tunnels or repository). Since the dewatering would tend to lock faults, restoration of original pore pressures could release sizable strains which had built-up during the operations of the underground facilities in the form of earthquakes.

Such effects due to changes of pore pressure at depth have been noted in other areas and when the magnitude of stresses is considered dewatering exerts greater stress on the rock than any conceivable removal of excavated material on spoil piles on the surface. These effects need more thorough consideration.

The DEA should also consider the possibility that construction of the shafts and underground facilities may provide zones of weakness in the rock that could lead to additional deformation, at greater than inferred past rates, in the area where waste may be implaced. This seems somewhat improbable, unless the effects of construction extend well beyond the area of excavation, but should be considered in the structural modeling.

Another issue needing attention is the effects of high total dissolved solids, fluoride and sodium present in deep groundwater if it is pumped from the test area and discharged so that it comes in contact with surface water or shallow groundwater.

Page 4-20: Greening of local flora through water application during site characterization would make those plants more desirable to foraging animals, increasing the chances of biological concentration of radionuclides (from surface spills of radioactive material from previous operations in the Area) through the terrestrial biota. Periodic tests should be conducted to assure that water used during hydraulic testing and consequently discharged by spraying or ponding has not been contaminated during the process.

There is a contradiction between the lack of impact said to result from the surface application of subsurface waters from hydraulic testing and the insistence that the deep basalt groundwater is unsuitable for crop irrigation (6.3.1.1.9, page 6-77). This distinction should be made clearer.

Page 4-22: The discussion of baseline monitoring should indicate whether the program is nearly complete and a higher priority given to resolving the uncertainty about hydraulic gradients.

The proposed method for constructing the exploratory shaft is going to have a major effect on groundwater levels. The DEA indicates (4.2.1.2.2) that "baseline monitoring would be conducted to determine the natural" flow regime, but no indication is made that this program is nearly complete. It is not expected that this resolution is near, given the great uncertainty about hydraulic gradients. Because of the scheduling required for shaft drilling, this aspect should be given a higher priority than is evident in the DEA.

It should be pointed out that the shaft construction could have the effect of clogging the pores of some of the aquifers by intrusion of drilling muds. It is also, therefore, necessary to complete testing of hydraulic parameters in the vicinity of the reference repository location well in advance of the shaft drilling so that the measurements will be representative of natural conditions and can be used along with tests run further away from the repository location.

Page 4-25: A conflict appears between the 8,400 cubic meters, obtained by simple calculation based on Figure 4-2 (p. 4-11), and the quoted 7,100 cubic meters of excavated material. Not all of this would be basalt, and some of the material will apparently be used as an admixture to the grout, but that would occur after shaft construction is complete. Additional rock, from beyond the drill bit diameter, would infall because of spalling and have to be removed. A more complete description of the calculation procedure should be provided, including bulking factors, amount to be used for backfill and differentiation between shaft drilling and test drilling values.

Pages 5-1, 5-11, 5-48: The DEA states on page 5-1 that "design shall not preclude . . . reprocessed wastes . . . and defense high-level waste." On page 5-11 the description of design and the subsequent discussion do not include defense wastes. On page 5-48, the DEA states that the repository may receive "small quantities" of defense HLW. These inconsistencies should be corrected and a discussion of the contribution of defense wastes to future radiological impacts should be included.

Pages 5-39 to 40: The impacts listed in Table 5-10 appear to be short-term effects, such as during construction, operation, and retrieval phases. Long term effects (such as groundwater transport of radionuclides and geochemical effects on the bedrock and faults) appear to have been left out of the table but treated to some extent in the text. This should be corrected by additions to the table.

In the discussion of surface water impacts, the potential effects of downstream contamination of the Columbia River have been inadequately addressed. The Columbia River is located 7 km (4 miles) from the reference repository location. The transport of radioactivity by streams is primarily by hydrodynamic processes; however, movement is also dependent upon physical and chemical characteristics of the radionuclide. It is also dependent on the stream system such as the chemical character of the bottom sediments and aqueous system, the surface concentrations of radionuclides on bed sediment and on biomass, and the amount and type of suspended matter.

The fraction of released radioactivity retained by bed sediments and biota is most important to hazard evaluations and is dependent on environmental conditions. Settling velocities and sediment transport, which can vary considerably at nearby points in the same stream, are important factors in determining the fraction of released radioactivity retained by the aquatic system and therefore available for uptake in food chains.

Page 5-40: The impacts of radionuclides on the aquatic ecosystem need more discussion. In aquatic systems the relative level of radionuclides in organisms can be related to the concentration of radioactivity in water through the use of concentration factors. Aquatic life may receive radiation from radionuclides present in the water and substrate and also from radionuclides that may accumulate within their tissues. Humans can

acquire radionuclides from a number of pathways, but recognized as among the most important are drinking water or edible fish and shellfish that have concentrated nuclides from the water. In order to prevent unacceptable doses of radiation from reaching humans, fish, and other important organisms, the concentrations of radionuclides in both fresh and marine water must be carefully monitored and restricted.

The DEA states that while there are currently no threatened or endangered species in the reference repository location site, three bird species are candidates for listing. The DEA states that available evidence does not preclude site qualification, the DEA should specifically define whether federal listing of the three candidate bird species as threatened or endangered would disqualify the site.

Page 5-46: The DEA defines the outer boundary for regional effects as "the highway intersection with the nearest major interstate highway or the railroad connection with major rail lines." This narrow definition severely limits the identification of hazards and analysis of impacts associated with transport to the Hanford site. A broader definition to include site specific, intrastate, interstate and national considerations would be more realistic. This viewpoint also appears to be supported by 10 CFR 960.5-8-2.

Page 5-49: The DEA does not adequately explain the rationale for the 70/30 modal split. While the DEA does remove the reference to "payload advantages" as the basis for the 70/30 split, and indicates USDOE was considering options, it still does not explain the rationale for the proposed modal split (para. 4). A more detailed discussion should be provided.

Page 5-51: Driver and population exposures have been underestimated in the DEA, based on the estimated number of truck shipments per day. Truck delays will occur due to weather, and an estimate of radiation exposure should be made at stops where trucks will be held awaiting improved weather conditions. Further, there will be a "small trickle" of shipments for the first few years of the operating life of the repository and a tapering off of the shipment numbers near the close of the repository. This would imply that the average number of shipments per day could be anticipated to be higher during a 10-year span. In addition, the RADTRAN II model assumes a 5-day turnaround time for truck casks and 3-day turnaround time for rail casks. The DOT requirements on stop time, travel time, and vehicle inspection by drivers would increase this turnaround time from reactor to repository and return to be approximately 22 days.

Page 5-52: The DEA states that the favorable condition of "A regional meteorological history indicating that significant transportation disruptions would not be routine seasonal occurrences" is present in the "region" encompassing the reference repository location. However, the DEA fails to fully address this issue. The discussion is limited by the narrow definition of "regional" (next major highway intersection) and the failure to more fully describe the activities at key exits and classification points both in the region and out.

Site Suitability Analyses

Page 6-23; Potentially adverse condition (1): The DEA fails to address the potential conflicts of surface and subsurface activities with existing land use. The 200 Areas are used for HLW and LLW storage/disposal and contain spent fuel reprocessing and plutonium production activities; reactor operation is contained in nearby 100 Areas. The possibility and magnitude of resulting off-site releases should also be addressed. The discussion should also address existing levels of radiation from natural sources, plutonium production and reprocessing, and radwaste storage and disposal and their relation to monitoring potential releases from the reference repository.

Page 6-24; Disqualifying condition: The DEA generally downplays use conflicts. While the characterization and repository activities themselves should not adversely impact other uses of the Hanford site, the somewhat unique concern with Hanford is the presence of other sources of radiation that contribute to the cumulative off-site exposures. In addition, due to the complexity of the site, it will be difficult to design an environmental monitoring program that can effectively differentiate releases from the repository from other nearby sources in order to take corrective action.

Environmental Quality (Section 960.5-2-5): The Wild and Scenic Rivers Act (16 USC 1271) would apply to the reference repository location if actions on the site directly and adversely affected (e.g. radionuclide contamination) the addition of the Hanford Reach to the Act. It is not clear if the Hanford Reach is still under consideration for designation as a wild and scenic river. DOI appears to have dropped it from the list around 1980 but the reason has not been given and there is no indication whether it may be reconsidered.

The DEA states "The reference repository location is approximately 7 kilometers (4 miles) from the Columbia River and no significant impacts on the river ecosystem are anticipated from repository activity." To adequately address this issue, the DEA should discuss the status of the designation and clearly indicate whether the designation of the Hanford reach would disqualify the site.

Page 6-45 to 51: The discussion of transportation qualifying conditions is inconsistent relative to prior discussions of transport modes. While only impacts of rail and truck transport have been discussed to any degree, the discussion now includes barging as a possible mode. The discussion of transport modes should be made consistent throughout the DEA.

Pages 6-45,46: While apparently the qualifying condition is met from access routes constructed from existing local highways and railroads (defined as regional), nearby routes to be utilized have high risk conditions. The Hinkle, Oregon, rail classification yard and major steep grades on Interstate 90 to the north, and Interstate 84 to the south, could contribute materially to accidents and delays, with concomitant radiation exposures.

Page 6-47: The DEA should address the possibilities of vehicle center of gravity changes, traffic obstructions, slide potential, and escort requirements. These factors, in combination with others, could necessitate some reconstruction or realignment of roads or tracks and should be addressed in the DEA.

Page 6-49: Radiation exposure and contamination potential related to barge shipment are not treated adequately in the DEA. The DEA only mentions that a favorable condition is not met for inland water because the existing loading facilities for barge shipments are located approximately 27 kilometers (17 miles) from the proposed repository site. However, the DEA then states, "materials transported by barge up the Columbia River could include repository equipment, construction and operating supplies and, perhaps, radioactive waste packages" and that "Transloading capability for barge shipments exists at a Port of Benton facility . . . 32 kilometers . . . from the proposed repository site..."

Page 6-59: Although no critical habitats have been recognized in association with recognized threatened or endangered animal species, an extremely valuable natural production area for significantly declining populations of chinook salmon and steelhead has been delineated in the Hanford Reach of the Columbia River. Under a March 20, 1980, mid-Columbia Settlement Agreement, Grant County PUD has agreed to study salmonid spawning, incubation, and rearing in this section of river. Studies were begun in the fall of 1978 and continued through spring of 1983. Initial results have shown that increased flows above present minimum stream flows provide increased spawning habitat.

The Hanford Reach of the Columbia River is the last free flowing portion of the river in the United States and has been considered for designation under the Wild and Scenic Rivers Act (16 USC 1271). As such, it would be considered a protected resource near the reference repository location and a potential conflict with the repository siting. The Wild and Scenic Rivers Act, 16 USC 1276, will have to be examined and analyzed in light of this.

Page 6-70: The claim that the hydraulic gradient is "predominantly" horizontal does not appear to be borne out by the data presented in Table 6-5 (page 6-73). The head differences are as great in a vertical direction and the distances are obviously shorter, so the vertical gradient, while not invariant, appears larger than the horizontal.

Page 6-107; Potentially adverse condition (2): The DEA ignores the possibility that the clay material resulting from degradation of joint infill material might dehydrate and shrink.

The DEA states that "no isolation characteristics of the dense interior...have been formally evaluated." This is an inappropriate response. The possibility should be included, estimates made of its effect, and any pertinent experimental evidence should be included.

Page 6-117; Favorable condition: The statement that proglacial flooding would have only a "minor" impact on the recharge of confined aquifers is debatable, but possible; there is almost certainly going to be an effect on the pressure regime in the aquifer as these are communicated very rapidly.

Page 6-126: The DEA refers to deep seismic, aeromagnetic or gravity surveys, but no data are provided on the sub-basalt stratigraphy. If the data exist, they should be included.

Page 6-135: The relevance of micro-earthquake swarm activity to fracturing of the basalt, and to the potential for a resultant increase in vertical conductivity of groundwater has not been addressed in the DEA. It appears to admit this possibility but does not see the likelihood of effects on the groundwater flow regime (see, for example, Section 6.3.1.7.9). The probability should be reported as it would pertain to the geohydrology.

Page 6-197; Disqualifying condition: The possibility of high inflows of water during construction indicates that isolation characteristics of the rock may not be as good as indicated in the geohydrologic sections of the DEA. The likelihood of high flow rates implies perviousness of the formation, however the DEA dismisses the implication, saying "while some water inflow...is anticipated, the volumetric flow rate is expected to be minimal based on current knowledge."

Page 6-122; Potentially adverse condition (2): The discussion of design earthquakes should consider the potential for magnification at depth. The DEA indicates (Section 6.3.3.4.5) design earthquakes will be determined in the course of site characterization, but indicates that other facilities at the Hanford site have used a 0.25 g zero-period horizontal acceleration (based on a 6.5 magnitude earthquake) in their design. This does impose a certain pressure for a similar design parameter for a repository at the site. There is no indication of any consideration of potential magnification at depth. Perhaps seismic monitoring of microseismic events from the exploratory shaft underground facility (to the extent other investigations do not disturb) should be included in the in situ testing (Section 4.1.1.6.2, p. 4-12) to define any such magnification factor. The design acceleration could be used in dynamic modeling of the repository design.

Page 6-123; Potentially adverse condition: Concluding that earthquakes larger than historical seismicity will not occur on the Columbia Plateau apparently questions an NRC conclusion and should be rewritten to avoid this implication. Is the change in interpretation due to newer data? If so, it should be cited. It should be noted that inactivity along a portion of the fault does not necessarily mean inactivity along the entire fault if there may be other faults that could satisfy the kinematic requirements for fracture.

Pages 6-222 to 226: The discussion of potential on-site radiological hazards under normal conditions is inadequate. The discussion should be expanded to include radiation doses to workers, airborne particulates, and accident potential.

Page 6-223: The discussion of consolidation of spent fuel rods is inadequate. An anticipated 26 fuel assemblies will be compacted per day, 250 days per year. Of these, approximately one percent will fracture, releasing an estimated 30 percent of the radioactive gases present. This results in a normal daily operational release of about 90 Curies of Krypton-85. Yearly releases will amount to approximately 22,500 Curies. The on-site and off-site exposures following the fracture of spent fuel rods during this consolidation process from the radioactive gases Krypton-85 and Iodine-129, require a complete analysis. These on-site and off-site exposures will occur as a part of normal operation of the repository during its 26-year life. In addition, it is important to consider the accidents possible during this compaction process.

Pages 6-261 to 269: There appear to be serious technical problems with the prediction of groundwater travel time relative to the approach used and the lack of original data.

While the results on radionuclide transport and groundwater travel time are given as requested, there do seem to be serious technical problems with the prediction of groundwater travel time (Section 6.4.2.3.5). This is first apparent when a calculation is made on the basis of deterministic values for all the relevant parameters; transmissivity was taken to be 0.15 square meters per day, the regional hydraulic gradient was 10-3, and the effective thickness was 0.04 m (all these values come from page 6-266). Combining these values, in the one-dimensional flow system assumed, gives a travel time of 7,300 years to the 10 km accessible environment boundary. This is closer to the 10% probability result in Figure 6-22 (page 6-269) than to the median value of 81,000 years.

Some of the shortcomings of the stochastic procedure used are easily seen. First, a uniform probability distribution (or, more likely, a log-uniform distribution) was used for effective thickness and hydraulic gradient. Such a distribution is intuitively uncomfortable in that it prescribes that the value can be up to some value, but not even a fraction above it; the sense of a best-estimate central value is very much diluted if not entirely lost. Surely there could be some estimate of a sample standard deviation which could be applied to scale a log-normal or log-triangular distribution. A logarithmically transformed distribution such as this would seem appropriate since these parameters have such a wide range of scales that they are normally thought of in that transformed space.

A final and important reason that the stochastic approach is not applicable to this question is that the groundwater regime is inherently self-biasing toward the non-conservative end. The contaminants will flow in the direction of the greatest gradient, not between boreholes as they happen to have been placed. The flow will seek out pathways of high transmissivity. The exception to this unconservative bias lies in effective thickness, where flows will tend toward thicker and more porous areas. The latter effect is reduced somewhat by the correlation to be expected between effective thickness and transmissivity. (The same correlation should also be accounted for in the analyses that were

reported in the DEA; this would reduce the spread of travel times.) Because of the unconservative way in which the groundwater phenomenon behaves in comparison to the calculations we make of it, a stochastic analysis should require a strong proof similar to that required for scientific hypothesis; the travel time should be reported not by the median value, but by the 95% certain value.

Public confidence in these analyses, at least among the technical community, would also be enhanced by greater presentation of original data. Tables of well and tracer tests with location, depth, and results, should be included in the section like (but more complete than) the tabulation of gradients (Table 6-5, page 6-73).

Pages 262,263: The discussion of thermal effects of the radwaste is inadequate. Concerns relative to vertical orientation of some of the jointing basalt and the choice of a synclinal structure in which to locate the repository should be addressed. The possibility of increased hydraulic gradients should be considered in the delineation of flow patterns as carriers for radionuclides.

Thermal effects are discussed in Section 6.4.2.3.5 and essentially dismissed. Simulation of this phenomenon is said to be only at a preliminary stage, which would imply that more extensive modeling is intended. A concern in this regard is not only the vertical orientation of some of the jointing in the basalt, but also the choice of a synclinal structure in which to locate the repository. The possibility of increased hydraulic gradients, due to thermal drive, along the rising limbs of the syncline, as well as a thinner effective width due to thermal stratification, should be considered in the delineation of flow patterns as carriers for radionuclides.

Minor Comments

Page 2-12: The Palouse Paleoscope (shown in Figure 3-23 on page 3-46) should be named where it is referred to in this section and some explanation for its origin given.

Page 2-12: The seismology section should include a map of the Pasco Basin and surrounding areas showing epicenters of deep earthquakes, corresponding to the shallow ones of Figure 2-10 (p. 2-16), to better assess the structural influence of the sub-basalt rocks on the seismicity of the site.

Page 2-15: Deformation patterns described here should be related back to plate tectonic mechanisms. This may not be well understood at this time, but a best estimate should be included.

Page 2-19: In Figure 2-12, the section of river identified north of the State of Washington, in British Columbia, as the Columbia River, is actually a section of the Kootenai River. The Columbia River is properly located north and west of the label. Also the Flathead River is not shown as connecting to the Clark Fork.

Pages 2-25, 2-26: The maps of potentiometric surface (Figures 2-15 and 2-16) are too small and the format is poor. A contour map would show the flow directions much more clearly than these isometric plots. Also, to enable a comparison of the water surface elevations of surface water systems, a cross-section of the Hanford site showing piezometric head profiles and the normal level of the Columbia River should be provided.

Page 2-32: The DEA should provide some indication of the depths, pumpage, and use of water wells in the Pasco Basin as groundwater pumpages may have an effect on hydraulic gradients and thus on groundwater travel times.

Page 3-108: The EPA and State of Washington drinking water standards for Tritium are 20 picocuries per milliliter. The DEA states that Tritium (H-3) level in drinking water at the Fast Flux Facility during 1982 was 18 pCi/milliliter, and that this amount of Tritium is 10 percent of the State of Washington drinking water standard when the value is actually 90 percent of the drinking water standard. This discrepancy should be corrected.

Page 4-22: There is an apparent discrepancy between the "minimal impacts expected on the aquatic ecosystem" (4.2.1.3.1.2) and the "conducting of hydrologic stress tests some of which would require discharge of large quantities of groundwater" in the previous section (4.2.1.2.1).