at or near the reference repository location is not supported; (6) the Rattlesnake Hills gas field is situated within the reference repository location; and (7) concerns exist regarding future drilling for resources in the reference repository location.

Response

Structures in the Columbia River Basalt Group may not reflect structures in geologic units underlying the basalt. It is therefore possible that structural and (or) stratigraphic traps containing accumulations of natural gas may exist beneath the reference repository location and vicinity. It was suggested in the comments that magnetotelluric data depicted on maps by Mitchell and Bergstrom (1983) demonstrated that structures within and beneath the basalt sequence differ. This interpretation could be inferred from the maps; however, it should be noted that Mitchell and Bergstrom (1983) stated that the depth and relief information shown in the report may be in error due to the magnetotelluric data quality and the preliminary nature of the analysis. Further analysis of that data and more recent data indicate that the isopach and structure maps presented in the report are in error. However, even though structural traps are likely to be associated with anticlinal ridges of the Yakima folds, the concern that structures (anticlines and synclines) in the basalts may not reflect the structures in the sedimentary units beneath the basalts is valid. The data needed to address this would be collected during site characterization.

Additional data are also needed to determine if stratigraphic and other nonstructural traps exist beneath the synclines. The oil companies have accumulated a large amount of information on the prebasalt stratigraphy, and to date have selected anticlinal ridges rather than synclines as prime lease positions and permitted drilling sites. Economically significant accumulations of hydrocarbons require the presence of certain conditions other than a trapping mechanism (see Subsection 6.3.1.8.5 of the Draft Environmental Assessment), and drilling to date has not encountered these conditions. Since 1980, the Shell Oil Company has completed a series of four wells, all on anticlinal ridges. Although three of the four wells encountered natural gas, the four wells were deemed noncommercial and consequently were plugged. The final Environmental Assessment has been changed to reflect the unknown nature of stratigraphic and structural traps that could be present in the sedimentary rocks beneath the basalt sequence in the Cold Creek syncline and reference repository location. These changes were made to the position analysis in Subsections 6.3.1.8.3 and 6.3.1.8.5.

The buried extension of the Yakima Ridge structure (see Subsection 3.2.3.4 of the Draft Environmental Assessment) is interpreted to be a plunging anticline but is not expected to be a target for hydrocarbon exploration. The crest of this structure is approximately 1.6 kilometers (1 mile) south of the reference repository location and possibly could be the target of future drilling. However, such drilling would probably take place further west where the basalt is thinner and structural closure is greatest. Additionally, the hydrocarbons would tend to migrate up the

dip to the west. Some uncertainty exists in this assumption because, as stated previously, the structures in the basalt may not reflect structures in the geologic units underlying the basalt. Changes have been made in Subsections 6.3.1.8.3 and 6.3.1.8.5 of the final Environmental Assessment to reflect the unknown nature of structural and stratigraphic traps that could be present in sedimentary rocks beneath the basalt sequence in the reference repository location and vicinity.

Although natural gas exists in and around the reference repository location, it is not known to be a resource that has or is projected to have a value great enough to be considered commercially extractable within the foreseeable future. Methane gas has been found in ground-water samples from the Cohassett flow that may have originated from beneath the basalts or from interbeds within the basalts. The presence of natural gas in the Cohassett flow is not unique; natural gas is commonly encountered during the drilling of wells into the basalt sequence of the central Columbia Plateau (McFarland, 1983). Gas introduced from below the basalt could originate from noncommercial gas (as seen in the four wells drilled to date) or coal beds, as well as potentially commercial gas accumulation. Future studies will attempt to determine the origin of the methane and potential for hydrocarbon resources in the reference repository location and vicinity. Subsection 6.3.1.8.3 of the final Environmental Assessment has been changed to specifically state that natural gas is present in the ground waters within the basalt sequence of the reference repository location and that the gas could have originated from beneath the basalts.

Since natural gas is present in ground-water samples from the reference repository location and various structural and stratigraphic traps may exist in geologic units underlying the basalts, the position for the first potentially adverse condition under postclosure human interference (natural resource) (DOE, 1984a; 960.4-2-8-1(c)(1)) must be changed to "present." The basis for this change is that the natural gas detected at the reference repository location indicates the presence of naturally occurring materials, although not actually identified, in such form that economic extraction is potentially feasible in the foreseeable future. Subsection 6.3.1.8.5 of the final Environmental Assessment has been changed to reflect a "present" position for the first potentially adverse condition under the postclosure human interference guideline.

The Geosciences Group, George Leaming Associates (GG/GLA, 1981) report considered the probability of finding three low-pressure gas fields, similar to the Rattlesnake Hills gas field, in calculating the 62 dollars per inhabitant value for the ten-county area within 100 kilometers (62 miles) of the reference repository location. If high-pressure commercial gas is discovered beneath the basalts, this value may increase. The amount of the increase would depend on the size of the field and the cost of recovery; however, no economic quantities of natural gas currently are known to exist in the reference repository location. The discussion of the economic analysis presented in the Draft Environmental Assessment during discussion of the first favorable condition of the postclosure human interference (natural resource) guideline (DOE, 1984a; 960.4-2-8-1(b)) is considered sufficient.

The site referred to on page 10, paragraph 2 of the Draft Environmental Assessment is the reference repository location situated in the Cold Creek syncline. The Rattlesnake Hills gas field was situated on the flank of Rattlesnake Mountain, an anticlinal ridge that formed a structural trap for accumulating natural gas. The executive summary has been changed to clarify that the Rattlesnakes Hills gas field is not located in the reference repository location.

The U.S. Department of Energy currently owns and controls the land and mineral resources of the reference repository location and will continue to do so up to at least 100 years after closure of a repository. This is a requirement of the Nuclear Waste Policy Act of 1982. Drilling for natural resources in the reference repository location during this period can be controlled by the U.S. Department of Energy. After 100 years beyond closure, the U.S. Department of Energy also is expected to control the land, but because of the potential loss of institutional controls hundreds to thousands of years beyond closure, permanent markers and records will be established to reduce the likelihood for exploration activities by future generations. Such markers and records are required by the U.S. Nuclear Regulatory Commission (NRC, 1985).

Issue: Geothermal resources

According to commenters, the geothermal potential of the reference repository location was not addressed in the Draft Environmental Assessment and should be considered in the final Environmental Assessment.

Response

The available data for assessing the geothermal potential is derived from continuous traces of down-hole temperatures that have been obtained from 15 boreholes drilled in the Pasco Basin, ranging in depth from approximately 300 to 1,500 meters (approximately 1,000 to 5,000 feet). The average geothermal gradient from these holes was approximately 38°C per kilometer (162°F per mile). These data agree with the temperature gradient contour map of the State of Washington shown by Stoffel and Korosec (1984). Stoffel and Korosec (1984) stated that although much of the Columbia Basin (i.e., central Columbia Plateau) has potential for space-heating energy, the Hanford Site is located in a "nonfavorable" area, defined as an area where the geothermal gradients are less than 45°C per kilometer (182°F per mile). Stoffel and Korosec considered temperatures greater than 45°C per kilometer (182°F per mile) favorable for space-heating energy.

Information on geothermal resources has been added to Subsection 6.3.1.8.3 of the final Environmental Assessment.

Issue: Ground-water resources

Several commenters were concerned that the ground water within the reference repository location was not considered a natural resource and that there was a potential conflict in statements made in Subsections 6.3.1.8.9 and 6.3.1.1.8 of the Draft Environmental Assessment.

Response

Ground-water resources are present in the reference repository location both in the unconfined and upper confined ground-water flow systems; therefore, the first potentially adverse condition under the human interference guideline (DOE, 1984a, 960.4-2-8-(1)(c)(1)) must be changed from "not present" to "present" since ground-water extraction as a resource is potentially feasible in the foreseeable future. This change in position is required based on a redefinition of the phrase "naturally occurring material." In the redefinition, ground water is considered to be a "naturally occurring material."

Subsection 6.3.1.8.5 of the final Environmental Assessment reflects a position change to "present" for the first potentially adverse condition under human interference (natural resource).

In addition to the ground-water resource potential, there is a ground-water concern regarding an apparent conflict in discussion of the fifth potentially adverse condition under postclosure human interference (natural resource) (DOE, 1984a; 960.4-2-8-1(c)(5)) in Subsection 6.3.1.8.9 of the Draft Environmental Assessment (see p. 6-143), and the first potentially adverse condition under postclosure geohydrology (DOE, 1984a; 960.4-2-1 (c)(1)) discussed in Subsection 6.3.1.1.8 of the Draft Environmental Assessment (see p. 6-76). This apparent conflict is believed to be caused by the wording of the General Siting Guidelines (DOE, 1984a). When the word "could" was used in the guidelines (see Subsection 6.3.1.8.9 of the Draft Environmental Assessment), an adverse condition was considered potentially present at the reference repository location if there were any reasonable probability of occurrence. In the discussion of potentially adverse condition in Subsection 6.3.1.1.8 of the Draft Environmental Assessment, the key word is "expected." Changes in geohydrologic conditions are not expected to occur; therefore, this potentially adverse condition does not appear to be present at the reference repository location. Ground-water use was also discussed in Subsection 6.3.1.1.9 of the Draft Environmental Assessment.

C.5.9 POSTCLOSURE SITE OWNERSHIP AND CONTROL

Comments assigned to this section have been cross-referenced to and discussed in Section C.6.2.

C.5.10 POSTCLOSURE SYSTEM GUIDELINE

No comments were assigned to this category.

C.5.11 ASSESSMENT OF POSTCLOSURE PERFORMANCE

The issues related to postclosure performance assessment encompassed a range of questions from general concerns about the safety of a repository at the Hanford Site to specific concerns about obtaining and interpreting data suitable for performance analyses. The general concerns were discussed in a subsection composed of a single issue that addressed the concept of risk and societal standards for judging the acceptability of specific risks. The principal remaining issues were grouped into subsections that focused upon specific aspects of performance analysis, particularly emphasizing the difficulties in identifying radionuclide pathways to the accessible environment and in defining the hydrologic and geochemical characteristics of those pathways. A topic comparable in importance to site hydrology in its effects on repository system performance, though fewer comments were addressed to it, was the source term (i.e., the radionuclide containment period and subsequent release rates). Several issues concerned the models and data required to analyze container corrosion and waste dissolution and transport. Comments that did not fit clearly within the categories of general safety, radionuclide pathways, and source term were addressed as "Miscellaneous issues."

C.5.11.1 Repository safety

Issue

Many comments were received regarding the broad issue of repository safety, concerning the capability of the total system to protect present and future generations. Any level of risk posed by the construction and operation of a repository at the Hanford Site, no matter how small that risk might be, was judged to be unacceptable and was claimed as a basis for rejection of the Hanford Site as a candidate repository location. In addition, several commenters were concerned that the presence of a repository at the Hanford Site would create the perception of a hazardous condition (e.g., contamination of the Columbia River or aquifers used for irrigation water). This perception could tarnish the image of the State of Washington and might reduce the market for State agricultural products even if the hazards were, in fact, nonexistent.

Response

The concept of risk is not widely understood, but a fundamental axiom is that any activity that provides a benefit to an individual or a society entails an element of risk (Ruckelshaus, 1984). Various personal and societal standards exist for judging acceptability of specific risks; an activity that does not meet those standards is not conducted. The issue is often quite complex because rejection of a particular course of action always requires acceptance of some other course of action. The choice between risk and no-risk never exists; the choice can only be between the different risks associated with alternative actions.

The benefit of a nuclear waste repository is that it supports the generation of electricity by nuclear power. To the extent that nuclear power may avert the risks of alternative energy forms, including conservation, or the potentially disastrous consequences of various scenarios involving energy shortages or competition for energy sources, acceptance of some level of risk is clearly warranted. Implicit in the promulgation of a release standard by the U.S. Environmental Protection Agency is the judgment that geologic disposal of nuclear waste is an acceptable activity if, and only if, the releases (i.e., the risk) can be constrained within the limits specified by the U.S. Environmental Protection Agency (EPA, 1985). Various concerns about general and specific aspects of repository safety (e.g., the possibility of waste leaking into the Columbia River, adequate consideration of all potential disruptive events, the adequacy of models for predicting system behavior) relate to the capability of the repository to meet the safety standard established by the U.S. Environmental Protection Agency.

The U.S. Environmental Protection Agency standard is expressed in terms of allowable releases of radionuclides into the accessible environment, areas (e.g., surface waters, usable aquifers) where humans might be exposed to the effects of these radionuclides. The U.S. Environmental Protection Agency stipulated specific limits based on analyses of "typical" natural uranium ore deposits; a repository should be as safe, the U.S. Environmental Protection Agency judged, as the ore deposit from which the waste originated. For the hypothetical scenario analyzed by the U.S. Environmental Protection Agency, and using a commonly accepted relationship between radiation exposure of a population and the incidence of fatal cancers in that population, the U.S. Environmental Protection Agency estimated that radiation from a repository (or an equivalent deposit of natural uranium ore) would cause approximately 10 deaths per century in the 10,000-year period after repository closure, a total of 1,000 deaths. Although any nonzero number specified as an allowable number of deaths may be disturbing to many people, there are few activities in any society that could meet so strict a standard. Therefore, in response to the question, "Can 1,000 deaths attributable to a repository be termed safe?", an affirmative response is reasonable in view of (1) the real, current benefits and future, potential benefits of nuclear power, (2) the risk associated with unmined uranium ore, and (3) the risk associated with any alternative course of action.

A conclusive judgment about the ultimate safety of a repository in basalt at the Hanford Site would be premature at this time. A limited amount of testing has been done to evaluate the geologic, hydrologic, and geochemical characteristics of the reference repository location. Preliminary analyses based on the data obtained to date suggest that the reference repository location has a reasonable potential to meet the safety standards stipulated by the U.S. Nuclear Regulatory Commission (NRC, 1983b) (primary among which is meeting the U.S. Environmental Protection Agency standard (EPA, 1985)). Assessments made at this phase of the program are aimed at judging whether further site characterization is warranted, not at judging whether the reference repository location can presently meet regulatory standards. An environmental assessment is

neither a license application nor an environmental impact statement; the level of detail required for these documents is substantially beyond the information base presently available. This distinction is an important one and must be recognized in reviewing the Environmental Assessment.

A perception of risk, even if it has no basis in fact, can be economically harmful to the agriculture and tourism industries of the State of Washington.

The essential ingredient in dispelling fears induced by nonexistent risks is education. The intense scrutiny under which the entire repository-development process will proceed may serve to mitigate fears that have been engendered by the current debate and by the assumption that accidental releases from past defense operations foretell similar accidental releases from future repository operations. The technical program established by the U.S. Department of Energy is designed to deliver the required product (i.e., a safe repository) accompanied by an information-dissemination program that will provide adequate visibility of the technical and decision-making processes. The U.S. Department of Energy is committed to building a repository that will meet the public safety requirements of 40 CFR 191 (EPA, 1985).

C.5.11.2 Conceptual model for ground-water travel time analysis

Many commenters expressed concern that the analysis of ground-water travel time (and, implicitly, radionuclide transport) did not address potentially important pathways, processes, and site characteristics. The principal specific areas noted were (1) vertical ground-water movement, (2) unsupported assumptions of boundary conditions, (3) analysis based on porous medium, and (4) rock (pathway) damage due to heat or tectonic activity.

Definition of the site conceptual model is a critical step in the overall process of evaluating ground-water flow characteristics and assessing the suitability of the Hanford Site for a repository. A thorough characterization program is being designed to include activities that will identify site features and disruptive events, both natural and human-induced, that would promote the release and transport of radioactive materials from a repository to the accessible environment. Several conceptual models have been hypothesized based on available experimental data and on speculation regarding features not yet identified but not precluded by current data.

Many commenters noted the possible existence of as-yet-unidentified unfavorable features and expressed judgments regarding their presence or the likelihood of their identification during site characterization. The basic response to the questions raised is that site characterization certainly would include the search for disqualifying defects in the Hanford Site as an integral part of data acquisition.

Issue: Vertical flow

The omission of vertical ground-water movement in the travel time analysis concerned several reviewers. A number of commenters suggested that the ground-water travel time calculations were questionable because of an assumption made in the Draft Environmental Assessment of horizontal ground-water movement. Several reviewers felt that the possibility of vertical movement and three-dimensional pathways was inadequately addressed in the Draft Environmental Assessment. Several commenters felt that the effects of discrete, crosscutting features (i.e., natural vertical conduits) and test boreholes (i.e., manmade vertical conduits) were inadequately addressed. Two reviewers stated that the ground-water travel time model results summarized in the Draft Environmental Assessment were inconsistent with the conceptual model developed from site hydrochemistry data, which suggest upward movement.

Response

The favored conceptual model of the deep ground-water flow system at the time of completion of the travel time analyses for the Draft Environmental Assessment suggested limited vertical movement of ground water. The assumption in the travel time model of strictly horizontal ground-water flow in the basalt flow tops was justified because, for limited vertical ground-water flow, these flow tops will be the pathways of likely and significant radionuclide transport following repository closure. In the final Environmental Assessment, the vertical component of ground-water flow is explicitly modeled (Clifton, 1985).

Analyses utilizing models that include vertical flow have been incorporated into Subsection 6.4.2.6.1 of the final Environmental Assessment.

Issue: Vantage interbed flow path

One commenter suggested that the Vantage interbed has a high hydraulic conductivity and would transmit ground water much more rapidly than the basalt flow tops.

Response

Current data from hydrologic tests in the vicinity of the reference repository location indicate that the Vantage interbed has a low conductivity and is a thin and discontinuous layer. The presence of the Vantage interbed is used as an indicator of transition from Wanapum to Grande Ronde Basalts, but the Vantage interbed is not considered a good transmitter of ground water within the Hanford Site (see Section 3.3.2 of the Draft Environmental Assessment.

Issue: Scale for flow modeling

One commenter stated that a general regional picture for the Columbia River basalts is characterized by downward ground-water flow in the anticlines and upward flow near the rivers.

Response

Although the general concept of downward flow in anticlines and upward flow near rivers is basically sound on a regional scale, the regional concepts do not necessarily provide meaningful detail on the smaller scale of the control zone (2 to 10 kilometers (1.2 to 6.2 miles)). An analysis of the potential for vertical ground-water movement is presented in a report by Clifton et al. (1984), which was quoted in the Draft Environmental Assessment.

Issue: Definition of boundary conditions

One reviewer stated that model boundary conditions used to generate the flow path were arbitrary and had little or no field data to support their use. The reviewer supported this statement by citing a report by Arnett et al. (1981) and asserting that it was the basis for the horizontal hydraulic gradients used in the Draft Environmental Assessment. The reviewer also suggested that a large number of head monitoring wells are necessary along the periphery of the Pasco Basin to establish boundary conditions.

Response

The analysis by Arnett et al. (1981) was not used as the basis for horizontal hydraulic gradients in the Draft Environmental Assessment analysis; nowhere in the Draft Environmental Assessment is this stated or implied. Horizontal hydraulic gradients over the 10-kilometer (6.2-mile) distance were conservatively estimated (i.e., taken from the high end of the observed range) based on measurements at approximately that scale (Yeatman and Bryce, 1984a, 1984b).

Most past reviewers (including the Draft Environmental Assessment reviewer cited here) have recommended that the results of a regional model be used to establish boundary conditions for a local model. Such an effort is under way. The local model is expected to be on a much smaller scale than the Pasco Basin. The statement that many boundary wells on the Pasco Basin scale are needed to adequately establish boundary conditions is contrary to most opinion and to the approach of the Interagency Hydrology Working Group. Although obtaining boundary conditions from wells may be feasible for a more local model and in fact may be the preferred method given the apparent influence of structures around the reference repository location, it is impractical and unnecessary on the Pasco Basin scale.

Issue: Assumption of porous medium flow

Modeling based on porous medium concepts rather than a fracture flow approach concerned several reviewers.

Response

It is true that basalt has been treated principally as a porous medium, because basalts have relatively frequent small fractures and

therefore probably behave as an equivalent continuum or porous medium in other than very small scale. Additionally, a review of the core of Grande Ronde Basalt dense interiors has shown that more than 99 percent of the primary fractures are completely filled with secondary minerals (Lindberg, 1986). The remainder are approximately half filled, on the average. This suggests that open fracture flow does not occur in the bulk of the dense interior basalts. Larger discrete fractures have been modeled in the past (DOE, 1982), and additional discrete feature modeling is under way to assess potential impacts of existing or induced fractures.

Issue: Steady-state flow assumption

Several reviewers questioned the assumption of steady-state ground-water flow used in the travel time analysis presented in the Draft Environmental Assessment and suggested that transient ground-water flow should be considered in future analyses of the Hanford Site.

Response

Modeling presented in the Draft Environmental Assessment was preliminary and emphasized the deeper basalts. Most transients, particularly the short-term transients (i.e., seasonal irrigation), affect the shallower zones more than the deeper ones. For this reason, preliminary modeling is often performed in the steady-state mode. The potential for transient ground-water flow is not being ignored and will be addressed in future analyses where appropriate. All major Basalt Waste Isolation Project ground-water computer codes are capable of modeling transient conditions. A brief summary of this point has been added to the final Environmental Assessment.

Issue: Damage to vesicular zone

Thermally induced damage to the vesicular zone in the repository horizon was noted by one reviewer as a potentially hazardous condition. The reviewer stated that if the repository is constructed in the central vesicular zone of the Cohassett flow, there might be a potential for the heat to expand the fluid-filled vesicles, fracture the vesicle walls, and increase permeability.

Response

Current plans locate the repository in an area that does not intersect the vesicular zone. The commenter is nevertheless correct in that if the temperature rises sufficiently (particularly near the waste packages), the expanding water in water-filled enclosed rock voids such as vugs may lead to some localized fracturing. Zones in which fracturing might occur are considered part of the "disturbed zone" as defined in 10 CFR 60 (NRC, 1985) and therefore are not included as part of the hydrologic barrier to ground-water flow.

Issue: Tectonic effects on pathways

One commenter expressed concern that earthquake activity might change the hydrology unfavorably.

Response

This is a relevant observation; identification of possible disruptive scenarios and evaluation of their effects on repository safety are critical activities within the overall site-characterization program. It is not apparent at this time that reasonably expected earthquake activity would produce changes in the hydrology that would significantly affect radionuclide flux to the accessible environment (i.e., repository safety). The potential for such effects and the effects of other disruptive scenarios deemed to be reasonably probable will be analyzed during site characterization, should the reference repository location be recommended.

C.5.11.3 Data base for ground-water travel time analysis

Several reviewers questioned the adequacy of data and interpretive techniques utilized to establish model inputs for ground-water travel time analysis. Of primary concern were (1) transmissivity and conductivity, (2) equivalent porous medium, (3) effective thickness and porosity, and (4) head gradients.

(See responses in Subsections C.5.11.2 and C.5.11.10.)

Issue: Transmissivity data

It was noted in one comment that the probability distribution of flow-top transmissivity used in the stochastic ground-water travel time analysis was based on all available transmissivity determinations from Grande Ronde Basalt flow tops. Since the distribution of transmissivity in the flow top immediately overlying the repository may be different from the distribution of all flow-top data, the ground-water travel time distribution shown in the Draft Environmental Assessment may be in error.

Response

The basis for the approach taken was that available transmissivity data for the flow top overlying the repository were insufficient to construct a distribution expressly for that flow top. In the absence of specific data, the ensemble of Grande Ronde Basalt flow-top transmissivities was used to generate a two-dimensional transmissivity field, which was then used as a representation of the flow top overlying the repository. The practice of using surrogate data sets to make initial predictions of performance for design purposes is common in the disciplines of engineering and hydrology. Should the reference repository location be recommended for characterization, more flow-top transmissivities will be determined as site characterization proceeds, and the stochastic travel

time modeling study will be updated. The conceptual model used as a basis for the travel time model also is expected to be modified and updated as additional information becomes available.

A similar question was raised concerning the use of the geometric means of basalt flow top hydraulic conductivities from the upper three basalt formations in the Cold Creek syncline as descriptive parameters for the hydraulic conductivities of these formations (see p. 3-88, Subsection 3.3.2.1.2 of the Draft Environmental Assessment). In one comment it was suggested that because of expected variability of hydraulic conductivities among flow tops within a basalt formation, an estimate of the horizontal hydraulic conductivity of an "average" unit may be more appropriately obtained by using a thickness-weighted arithmetic mean of the geometric means for individual units.

The concept of developing an equivalent homogenous porous medium for a given heterogeneous medium has been empirically investigated by Warren and Price (1961). These authors investigated the problem of defining an equivalent homogeneous medium when ground water flows in two or three dimensions in a heterogeneous medium. They concluded that the volumetric rate of ground-water flow through the system will be the same in the heterogeneous and equivalent homogeneous media provided that (1) hydraulic conductivity in the heterogeneous medium is log-normally distributed, and (2) hydraulic conductivity of the equivalent homogeneous medium is taken to be the geometric mean of the hydraulic conductivities in the heterogeneous medium.

Development of an equivalent homogeneous porous medium for a heterogeneous medium composed of parallel, homogeneous layers, when ground water flows in one dimension either parallel or normal to the layering, is covered in many ground-water hydrology textbooks (e.g., Bear, 1972; Freeze and Cherry, 1979). For the case of one-dimensional ground-water flow parallel to the layers, the hydraulic conductivity of the equivalent homogeneous medium is the thickness-weighted arithmetic mean of the hydraulic conductivities of each layer. For flow normal to the layers, the hydraulic conductivity of the equivalent homogeneous medium is the thickness-weighted harmonic mean of the hydraulic conductivities of each layer. In deriving the hydraulic conductivities of these equivalent homogeneous media no assumptions were made about the probability distribution of hydraulic conductivity in the heterogeneous medium. The hydraulic conductivity of each layer in the heterogeneous medium was assumed to be homogeneous, and ground-water flow was assumed to be one-dimensional, either parallel or normal to the layers.

The geometric mean is used in Subsection 3.3.2.1.2 of the Draft Environmental Assessment purely as a descriptive parameter, and its use in any other study would have to be soundly justified. The geometric mean is considered a reasonable measure of central tendency of the group of basalt flow-top hydraulic conductivities from each formation because data indicate that the basalt flow tops are heterogeneous, and the layered nature of the basalt sequence promotes horizontal, two-dimensional ground-water flow within each flow top. The use of the thickness-weighted

arithmetic mean of hydraulic conductivities would be appropriate for modeling studies where a lumped horizontal hydraulic conductivity is required (e.g., Arnett et al., 1981).

Issue: Effective thickness and porosity

The effective thickness distribution used in the Draft Environmental Assessment ground-water travel time analysis was based on an assumed effective porosity range of 10^{-4} to 10^{-2}. Results from the borehole DC-7/8 tracer test indicate an effective porosity of between 10^{-4} and 10^{-3}; thus, the range chosen for the Draft Environmental Assessment analysis was challenged as being too large and therefore wrong. Several other commenters also expressed concern with the effective porosity value used in the modeling and contrasted it with the value obtained from the field tracer tests. One group of commenters stated that effective porosities used in the performance modeling should be derived exclusively from the field tracer tests. Another reviewer of porosity stated, " . . . some of these (porosity histograms in SD-BWI-TI-254) don't look at all lognormal to me. Some of the histograms suggest a mixture of subpopulations . . . "

Two commenters stated that the probability encoding methodology (i.e., the expert opinion survey noted above) used to estimate probability distributions for values of effective porosity (see Subsections 6.3.1.1.11 and 7.3.1.1.12 of the Draft Environmental Assessment) would bias the results of ground-water travel time if they were used in the hydrologic analysis.

Response

The estimation of an appropriate range and probability distribution for effective thickness (i.e., the product of effective porosity and flow domain thickness) is difficult because effective thickness has been determined at only one location in a Grande Ronde Basalt flow top in the Cold Creek syncline (Leonhart et al., 1985). Two tracer tests were run in the McCoy Canyon flow top at the paired borehole location DC-7/8 and resulted in an effective thickness of about 2×10^{-3} meter (6×10^{-3} foot). Based on this value of effective thickness and the maximum possible flow domain thickness of 12.5 meters (41 feet), the lower bound of the effective porosity of this test interval is estimated to be 1.6×10^{-4}. Geophysical logs run subsequent to the tracer test indicate that the apparent zone of highest permeability (i.e., major contributor to ground-water flow) could be as thin as 1 meter (3.3 feet) or less (Leonhart et al., 1985), which implies the effective porosity of this test interval could be 2×10^{-3} or more. Geophysical logs run in other Grande Ronde Basalt flow tops in the Cold Creek syncline indicate that the ground-water flow regime in the deep flow tops can range between a regime with a relatively thin contributing zone, possibly a discrete conduit (e.g., McCoy Canyon flow top at borehole DC-7/8), and a regime with a relatively thick contributing zone that spans most of the flow top and resembles a uniform porous medium (e.g., Strait and Spane, 1982b, 1983b). Basalt flow tops having relatively thick zones contributing to ground-water flow resemble uniform porous media. These zones can be expected

to have relatively large effective porosities, and consequently, relatively large effective thicknesses. Thus, the effective thickness of the McCoy Canyon flow top determined at borehole DC-7/8 most likely lies at the low end of the range of deep basalt flow-top effective thicknesses. Supporting arguments for this assertion come from laboratory determinations of basalt flow top total and apparent porosities, which are as high as 0.2 (Loo et al., 1984; Sublette, 1983). These porosity determinations were made on short sections of Grande Ronde Basalt flow top core samples, and are probably not representative of the average porosities of larger blocks of basalt flow top. If the effective porosities of these core samples were as high as 0.01, the effective thickness of a basalt flow top may be as high as 10^{-1} meter (0.3 foot). Based on these arguments, a reasonable range of effective thickness of Grande Ronde Basalt flow tops appears to be 10^{-3} to 10^{-1} meter (0.003 to 0.3 foot).

A supporting argument for selecting a range of two orders of magnitude for effective thickness can be developed from empirical formulas that relate permeability and porosity (e.g., Bear, 1972). These formulas indicate that permeability roughly is a cubic function of porosity. Thus, if the effective thickness ranges over two orders of magnitude, transmissivity could be expected to range over six orders of magnitude, which is slightly less than the range observed in Grande Ronde Basalt flow tops.

A supporting argument for selecting 10^{-3} meter (0.003 foot) as the lower bound for effective thickness comes from a survey of the opinions of eight experts about the effective porosity of the Cohassett flow top (Runchal et al., 1984b, p. 16). This survey indicates that five of the experts believe the effective porosity of the Cohassett flow top is greater than 10^{-4}. Two of the experts believe there is a 90-percent chance the effective porosity exceeds 10^{-4}, and one expert believes there is a 50-percent chance the effective porosity exceeds 10^{-4}. If 10^{-4} is taken to be a reasonable lower bound for the effective porosity of a deep basalt flow top, it follows that a reasonable lower bound for the effective thickness of a deep basalt flow top would be 10^{-3} meter (0.003 foot) if the flow top is assumed to be 10 meters (33 feet) thick. It is of interest to note that most of the experts believe the effective porosity of the Cohassett flow top is as high as 10^{-1}, which, by the above arguments, implies an effective thickness of 1 meter (3.3 feet). This effective thickness is one order of magnitude higher than the upper bound of flow top effective thickness used in these analyses, which is 10^{-1} meter (0.3 foot). Since smaller effective thicknesses predict shorter ground-water travel times, selecting 10^{-1} meter (0.3 foot) in preference to 1 meter (3.3 feet) as the upper bound for flow top effective thickness produces conservative estimates of travel time through the flow tops.

Having developed an estimate for the range of the deep basalt flow top effective thicknesses, the next step is to assign a type of probability distribution to this parameter. Empirical studies suggest that total porosity is normally distributed in a given formation (Neuman, 1982; Freeze, 1975; Davis, 1969). No similar studies exist for effective porosity, but if it is assumed that the effective porosity is a constant

fraction of the total porosity, then effective porosity will also be a normally distributed parameter. If the thickness of the formation is constant, it follows that the effective thickness will be normally distributed. Thus, a normal distribution would appear to be the most appropriate for effective thickness. In the travel time analyses in the Environmental Assessment, a uniform probability distribution is used to describe effective thickness in preference to a normal distribution for the following reasons:

- For a given range, a uniform distribution has a larger variance than a normal distribution, and thus will tend to overestimate the uncertainty in a random variable.

- Any value within the range of a uniform probability distribution is equally likely, which is not true for a normal distribution. Thus, choosing a uniform distribution instead of a normal distribution for effective thickness causes the uncertainty in predicted ground-water travel time to be slightly higher and exceedance probabilities for shorter travel times to be underestimated. This leads to conservative conclusions and is also favorable from a risk analysis point of view.

The commenter's observation with regard to the histograms is correct. It was suggested in Loo et al. (1984) that dense interior samples generally appeared to follow a lognormal distribution, whereas the flow top may not. Since publication of the report by Loo et al. (1984), a more rigorous statistical analysis of the core sample porosities was completed. Nine of the most reliable goodness-of-fit tests were performed on 39 data sets, testing for both normality and lognormality. Several different tests were used since no single test for normality is clearly superior to the others for identifying all possible distributional alternatives to normality. Many of the data sets had too few samples to provide reliable results. The results of the tests can be summarized by three broad generalizations:

- Apparent porosity follows a lognormal distribution for most rock types, with the flow tops and breccias tending to follow a more normal distribution.

- Total porosity could be considered to follow a lognormal distribution; however, for 11 of the 17 data sets for total porosity, distinction between a normal and lognormal distribution was not possible.

- Nine of the 22 tests for apparent porosity suggest several groupings of data values rather than one smooth distribution.

The results are not conclusive; however, the total and apparent porosity data were provided as background and were used together with general literature information to suggest types of distributions that might govern effective porosities and, consequently, flow top effective thickness. In the travel time analyses presented in the Environmental Assessment, a uniform distribution is used to describe flow top effective thickness in preference to either a normal distribution or any type of logarithmic distribution for the reasons given in the second bullet in the preceding paragraph.

The probability encoding method developed by Stanford Research Institute (van Holstein and Matheson, 1979) is widely recognized by the decision analysis community as a means for effectively identifying and reducing biases of persons making expert judgments. Probability encoding was used to augment, rather than to supplant, sparse site-specific and probably unrepresentative data on effective porosity.

Effective porosity data are available from only one location and are based on a single test. The probability of the single test-based value being a representative mean value is low (especially for lognormally distributed parameters). For this reason, five nationally known hydrologists were asked to review the site-specific data independent of U.S. Department of Energy contractor hydrologists, and estimate the distribution of occurrence probabilities for any given value of effective porosity (Runchal et al., 1984a). The hydrologists relied on the existing data base, in conjunction with their related expertise in the hydrology of fractured rocks, to arrive at a more defensible estimate of the probability distribution of effective porosity values. Estimates reflected the professional judgments of the hydrologists as to whether or not a specific field test value is likely to be representative.

Issue: Hydraulic gradients

A reviewer stated that Loo et al. (1984) presented a value of horizontal gradient on the order of 10^{-4}. One commenter noted that test values for hydraulic gradients are low and therefore difficult to measure, which leads to uncertainty in the ground-water travel time analysis.

Response

The statement attributed to Loo et al., (1984) is incorrect. Loo et al. (1984) made no comment or suggestion regarding hydraulic gradient. Observed values of gradient are indeed low, but recent test data are sufficiently precise to define a narrow range of expected hydraulic gradients. A discrete value selected from the high end of this range has been used in the updated travel time calculations for the final Environmental Assessment. This constitutes a reasonably conservative application of the available field data.

C.5.11.4 Ground-water travel time analysis

Several commenters pointed to possible defects in the analytical methodology and results presented in the Draft Environmental Assessment and criticized the lack of clarity in the presentation.

An important aspect of the analytical approach utilized by the U.S. Department of Energy to estimate ground-water travel time from a repository in basalt to the accessible environment is that it is probabilistic. Input data for the computer models are not expressed as single values representing a best-estimate or worst-case, but are instead expressed as probability distributions representing current estimates of

the range of possible values and current judgments of the occurrence probability of specific values within that range. Multiple trials of the travel time calculation are run using randomly selected values from the input distributions, and the result is expressed as a distribution composed of the individual outcomes.

The formal methodology for rational, unbiased development of input data distributions by expert panels is a relatively new scientific discipline, but it is recognized as a potentially powerful means for integrating limited specific data and related expertise into reasonable models for predicting system behavior. Probabilistic models supported by a substantial, site-specific data base offer a tool by which system performance can be estimated, and the nature and range of performance uncertainties can be clearly displayed. As noted in Subsection C.5.11.3, this data base is not presently available, resulting in estimates in the Draft Environmental Assessment that are strictly preliminary and sufficient only to determine if further site characterization is warranted. The site-characterization program is intended as a means to obtain data suitable for models to support a repository siting decision.

(Also see Subsection C.5.11.10 on compliance with guidelines.)

Issue: Buoyancy effect

Several reviewers felt that the discussion of thermal buoyancy effects on the ground-water flow paths was inadequate. One commenter presented a calculation of thermal Rayleigh number and concluded that if a high average hydraulic conductivity existed, thermal convection could occur in the emplacement horizon flow top. Several commenters noted that thermal loading could cause increased radionuclide transport to overlying flow tops or even to the unconfined aquifer. One reviewer stated that because thermal loading will cause increased vertical flow of ground-water to the flow top, the U.S. Department of Energy should acknowledge the possible presence at the Hanford Site of the third potentially adverse condition in the geohydrology section (DOE, 1984a; 960.4-2-1(c)(3)).

Response

Although buoyant effects are important and will be considered in radionuclide transport analyses, the following should be noted.

- Ground-water travel time calculations used to judge compliance with regulations and siting guidelines are intended for pre-waste-emplacement conditions and would not take into consideration thermal effects of the waste.

- The waste package containment period of 1,000 years or more will allow buoyant effects to attenuate from their peak values.

- Thermal buoyancy was considered in the repository seals analysis.

- The value of hydraulic conductivity quoted in one comment (3×10^{-4} meter per second (9×10^{1} feet per day)) for onset of thermal convection is several orders of magnitude higher than the mean Grande Ronde Basalt flow top hydraulic conductivity (2×10^{-7} meter per second (6×10^{-2} foot per day)) calculated using available field data.

- Analyses of coupled ground-water flow, heat transfer, and mass transport indicate that under expected conditions, the thermal pulse generated by the decaying nuclear waste does not drive any radionuclides beyond the first few basalt flows above the repository horizon (Long and WCC, 1984).

- The effects of thermal convection within a flow top may create thermal convection cells that would limit the extent of the upward driving force associated with thermal bouyancy.

- No site credit is presently taken for ground-water travel time through the dense interior of the emplacement horizon; therefore, increased vertical flow in that zone is irrelevant to the guideline conclusions of the Draft Environmental Assessment.

- The concerns of the reviewer are unclear regarding thermal buoyancy as a factor in Hanford Site complexity. The process is well understood, and it appears that the necessary thermal properties will be relatively easy to determine.

- As stated in the Draft Environmental Assessment, the third potentially adverse condition in geohydrology (DOE, 1984a; 960.4-2-1(c)(3)) was already considered present at the Hanford Site and at all other sites for reasons other than thermal buoyancy.

Issue: Computation of median travel time

One reviewer noted that deterministic calculations of ground-water travel times based on the central moments (i.e., means or medians) of the parameter distributions used in the Draft Environmental Assessment analysis do not yield the median travel time of 81,000 years stated in the Draft Environmental Assessment.

Response

This observation is correct, because in the stochastic ground-water travel time model described in the Draft Environmental Assessment, there is a nonlinear relationship between the parameters. Therefore, the median result cannot be obtained by a calculation based on median values of the individual parameters. In addition, the path traversed by a particle in any trial is tortuous because of the heterogeneity of the flow top. As a result, the use of 10 kilometers (6.2 miles) as the total distance traveled is incorrect.

Issue: Summary of prior studies

Several commenters noted that the ground-water travel time calculations summarized in Table 6-3 were quoted in Subsection 6.3.1.1.11.1 of the Draft Environmental Assessment, except for the 3,600-year travel time calculated by Arnett and Sagar (1984). One commenter stated that the table did not include mean values and variances. The reviewers generally felt that the discussion of calculations in the table was inadequate.

Response

The entry in Table 6-3 was incomplete in that Arnett and Sagar (1984) calculated ground-water travel times ranging from 3,600 to 142.000 years (as noted by one reviewer). The table and the related discussion in Subsection 6.3.1.1.11.1 of the final Environmental Assessment should address those calculations in the same detail as the others. The values reported in Table 6-3 were all results of deterministic analyses; means and variances were not estimated.

Issue: Use of data averaging

Several reviewers questioned whether averaging data was appropriate since ground water takes the path of least resistance.

Response

Ground water will flow along a path governed by gradient and resistance. In a heterogeneous medium such as a basalt flow top, particles of ground water will encounter zones of both high and low resistance, resulting in a range of possible travel times. The stochastic ground-water travel time analysis presented in the Draft Environmental Assessment illustrates the range of travel times obtained with a representative model of the Hanford Site.

Issue: Computational approach

One commenter questioned why the ground-water travel time model was sensitive to some of the constraints imposed on the inputs to the model, such as grid block size and correlation range of log-transmissivity. Another commenter questioned the use in the travel time model of an isotropic covariance function for log-transmissivity. Several comments focused on the sensitivity of the travel times to various inputs.

Response

The sensitivity to grid block size results from the scale of the heterogeneities within the transmissivity field. Larger grid blocks will mask any variation on a small scale, causing a distortion in the ground-water velocity field and, consequently, in the calculated travel times. Masking spatial variability is undesireable in such a stochastic analysis. The sensitivity of the travel time model to correlation range of log-

transmissivity can be understood by referring to finite-order stochastic equations, such as those in Sagar and Clifton (1983), which demonstrate how the variability of a stated variable (e.g., travel time) is affected by the range of correlation of a parameter field (e.g., transmissivity). This point is also discussed by Clifton (1985), where it is demonstrated that a grid block size to correlation range ratio of 1:5 is adequate for predicting travel times over a distance of 10 kilometers (6.2 miles). This ratio is the same as the grid block size to correlation range ratio used in the Draft Environmental Assessment travel time analysis.

The model in the Draft Environmental Assessment considered two-dimensional flow in the horizontal plane. The use of a two-dimensional, isotropic covariance function to model the transmissivity field is considered reasonable because ground-water flow was modeled in a single ground-water bearing unit. If three-dimensional flow had been modeled, use of an anisotropic three-dimensional covariance function would probably have been necessary.

The point was made, and is readily acknowledged by the U.S. Department of Energy, that some of the risk probabilities for short travel times can be strongly affected by small changes in the model inputs. Travel times at the extremes of the probability distribution are typically more sensitive to changes in model inputs, which points to the need for a sound data base for input to such a model.

One commenter pointed out that the pathlines in the travel time model of the Draft Environmental Assessment may start at a location within the disturbed zone around the repository. This would conflict with the requirement specified by the U.S. Nuclear Regulatory Commission that pre-waste-emplacement ground-water travel time be calculated from the edge of the disturbed zone. The starting location of pathlines in the travel time model is a point in the flow top immediately above the down-gradient edge of the repository, and it is implicitly assumed the edge of the disturbed zone lies between this point and the repository excavations. A similar assumption is made in the travel time analyses for the final Environmental Assessment (Clifton, 1985). These assumptions are made pending a precise definition of the disturbed zone by the U.S. Nuclear Regulatory Commission.

The Arnett and Sagar (1984) entry in Table 6-4 of the final Environmental Assessment has been modified to show the full range of calculated values (see Table 6-3 of the Draft Environmental Assessment).

C.5.11.5 Analysis of release from the isolation system

Several reviewers questioned the data utilized as inputs in the system performance analysis, the sufficiency of the group of radionuclides considered, and the adequacy of treatment of subsystems interactions. Specific areas of concern included (1) omission of defense waste, (2) solubility values used in analysis, (3) sorption values used in analysis, (4) radionuclide screening criteria, (5) basis for the performance limits case, and (6) subsystem integration.

(Also refer to Subsection C.5.11.8, Release rate analysis.)

Issue: Defense waste

One commenter was concerned that the addition of defense waste to the repository would make the repository less likely to meet regulatory safety standards. The ability of the system to accommodate commercial high-level waste was also questioned.

Response

The regulations are based on radionuclide releases per 1,000 metric tons (1,100 tons) of waste; an increase in the amount of waste stored in the repository carries a corresponding increase in the allowable radionuclide release. Because several radionuclide species have been removed from defense waste prior to storage, the radionuclide content is equal to or less than that of commercial spent fuel. Reprocessed commercial high-level waste may be packaged at higher heat content per package than spent fuel, but temperatures are controlled to some extent by design (e.g., package spacing within the repository). Expected temperatures are well within the limits currently estimated for typical borosilicate glass, envisioned as the reprocessed commercial high-level waste and defense waste form.

Issue: Solubility values

Solubilities and their relation to redox conditions are addressed in Section C.5.2, Geochemistry, of this appendix, but it should be noted here that one commenter erroneously asserted that system performance was computed on the basis of the lowest current estimates of radionuclide solubilities.

Response

The assumption used in the Draft Environmental Assessment was that solubilities spanned the range from "expected" to "conservative," as reported in Salter and Jacobs (1983), and were uniformly distributed within this range. With this assumption, the median solubility is one-half the conservative value, which provides a bias toward the highest observed values (often obtained in inappropriately high oxidizing environments) compared to the medians that would be obtained if alternative distributions were assumed. The data base would be improved during site characterization, and clear judgments on the conservatism or nonconservatism of solubility estimates and compliance with solubility-related guidelines would replace the preliminary judgments made to date.

Issue: Sorption values

Two comments questioned the sorption values used in the screening process in Subsection 6.4.2.3.2 of the Draft Environmental Assessment. The issues raised include (1) the effects of reduced sorption due to near-saturation conditions, and (2) the uncertainty in the values of distribution coefficients due to the possible existence of several different complexing states for each radioelement.

Response

The distribution coefficients used in screening the radionuclides were the conservative (low) values stated in the data package. As the experimental data base and the mathematical models improve, the new information (possibly including the effects of nonlinear sorption) will be incorporated.

Issue: Radionuclide screening by half life

Two reviewers questioned the use of a 100-year half-life for screening radionuclides as discussed in Subsection 6.4.2.3.2 of the Draft Environmental Assessment.

Response

The primary basis for this screening criterion is the prediction that a majority of containers will fail after 5,000 years. For radionuclides that have no long-lived parents, this decay period would result in insignificant inventories of radionuclides with half-lives of 100 years or less. Thus, the release of these radionuclides would be insignificant. As the container failure model is improved, the predicted container life span could change. If the revised predicted container life span is significantly less than 5,000 years, attention might have to be focused on radionuclides such as strontium-90 and cesium-137, both of which have half-lives of approximately 30 years. However, even with a minimum container life of 300 years and a minimum travel time of 1,000 years, both radionuclides will decay to very low levels prior to container failure.

Issue: Water flow rate assumption

One commenter stated that the source of the assumption of 0.5 liter per year per 1,000 metric tons of waste in the analysis of cumulative release presented in Subsection 6.4.2.3.5 should be described more fully. Another comment requested a clearer, more concise statement of all data and assumptions.

Response

As a result of these comments, a slightly different approach, and a fuller description of that approach, has been included in the revised analysis for the final Environmental Assessment. The following clarification of the water flow-rate value selection augments the brief statement made in the Draft Environmental Assessment.

The release rates shown in Table 6-29 indicated that only iodine-129 and selenium-79 will release quantities that could be significant at the accessible environment. Sorption of selenium-79 precludes the possibility of it being a significant contributor to release at the accessible environment, leaving only iodine-129 as a radionuclide warranting careful analysis.

The code EPASTAT cannot use a time-variant release rate as an input. The iodine-129 curve shown at the top of Figure 6-18 was therefore "averaged" as a constant fractional release rate of 15×10^{-5}, starting at year 4700 and lasting 6,667 years to depletion. From the relations,

$$\text{release rate} = fI = mMSW \qquad \text{(C.5-5)}$$

where

- f = fractional release rate = 15×10^{-5}
- I = Inventory = 33 curies per thousand metric tons
- m = median molar solubility = 0.5 mole per liter
- M = molecular weight = 129 grams per mole
- S = Specific activity = 1.74×10^{-4} curie per gram
- W = water flow rate to simulate computed release rate, liter per year per thousand metric tons,

the water flow rate to match the computed release rate is 0.44 liter per year per thousand metric tons of waste. This was rounded upward to 0.5 for input to EPASTAT.

Issue: Performance Limits case

One commenter questioned the conservatism of the Performance Limits case in the analysis of cumulative release at the accessible environment.

Response

The Performance Limits case is, in fact, nonconservative because iodine-129 is constrained by the assumptions to a release rate that is lower than the predicted value, and iodine-129 is the only radionuclide that exhibits significant release at the accessible environment. The analysis has been rerun for the final Environmental Assessment, primarily to incorporate changes in 40 CFR 191 (EPA, 1985). At the same time, however, the Performance Limits case for the final Environmental Assessment assumed allowable U.S. Nuclear Regulatory Commission release rates (see Table 6-29 of the Draft Environmental Assessment) instead of 10^{-5}. A conservative approach to analyzing radium-226 was defined (to compensate for its low inventory at 300 years), though its sorption characteristics preclude significant release at the accessible environment. With these changes, the revised Performance Limits case is conservative.

Issue: Container life assumption

With the median of estimated container life at 6,100 years, too much emphasis is being accorded the waste-package subsystem, a concern raised in one comment.

Response

As noted previously, for the analysis of the total system, two cases were considered (see p. 6-272 of the Draft Environmental Assessment). The first case considered the preliminary estimate of a container life median of 6,100 years; in the second case, the container life was assumed to be only 300 years. For performance assessment of the site subsystem in the second case, minimum weight was given the performance of the waste-package subsystem. Therefore, while the engineered barrier systems will be designed to be as safe as feasible, waste-package performance will not be allocated a greater role than site performance.

Issue: Estimated releases

One reviewer asked when and in what amount waste would reach the Columbia River.

Response

Results shown on page 6-274 of the Draft Environmental Assessment indicate a high probability that release to the accessible environment (an arbitrary boundary 5 kilometer (3.1 miles) from the repository) in the first 100,000 years after closure would be only a small percentage of the allowable limit specified by the U.S. Environmental Protection Agency. (See C.5.11.1, Repository safety.) Because the Columbia River is beyond the boundary defined for assessing performance against regulatory criteria, and because discharge locations into the river have not been clearly identified, radionuclide releases into the river and the time of such releases have not been analyzed.

Issue: Subsystem integration

Subsystem integration was questioned by one reviewer who expressed concern that in combining the performance of the three subsystems, errors in transferring information between these subsystems have not been considered.

Response

Contrary to the suggestion in the comment, the uncertainties in the performance of the three subsystems have not simply been added together to estimate the uncertainty in the performance of the total system. Rather, the uncertainties are propagated according to process models that are often nonlinear.

In a report by Nguyen and Lehman (1985), cited by the reviewers, there is some confusion between the physical relationships between variables and their statistical correlations. That analysis does not have a direct relevance to the analysis presented in the Draft Environmental Assessment. For the calculations in the Draft Environmental Assessment, correlations between variables, where these could be inferred, were not neglected.

Issue: Radionuclide selection

Two commenters indicated that elimination of americium-241 and radium-226 due to low solubility and high sorption of parents requires supporting calculations.

Response

Calculations for americium-241 and radium-226 have been included in the final Environmental Assessment. (Also, refer to Subsection C.5.11.8, Release rate analysis.)

The Performance Limits analysis has been rerun and documented in Subsection 6.4.2.6.2 of the final Environmental Assessment, and the cited paragraph in the comment has been revised to reflect the assumptions used in the new analysis.

Subsection 6.4.2.1, paragraph 1, has been changed from "at . . . time." to " . . . at the rate allowed by the applicable regulation (NRC, 1983b)."

Data on americium-241 and radium-226 have been added to Tables 6-28, 6-30, and 6-31 in the final Environmental Assessment (see Tables 6-28, 6-29, and 6-30 in the Draft Environmental Assessment).

Subsection 6.4.2.3.3, Estimation of release from a single container, has been changed to clarify the basis for selection of radionuclides for analysis.

C.5.11.6 Containment and release models

Several reviewers questioned the usefulness of the simplistic conceptual models utilized for assessment of containment and radionuclide release; the commenters asserted that important processes were neglected and that the treatment of corrosion was insufficient. One commenter expressed concern that 200 replications are insufficient for an accurate representation of the theoretical release rate distribution function. (Also, refer to Subsection C.5.11.7, Container life analysis, and Subsection C.5.11.8, Release rate analysis.)

Issue: Model adequacy

One commenter stated that a number of processes were omitted in assessing the performance of the waste package and, therefore, the analysis in the Draft Environmental Assessment was too simplistic. The processes omitted were basalt resaturation time, packing penetration time, penetration of the fuel rod cladding, and waste-form dissolution. Similarly, failure modes other than uniform corrosion were not considered, nor were scenarios such as earthquakes and human intrusion. The reviewers implied that all these omissions contributed to the long (nonconservative)

container life predicted by the uniform corrosion model, and would like to see a performance assessment methodology that incorporates all these processes.

Response

Although no analysis of basalt resaturation was presented in the Draft Environmental Assessment, in the container corrosion model corrosion was assumed to occur in an air-steam environment for the first 100 years after closure, after which the repository was assumed to be fully resaturated. Thus, a resaturation time of 100 years was implied. However, the reviewers were correct concerning the processes that were omitted from the analysis presented in the Draft Environmental Assessment. The rationale for these omissions is given below.

1. Degradation of cladding was not considered because, at this time, the U.S. Department of Energy does not intend to take credit for the protection provided by cladding except that, as stated on page 6-233 of the Draft Environmental Assessment, omission introduces some degree of conservatism. In future analyses, however, such a process may be explicitly included.

2. The performance analyses of the waste package presented in the Draft Environmental Assessment were for the base case (i.e., in the absence of any disruptive scenarios). The U.S. Department of Energy is currently working on defining credible disruptive scenarios (see pp. 6-279 through 6-283 of the Draft Environmental Assessment), and these will be considered in future analyses.

3. As noted on page 6-242 of the Draft Environmental Assessment, corrosion modes other than uniform corrosion may be important in determining the life of the waste container. Only uniform corrosion was included in the Draft Environmental Assessment, since only data on this failure mode were available. The assumption of uniform corrosion was reasonable for preliminary analysis since there is no clear evidence to indicate that general corrosion is not the dominant corrosion mechanism in low-carbon steel under repository conditions. As the data base is broadened, other failure modes will be considered if appropriate.

As stated in the Draft Environmental Assessment, the analyses presented were preliminary and are likely to change as more data are obtained and as more processes are included in the model. In summary, the U.S. Department of Energy agrees with the reviewers that a more complete waste-package performance assessment model is needed.

Issue: Reproducibility of results

One reviewer noted that 200 replications of the release rate calculation will not necessarily yield convergence with the infinite-trial solution.

Response

This observation is probably correct, although one test case with 1,000 replications did appear to match results obtained from 200 replications. Analysis using a higher-capacity computer is planned, and it is expected that 1,000 replications will be run routinely, providing the necessary level of convergence.

Issue: Basis for corrosion model

One commenter questioned the validity of extrapolating the corrosion data used in the Draft Environmental Assessment, and stated that since no phenomenological modeling is used, the canister lifetime probability distribution function presented in the Draft Environmental Assessment lacked justification.

Response

As stated in the Draft Environmental Assessment and in the supporting documents (e.g., Sagar et al., 1984), the probability distribution function of the container lifetime presented in the Draft Environmental Assessment is very preliminary. The U.S. Department of Energy believes that considerably more work, including long-term corrosion experiments, will have to be done before a reliable estimate of the container lifetime probability distribution function is obtained. Currently, the short-term corrosion data are the only data available, and extrapolation of these data appears to be the only way to estimate the container life probability distribution function. However, the U.S. Department of Energy agrees that a phenomenological corrosion model accounting for physical conditions such as temperature, Eh, pH, and radiation effects would be a preferable model.

Issue: Near-field environment

One reviewer expressed concern that all the uncertainties in the near-field environment of the waste package have not been considered in the assessment of the waste-package performance. The reviewer pointed out that the effects of high temperature and oxic conditions during the preclosure phase, effects of radiolysis in the postclosure phase, and coupling between the heat and moisture transport in the very near field were omitted from the analysis.

Response

In the empirical container corrosion model (see p. 6-241 of the Draft Environmental Assessment), the preclosure high temperature, air-steam environment was considered to be similar to conditions during the resaturation period. This total period of 100 years was accounted for in the estimation of the corrosion rates. Similarly, the effects of radiation on container corrosion were included by introducing an irradiation enchancement factor in the corrosion equations (Fish and Anantatmula, 1983). The corrosion equations used in the analyses of the Draft Environmental Assessment are not continuous functions of temperature. A threshold value of 125°C (257°F) was used, on either side of which

the corrosion rates are different. In the present model, therefore, uncertainty due to the coupled nature of the heat and moisture transport is not a factor.

A more rigorous analysis of the temperatures around the waste containers is currently under way, and the corrosion model is being modified to include additional experimental data now being collected.

Issue: Resaturation

One commenter questioned how and for what period of time water will be kept away from wastes.

Response

The low hydraulic conductivity of the packing material around the waste containers will delay the contact of water with the containers. Except for the packing material, there are no specific barriers designed to keep water away from the containers under postclosure conditions. As noted previously, Draft Environmental Assessment estimates of container life assume a mixture of air and steam to be in contact with the containers for the first 100 years after repository closure (see p. 6-241 of the Draft Environmental Assessment).

Issue: Function of packing material

Another commenter pointed out an inconsistency in the description of the function of the packing material provided in Subsections 5.1.4.3.1 and 6.4.2.2.1 of the Draft Environmental Assessment.

Response

The inconsistency has been corrected in the final Environmental Assessment.

Issue: Nonconservative assumptions

One reviewer asserted that the degree of conservatism suggested in the Draft Environmental Assessment on page 6-233 was overemphasized, while some nonconservative assumptions were not mentioned. Detailed comments on the nonconservative assumptions were then provided by the reviewer as separate comments.

Response

Nonconservative assumptions were mentioned wherever these were made in the text of the Draft Environmental Assessment. For example, on page 6-242, paragraph 3, the nonconservative nature of failure by uniform corrosion was acknowledged. Similarly, on page 6-256 it was reported that the distributed failure of containers leads to fractional release rates that are lower than those that would be obtained if all containers were assumed to fail simultaneously.

The first conclusion near the end of Subsection 6.4.2.3.3 of the Draft Environmental Assessment has been changed to read: "There is no reason to believe that the waste package subsystem cannot be designed to provide substantially complete containment of the radionuclides for longer than 1,000 years." The revised conclusion appears in Subsection 6.4.2.4 of the final Environmental Assessment.

The first conclusion in Subsection 6.4.2.4.1 has been modified to read: "Based on a simplified empirical corrosion model and considering failure by uniform corrosion only, the preliminary estimates of container life time provide no indications that the container may not last for longer than 300 to 1,000 years. Consideration of other failure modes, however, may lead to modifications in container design." This revision appears in Subsection 6.4.2.7.1 of the final Environmental Assessment.

In addition, paragraph 1 in Subsection 5.1.4.3 has been changed to state: "After emplacement, requirements mandate limiting ground-water intrusion to the container, reducing radionuclide release by restoring ambient ground-water Eh and pH, and providing a low permeability environment between the waste container and the surrounding rock walls."

Subsection 6.4.2.2.1 has been revised to read: "2) Restoring ambient reducing (i.e., low Eh) conditions, in which many radionuclides have low solubility."

C.5.11.7 Container life analysis

Several reviewers challenged the values of container life presented in the Draft Environmental Assessment, asserting primarily that the basic representation of the environment and the corrosion processes, as well as data utilized in the preliminary corrosion model, were inadequate for a defensible analysis.

Issue: Validity of container life conclusion

In one comment, the reviewer takes issue with the statement in the Draft Environmental Assessment that "It can be qualitatively concluded that the waste package can be designed to provide substantially complete containment of the radionuclides for longer than 1,000 years." According to this commenter, there are too many uncertainties in the data and analyses for this conclusion to be reached.

Response

The presence of various uncertainties in the data and the analyses was recognized in the Draft Environmental Assessment. For this reason, despite the fact that preliminary numerical estimates of containment duration were obtained, the conclusions were provided only in a qualitative sense. To further reflect the uncertain nature of the conclusions, the statement of the conclusion has been changed in the final Environmental Assessment.

Issue: Use of empirical data

Other reviewers questioned the appropriateness of using empirical distribution functions for the parameters of the container corrosion model. It was suggested that a physically-based probability curve for waste package failure be derived. In this regard, reference was made to a paper authored by the reviewers, Abi-Ghanem and Nguyen (1982).

Response

The reasons for selecting the distributions for the parameters of the corrosion model are discussed on page 6-242 of the Draft Environmental Assessment. As indicated there, the distributions were based on a few short-term corrosion experiments and on professional judgment by the U.S. Department of Energy contractor staff. In general, the U.S. Department of Energy agrees with the reviewers that a physically based probability distribution for the corrosion rates would be appropriate. A method to obtain such a distribution, however, is currently not available in the corrosion literature. The paper by Abi-Ghanem and Nguyen (1982), cited in the comment, is not relevant to the problem of corrosion with a physical basis different from that of the elasticity discussed by the authors.

Research sponsored by the U.S. Department of Energy is currently in progress to improve the corrosion model by incorporating causal relationships between corrosion rates and physical phenomena. In addition, the experimental data base is being extended to improve estimates of the distributions of corrosion model parameters.

Issue: Assumption of independent container failures

Several commenters raised the issue of whether the independence assumed in the failure of the waste containers, as discussed in Subsection 6.4.2.3.3 of the Draft Environmental Assessment, is appropriate. The reviewers suggested that other correlated failure modes are possible.

Response

The U.S. Department of Energy agrees with this comment and acknowledges that correlated failure modes are possible. In fact, it was stated in the Draft Environmental Assessment (see p. 6-256) that if perfect correlation were assumed (i.e., all containers failed at the same time), the estimated release rates would be higher than those shown in the Draft Environmental Assessment. Consideration of correlated container failure modes is the next step in the development of the waste package assessment methodology and currently is being pursued.

Issue: Corrosion during near term

On page 6-229 of the Draft Environmental Assessment, it was stated that container corrosion in an air-steam environment during the first 50 years after emplacement is "minor." The reviewer asked that this assumption be verified and the term "minor" quantified.

Response

It should be noted that although the corrosion in the first 50 years is termed minor, it is not neglected in the estimation of the container life (see p. 6-241 of the Draft Environmental Assessment).

In response to the comments discussed in this section, several changes have been incorporated into the final Environmental Assessment. In Subsection 6.4.2.2.1, the sentence: "Based on current information, the amount of corrosion . . . (Anderson, 1983) . . . " was deleted. In addition, the first conclusion near the end of Subsection 6.4.2.3.3 was modified as noted in response to issues on containment and release models in this section.

C.5.11.8 Release-rate analysis

Many concerns were expressed regarding the release-rate analysis. These encompassed questions about the impact of the container failure distribution profile, neglect of significant chemical and transport processes, selection of radionuclides for analysis, and adequacy of data utilized as input to the release-rate model.

(Also see Subsection C.5.11.5, Analysis of release from the isolation system.)

Issue: Container failure distribution

One reviewer asserted that the broad distributions of container lifetimes are a result of uncertainties in the model and in the data, not variations in the corrosion rates from container to container; therefore, this derived distribution appears to be used inappropriately in release-rate calculations.

Response

While the form of the corrosion equation is assumed to remain the same, the coefficients of this equation are random variables. These random coefficients are considered to represent the stochastic variation in the corrosion rates (not just uncertainties in the model and the data as suggested by the reviewer) of various containers in the repository. The distributions of these random coefficients are based on short-term experimental data and on professional judgment. Obviously, a physical basis for these distributions would lead to a much larger confidence in the corrosion prediction, but such a physical basis currently is not available.

Issue: Convection effects

Another commenter stated that the effects of convection on waste-package performance were neglected.

Response

The release rates shown in Figures 6-18 and 6-19 of the Draft Environmental Assessment were estimated on the basis of diffusional transport. The effect of convection was ignored primarily because of the low hydraulic conductivities of the packing material and the host rock, and the decay of thermal buoyant effects due to the long container life. Note that this assumption does not affect the evaluation of the total system performance (see p. 6-279 of the Draft Environmental Assessment) for the Performance Limits case. However, more detailed analyses of convective effects will be done to ensure there is no impact to waste-package performance.

Issue: Computational boundary

One reviewer stated that waste-package releases across a boundary 7.5 meters (24.6 feet) from the center of the container were calculated (see p. 6-248 of the Draft Environmental Assessment). In this case, the final Environmental Assessment should provide support for including the fractured host rock as part of the engineered barrier system, rather than for calculating the releases at the boundary of the packing material, which is only 44.5 centimeters (17.5 inches) from the center.

Response

The releases from the waste package were not calculated at 7.5 meters (24.6 feet), but rather at 44.5 centimeters (17.5 inches). This boundary was clearly marked as C in Figure 6-17 (see p. 6-246 of the Draft Environmental Assessment). The boundary at 7.5 meters (24.6 feet) is a mathematical boundary and is the outermost limit of the numerical model.

Issue: Release rate guideline

In one comment, doubts were raised about the favorable condition judged present based on the fourth guideline under geochemistry (DOE, 1984a; 960.4-2-2(b)(4)) (see p. 6-91, Subsection 6.3.1.2.6 of the Draft Environmental Assessment): "A combination of expected geochemical conditions and a volumetric flow rate of water in the host rock that would allow less than 0.001 percent per year of the total radionuclide inventory in the repository at 1,000 years to be dissolved." The reviewers assert that the dissolution rate is directly proportional to the ground-water flow rate and that the flow rate has not yet been proven small enough to meet this favorable condition.

Response

Due to the rather low hydraulic conductivity (10^{-12} meter per second (2.8×10^{-7} foot per day)) of the packing material and the exceedingly small hydraulic gradient in the vicinity of the waste packages, the advective water flow contacting the waste packages is small (see Subsection 6.3.1.2.6 of the final Environmental Assessment). For this reason, the radionuclide flux out of the waste-package subsystem is likely to be controlled by diffusional processes. This is the basis of

release-rate estimates described in Subsection 6.4.2.3.3 of the Draft Environmental Assessment, which show that there is a high probability of meeting this guideline. A hypothetical case was formulated and analyzed (see final Environmental Assessment) to demonstrate that this guideline is met.

Issue: Regulatory criteria

One reviewer stated that the radionuclide screening mechanism used in Subsection 6.4.2.3.2 of the Draft Environmental Assessment was not consistent with the U.S. Nuclear Regulatory Commission (NRC, 1985) release-rate criterion. Another commenter stated that the drinking water protection standard should have been addressed in the screening procedure.

Response

The screening mechanism used in Subsection 6.4.2.3.2 of the Draft Environmental Assessment was based on the U.S. Environmental Protection Agency (EPA, 1984) criterion for cumulative release, rather than the U.S. Nuclear Regulatory Commission release-rate criterion. For selection of radionuclides for a detailed analysis in the Draft Environmental Assessment, the U.S. Environmental Protection Agency criteria were considered to be the overriding safety criteria. The U.S. Nuclear Regulatory Commission release-rate criterion was not utilized in the automated screening process, and several high-solubility radionuclides (e.g., cesium-135 and nickel-59) subsequently were analyzed to verify that they did not warrant inclusion in the list of key radionuclides because of excessive release rates. Although these radionuclides did in fact meet the release-rate criterion, it is important to note that the primary objective of the U.S. Nuclear Regulatory Commission is to meet the U.S. Environmental Protection Agency cumulative release standard, and the travel time, containment, and release-rate criteria are not specified as mandatory performance requirements.

The drinking water protection standard issue (EPA, 1985) was not addressed in the screening criteria. This standard applies only to "special sources of groundwater" and only for the first 1,000 years. The deep flow tops beneath the reference repository location do not fit the definition of "special sources of groundwater." Also, due to the expected container life of more than 5,000 years and the disqualifying condition for travel times of less than 1,000 years, this criterion was not addressed in detail.

Issue: Solubility and sorption data

Questioned in some comments were the solubilities and distribution coefficients used in the screening process and in the release-rate analysis.

Response

The values used were based on conservative interpretation of currently available experimental and analytical data. Ongoing research is focused on improving the data base and the understanding of the fundamental geochemical processes to improve the quality of future performance assessments.

According to one comment, the solubility values in Table 6-27 of the Draft Environmental Assessment were different from those given by Salter and Jacobs (1983). The reviewers requested more details on how these values were determined.

As stated in footnote c of Table 6-27 (see p. 6-247 of the Draft Environmental Assessment), the effective solubility values in this table were obtained by multiplying the element solubility values given by Salter and Jacobs (1983) by the mass fraction of the particular isotope. For example, the mass fraction of carbon-14 (i.e., mass of carbon-14/total carbon) is 4.0×10^{-3}.

Issue: Radionuclide screening

One reviewer stated that both radium-226 and americium-241 have been screened from consideration using the four steps listed in Subsection 6.4.2.3.2 of the Draft Environmental Assessment. This commenter stated that it was possible (but unlikely) for up to 4 curies of radium-226 to be released per metric ton (per ton) of uranium.

Response

The commenter is correct in noting that for certain actinides for which the precursors have significant inventories, the screening criteria might be inappropriate. The screening criteria have been modified to incorporate the effects of actinide production.

With respect to the 4 curies that the commenter stated as an upper limit for radium-226 cumulative release per metric ton (per ton) of waste: the chief precursor of radium-226 during the first 10,000 years is uranium-234. There is less than 1 curie of uranium-234 per metric ton (per ton) of uranium during the first 10,000 years of decay. Uranium-234 has a half-life of approximately 245,000 years. In 10,000 years, approximately 3 percent of the initial uranium-234 will decay. Were uranium-234 to decay immediately to radium-226, this would result in approximately 4 curies of radium per curie of decayed uranium-234. In fact, in the decay chain from uranium-234 to radium-226, the atoms must first decay to thorium-230, which has a half-life of approximately 75,400 years. Thus, only a small fraction of any uranium-234 will become radium-226 during the first 10,000 years of decay.

Several changes have been incorporated into the final Environmental Assessment to address comments discussed in this response. In Subsection 6.4.2.3.3 of the Draft Environmental Assessment, a sentence, "Note that the releases from the waste package are calculated at the boundary of

the packing material, which is boundary C in Figure 6-17 . . . " was added at the end of the segment on estimation of release from a single container. Note that in the format adopted for the final Environmental Assessment, this item appears in Subsection 6.4.2.7.1. In addition, the reference to Clifton et al. in the top paragraph on page 6-92 is erroneous and was removed. A sentence was added to the first paragraph of page 6-236 after " . . . 10,000 years, . . . " stating "For the purposes of screening radionuclides in this work, the U.S. Environmental Protection Agency criteria have been considered the overriding safety criteria." Also, radium-226 and americium-241 have been added to the list of radionuclides requiring detailed analysis.

C.5.11.9 Seal subsystem performance analysis

Many commenters questioned the sufficiency of the seal subsystem analysis as a basis for assessing the importance of sealed excavations as preferential pathways for radionuclide migration. The principal areas of concern were (1) the relationship between the site and seal pathways, (2) head gradients promoting flow through the seal pathway, (3) the properties of damaged rock, (4) the definition of an accessible environment boundary for seal subsystem analysis, (5) identification of key radionuclides for the seal subsystem analysis, and (6) subsystem interactions.

Issue: Flow split between site and seals

One reviewer implied that the assumption of the flow split between the seal and site pathways for the repository seals subsystem analysis was not conservative.

Response

Flow analyses within and outside the project tend to support the contention that flow through the seal pathway is a very small fraction of flow through the repository. In addition to the two studies referenced in the Draft Environmental Assessment, a more recent study (Estey and Arnett, 1985) concludes that the flow through the seal pathway is substantially less than 1 percent of the total flow through the repository. This analysis considered hydraulic conductivities in the backfill as high as 10^{-5} meter per second (2.8 feet per day), which yielded no significant changes to the base-case pathlines. The Draft Environmental Assessment analysis was based on the assumption that hydraulic conductivities were controllable in the backfill material to be used for the drifts and shafts. Recent tests of the backfill material (Carlson, 1986) indicate that the hydraulic conductivity of the backfill will actually be 3 to 4 orders of magnitude less than the 10^{-6} and 10^{-7} meter per second (0.28 and 0.028 foot per day) used in the studies referenced by the Draft Environmental Assessment.

Based on the information in the Draft Environmental Assessment and this additional information, the 10-percent flow split assumption is considered conservative for the preliminary repository seals subsystem analysis.

The current analysis of the repository seals subsystem utilizes an improved model that considers coupled heat, flow, and radionuclide transport through a two-dimensional representation of the area surrounding a cross-section of the repository. Actual flow paths will be determined, with no assumption of flow split needed for this analysis.

Issue: Seal pathway

Two commenters stated that the analysis did not eliminate the repository seals subsystem as a potential preferential pathway for radionuclide release.

Response

As noted above, the results of preliminary analyses, both in-house and by outside consultants, indicate that the repository seals subsystem cannot be considered a preferential pathway for radionuclide migration. Due to the conservative assumptions built into the seals analysis, the simple modeling approach can be considered adequate for preliminary radionuclide-release calculations. As more data (e.g., physical and hydrologic properties of rock, grouts, seal materials) become available, the models for the repository seals subsystem will become more realistic.

Issue: Buoyant gradient in the seal pathway

One reviewer stated that the thermally induced gradient had been neglected in the analysis of the repository seals subsystem.

Response

The commenter is incorrect. The thermally induced gradient is considered significant (long duration and relatively large magnitude; see pp. 6-257 and 6-259 of the Draft Environmental Assessment) in the repository seals subsystem analysis. The thermally induced gradient is vertical in direction, driving the radionuclides into the flow interior above the repository, rather than along the horizontal drift (flow pathway).

Issue: Uncertainty in damaged rock properties

One commenter contended that the thicknesses and physical properties of the disturbed and damaged rock zones shown in Figure 6-17 (see p. 6-246 of the Draft Environmental Assessment) currently are not known. The values assumed in the Draft Environmental Assessment will greatly affect predictions of radionuclide transport.

Response

The assertion is basically correct; the actual properties of the disturbed and damaged rock zones will be determined during site characterization if the reference repository location is recommended for characterization. The values used in the Draft Environmental Assessment are best estimates based on a literature survey and professional judgment. While these zones may have a nonnegligible effect on the maximum fractional release rate, analyses conducted thus far have determined their effect on the cumulative release at the accessible boundary to be extremely small.

Issue: Lack of conservatism

Two commenters implied a possible lack of conservatism in both the assumption that flow through the repository seals subsystem occurs in the damaged rock zone, and the hydraulic conductivity values used for the damaged rock zone.

Response

Current data indicate that conductivity through the damaged rock zone will be significantly greater than that in backfilled areas. At this time, it is not likely that high permeability backfill will be used to take advantage of adsorption. The crushed basalt and bentonite clay mixture that will be used as backfill is expected to retain its initial properties for the life of the system.

For this preliminary analysis, the backfill-rock interface and the damaged rock zone are considered as one composite region. The hydraulic conductivity through the most damaged section of the damaged rock zone was considered to be about three orders of magnitude greater than that of intact rock (Cottam, 1983). The values used in the analysis represent approximate composite damaged rock conductivities. These were derived from reference hydraulic conductivities for the intact layers of the host rock, roughly 10^{-7} meter per second (0.028 foot per day) for flow tops and 10^{-13} meter per second (2.8×10^{-8} foot per day) for dense interiors. Considering the relative sizes of these layers and the size of an unspecified interface zone (if bonding is incomplete), the range of values used for this preliminary analysis represent a reasonable characterization of a damaged rock zone.

Issue: Discharge location for seal pathway

One commenter stated that it is not conservative to consider the Vantage interbed as the release point to the accessible environment.

Response

Due to significant ground-water travel times through the Grande Ronde Basalts, any radionuclides released from the repository seals subsystem to the site subsystem below the Vantage interbed will not reach the accessible environment within 10,000 years. In general, the Wanapum Basalts in the central Pasco Basin appear to be more permeable and include shallower

portions with aquifers that are used for irrigation and drinking water supplies. Since the Vantage interbed is a border between the Grande Ronde and Wanapum Basalts, it was selected as the release point.

Issue: Selection of radionuclides

One reviewer indicated that radionuclides other than those considered in the evaluation of the seals subsystem in the Draft Environmental Assessment should be analyzed.

Response

The nine radionuclides analyzed in the Draft Environmental Assessment were selected based on the screening process discussed in Subsection 6.4.2.3.2 of the Draft Environmental Assessment. Conservative assumptions were used in this screening process so that important radionuclides were not screened out. The screening procedure is currently being updated, and analyses for other radionuclides may be performed in the future.

Issue: Seal and site pathway interactions

One commenter expressed concern that interactions between the repository seals subsystem and the site subsystem would affect the analysis and that this interaction was not adequately considered in the Draft Environmental Assessment.

Response

It should be noted that this preliminary analysis indicated that the repository seals subsystem would not be a significant pathway for radionuclide release to the accessible environment. Conservative assumptions were made to offset the uncertainty of the input data. The repository seals subsystem release calculations had no effect on the site subsystem analysis. For the purposes of this analysis, 100 percent of the waste-package releases were considered to migrate through the site; while for the seals analysis, 10 percent of the total waste-package release was assumed to enter the seals pathway.

Issue: Effect of entrance shaft

One reviewer requested an explanation of the role the entrance shaft would play in migration of wastes.

Response

The entrance shaft and its seals will be designed so that they do not form a preferential pathway for the migration of radionuclides. As noted above, current calculations show that only a small part of the total flow would occur in the damaged rock zone around the shafts; therefore, the shaft will not be a preferential pathway for radionuclides moving toward the accessible environment. These calculations were discussed in Subsection 6.4.2.3.4 of the Draft Environmental Assessment.

In Subsection 6.4.2.5, the word "horizontal" has been inserted following " . . . driving force along the . . . " in the first bullet, line 8. In the cumulative radionuclide release segment of Subsection 6.4.2.6.2, the text has been revised to read: "Radionuclide release rates from the waste packages were assumed to be the same as the results presented in Subsection 6.4.2.4, thus, no credit was taken for radionuclides that migrate through the repository seals subsystem."

C.5.11.10 Compliance with guidelines

Several commenters challenged the position taken by the U.S. Department of Energy on specific guidelines, either because of disagreements with U.S. Department of Energy rationale or because of misinterpretation of particular requirements. The wide range of ground-water travel times presented in Chapter 6 of the Draft Environmental Assessment was cited as evidence that too much uncertainty exists in site performance and that the site is too complex to characterize adequately.

(Also see Subsections C.5.11.2, C.5.11.3, C.5.11.4, and C.5.11.8, on conceptual model for ground-water travel time analysis, data base for ground-water travel time analysis, ground-water travel time analysis, and release rate analysis.)

Issue: Favorable condition for ground-water travel time

Many commenters asserted that the Hanford Site should not have taken credit for the favorable condition, " . . . pre-waste-emplacement ground-water travel time . . . would be more than 10,000 years . . . " (DOE, 1984a; 960.4-2-1 (b)(1)) because the wide range of experimental hydrologic data can be interpreted to yield computed travel times as low as 20 years or as high as several million years. Computational exercises demonstrating this range of possibility were submitted as criticism to the U.S. Department of Energy Site Characterization Report for the Basalt Waste Isolation Project (NRC, 1983b).

Response

The Draft Environmental Assessment clearly stated on page 6-62 that a final conclusion on this favorable condition could not be made at that stage. Based on currently available data and interpretations, it appears that this favorable condition can be met. This does not preclude the possibility that predicted ground-water travel times will change as more data become available and as the conceptual model of the flow system is revised. In the calculations of ground-water travel time presented in Subsection 6.4.2.3.5 of the Draft Environmental Assessment, every effort was made to (1) use all available data, (2) explicitly account for uncertainties in these data in a reasonably conservative but not necessarily "worst-case" manner, (3) make predictions of travel time that would

span the range of possible travel times, and (4) provide a graphic representation that displays both the total range of possibilities and current estimates of the likelihood of specific values within that range.

In contrast to the analysis summarized in Section 6.4.2.3.5, the studies listed in Table 6.3, page 6-64, and discussed in Subsection 6.3.1.1.11.1, page 6-79 of the Draft Environmental Assessment use different assumptions, and in some cases modeling approaches, to determine ground-water travel times. These studies are presented in the Draft Environmental Assessment purely for completeness. Some are based on previous interpretations of the flow system and on very limited data bases. The fact that these studies have resulted in a variety of predicted ground-water travel times illustrates how results change as more data become available and emphasizes the need for further site characterization.

Issue: System guideline

One reviewer felt there was an inconsistency between taking credit for a favorable condition on the overall postclosure system guideline (DOE, 1984a; 960.4-1) and an admitted potential for an adverse condition arising from human-induced events or processes.

Response

The conclusion on the system guideline in Subsection 6.3.2.3 of the Draft Environmental Assessment is a Level 3 conclusion (i.e., available evidence does not support a finding that the reference repository location is not likely to meet the qualifying condition). This does not preclude a potential for human activities that could adversely change portions of the ground-water flow system important to waste isolation.

Evaluations for the purpose of drawing a conclusion on the postclosure system guideline were performed in terms of the entire collection of technical guidelines that support the postclosure system guideline; the postclosure system guideline itself was not used as a basis for assessment. The absence of a single favorable condition or the presence of a single potentially adverse condition does not preclude a Level 3 conclusion for the overall postclosure system guideline, since favorable and adverse conditions are used as early indicators of site suitability and are not intended to replace the requirements of the qualifying condition.

Issue: Engineered barriers

A reviewer expressed concern that part of the postclosure system guideline (DOE, 1984a; 960.4-1) requiring that the geological setting of the site allow the use of engineered barriers was not adequately addressed.

Response

The guideline in question encompasses a wide, undefined range of areas in which compatibility between the engineered barriers and the site must be confirmed. The most obvious example of a compatibility requirement is the ability of the container material to resist corrosion in the chemical environment of the site. Identification of potential interactions between the site and the engineered barriers, and assessment of potentially adverse effects of these interactions, is an integral part of the overall system and subsystem research and design effort. As stated in Subsection 6.3.2.3 of the Draft Environmental Assessment, a final conclusion on the guideline cannot be drawn at this time; however, available evidence does not support a finding that the guideline cannot be met. Another commenter was incorrect in asserting that containment within the waste package cannot be the means for meeting the ground-water protection requirement of the U.S. Environmental Protection Agency (EPA, 1985).

Issue: Sorption guideline

The ability of the Hanford Site to meet the sorption guideline (DOE, 1984a; 960.4-2-2(b)(5)) was questioned on the basis of failure of the analysis to consider irreversible sorption or the specific nature and abundance of sorption sites along the radionuclide pathways.

Response

The brief analysis supporting the guideline position has been revised to clarify that position. It is not apparent that hysteresis or irreversible sorption effects would alter the validity of the analysis for purposes of assessing the effectiveness of sorption (i.e., at least a factor-of-10 improvement with sorption as compared to without sorption). Conservative host rock properties were utilized in the analysis, which should provide an adequate representation of sorption in clay-filled fractures for the purpose of this simplistic analysis.

Issue: Disqualifying condition on ground-water travel time

One commenter expressed a belief that the site-characterization program might not provide sufficient information to change the present Level 1 conclusion on the ground-water travel time disqualifying condition (DOE, 1984a; 960.4-2-1(d)) (i.e., evidence does not support a finding that the site should be disqualified) to a Level 2 conclusion (i.e., evidence supports a finding that the site should not be disqualified).

Response

The comment is speculative, and the U.S. Nuclear Regulatory Commission will judge, based on the site-characterization plans to be prepared by the U.S. Department of Energy, whether the site-characterization programs for those sites selected for characterization can reasonably be expected to yield the required information.

Subsection 6.3.1.1.11.1 of the final Environmental Assessment has been changed to state that the results presented in Subsection 6.4.2.3.5 of the Draft Environmental Assessment were used as the basis for claiming that the favorable condition is present, and that the results from previous studies, listed in Table 6.3, are included purely for completeness. An incorrect reference callout has been corrected.

C.5.11.11 Miscellaneous issues

Several comments did not fall clearly within the categories discussed in this section and therefore were addressed within a general heading. These involved areas such as the adequacy of computer modeling and the specific models for performance assessment, concerns about waste-handling methods, and difficulties encountered in reviewing the Draft Environmental Assessment.

Issue: Availability of documents

One commenter indicated that reviewers could not obtain copies of supporting documents in time to complete a meaningful review of the Draft Environmental Assessment before the deadline for receiving comments.

Response

In this instance, the U.S. Department of Energy has agreed to accept comments beyond the specified deadline. To avoid a similar problem with the final Environmental Assessment, the U.S. Department of Energy will release revisions to existing supporting documents and any additional supporting documents referenced in the final Environmental Assessment before or concurrent with the release of the final Environmental Assessment.

Issue: Waste-handling methods

Another reviewer inquired about the waste-handling methods to be employed after the 1,000-year containment period.

Response

There is a misunderstanding in this instance about the overall disposal process, since after the repository is closed and sealed (following a 50-year period during which the waste packages are to be retrievable), the waste will no longer be handled in any way. Active protection (e.g., guards) of the reference repository location is assumed to be present for 100 years after closure, with passive protection measures (e.g., permanent markers) employed thereafter.

Issue: Defense waste handling

Two commenters questioned the manner in which defense waste has been handled at the Hanford Site and indicated that the waste containers should be handled with great care, not as they have seen them handled on television.

Response

High-level waste, the safe disposal of which is the subject of the Draft Environmental Assessment, should not be confused with comparatively benign, medical-type low-level wastes (e.g., contaminated rubber gloves and syringes), which the reviewers may have seen handled on television. The U.S. Department of Energy is fully aware that high-level waste containers require careful handling. Repository design features and operating procedures are intended to reduce the risks of this operation (see p. 6-223 of the Draft Environmental Assessment).

Issue: Methane danger

One reviewer expressed concern about the potential danger of an explosion should methane gas come into contact with the hot waste containers.

Response

The danger of an explosion is minimal during the preclosure period, because ventilation of the drifts and service shafts will reduce the concentration of methane gas to a negligible level. During the postclosure phase, oxygen concentrations will be insuffient to cause an explosion.

Issue: Hydropower

One commenter asked if radionuclide contamination of surface water would affect the generation of hydropower.

Response

If releases from the repository meet the constraints of the U.S. Environmental Protection Agency regulation (EPA, 1985), radionuclide concentrations in a large body of water (i.e., any river on which a hydropower station would be located) would be extremely low. Although no detailed analysis has been conducted, it is not likely that either personnel or equipment would be affected. If the Columbia River were the body of water involved, releases far in excess of the U.S. Environmental Protection Agency limits could be tolerated without significant impact on hydropower generation.

Issue: Computer models as a decision tool

Several commenters denigrated the use of computer models as a legitimate element of the decision-making process, because the decisions that must be made are so critical to human health and safety.

Response

It must be recognized that throughout history decisions at all levels of importance have been made in the face of uncertainty and have included some form of forecasting and some form of information integration. Field experiments cannot be run for periods of thousands of years, but process models incorporating the results of comprehensive data acquisition programs can provide predictions of system behavior far into the future. These predictions, reviewed by experts to assess their reasonableness in the context of the collective experience of those experts, cannot be claimed as certainties, but they provide a strong basis for rational decision-making (i.e., computer models do not replace the human element of decision-making; they complement the human element). "Garbage in, garbage out" is clearly true, as noted by the reviewer, but it does not preclude the possibility of valid forecasts by means of computer models; it simply highlights the importance of an effective site-characterization program to support computer model development.

Issue: Computer model validation

Several commenters stated that it was not possible to perform technically thorough checks on the results of the computer models without validating the codes and models involved (i.e., PORFLO, CHAINT-MC, MAGNUM-2D, MAGNUM-3D, REPSTAT, EPASTAT, REPREL, and EPASTAT) against equally complex engineering problems. This cannot be done until the codes and their documentation, as well as model validation activities, are completed.

Response

In answering these comments, the terms "validation" and "verification," as well as the term "benchmarking," which was not mentioned, must first be defined. Verfication is the process that assures that the computational algorithm as represented by the computer code is correctly executed. Verification also ensures that the machine running the code does indeed perform the calculations and model algorithms per expectations and assumptions on which the coding of the model is based. Benchmarking also ensures that the answers given by the code-machine system are comparable to the answers given by other code-machine systems analyzing similar problems of similar complexity. Validation confirms, by comparison of analytical and experimental results, that the code-machine analog to the natural system has a phenomenological basis in reality and reasonably approximates the behavior of the natural system to within scientifically acceptable limits of error.

The processes of verification, benchmarking, and validation are ongoing. Validation is presently in the early stages of small-scale laboratory experiments and hydrologic-geologic tests that can be conducted from the surface. Most verification studies will be complete, and most codes (as well as preand postprocessors and associated documentation) have been released.

Validation of the computer models will continue as the data base for the computer models expands during site characterization, if the reference repository location is recommended for characterization. The models and the associated data base are subject to the scrutiny of the scientific community for its concurrence or rejection. It is expected that validation will be an iterative process incorporating studies both at the Hanford Site and throughout the technical and scientific communities.

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C.6 PRECLOSURE RADIOLOGICAL SAFETY

This section addresses comments on the behavior and effects of radionuclide releases during repository operations. It corresponds to the system guideline on preclosure radiological safety and includes all the guideline evaluations that support the system guideline. In this respect, comments on preclosure radiological safety also address the ability of the repository system to meet the requirements of the applicable U.S. Nuclear Regulatory Commission and U.S. Environmental Protection Agency regulations (10 CFR 20 (NRC, 1985b), 10 CFR 60 (NRC, 1985a), and 40 CFR 191, Subpart A (EPA 1985)).

C.6.1 POPULATION DENSITY AND DISTRIBUTION

Comments assigned to this section have been cross-referenced to and discussed in Section C.7.4.

C.6.2 SITE OWNERSHIP AND CONTROL

Several reviewers voiced concern with an apparent land-use conflict between (1) Federal, State, and private land interests on or near the reference repository location, and (2) site-characterization activities and potential repository construction and operation activities.

Issue: State of Washington lease area (U.S. Ecology, Inc.)

Several reviewers stated that an apparent land-use conflict exists between activities on the State of Washington leased land and activities related to site characterization and potential repository construction and operation.

Response

Figure 3-38 in the Draft Environmental Assessment (DOE, 1984) may lead to confusion regarding the relationship between the State of Washington leased land (subleased by U.S. Ecology, Inc.) and surface activities on the reference repository location. Section 3.4.1 of the Draft Environmental Assessment states that the land designated for the reference repository location consists of acquired land plus sections that have been withdrawn from all forms of appropriation under the public land laws. The area designated as the reference repository location includes a portion of the 405-hectare (1,000-acre) site leased by the U.S. Department of Energy to the State of Washington for nuclear-related activities compatible with U.S. Department of Energy programs. The portion of the leased area within the reference repository location is not currently used by the State or subleased to others and the U.S. Department of Energy may terminate this portion of the lease upon 60-days notice. A 40.5-hectare

(100-acre) portion of the State leasehold is leased to U.S. Ecology, Inc. for a licensed low-level radioactive-waste-disposal facility. This subleased portion is located outside the boundaries of the reference repository location. In assessing potential surface-land-use conflicts (see Subsection 6.2.1.3), the nature of activities on the State of Washington leased land was considered and judged not to impact site-characterization activities or potential repository construction or operation activities.

The final Environmental Assessment has been enhanced to indicate that no surface-land-use conflicts are expected between activities on the State of Washington leased lands and activities related to site characterization and potential repository construction and operation.

Issue: Mineral leases held by Big Bend Alberta Company

One reviewer requested more information regarding the potential land-use conflict between activities related to site characterization and potential repository construction and operation and activities on lands leased by the Big Bend Alberta Company.

Response

The mineral leases held by the Big Bend Alberta Company are located more than 10 kilometers (6.2 miles) from the reference repository location. Due to this remoteness, no land-use conflicts are expected between potential Big Bend Alberta Company activities and activities related to site characterization and potential repository construction and operation.

Issue: U.S. Army Yakima Firing Center

More information was requested by one reviewer regarding potential conflict between activities on the U.S. Army Yakima Firing Center and activities related to site characterization and potential repository construction and operation.

Response

Section 3.4.1 of the Draft Environmental Assessment identifies the U.S. Army Yakima Fire Center as being located more than 10 kilometers (6.2 miles) from the Hanford Site and 20 kilometers (12.4 miles) from the reference repository location.

The Yakima Firing Center is used primarily as a training area for large-scale maneuvers, particularly those involving tracked vehicles (tanks and armored personnel carriers), and for training in use of large, long-range weapons. The use of the Yakima Firing Center is necessary to enhance the ability and readiness of the primary headquarters, 9th Infantry Division, Fort Lewis, Washington and Reserve Components (U.S. Army Reserve, National Guard) in accomplishment of their military mission.

In an environmental impact statement issued by the U.S. Department of the Army in 1977 (DOA, 1979, p. 67-109), no current or proposed activity on the Yakima Firing Center was identified that would significantly impact nuclear-related operations on the Hanford Site. These included assessments of land use and environmental or socioeconomic impacts resulting from any current or proposed activity on the Yakima Firing Center.

Due to the remoteness of the Yakima Firing Center from the reference repository location, no impact to site-characterization activities or potential repository construction is foreseen. Additional information and references have been added to Subsection 3.4.1.2 of the final Environmental Assessment.

C.6.3 METEOROLOGY

All comments received regarding the current meteorology data base have been addressed in Subsection C.4.1.3.3, Air quality and weather. Those comments received regarding the use and analysis (modeling and impacts) of the meteorology data base have been addressed in Subsection C.7.2.3, Air quality.

C.6.4 OFFSITE INSTALLATIONS AND OPERATIONS

Many commenters expressed concern that the Draft Environmental Assessment did not adequately describe the presence and impact of defense-waste facilities at the Hanford Site, particularly those in and near the reference repository location. Commenters also expressed concern regarding past and present defense-waste management activities at the Hanford Site and plans for final disposition of existing defense waste. Some commenters believed additional information on defense activities and impacts was required to make an informed judgment relative to potential conflicts between defense activities and a geologic repository.

C.6.4.1 Offsite installation description

Issue

Many commenters were concerned that the Draft Environmental Assessment did not adequately describe the presence of defense-waste facilities at the Hanford Site.

Response

Chapter 3 of the Draft Environmental Assessment describes site characteristics (e.g., water use, water quality, radiological conditions, and radiation exposures) relative to all activities at the Hanford Site. It did not, however, provide a detailed description of the defense facilities. Some of these facilities are located on the reference repository location, while others are located outside the boundaries of the reference repository location but still on the Hanford Site. Additional description of these facilities has been added in Section 3.4.1 of the final Environmental Assessment.

The U.S. Department of Energy is presently developing plans for final disposition of defense wastes that are stored on the Hanford Site. Options for disposal that are being evaluated range from geologic disposal to continued storage and monitoring.

It is not the purpose of the final Environmental Assessment to describe defense programs or the current disposal practices for defense wastes. The final Environmental Assessment is intended to assist the U.S. Department of Energy in determining the suitability of the Hanford Site for further study as a potential geologic repository. A draft environmental impact statement, which will discuss the presence of high-level and transuranic defense waste at the Hanford Site and alternatives for its disposal, is scheduled for release by the U.S. Department of Energy in early 1986.

C.6.4.2 Offsite installations radiological conditions description

Many commenters expressed concern over the lack of detail in the Draft Environmental Assessment concerning existing radiological conditions at the Hanford Site. This included the need for more detail of the nature of these radiological sources with specific questions or concerns about radionuclides in soil and vegetation, gross beta measurements, tritium, strontium, and plutonium in the environment.

Issue: Lack of detail concerning radiological conditions

Several commenters requested information about the nature of radiological sources and the existing radiological environment.

Response

Existing conditions in the environment are described in general in Section 3.4 of the Draft Environmental Assessment, with radiological conditions being described in Subsection 3.4.2.7. Detailed descriptions of the existing environment have been reported elsewhere (Price et al., 1985) and have therefore not been duplicated in the Draft Environmental

Assessment. Reports of environmental monitoring data have been issued for each of the last 25 years, and the data for the last 15 years have been placed in a computerized data base. These reports and the data base establish a baseline of environmental conditions for historically monitored media, parameters, and locations. Should the Hanford Site be recommended for site characterization, additional parameters and locations would be monitored. The current environmental monitoring program for the non-operations areas of the Hanford Site includes the collection of samples as listed below.

Sample type	Number of locations
Air	48
Ground water	339
Columbia River	3
Ponds	4
Foodstuffs	7
Wildlife	12
Soil and vegetation	31
Dose rate	54
Waste-site surveys	83
Roadway surveys	16

Additional environmental monitoring is done within the operating area, drinking water is monitored, and an annual wildlife census is taken. Samples are analyzed for radiological and nonradiological constituents. Monitored emissions and environmental data are used to estimate the offsite doses and are reported annually (Price et al., 1985).

Environmental monitoring results for calendar year 1984 have been reported and are compared to the previous four years (Price et al., 1985).

Issue: Tritium concentrations in ground water

The Draft Environmental Assessment presents an apparent discrepancy between tritium concentrations in the ground water at the exploratory shaft and elsewhere in the Hanford Site.

Response

As stated in the Draft Environmental Assessment, the tritium concentration in the unconfined aquifer at the exploratory shaft location is less than 2 picocuries per milliliter. Other documentation supports these concentration values (Prater et al., 1984). The exploratory shaft site is located within an area of low tritium concentrations (less than 2 picocuries per milliliter), and is outside of the 200 West Area where

higher concentrations (30 to 3,000 picocuries per milliliter) have been measured (Prater et al., 1984). Excavations or drilling will not exhume or encounter radioactive wastes or bring contaminated ground water to the surface if such activities are not carried out within the 200 West Area.

Issue: Dose calculations of tritium at the Fast Flux Test Facility

Several commenters were concerned with the dose calculations given in the discussion of tritium at the Fast Flux Test Facility.

Response

The comment is correct that the drinking water standard for tritium is 20 picocuries per milliliter. However, the Draft Environmental Assessment refers to the expected occupational dose of tritium to workers at the Fast Flux Test Facility site. The distinction between dose and concentration is important because workers at the Fast Flux Test Facility consume drinking water from the Hanford Site only a portion of the year (i.e., approximately one-half of the average adult consumption per year (Prater et al., 1984)). As the reference points out, the annual whole-body dose attributable to tritium, based on an ingestion rate of 250 liters (66 gallons) of water, is approximately 10 percent of the 4-millirem maximum permissible dose to the total body. There is an error in the Draft Environmental Assessment, though. The reference document (Prater et al., 1984) contains 1983 data, rather than 1982; and the average concentration of tritium in the drinking water in this reference is 25 picocuries per milliliter rather than the 18-picocurie value from an earlier reference (Eddy et al., 1983). Data from the later reference (Prater et al., 1984) should be used.

The final Environmental Assessment has been modified to use the correct reference (Prater et al., 1984) and states that "the average concentration of tritium in the drinking water is 25 picocuries per milliliter."

Issue: Gross beta radiation

One reviewer suggested that higher gross beta radiation measured at Spokane, Washington compared to Seattle, Washington is the result of current operations at the Hanford Site and should be mentioned in the Draft Environmental Assessment.

Response

Gross beta radiation measurements vary with time and location due to the conduct of nuclear weapons tests and relationship to the changing weather patterns responsible for the intrusion of globally distributed fallout, and caused by natural local sources. During the period in question, July 1981 through June 1982, the average gross beta measured at

Spokane, Washington was 0.02 picocurie per cubic meter compared to 0.01 at Seattle, Washington (State of Washington, 1982). During this same period, monthly measurements at 37 locations across the country (including Spokane and Seattle) ranged from 0 to 0.10 with measurement at Spokane and Seattle ranging from 0.01 to 0.07 and 0 to 0.03, respectively (EPA, 1981, 1982a, 1982b, 1982c). The Hanford Site perimeter average for the period was 0.05 and the 2-week samples from all perimeter sampling locations ranged from 0.008 to 0.19. Therefore, while values at Spokane are higher than those at Seattle during this period, they are not atypical of those measured elsewhere, and measurements at the Hanford Site perimeter are too small to account for measurable contributions at Spokane. Potential contributors to beta radiation that would be unique to the Spokane area are daughter radionuclides from natural uranium that is known to exist in the Spokane area as evidenced by the existence of a local uranium mining industry.

Issue: High strontium-90 levels in Spokane milk

One reviewer suggested that strontium-90 levels in milk in the early 1970's were higher in Spokane, Washington than other parts of the State due to operations at the Hanford Site.

Response

The State of Washington Department of Social and Health Services reports (State of Washington, 1972, 1973, 1974, 1975, 1976) for the period from July 1971 through June 1976 indicate that the average concentration for the 5-year period of strontium-90 in raw milk samples for the Spokane (Sandpoint) and Skagit areas of the State were 6.3 and 5.4 picocuries per liter, respectively. While the reports do not explicitly state the error associated with these measurements, it is probable that the errors associated with each measurement are larger than the difference between them. Typical measurement precisions during this timeframe were plus or minus 1 to 2 picocuries per liter (EPA, 1974). Review of data from other locations in the country demonstrates that these values are not unusual for global fallout. For example, available data for 1970 to 1973 from the U.S. Public Health Services (NCRP, 1975) milk- (pasteurized) monitoring network show values for 9 cities ranging from 1 to 10 picocuries per liter with Spokane (1 of the 9 cities) ranging from 4 to 6 picocuries per liter during the period.

Issue: Plutonium concentrations attributable to fallout

One reviewer suggested that plutonium concentrations reported by the Hanford Environmental Monitoring program for 1983 are higher than attributable to fallout as described in the report for that year (Price et al., 1984) and referenced in the Draft Environmental Assessment (p. 3-109).

Response

Soil monitoring sites are located both on and off the Hanford Site. Since the concentrations of any deposited materials in soils decreases rapidly with distance offsite, soil sampling locations have been selected near the Hanford Site perimeter to measure the maximum offsite concentrations. A location at Sunnyside, Washington is also monitored because it is generally upwind and blocked from the Hanford Site by the Rattlesnake Ridge. The Sunnyside monitoring site is generally much less affected by Hanford Site emissions than other locations in the immediate regions and can be expected to most closely reflect background concentrations.

The soil concentration of plutonium-239 and -240 reported for Sunnyside in 1983 (Price et al., 1985) was 0.026 picocurie per gram of soil for a sample taken from a layer of soil 2.5 centimeters (1 inch) deep. Comparison of this measurement with worldwide fallout values requires a conversion to different units (millicuries per square kilometer of surface) and some additional assumptions. For this conversion it is assumed that the soil density could be in the range of 1.0 to 1.6 grams per cubic centimeter (0.036 to 0.06 pound per cubic inch) and that the 0- to 2.5-centimeter (0- to 1-inch) layer could contain from 50 to 70 percent of the plutonium in the total soil column (Bernhardt, 1976). Based on these ranges, the 0.026 plus or minus 0.0045 picocurie per gram value calculates to be 0.90 plus or minus 0.15 through 2.08 plus or minus 0.35 millicuries per square kilometer, with the average being 1.49 plus or minus 0.25 millicuries per square kilometer.

Worldwide fallout values for the 40 to 50 degree latitude belt are reported to average 2.2 plus or minus 0.5 millicuries per square kilometer, with the United States sites ranging from 1.4 to 2.6 meters per square kilometer (11.9 to 22 feet per square mile) (Hardy et al., 1973). Based on these data, the levels of plutonium in soils at Sunnyside, Washington and at the Hanford Site perimeter do not indicate a detectable contribution from the Hanford Site. In reality, there likely is some small contribution from Hanford Site emissions; however, these data indicate that the total from the Hanford Site and worldwide fallout is not significantly different than totals elsewhere that are due to fallout alone. Special measurements designed to estimate the relative proportions of fallout and Hanford Site-related plutonium have been made and are being analyzed.

Issue: Soil and vegetation radionuclide concentrations

Commenters questioned the assertion that soil and vegetation radionuclide concentrations across the Hanford Site are uniform in light of apparently conflicting information in a report cited by the reviewers.

Response

Soil and vegetation assays taken from the Hanford Site environs show that some locations near operations areas have slightly elevated levels of radionuclides. Subsection 3.4.2.7 of the final Environmental Assessment has been enhanced to amplify this fact (Price et al., 1985, pp. 31 and 33).

C.6.4.3 Offsite installations radiological impact

Many commenters expressed concern over the lack of information in the Draft Environmental Assessment regarding the radiological impact of defense activities at the Hanford Site. Among these concerns is the possibility that existing high-level waste would mask repository activities or make monitoring repository performance difficult. Other commenters inquired about the combined offsite radiological exposures due to all installations and sources at the Hanford Site, including the projected repository contribution.

Issue: Radiological impact of current operations at the Hanford Site

Several commenters expressed concern over the radiological impact of current operations and the reliability of these estimates.

Response

The radiological dose estimates for Hanford Site operations in calendar year 1982, as cited by one reviewer, are correct as reported on page 3-107 of the Draft Environmental Assessment.

Annual dose assessments from current operations are made using two separate approaches: (1) direct measurements in the environment and (2) computer modeling.

Direct environmental measurements are made for all emissions and pathways potentially carrying radioactivity to man that could result in a dose of 0.1 millirem or more. Measurement methods are sufficiently sensitive to detect concentrations leading to this level of dose or less. The concentrations of most of the radionuclides in the environment are far below even these levels. However, even at these low levels it is desirable to assess annually how doses are changing due to changing operations and population distributions, and changes in the way people are potentially exposed to radionuclides in the environment because of changing usage patterns. Because the levels in the environment are so low, the dose estimates reported are based on the model calculations. The modeled and measurement results are then compared for consistency.

The models utilized are essentially those currently used by the U.S. Nuclear Regulatory Commission and are based on assumptions and dose assessment methodologies recommended by the International Commission on

Radiation Protection and the National Commission on Radiation Protection. Both commissions are made up of nationally and internationally recognized medical, health, and environmental experts. The U.S. Department of Energy radiation standards for exposure to workers and the public are also based on the recommendations of these commissions.

In addition to utilizing exposure standards and exposure assessment methods based on recommendations of independent commissions (the International Commission on Radiation Protection and National Commission on Radiation Protection), the Hanford Environmental Monitoring Program results have been reported and distributed for independent review for the last 25 years. Distribution has included State and Federal environmental and health agencies. The monitoring results and dose assessment for 1984 were the subject of a public workshop hosted by the Environmental Monitoring Committee of the State of Washington Nuclear Waste Board, whose members are appointed by the governor. The results and methods used are available for discussion and review by any independent party.

The State of Washington has conducted an independent Hanford Environmental Monitoring Program for many years consisting of Columbia River water sampling, ground-water sampling, external radiation monitoring, and milk sampling and has generally found good agreement between their results and those reported by the Hanford Environmental Monitoring Program (State of Washington, 1982).

Issue: Repository performance monitoring against a background of radiocontaminants from defense-waste activities is impossible

Several comments related to the problem of monitoring performance and integrity of the repository against the background of radiocontaminants from defense-waste activities existing in the ground and ground-water systems.

Response

The comments are valid in that the existence of radiocontaminants in both the vadose and saturated zones (from defense-waste-disposal operations) could complicate repository monitoring. The proposed Basalt Waste Isolation Project environmental program is being designed to effectively differentiate between potential releases from the repository and other nearby sources of radiocontaminants.

The Cohassett flow at the reference repository location is greater than 869 meters (2,850 feet) below the ground surface, and the hydrologic system(s) at this depth appears to be essentially isolated from the upper, unconfined aquifer that is impacted by the defense-waste-disposal activities. Extensive studies are in progress to determine conclusively the existence or absence of system isolation. In addition, a

comprehensive network of observation wells is being installed to monitor the deep, confined hydrologic systems. Most of the wells are completed, with water-level measurements and water-quality analyses made routinely. Monitoring of the upper, unconfined hydrologic system has been in effect for more than 35 years. In the near term, if isolation is confirmed, repository monitoring will be straightforward. The extensive baseline analyses will quantify water quality and occurrence of contaminants from all sources adjacent to the repository. In the future, variances from baseline conditions will have to be compared to differences in the spectrum of radioisotopes at various potential sources to define the actual source (see Section C.6.5).

Issue: The Draft Environmental Assessment provided insufficient information about the combined offsite radiological exposures

Several commenters inquired about the combined offsite radiological exposures due to all installations and sources at the Hanford Site including the projected repository contribution.

Response

The combined radiological dose to the public due to the proposed repository, existing Hanford Site operations, and existing and potential commercial operations are discussed in the Draft Environmental Assessment, Subsection 6.2.1.5.2. Based on 1982 dose estimates for Hanford Site operations, the combined dose was reported as 2.8 millirem (p. 6-23). Dose estimates for Hanford Site operations in calendar year 1984 (Price et al., 1985) are larger than estimated for 1982 and would increase the combined estimate from 2.8 to 4.7 millirem (assuming the operation of three Washington Public Power Supply System reactors). Contributions from operations of U.S. Ecology, Inc. and Exxon Nuclear Company, Inc. to these whole-body doses would not change these numbers, and the Exxon Nuclear Company, Inc. dose to the lung of a full-time resident located at the fence line would be less than 1 millirem and much less than the nearest actual resident (State of Washington, 1982).

The existing discussion of facilities on page 6-22 and sources of additional information have been enhanced in the final Environmental Assessment.

Issue: Concern over the potential health consequences of radiological emissions from a repository at the Hanford Site

Several reviewers expressed concern over the potential health and economic consequences of radiological emissions from a repository at the Hanford Site.

Response

Preliminary estimates of the radiological dose to people from the combination of current operations and a repository are addressed in the Draft Environmental Assessment, Subsection 6.2.1.5.2. The additive potential dose due to transportation is addressed in Subsection 5.2.2.5. As described in these discussions, these preliminary estimates indicate that the contribution from a repository would be a small increment to total dose from the Hanford Site, and the combined whole-body dose to the maximum exposed individual would be only about 5 percent of that due to natural sources of radiation. These estimates are well within the proposed U.S. Environmental Protection Agency dose regulation (EPA, 1985) applicable to repository operations, as cited in Subsection 6.2.1.5.2, and decreases rapidly with distance from the site.

It should be noted that these are preliminary estimates for the purpose of site screening. If the reference repository location is recommended for characterization, a more definitive analysis will be possible when the site-characterization studies and further preliminary design work are done in the development of the repository-siting environmental impact statement. This work will be especially useful in addressing the potential for releases to ground and river water.

C.6.5 SYSTEM GUIDELINE--PRECLOSURE RADIOLOGICAL SAFETY

This section contains issues and responses related to preclosure radiological safety topics. The impact of monitoring defense radioactive waste are considered.

Issue: Monitoring defense radioactive waste

Several commenters stated that radionuclide releases from the defense waste stored at the Hanford Site raises questions about the ability to effectively monitor for sources of radioactive releases from the repository.

Response

The provisions of 10 CFR 60.140 (NRC, 1985a) on the performance-confirmation program require the monitoring of natural and engineered system barriers during the preclosure period to ensure that they are functioning as intended and are within the limits assumed in the licensing review. In addition, 10 CFR 60.143 (NRC, 1985a) requires monitoring of the condition of the waste package as long as practical up to the time of permanent closure. Compliance with these requirements will ensure that any potential radionuclide releases from the repository are effectively monitored during the time up to permanent closure.

In actuality, radionuclides released from the repository would be monitored by the same type of program that effectively monitors current Hanford Site facilities and the surrounding environs. In addition to such a comprehensive environmental surveillance program, potentially radioactive gaseous and liquid effluents would be monitored during the preclosure period at likely repository release points (e.g., stacks and pipelines). If, following repository operation, a significant increase in radioactivity in the surrounding environs were to occur (in comparison to past measurements), it is expected that it will be possible to distinguish between repository and defense waste sources by (1) observing the isotopic differences between pre- and post-repository operation ground-water contamination, and by (2) monitoring and analyzing contamination in test wells.

Compliance with the performance requirements of 10 CFR 60.133 (NRC, 1985a) will provide reasonable assurance that any radionuclide releases after permanent closure of the repository will not exceed public safety limits.

C.6.6 ASSESSMENT OF PRECLOSURE PERFORMANCE

This section contains issues and responses associated with performance assessment during both normal operations and postulated accidents at the proposed repository for the preclosure period. Both public and repository personnel safety are assessed.

Issue: Accident analyses

Numerous commenters questioned the preclosure radiological accident analysis presented in the Draft Environmental Assessment. Some of these comments were related to the scope of accident initiators considered; others were concerned with the method of analysis used. Nine comments were related to the analysis of the consequences of accidents, four having to do with the range of potential source terms and five related to exposure considerations.

Response

The hoist drop incident in the Draft Environmental Assessment (see Subsection 6.4.1.4.4) was judged to be the bounding accident for environmental assessment of radiological consequences. This was based on a preliminary safety analysis, which used existing site data and the preliminary facility design (Rockwell, 1984). This bounding analysis is a conservative scoping one and is based on the most serious accident considered in the generic environmental impact statement for commercial waste management (DOE, 1980). It was not intended to be comprehensive. However, preclosure safety assessment will be a comprehensive, iterative

process that will get progressively more definitive as repository design, construction techniques, and operating procedures evolve. The methodology for the subsequent preclosure safety analysis is described in the Draft Environmental Assessment (see Subsection 6.4.1.3). Fault-tree analysis will be used to comprehensively investigate potential accident initiators. The type of accident precursors that will be considered are off-normal operations, surface spills, transportation, waste receipt and handling, fuel rod compaction process, fuel assembly drop accidents, fires, explosions, natural phenomena such as tectonic disturbances and surface flooding, and human errors. System descriptions will give the supporting details for processes and systems (e.g., credit for filter systems, monitoring systems, emergency plans). The consequence of an accident scenario will consider the range of potential source terms (e.g., volatiles, particulates, actinides, time out of reactor) and details of the transport pathway and exposure points (e.g., airborne or surface release, public roads, surface-water systems, whole-body and organ-specific doses). Risk management will be an important element of preclosure safety analysis.

Final preclosure safety analyses will be presented and reviewed as part of the license application if the reference repository location is recommended as the site for the first repository. The repository will be authorized to operate only on issuance of a license by the U.S. Nuclear Regulatory Commission. This will require public hearings in accordance with the rules of practice of 10 CFR Part 2 (NRC, 1984).

With regard to the bounding analysis in the Draft Environmental Assessment, it is standard practice to assign decontamination factors for particulates of 1,000 and 10, respectively, for high-efficiency particulate air and roughing filters that are carefully installed and tested in place. Thus, for a roughing filter and two high-efficiency particulate air filters in series, a total decontamination factor for particulates of 10^7 is appropriate.

A review of the hoist drop analysis presented in Subsection 6.4.1.4.4 of the Draft Environmental Assessment indicates that the correct distance from the repository release point to the assumed maximum exposed individual located on Route 240 should have been approximately 1.6 kilometers (1 mile). Subsection 6.4.1.4.4 of the final Environmental Assessment has been revised to reflect this change. The distance, atmospheric dispersion factor, and whole-body dose commitment changed as a result of this.

Issue: Radiological releases during normal operations

Numerous commenters questioned the preclosure analysis of routine radiological releases presented in the Draft Environmental Assessment. Some of these comments were directed to the consideration of potential source terms. Commenters questioned the exposure area considered in the analysis. Other comments were related to the analysis method.

Response

The radiological analysis of the potential release from continuous abnormal operation in the handling of spent-fuel assemblies (as presented in Subsection 6.4.1.4.2 of the Draft Environmental Assessment) deliberately overestimated the projected radiation dose to members of the public from routine repository operations. The intent of this bounding analysis and its method of presentation is to demonstrate that any projected routine radiological exposures to the general public would meet the safety requirements of 10 CFR 20 (NRC, 1985b), 10 CFR 60 (NRC, 1985a), and 40 CFR 191, Subpart A (EPA, 1985).

The actual quantity of radioactivity that could be released during normal operations would be highly dependent on the type of waste handled, the processing operations performed at the repository, and the engineered features designed to prevent or mitigate releases of radioactivity. As stated in Subsection 6.2.2.1.3 of the Draft Environmental Assessment, the repository will be designed such that routine emissions are not expected to have concentrations of radionuclides above applicable standards. This expected small release from the repository, along with contributing releases from other nearby commercial nuclear installations, should represent a small fraction of the allowable exposure limits.

Assessments of expected routine operational releases of radionuclides will be performed to ensure compliance with the above safety requirements. These assessments will be consistent with the repository design and operating procedures. In these analyses, due consideration will be given to all potential source-term contributors, the exposure area considerations, and the various analysis methods. Examples of source-term contributors that will be considered are contaminated shipping casks, exposure from waste containers, crud from spent-fuel assemblies, leaky fuel in lag storage, ventilation filters, incinerated solid waste, process gases and liquids, airborne particulates, volatiles, actinides, iodine-129, and krypton-85. The exposure area considered will be consistent with regulatory definitions given in 40 CFR 191 (EPA, 1985) and 10 CFR 20 (NRC, 1985b).

The analysis methods used will consider such factors as releases from other nuclear installations, filtration decontamination factors, reliability of ventilation dampers and radiation detectors, and updated design features.

Some kind of an environmental surveillance program has been conducted for the Hanford Site since the project started up in the 1940's. An assessment of the radiation doses potentially received by the public in the surrounding environs from operations at the Hanford Site has been published since 1957. Doses are calculated for both the general public and a maximum exposed individual. For the latter, the doses are assumed

to be potentially received by a hypothetical individual whose location and characteristics are chosen so as to maximize the combined doses from all realistically available exposure pathways. The exposure pathways considered are given below.

- Inhalation, air submersion, and exposure to contaminated ground.
- Consumption of foodstuffs irrigated with Columbia River water.
- Consumption of drinking water and fish from the Columbia River.
- Recreation on the Columbia River including time spent boating, swimming, and fishing.

Fifty-year cumulative doses are calculated for the whole body, gastrointestinal tract, bone, lung, and thyroid.

The radiological analysis of the bounding routine release presented in Subsection 6.4.1.4.2 of the Draft Environmental Assessment is consistent with the Hanford Site annual environmental surveillance of the maximum exposed individual. Should the repository become operational, the impact of routine releases will be calculated in the same manner as in the above described Hanford Site program.

Issue: Worker safety

Twenty commenters questioned the preclosure assessment of worker safety presented in the Draft Environmental Assessment. Thirteen of these commenters were concerned about worker protection from radiation exposure. Eight comments were related to compliance with the Mine Health and Safety Act of 1977, risk of injury and death, and provision of preventive and mitigative measures associated with worker safety.

Response

The provisions of 10 CFR 60.131 (NRC, 1985a) require the repository design to meet important worker-protection limits in the area of both radiological and nonradiological safety. The methodology for preclosure safety analysis described in Subsection 6.4.1.3 of the Draft Environmental Assessment will be used to assess worker safety. Fault-tree analysis will be used to comprehensively investigate potential radiological and nonradiological accidents. System descriptions will give supporting details for systems and procedures, including the need for prevention and mitigation measures. Consequence analyses will determine the impact from normal operations and accidents (e.g., injury potential, available shielding, worker access time, external radiation exposure, dose from airborne particulates, and internally absorbed radionuclides).

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C.7 ENVIRONMENT, SOCIOECONOMICS, AND TRANSPORTATION

This section addresses comments on (1) the environmental, socioeconomic, and transportation-related effects of repository development and site characterization, (2) the technical guidelines for socioeconomics, transportation, and the environment, and (3) the use of these guidelines in evaluating the relevant system guideline. Most comments in this category are concerned with the characteristics of the repository before it is closed and decommissioned. There are many parallels between this category and Section C.4, which includes comments on the data base, proposed activities, and repository design. Where Section C.4 discusses baseline conditions, Section C.7, discusses how site characterization or repository development changes these conditions. Most comments about the effects of the repository on the environment or communities near the repository are included in this category.

C.7.1 EXPECTED EFFECTS OF SITE CHARACTERIZATION

Concerns about the expected effects resulting from site-characterization activities described in the Draft Environmental Assessment (DOE, 1984b) are summarized and responded to in this appendix section. Two categories of issues were established to discuss effects on the physical environment and on the socioeconomic conditions near the Hanford Site. Comments on the expected effects on the physical environment relate to the ground-water system beneath the Hanford Site. It was determined that the socioeconomic concerns could best be addressed with the other socioeconomic issues discussed in Section C.7.4 of this appendix.

C.7.1.1 Effects on the physical environment

This subsection addresses those comments received on Chapter 4 of the Draft Environmental Assessment regarding the environmental impact of hydrologic site-characterization activities. Concerns raised were grouped in two categories:

- C.7.1.1.1, Unconfined aquifer.
- C.7.1.1.2, Discharge water impact.

C.7.1.1.1 Unconfined aquifer

Several commenters were concerned about the environmental impact on the unconfined aquifer. Comments covered such topics as the chemical

composition of spoil piles, extent of existing tritium plume, need for a water balance during drilling operations, and the potential impact from water discharges.

This subsection is divided into two issues:

- Unconfined aquifer tritium plume.
- Water balance for drilling activities.

Issue: Unconfined aquifer tritium plume

The nature, extent, and cause of the tritium plume in the unconfined aquifer were subjects of four comments. Two of these reviewers expressed concern that the tritium plume may be an indicator of what could happen to the repository wastes in the future (see Subsection 4.2.1.3.6 of the Draft Environmental Assessment). Two other comments, referring to Subsections 3.4.2.7.5 and 4.2.1.3.6, requested information on the concentrations of iodine-129 and other radionuclides. An additional comment stated that ground water already is contaminated from waste-storage facilities.

Response

Eddy et al. (1983) contains a synopsis of radiological and nonradiological data within the unconfined aquifer as referenced in the Draft Environmental Assessment (see Section 3.3.2 of the Draft Environmental Assessment). The Environmental Assessment is a decision document for site nomination and recommendation relative to a repository. A summary of appropriate background information on the Hanford Site is included to aid in these decisions. Many details are provided by references, as is the case for tritium and other contaminants found in the unconfined aquifer resulting from 40 years of waste-water disposal on the Hanford Site.

Issue: Water balance for drilling activities

One comment was received regarding the lack of data within the Draft Environmental Assessment from which a water balance for drilling activities could be calculated. The commenter referenced Subsection 4.2.1.2.1 of the Draft Environmental Assessment and requested quantification of infiltration rates and statements based on these rates.

Response

It is agreed that the expected impact from drilling operations would be small and that a complete quantification of this impact has not been finalized. Preliminary data are available to determine a water balance for drilling activities and this likely will be performed for those activities. The commenter is referred to Subsection C.7.1.1.2 for more details.

C.7.1.1.2 Discharge-water impact

Comments on discharge-water impacts have been divided into the following issues:

- Environmental impact of Grande Ronde Basalt water discharge.
- Concern over leaching of chemicals from rock spoils piles.

Issue: Environmental impact of Grande Ronde Basalt water discharge

Several comments were received regarding the environmental impact of surface discharge of Grande Ronde Basalt ground water during hydraulic testing and (or) dewatering activities at the underground facilities. The need was stressed for assessing the potential impact for soil encrustation, and the mixing of discharged water with the unconfined ground water.

Response

While some uncertainty exists, it is estimated conservatively that less than 1×10^5 cubic meters (3×10^7 gallons) of ground water will be discharged to surface holding ponds during large-scale hydraulic testing in the vicinity of the reference repository location over the next 4 years.

This discharge is less than 2 percent of the amount of water discharged in the 200 West Area (most of which is within the boundary of the reference repository location) during 1983 (Law and Allen, 1984). Therefore, in terms of absolute quantities of ground water, future hydraulic testing should have little impact.

If dewatering activities associated with the exploratory shaft and repository are addressed, it is acknowledged that considerable uncertainty exists pertaining to the total volume of ground water involved. Studies will be carried out to define the rate of ground-water inflow to the Exploratory Shaft Facilities and repository and, hence, the total amount of surface disposal required.

Additional uncertainties are associated with the chemical effects of surface disposal of large quantities of Grande Ronde Basalt ground water. One commenter expressed concern that precipitation reactions will lead to salt encrustation in the soil. Two major types of reactions might occur:

- Reactions related to decreases in temperature and pressure of discharged water.

- Reactions related to evaporation of discharged water.

Geochemical modeling studies are planned to evaluate the importance of precipitation reactions. Data are available with which to assess the relative importance of evaporation and infiltration in any holding ponds.

Oberg (1966), Sisson and Fecht (1981), Sisson and Graham (1982a, 1982b), and Fuchs (1983, 1984a, 1984b) have assessed water infiltration rates at the Hanford Site. Apparently, a value of approximately 40 centimeters per day (10 gallons per square foot per day) is an appropriate estimate for this parameter. The Draft Environmental Assessment (see Subsection 3.3.1.1) reported that local lake evaporation rates are approximately 100 to 105 centimeters per year (39 to 41 inches per year). Therefore, as an annual average, infiltration is expected to exceed evaporation by approximately 140 to 1.

The final concern expressed in all questions involved the chemical impact of surface disposal of Grande Ronde Basalt ground water during hydrologic testing on ground waters of the unconfined aquifer. As noted above, the quantity of surface discharge is a very small fraction of total disposal of water in the 200 West Area; therefore, the effects of dilution with disposed water (previous and future) will be significant. Mixing of chemically different waters may lead to precipitation-dissolution reactions. The significance of these reactions is likely to be slight though studies have not been completed.

Subsection 4.2.1.2.1 of the final Environmental Assessment has been revised extensively to more fully address water discharge, evaporation, and infiltration, plus the chemical composition of these discharged waters.

Issue: Concern over leaching of chemicals from rock spoils piles

Comments were received expressing concerns regarding impacts of spoils piles on ground water and the environment. One reviewer requested additional information on chemical composition of rock chips and bentonite, revegetation techniques for stabilizing spoils piles, amounts of sediment expected from spoils piles, and methods used and basis for design of ditches, culverts, and sediment ponds. A second commenter stated that the weight of the spoils piles and the application of water for dust suppression will affect the ground-water profile. Two commenters requested information on the size of the excavated rock spoils pile so that aesthetic and environmental impacts could be assessed.

Response

The chemical composition of leachate from spoils piles would be determined by chemical analysis. Tables 3-1 and 3-2 in the Draft Environmental Assessment provided results of chemical analyses of the basalt flow in the candidate repository horizons and overlying basalt flows. Bentonite clay is a naturally occurring hydrous aluminum silicate, also containing oxides of magnesium, calcium, potassium, and sodium. At present, revegetation techniques for stabilizing spoils piles are not planned. If top soil is stripped, it would be stockpiled and stored for future replacement and planting. The quantity of sediment expected from the spoils piles has not been calculated, but is not expected to be significant. The Hanford Plant Standards (RKE/PB, 1983, Appendix B), supplemented by conventional civil engineering design practices, would be used for design of drainage features and storage ponds. Drainage

structures would be designed to accommodate runoff due to credible precipitation or snow melt, as provided for in the applicable standards.

The effect of spoils piles on the ground-water profile would be localized, with negligible long-term impact. No short-term adverse effects are likely.

The dimensions of the excavated rock storage pile, from the 1982 conceptual design (RKE/PB, 1983), is 439 meters (1,440 feet) square and 14 meters (46 feet) high. For the current design, the volume of excavated rock will be higher, so the dimensions of the rock storage pile will increase. As indicated in Section 5.2.1 of the Draft Environmental Assessment, no significant environmental or aesthetic impacts from the rock storage pile are expected.

C.7.1.2 Effects on socioeconomic conditions

Comments assigned to this subsection have been cross-referenced to and discussed in Section C.7.4.

C.7.2 ENVIRONMENTAL QUALITY

Many comments were received regarding the inadequacy and (or) insufficiency of the environmental baseline presented in the Draft Environmental Assessment. Most reviewers stated that this inadequacy resulted in the inability of the U.S. Department of Energy to perform a credible assessment of the impact of site characterization and potential repository activities. Most of the comments can be categorized into one or more areas, including a need to expand the ecosystem impact discussion, a need to expand the various radiological and nonradiological and weather data bases, and a need to expand the impact to land use, archaeological, cultural, and historical resources. Additionally, several commenters were concerned with the limited discussion on environmental compliance activities.

Comments concerning the potential radiological impacts from site-characterization activities and repository construction and operation are addressed in Section C.6.4.2., Offsite installations and operations, and Subsection C.6.4.3, Offsite installations radiological impact.

C.7.2.1 Land use

Other activities at the Hanford Site were the subject of many comments. These dealt primarily with defense activities. Several requested an expanded discussion of other activities at the Hanford Site, others were concerned over the past record of activities at the Hanford Site, and a few were concerned about container leaks and the impact of

defense activities on the long-term repository performance monitoring. A few commenters questioned the existing and future oversight role of the State of Washington. These concerns have been addressed in Section C.6.4, Offsite installations.

Several commenters were concerned with an apparent conflict in land use between site characterization and repository activities and the State of Washington lease area (U.S. Ecology, Inc.) and those areas associated with the Big Bend Alberta Company. These concerns have been addressed in Section C.6.2, Site ownership and control.

C.7.2.2 Ecosystems

Many reviewers expressed the concern that the Draft Environmental Assessment did not adequately describe the impacts to the local and regional ecosystems from site characterization and repository construction activities.

Comments regarding the inadequacy and (or) insufficiency of the environmental baseline addressed in the Draft Environmental Assessment are addressed in Subsection C.4.1.3, Environmental conditions.

C.7.2.2.1 Terrestrial ecosystems

The following issues are addressed in this subsection:

- Threatened, endangered, and State-protected species.
- Impact of helicopters, utilities, and rock piles.
- Rock pile and fence impacts.
- Surface-water discharge.
- Contamination of the unconfined aquifer.
- Revegetation and site reclamation.
- Radon releases.

Issue: Threatened, endangered, and State-protected species

The assessment of the impact to threatened, endangered, and State-protected species was considered inadequate in the Draft Environmental Assessment by several reviewers.

Response

The Draft Environmental Assessment was incorrect in claiming " . . . the absence of any federally recognized threatened or endangered species at the repository location . . . " as was done on pages 2-71 and 6-35, since the available data show the bald eagle and the peregrine falcon have been observed there. The correct assessment would indicate

that the bald eagle and the peregrine falcon use the reference repository location for occasional foraging, but that it is not considered an area of critical habitat (e.g., nesting).

Subsection 3.4.2.5 of the final Environmental Assessment has been enhanced to provide further discussion and additional references related to the baseline information available on threatened and endangered species associated with the reference repository location. It also includes a discussion of species listed for potential inclusion on the Federal threatened and endangered list and those identified as State protected.

The evaluation of impact to threatened or endangered species, as summarized in Table 4-1 of the Draft Environmental Assessment, is sufficient for the purposes of this assessment. Impacts are expected to be minimal from both site-characterization activities and potential repository construction and operation activities through the use of detailed monitoring and mitigation efforts.

Should the reference repository location be recommended for characterization, the U.S. Department of Energy will undertake, a program to further identify areas on and off the Hanford Site that could be impacted from Basalt Waste Isolation Project site-characterization activities. A monitoring and mitigation program will then be implemented to further characterize and assess those potentially impacted species. This baseline program will involve the study of ecosystems (including threatened or endangered species), air quality, noise, archaeology and cultural resources, and background radiation.

Statements in the final Environmental Assessment have been changed to reflect that "no Federally recognized threatened or endangered species are known to nest or reside at the repository location."

Issue: Impact of helicoptors, utilities, and rock piles

Several reviewers felt that the Draft Environmental Assessment did not provide sufficient information concerning the potential impacts of helicopters, transmission lines, rock piles, and several other features in Table 5-11.

Response

Since helicopter flights will be restricted to predetermined routes, there is no need to assess the impacts of not following predetermined routes. Regarding the potential electrocution of birds from transmission lines closer than 1.8 meters (6 feet) to one another, mitigation of this potential impact will result in transmission lines erected further than 1.8 meters (6 feet) from one another.

A summation of impact due to "Construction and fencing of rock storage piles, parking lot, helicopter pad, and central process areas" have been added to Table 5-11 in the final Environmental Assessment.

Issue: Rock pile and fence impacts

One reviewer felt that the Draft Environmental Assessment provided insufficient information on the impacts of the waste rock pile and fences on animal movement.

Response

The size of the surface facilities and the installation of the security fences was considered during the evaluation of the environmental impacts associated with construction of the facilities. It is not expected that the spoils pile or the installation of the fencing would have an impact on the terrestrial ecosystem, other than the removal of this land from productivity. The loss of this amount of land, in relation to the remainder of the Hanford Site, was judged to be insignificant. However, should the reference repository location be chosen for characterization, a monitoring and mitigation plan will be designed and implemented to identify and mitigate any adverse effects from potential construction and operation of a repository.

Issue: Surface-water discharge

Several commenters stated that the Draft Environmental Assessment failed to properly address the impacts of surface discharge of large volumes of water and the potential for discharging contaminated water.

Response

Water discharged during hydraulic testing would not be released to any natural surface waters on the Hanford Site. The water from hydraulic testing will be discharged to an engineered pit designed to avoid ponding. This activity could result in localized increases in soil salinity and minimal greening of the effected flora. The amount of the increase will depend on the size of the area to which the water is applied and percolation and evaporation rates. These areas will be adequately protected (e.g., fencing) to mitigate any impact to animals.

Section 4.2 of the final Environmental Assessment reflects that pumping activities could result in localized increases in soil salinity and minimal greening of the effected flora.

Issue: Contamination of the unconfined aquifers

One reviewer stated that the Draft Environmental Assessment failed to properly address the impacts of surface discharge of large volumes of water and the potential for contamination of the unconfined aquifer.

Response

Except for the localized increases in soil salinity and minimal greening of the effected flora, no aquifers will be adversely impacted by

pumping operations. Subsection 4.2.1.2 has been enhanced to provide more information on the disposal of test waters and their effect on the physical environment. More information on the assessment of potential impacts from pumping activities is located in Subsection C.7.1.1.2, Discharged water impact.

Issue: Revegetation and site reclamation

Several commenters felt that the Draft Environmental Assessment provided insufficient information regarding revegetation, site reclamation, mitigation, effects of range fires, and the impacts of the spoils piles.

Response

The Draft Environmental Assessment states that surface-disturbed lands will be revegetated and that top soil will be stripped and saved for revegetation. The exact size and location of the spoils piles is not now known; hence, detailed determination of the expected impacts and mitigation efforts cannot be made at this time. It is not expected that range fires would pose a threat to repository surface facilities, since the area around such facilities would have been cleared of vegetation previously.

The final Environmental Assessment has been modified to reflect that available techniques will be used to reclaim surface-disturbed lands with native seeds.

Issue: Radon releases

One reviewer felt that the Draft Environmental Assessment provided insufficient information regarding radon release during mining.

Response

Radon release during basalt mining operations would not be any greater than with most other conventional mineral mining operations. Basalt contains much less radium (about one-tenth) than silicic igneous rocks associated with most metallic mineral mining operations. It is not felt that specific monitoring for radon release is needed.

C.7.2.2.2 Aquatic ecosystems

The following issues are discussed in this subsection:

- Columbia River impact.
- Aquatic impacts.
- Thermal pollution.

Issue: Columbia River impact

Comments received pertaining to aquatic impacts centered on potential impacts to the Columbia River including thermal, water withdrawal, entrainment, impingement, drainage of surface water from the reference repository location, ranges of radiological and nonradiological water quality parameters, and impacts to salmonid spawning.

Response

The Columbia River and its biotic resources are briefly described in Subsection 3.4.2.6 of the Draft Environmental Assessment, and references to more detailed data are provided. Because of the location of the river and the very minor effect of any expected effects, this information is considered adequate except for more water-quality detail. There are no expected impacts to the Columbia River from site characterization or construction of a repository at the reference repository location because the reference repository location is located some 12 kilometers (7.4 miles) from the Columbia River. The only postulated effect on the river will be the withdrawal of a small amount of the total river flow from an existing river pump station. More information on the potential impacts to the Columbia River and its resources may be found in Section C.5.11, Assessment of postclosure performance.

While all repository-construction activities are not known at this time, the 1982 conceptual design (RKE/PB, 1983) includes plans to install two new pumps at an existing river pump station. These activities are not expected to have any adverse impacts on the aquatic habitat. Impingement and entrainment of aquatic biota have been well studied at the Hanford Site. Due to the size of the most important organisms, pump entrainment can be avoided. If impingement becomes a problem as a result of the addition of the two pumps, fish-return systems can be used to return the fish to the river with little or no mortality.

Ranges for Columbia River radiological and nonradiological water-quality parameters have been added to Subsection 3.4.2.6.3 of the final Environmental Assessment.

Issue: Aquatic impacts

Many reviewers felt that the Draft Environmental Assessment provided insufficient impact information pertaining to aquatic impacts to the Columbia River resulting from drainage of surface water from the reference repository location.

Response

There are no naturally occurring surface waters at the reference repository location. Cold Creek is an ephermal and interrupted stream. Except for spring time floods in some years, the Cold Creek drainage does not contain surface water at the reference repository location. There is expected to be no surface runoff from the reference repository location to the Columbia or Yakima Rivers.

Issue: Thermal pollution

Several reviewers felt that the Draft Environmental Assessment provided insufficient impact information pertaining to aquatic impacts to the Columbia River resulting from thermal pollution from a repository.

Response

Ground-water travel from the reference repository location is sufficiently slow so that if warmed by the repository, it is expected to have cooled to ambient temperature before intersecting any surface waters. Therefore, no thermal effects to aquatic biota are expected. More information on the potential impacts to the Columbia River and its resources may be found in Section C.5.11, Assessment of postclosure performance.

C.7.2.3 Air quality

Many commenters voiced a general concern over an insufficiency of information regarding air-quality impacts associated with site-characterization activities and repository construction and operation. These included questions related to methods for calculating pollutant concentrations and the application of standards. Others were concerned that the position taken in the Draft Environmental Assessment regarding the comparative evaluation against the guideline on the first potentially adverse condition under meteorology (DOE, 1984a; 960.5-2-3(c)(1)) was unsubstantiated.

Issue: Air-quality impacts

Many reviewers felt that the Draft Environmental Assessment provided insufficient information regarding air-quality impacts associated with repository construction and operation.

Response

Detailed modeling using actual meteorological data has been completed for repository construction and operation activities. This information is presented in Subsection 5.2.1.3.2 of the final Environmental Assessment. This evaluation indicates the ability of repository construction and operation activities to meet applicable ambient air-quality standards.

Subsection 5.2.1.3.2 of the final Environmental Assessment has been enhanced to indicate the results of the above-noted air-quality impact modeling for repository construction and operation activities.

Issue: Meteorology in the vicinity of reference repository location

The position taken in the Draft Environmental Assessment regarding the comparative evaluation against the guideline for the first potentially

adverse condition under meteorology (DOE, 1984a; 960.5-2-3 (c)(1)), was felt by several reviewers to be unsubstantiated.

Response

In the Draft Environmental Assessment, it was stated that the first potentially adverse condition under meteorology is not "substantively present" at the Hanford Site. This condition is concerned with "Prevailing meteorological conditions such that radioactive emissions from repository operation or closure could be preferentially transported toward localities in the vicinity of the repository with higher population densities than are the average for the region."

The concern is valid. The key to the concern is the interpretation of the word "vicinity" and the phrase "Prevailing meteorological conditions" in the guideline.

Winds at the reference repository location do blow preferentially toward the southeast (in the direction of Richland, Pasco, and Kennewick about 16 percent of the time). The rationale behind the Draft Environmental Assessment conclusion was that, while winds at the reference repository location preferentially blow toward the southeast, the population centers in this sector are over 35 kilometers (22 miles) away from the reference repository location and therefore well beyond the "vicinity" of the reference repository location. Over the course of 35 kilometers (22 miles), even under the very worst dispersion conditions, material would be well diffused by the time it reached a densely populated area. In addition, under very poor dispersion conditions, light winds would transport the material very slowly, giving a substantial amount of time for evacuation or other emergency action to be taken in the event of some catastrophic event.

Despite the above assessment, the comparative evaluation against the guideline on the first potentially adverse condition under meteorology appears in the final Environmental Assessment as "present." This change is based on a reinterpretation of the phrase "Prevailing meteorological conditions" as "the most common annual average wind direction in any 22-1/2° sector." The word "vicinity" has been interpreted as "any population center out to 80 kilometers (50 miles).

Issue: Air-quality standards

Some reviewers questioned why the Draft Environmental Assessment did not reference the State of Washington, county, and National Ambient Air Quality Standards for the pollutant concentrations presented in Table 3-11.

Response

For the pollutant concentrations presented in Table 3-23, the State of Washington, county, and National Ambient Air Quality Standards are identical. This has been noted in the caption of the table in the final Environmental Assessment.

Issue: Annual average pollutant concentrations

Several reviewers questioned why the justification for using one-hour to annual-average conversion factor for pollutants was not presented in the Draft Environmental Assessment.

Response

In paragraph 2 on page 4-32 of the Draft Environmental Assessment, it was stated that " . . . annual average pollutant concentrations have been estimated using a sector-average, point source Caussian plume model, with the Hanford Site average wind speed of 3.4 meters per second (7.7 miles per hour) and neutral atmospheric conditions." Calculations were not performed using actual meteorology measured in the vicinity of the exploratory shaft site. The approach followed in the Draft Environmental Assessment of using one hour of average conditions and applying it throughout the year provides a conservative approximation of annual values. Additional clarification has been added to Subsection 4.2.1.3 of the final Environmental Assessment.

Issue: Worst case air-quality values

Reviewers felt that pollutant concentrations listed in Table 4-5 of the Draft Environmental Assessment should have been added to background levels, then applied against applicable standards.

Response

Values obtained in this section were not added to background concentrations because of the bounding nature of the calculations. These worst-case air-quality values presented in Table 4-5 provide sufficient estimates to assess that the Basalt Waste Isolation Project site-characterization activities will not significantly impact offsite air quality. Subsection 4.2.1.3.2 of the final Environmental Assessment has been modified to clarify the assessment methodology.

Issue: One-hour pollutant concentrations

Several reviewers felt the calculation of one-hour pollutant concentrations for a point located 1,000 meters (3,281 feet) from a pollutant source is questionable.

Response

The 1,000-meter (3,281-foot) distance was used to provide a very conservative estimate of potential impacts from emissions to the public. In actuality, the projected location of the exploratory shaft is over 1.5 kilometers (0.93 mile) from the nearest point of public access (project fence line) to the Hanford Site. The use of the 1,000-meter (3,281-foot) distance was clarified in Section 5.2 of the final Environmental Assessment.

C.7.2.4 Aesthetic conditions

Several reviewers commented that the Draft Environmental Assessment should mention the potential repository as an aesthetic resource. Others felt that the Draft Environmental Assessment did not sufficiently address the impact of a potential repository waste pile on the aesthetic value of the repository location.

Issue: Regional aesthetic resources

Several commenters stated that the Draft Environmental Assessment should mention the potential repository as an aesthetic resource.

Response

The discussion of aesthetic resources within 80 kilometers (50 miles) of the Hanford Site does not mention the repository site because it does not stand out as aesthetically as adjacent areas.

The final Environmental Assessment has been changed to indicate that the referenced aesthetic sites are "natural sites."

Issue: Repository impact on aesthetics

Several reviewers felt that the repository spoils pile will significantly alter the aesthetic value of the reference repository location.

Response

The impact of a potential repository spoils pile on the aesthetic value of the reference repository location is considered to be minimal. This assessment is qualitative and is based on a judgment that, although somewhat visible from Route 240, the appearance of both the surface facilities and spoils pile would be comparable to other visible facilities on the Hanford Site.

The final Environmental Assessment has been enhanced to indicate that the rock pile will also be visible from Route 240, but its appearance will not significantly alter the aesthetic value of the repository location.

C.7.2.5 Noise impacts

Issue

Several commenters suggested that the Draft Environmental Assessment provide more information on the impact of noise, including that resulting from construction and operation of road and railroad access on the general public and the noise impacts of transportation on wildlife.

Response

The remote location of the reference repository location generally accounts for the postulated lack of noise impacts on the general public, including the construction and operation of road and railroad access.

Though impacts of noise on wildlife cannot be measured quantitatively, nor does the Noise Control Act of 1972 establish limits on environmental noise for acceptable impact, the Draft Environmental Assessment (pp. 4-36 and 5-44) states that effective muffler systems would be used on heavy equipment during site-characterization and construction activities to minimize adverse environmental impacts. Should the reference repository location be recommended for characterization, a monitoring program will be developed to determine the effects of site-characterization activities on the environment. Should noise be identified as a problem to animals near areas of human activity, then the mitigation plan would address this, and an attempt would be made to mitigate the impact.

The final Environmental Assessment has been changed to reflect that local communities will not be affected by noise resulting from site-characterization activities if the reference repository location is recommended for characterization.

C.7.2.6 Archaeological, cultural, and historical resources

Comments were received regarding the current status of archaeological, cultural, and historical resources both on and near the reference repository location. These comments included concerns regarding the insufficient information regarding archaeological surveys and impacts that have occurred at the Hanford Site and a failure to mention any postulated impacts to the cultural and historical resources of the affected Indian tribes due to site-characterization activities and potential repository construction and operation.

Issue: Archaeological surveys

Several reviewers felt that the Draft Environmental Assessment presented insufficient information regarding archaeological surveys that have been performed at the Hanford Site.

Response

Section 3.4.6 of the Draft Environmental Assessment summarized the archaeological, cultural, and historical resources both on and near the reference repository location with references to more detailed information provided.

Issue: Gable Mountain

Several commenters stated that the Draft Environmental Assessment failed to mention the previous impact to the Gable Mountain archaeological locality from the construction of the Near-Surface Test Facility and boreholes DC-11 and DC-21. Also, the impact to archaeological site 45-BN-165 from borehole DC-15 was not mentioned.

Response

Parts of Gable Mountain have been previously examined by a reconnaissance-level study that identified Gable Mountain and Gable Butte as an archaeological locality having religious significance to local Indian groups (Rice, 1984).

Regarding the impact to the Gable Mountain archaeological locality, isolated pieces of cryptocrystalline lithic debitage were observed near borehole DC-11, but in no concentration to define the locality. Scattered rock cairns relating to the Indian spirit quest vigil were previously reported in the locality (Rice, 1968) and may have been impacted by the construction of the Near-Surface Test Facility in 1978.

The Gable Mountain locality was nominated to the National Register of Historic Places by the Atomic Energy Commission in 1976. The application was returned by the National Register and subsequently withdrawn by the Atomic Energy Commission since none of the sites met the criteria of eligibility for listing. In spite of this, the rock cairns in the Gable Butte-Gable Mountain locality are now being protected by the U.S. Department of Energy and are not expected to be impacted by site characterization.

Archaeological sites were identified at borehole locations DC-15 and DC-21. The archaeological site at DC-15 was previously reported (Rice, 1968) as 45-BN-165 and was described as a small fishing station along the west bank of the Columbia River. The impact to the archaeological site was a bulldozer cut across the site surface. A crytocrystalline flake and eight fire-cracked rocks were observed. The extent of disturbance to the site was limited and no new material that would contribute to a knowledge of regional prehistory was found from shovel tests (Rice, 1984).

An archaeological site at borehole DC-21 was previously recorded (Rice, 1968) as 45-BN-149 and was described as a housepit site along the Columbia River bank. The site is listed on the National Register as part of the Rye-grass Archaeological District (not the Gable Mountain archaeological locality). The site was not disturbed by borehole drilling activity, but was narrowly missed by a bulldozer staging area for equipment (Rice, 1984). An enhanced program of preactivity monitoring has been established to assure that impacts to archaeological sites, if any, will be minimized.

Subsections 4.2.1.3.5 and 5.2.1.3.5 of the Draft Environmental Assessment indicate that neither site-characterization activities or potential repository construction and operation in the reference repository location will impact significant archaeological sites. Impacts to archaeological, cultural, and historical resources off the reference repository location from site-characterization activities will be mitigated through appropriate preactivity monitoring.

Issue: Cultural and historical resources of the affected Indian Tribes

Several commenters stated that the Draft Environmental Assessment failed to mention the cultural and historical resources of the affected Indian Tribes or any postulated impacts to those resources due to site-characterization activities and potential repository construction and operation.

Response

Section 3.6.6 of the Draft Environmental Assessment summarizes the relationship between the affected Indian Tribes and the Basalt Waste Isolation Project. The Yakima, Umatilla, and Nez Perce Indian reservations are located 50, 120, and 200 kilometers (31, 74.5, and 124 miles) from the reference repository location, respectively. This remoteness, combined with the limited scope of studies conducted to date, are responsible for the lack of any significant identified impacts to date on the respective reservations from site-characterization activities and potential repository construction and operation.

The U.S. Department of Energy, as part of repository-siting environmental impact statement scoping process, will undertake with the affected Indian Tribes and the State of Washington, a program to identify those areas both on and off the Hanford Site that could be impacted from future site-characterization activities and potential repository operation activities. This program will include the study of ecosystems, air quality, water quality, noise, aesthetic conditions, archaeology and cultural resources, and background radiation.

Issue: Indian hunting rights

One reviewer stated that the Draft Environmental Assessment failed to assess potential impact to hunting rights of the affected Indian Tribes due to site-characterization activities and potential repository construction and operation.

Response

Article III of the Treaty with the Yakima, 1855 between the U.S. Government and the Yakima Indian Nation provides:

"The exclusive right of taking fish in all the streams, where running through or bordering said reservation, is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at

all usual and accustomed places, in common with citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting; gathering roots and berries, and pasturing their horses and cattle upon open unclaimed land."

The privilege secured by the treaty for hunting and gathering rights is limited to "open unclaimed land." The privilege does not exist when land is no longer open and unclaimed. The Hanford Site is neither "open" nor "unclaimed." The Hanford Site was established in 1943 to carry out an essential defense function of the Federal Government. The activities at the Hanford Site have been greatly expanded by other research, development, waste management, production, and other statutory functions of the U.S. Department of Energy and its predecessor agencies. Access to the Hanford Site has been limited since 1943. Since the Hanford Site, including locations for site-characterization activities or a potential repository, is not "open" or "unclaimed" as defined by the 1855 treaty, this proposed action does not affect any hunting or gathering privilege of any affected Indian Tribe.

Issue: Indian fishing rights

One reviewer stated that the Draft Environmental Assessment failed to assess potential impact to fishing rights of the affected Indian Tribes due to site-characterization activities and potential repository construction and operation.

Response

The proposed locations of a potential repository are 7 kilometers (4.3 miles) from the closest segment of the Columbia River. Site-characterization activities and potential repository construction and operation are not expected to result in any significant impact to the Columbia River and would not be expected to affect fishing rights of any affected Indian Tribe.

To date, there is no reason to believe that any treaty right of an affected Indian Tribe would be detrimentally affected by the location of a repository.

C.7.2.7 Background radiation

Several commenters requested an expanded discussion on background radiation as a result of other Hanford Site activities. These concerns and the concerns that deal primarily with the radiological impacts of defense activities have been addressed in Subsections C.6.4.3, Offsite installations radiological impacts, and C.6.4.2, Offsite installations radiological conditions description.

C.7.2.8 Environmental compliance

Environmental compliance laws were the subject of several comments. These included the need for further consideration of the Wild and Scenic Rivers Act and suggested additions to Table 6-2 of the Draft Environmental Assessment. Other comments suggested the need for the U.S. Department of Energy to seek consultation with other government agencies at all levels of government.

Issue: Oversite role of the State of Washington

One reviewer stated that the Draft Environmental Assessment presented little information regarding the existing and future oversight role of the State of Washington towards the Basalt Waste Isolation Project activities.

Response

The U.S. Department of Energy, as part of the repository-siting environmental impact statement scoping process, will undertake with the affected Indian Tribes and the State of Washington, a program to identify those areas both on and off the Hanford Site that could be impacted from site-characterization activities or potential repository operation activities.

An environmental monitoring and mitigation program will be developed to address impacts due to site-characterization activities. A larger-scale environmental baseline program will also be implemented to further characterize those areas potentially impacted from potential repository operation activities. Both programs will include the study of ecosystems, air quality, water quality, noise, aesthetic conditions, archeology and cultural resources, and background radiation.

Issue: Wild and Scenic Rivers

Several commenters felt that the Draft Environmental Assessment did not indicate that the Yakima and Columbia Rivers may be designated as Wild and Scenic Rivers.

Response

The Yakima and Columbia Rivers have not been designated as "Federal Wild and Scenic Rivers" (Wild and Scenic Rivers Act of 1968). As indicated in Table 6.2 of the Draft Environmental Assessment, site-characterization activities and potential repository construction and operation are not expected to affect the Yakima or Columbia Rivers in any way.

Table 6-2 has been enhanced to indicate that the Yakima and Columbia Rivers have not been designated as "Federal Wild and Scenic Rivers."

Issue: Permit for mixed wastes

One reviewer stated that the Draft Environmental Assessment failed to identify the need to permit mixed wastes.

Response

The applicability for permitting "mixed waste" has not been identified at this time and for that reason not addressed in the Draft Environmental Assessment.

Issue: U.S. Army Corps of Engineer permit

One reviewer stated that the Draft Environmental Assessment failed to address the need to obtain a permit from the U.S. Army Corps of Engineers for dredging activities in the Columbia River.

Response

Dredging of the Columbia River has not been identified as a required activity for site-characterization activities or potential repository construction and operations and, therefore, was not addressed in the Draft Environmental Assessment.

Issue: Table 6-2 of the Draft Environmental Assessment

One commenter felt that Table 6-2 of the Draft Environmental Assessment is not consistent with Table 6-2 of the other sites.

Response

This comment is valid. Table 6-2 of the final Environmental Assessment will be reformatted to provide consistency between sites.

Issue: Consultation with government agencies

Several reviewers stated that the Draft Environmental Assessment failed to address which government agencies the U.S. Department of Energy will seek consultation with regarding environmental concerns and issues.

Response

The U.S. Department of Energy will seek the consultation and cooperation of those government agencies involved with environmental matters deemed applicable to the Basalt Waste Islation Project. These contacts will include, but not be limited to, the State Historic Preservation Officer, Advisory Council on Historic Preservation, U.S. Fish and Wildlife Service, and the Washington Natural Heritage Program.

Issue: Water rights

One commenter asked if the U.S. Department of Energy must apply for a water rights permit under Title 90 of the Revised Code of Washington for site-characterization activities.

Response

The U.S. Department of Energy believes that it has a reserved water right for site-characterization activities, but has determined as a matter of cooperation and comity to submit to the State an application for a permit to use water for site-characterization activities.

C.7.3 EXPECTED EFFECTS OF TRANSPORTATION

The U.S. Department of Energy has divided the numerous transportation comments received into two categories: general and site-specific. The responses to general comments, which are those comments having national significance and that are applicable to all sites, are presented in Subsection C.2.4.1 of this appendix. Since the sorting of general versus site-specific comments is subject to individual viewpoints, the reader is encouraged to review Subsection C.2.4.1 before reviewing the site-specific responses in this section. The U.S. Department of Energy believes that, collectively, the general and site-specific response sections adequately respond to the numerous transportation-related comments received.

Discussion of all site-specific comments having transportation as the primary focus is included in this section of this appendix. These comments could have originated in any of several chapters of the Draft Environmental Assessment that address transportation: (1) Chapter 3, which described transportation baseline conditions (i.e., the characteristics of the existing transportation network), (2) Chapter 4, which addressed the transportation impacts of site characterization, (3) Chapter 5, which described the probable repository-related transportation impacts if the Hanford Site is selected as a repository location, and (4) Chapter 6, which presented an assessment of the site against the transportation guideline of the General Siting Guidelines (DOE, 1984a). Comments on Appendix A of the Draft Environmental Assessment are covered in Subsection C.2.4.1 rather than in this section because they are general rather than site-specific. The reader whose primary interest is in transportation need only refer to two portions of this appendix, Subsection C.2.4.1 and this section. Transportation may be mentioned in other portions of this appendix, but only to provide complete responses to comments that address other topics of primary concern and mention transportation in a subsidiary fashion.

All of the site-specific comments addressed in this section have been categorized into eight issues:

- Weather disruptions of transportation operations.
- Definition of "regional" and "local."
- Barge shipment.
- Emergency response.
- Route-specific data and analyses.
- Accident consequences and other safety issues.
- Transportation impact of site characterization.
- Transportation of Hanford Site defense waste.

The comment responses in this section are heavily cross-referenced to Subsection C.2.4.1, since many of the site-specific transportation issues are closely related to corresponding general transportation issues. Similarly, the revised Appendix A is frequently referenced in this section, in Subsection C.2.4.1, and in the transportation portions of the final Environmental Assessment text, since Appendix A contains detailed information that responds to general transportation issues.

The reader should recognize that numerous changes to the Draft Environmental Assessment text have been made for consistency with responses to general issues in Subsection C.2.4.1 and with new information presented in Appendix A. Several of these changes are not specifically identified in this section. The most significant examples of such changes are (1) inclusion of an alternative transportation scenario that includes a monitored retrievable storage facility, (2) incorporation of all defense high-level waste source locations in national waste shipment bases, (3) assumption of newer shipping casks that are better suited for shipments to a repository than existing shipping casks, and (4) improvements to the RADTRAN computer code used for transportation cost-risk calculations.

Issue: Weather disruptions of transportation operations

Several commenters disagreed with the finding on the favorable condition related to transportation disruptions due to severe weather conditions (DOE, 1984a; 960.5-2-7(b)(1)). The lack of route-specific data on highway hazards and closures due to weather conditions was criticized. It was suggested that the finding on this favorable condition should be based on an area far beyond the current definition of "regional" (i.e., including the Rocky Mountains and Great Plains states). Specific locations that were claimed to be particularly prone to weather-related traffic disruptions were the portions of Interstate 84 in the Columbia River Gorge and between Pendleton and LaGrande, Oregon; these locations are subject to icing and packed snow conditions during the winter season, and the highway in the latter area includes steep grades and sharp curves. The mountain passes on interstate highways within Idaho and Montana also were mentioned as being subject to closure due to winter snowfall.

Response

Since the favorable condition is specific to regional meteorological conditions, only regional data are discussed. However, for purposes of this issue only, the region considered has been expanded to include points at which a routing change could be made if warranted by weather conditions along the intended route. It is believed that sufficient knowledge of actual and forecasted weather conditions are available to traffic management personnel before and during transport to minimize enroute transportation delays of repository-destined shipments due to weather conditions.

The additional discussion of potential transportation disruptions due to regional weather conditions has been included in Section 3.5.2.2 of the

final Environmental Assessment and referenced in the position on the favorable condition in Subsection 6.2.1.8.11. The general application of the favorable condition has been reevaluated and is described in Subsection C.2.4.1 of this appendix. The favorable condition continues to be considered present for the Hanford Site.

Issue: Definition of "regional" and "local"

Several commenters expressed opinions that the terms "regional" and "local" as used in the General Siting Guidelines for transportation (DOE, 1984a; 960.5-2-7) and in the Draft Environmental Assessment transportation analyses were defined too vaguely, were not interpreted consistently among the sites, and were used to describe distances from the site that are far too short to truly reflect site-specific transportation impacts. Many commenters suggested that expanded definitions of these terms could result in reversed findings on many of the favorable conditions and potentially adverse conditions for transportation.

Response

The U.S. Department of Energy-Headquarters and repository project personnel will continue to use a definition of "regional" that is consistent with the intent of the General Siting Guidelines for transportation analyses. A minimum definition of "regional" has been provided in Subsection C.2.4.1 of this appendix. Repository projects have freedom to choose a site-specific definition of "regional" that is appropriate for site-specific conditions and is in compliance with the minimum definition. However, as indicated in the Subsection C.2.4.1 treatment of this topic, the intent of the siting guidelines is to focus on effects near the repository sites being considered. The site-specific definition of "regional" used in the transportation analyses in the Draft Environmental Assessment remains unchanged, and has been clarified in Section 5.2.2 of the final Environmental Assessment. This site-specific definition of "regional" exceeds the minimum definition provided in Subsection C.2.4.1, in that the closest large population centers (Spokane, Washington, and Boise, Idaho) along the east-west interstate highways and mainline railroads are included in the regional transportation analyses.

Issue: Barge shipment

A large number of commenters pointed out that only brief mention was made of the barge option, and that a more detailed discussion was warranted. Several reviewers addressed the frequency of barge shipments and the need for raising bridges along the Columbia River to permit barge passage. Other commenters were concerned that if barge transport were used, there would be a significant potential for accidents that would contaminate the Columbia River. A few commenters were concerned that barge transport into Puget Sound via the Strait of Juan de Fuca was being considered.

Response

Subsection C.2.4.1 of this appendix addresses general comments on barge transport. Appendix A has been expanded to include a discussion of the current U.S. Department of Energy-Headquarters philosophy on barge transportation. This philosophy includes an option for barging from eastern reactors to the Gulf Coast (or up the Mississippi River), but does not include barging to the West Coast via the Panama Canal. The results of a recent study of barge transport also are summarized in Appendix A. The U.S. Department of Energy-Headquarters is currently leaving an open option for barging from some western reactors up the West Coast to a repository at the Hanford Site, although logistics considerations may invalidate this option. For barge shipments from the West Coast to the Hanford Site, the Columbia River provides a more viable route than the Strait of Juan de Fuca into Puget Sound, since this latter route would require an intermodal transfer to rail in the Puget Sound region followed by land transport over the Cascade Range to the Hanford Site.

A discussion of barge transport has been added in Subsection 5.2.2.4 of the final Environmental Assessment to cover the possible scenario of barge shipment from some western reactors to a repository at the Hanford Site. This new discussion includes information on the capabilities of specific reactor locations to ship by barge and the likelihood that barge shipment would be a viable option in view of current barge shipment capability and the relatively small quantity of spent fuel that would be available for shipment by barge. It is concluded that the likelihood of barge transport of spent fuel up the West Coast to the Hanford Site is too low to warrant a more detailed analysis at this time.

Issue: Emergency response

A few commenters were concerned about the need for local communities and Indian Tribal personnel to provide an expanded emergency response capability specifically to deal with potential nuclear waste transportation accidents. Concerns also included the question of who would pay the costs associated with an expanded emergency response capability. A few commenters expressed the opinion that the favorable condition on emergency response should not be considered present for the Hanford Site or for any site, since the characteristics and frequency of nuclear waste shipments to a repository are significantly different from those of prior low-level waste shipments, for which emergency response plans exist.

Response

A general response to this issue has been provided in Subsection C.2.4.1 of this appendix. More detailed information has been added to Appendix A to address concerns about emergency response. Although the finding on the favorable condition for emergency response remains unchanged, it is noted in Subsection 6.2.1.8.10 of the final Environmental Assessment that further evaluation of emergency response preparedness may be warranted at the time of repository site selection.

Issue: Route-specific data and analyses

A large number of comments were received on the lack of route-specific data and analyses. Examples of the route-specific data that was requested include accident frequencies, weather-closure frequencies, current physical condition of roads, traffic densities, and noteworthy hazardous conditions (e.g., bridges, tunnels, sharp grades or curves). Many commenters were critical of the fact that transportation risk analyses were based on national average accident frequency data rather than route-specific data. At least one commenter felt that the population density data used for the regional transportation analyses was not sufficiently accurate to allow route comparisons.

Response

A general response to this issue has been provided in Subsection C.2.4.1 of this appendix. The general response states the U.S. Department of Energy position that route-specific transportation risk analyses are not needed at the time of site nomination for site characterization, but that such route-specific analyses will be performed in support of future repository site selection. The general response also indicates that route-specific analyses for transportation corridor states, through which a majority of shipments would pass, will also be performed to support future repository site selection.

In keeping with the general response, revised transportation risk calculations do not incorporate route-specific data. However, additional regional and local route-specific data (e.g., traffic volumes and accident rates) have been compiled and summarized in Subsection 3.5.2.1 of the final Environmental Assessment for information purposes; comparisons to national averages have been indicated within data-base comparability limitations.

Since some commenters expressed the belief that the data presented in Section 5.2.2 of the Draft Environmental Assessment was intended to be a risk comparison between the northern and southern routes to the Hanford Site from the east, the text in Subsection 5.2.2.3 has been modified to clarify that route comparison was not intended and should not be performed until more complete and accurate route-specific data are obtained.

Issue: Accident consequences and other safety issues

Many commenters expressed broadly stated concerns about the potential consequences of transportation accidents and about transportation safety in general. In the case of accidents, the comments were centered around possible radiological impacts on water supplies, agricultural crops, mountain lakes and rivers, and people.

Response

A general response to this issue has been provided in Subsection C.2.4.1 of this appendix, and Appendix A has been expanded to describe consequences of potentially severe accidents. In addition to

reporting risk, which is the product of probability and consequences, the probabilities and consequences have been reported separately in the additional Appendix A material. Appendix A also has been expanded to include postulated normal radiation exposures for a variety of potential high-exposure individuals, such as transportation service industry employees (e.g., service station attendants and truck stop workers) and other individuals who might be in close proximity to a significant fraction of total waste shipments.

Issue: Transportation impact of site characterization

One commenter pointed out that Chapter 4 of the Draft Environmental Assessment contained very little discussion of the transportation impacts associated with site-characterization activities.

Response

Additional discussion has been provided in Section 4.2.3 of the final Environmental Assessment on transportation impacts of site characterization. Impacts mentioned include those due to construction of an additional access road (also included under exploratory shaft construction impacts elsewhere in Chapter 4), incoming shipments of small quantities of construction materials and supplies, and potential traffic congestion due to commuting by construction and operations personnel. The additional discussion provides support for the point previously made in the Draft Environmental Assessment that the transportation impacts of site characterization are so small as to be negligible.

Issue: Transportation of Hanford Site defense waste

A few commenters felt that the topic of Hanford Site defense waste transportation to a repository, whether located at the Hanford Site or elsewhere, was not adequately addressed.

Response

As a general response included in Subsection C.2.4.1, the national transportation cost-risk analyses have been revised to include all defense waste source locations rather than only the Savannah River Plant. Appendix A has been modified to include the new risk analyses and results. The regional transportation impacts presented in Subsection 5.2.2.3 have also been modified to include shipments from all defense high-level waste sources.

Subsection 5.2.2.5 has been added to emphasize that Hanford Site defense high-level waste has been included in the national and regional transportation risk analyses for shipments to a repository. For a repository located at the Hanford Site, the transportation of Hanford Site defense high-level waste has negligible impact due to the short transport distance and the lack of a nonoccupationally exposed population.

Calculated regional impacts of outgoing shipments from the Hanford Site to a repository located elsewhere have not been included in

Subsection 5.2.2.5 or specifically considered (i.e., separate from the national impacts) in comparing the Hanford Site to other candidate repository sites. This Environmental Assessment addresses impacts of a repository located at the Hanford Site, and its scope does not include impacts on the Hanford Site region of a repository located elsewhere. Impacts of Hanford defense high-level waste transportation will be addressed in an upcoming environmental impact statement specific to Hanford defense waste disposal.

C.7.4 EXPECTED EFFECTS ON SOCIOECONOMIC CONDITIONS

Many comments were received concerning the analysis in the Draft Environmental Assessment of the expected effects on socioeconomic conditions resulting from site-characterization activities and repository construction, operation, and closure. These comments form the basis for nine issues addressing public health, population density, proximity to affected Indians, emergency response, mitigation, quantification of socioeconomic effects, impact on regional industries, expansion of the area analyzed, and the consequences of contamination. In addition, a number of comments addressed miscellaneous concerns unrelated to any of the aforementioned issues. These comments were grouped into a subsection titled "Miscellaneous."

Issue: Public health

Numerous comments expressed concern about public health. Several stated that the final Environmental Assessment should discuss the general public health of the region. The other comments were concerned with both the near-term and long-term health effects that radiation from the Hanford Site would have on the population of the region.

Response

One indication of the general health of the population of Benton and Franklin Counties can be gleaned from a comparison of death rate statistics between this area and the State of Washington. Age-adjusted death rates per 100,000 individuals, by selected causes of death for three time periods (1968 to 1971, 1972 to 1975, and 1976 to 1979), are presented in Table C.7-1. These death rates have been standardized to control for the effects of differences in the age distributions of the populations involved; therefore, the figures presented here are useful only in a comparative sense. In general, heart disease, and bronchitis, emphysema, and asthma have decreased at both the county and the State level since 1968.

Although there are small differences between the death rates in the individual counties and in the State from infectious disease, cirrhosis of the liver, and suicide, these differences are not statistically significant. Because the populations of the two counties are much smaller than the population of the State of Washington, larger relative differences

Table C.7-1. Age-adjusted death rates per 100,000 individuals for Benton and Franklin Counties and the State of Washington

Cause of death	Time period	Benton County			Franklin County			State of Washington		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Infectious diseases	1968-1971	6.4	4.7	5.6	11.2	5.1	8.2	6.5	4.6	5.5
	1972-1975	6.4	4.7	5.6	11.2	5.1	8.2	6.5	4.6	5.5
	1976-1979	3.6	7.1	5.3	8.9	3.2	6.0	6.3	4.0	5.1
Malignant neoplasms	1968-1971	192.5	109.8	148.4	240.9	94.3	159.6	196.8	128.3	158.1
	1972-1975	188.1	133.2	157.6	197.2	111.0	151.3	203.3	130.8	161.7
	1976-1979	199.9	130.1	160.4	200.8	170.9	181.0	208.2	138.2	167.1
Cirrhosis of liver	1968-1971	18.1	10.7	14.3	23.1	6.4	14.8	18.4	10.6	14.3
	1972-1975	15.1	5.9	10.3	9.2	6.9	8.1	21.2	11.0	15.8
	1976-1979	9.7	7.5	8.5	13.3	8.7	11.0	17.8	9.0	13.1
Suicide	1968-1971	18.7	6.3	12.3	18.9	2.2	10.4	20.3	8.5	14.1
	1972-1975	19.9	5.9	12.3	10.4	11.6	11.0	20.7	8.3	14.2
	1976-1979	25.2	6.7	15.1	31.6	1.3	15.8	20.1	7.3	13.4
Heart disease	1968-1971	422.3	220.3	315.6	461.3	258.5	355.9	471.1	239.5	344.6
	1972-1975	445.9	211.1	316.9	412.9	262.0	336.3	419.6	216.9	307.7
	1976-1979	334.9	186.2	257.2	401.2	213.5	296.7	374.3	192.4	272.5
Bronchitis, emphysema, asthma	1968-1971	38.3	8.2	21.8	30.1	19.1	24.7	34.2	8.0	19.5
	1972-1975	35.1	6.5	18.9	41.7	11.5	25.2	27.0	6.9	15.5
	1976-1979	21.4	10.2	14.7	41.0	7.1	20.7	18.3	6.0	11.1

NOTE: Taken from Frost and Thomas (1981).

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would be required to indicate a statistically significant difference in death rates by these causes of death. Malignant neoplasm (cancer) mortality rates have fluctuated at the county and State level, but display an overall increase. Aside from the most recently reported time period for Franklin County, malignant neoplasm mortality rates do not vary significantly between the counties and the state.

Another measure of the general health of an area is the infant mortality rate, which is the number of deaths of infants under one year of age per 1,000 live births (Table C.7-2). The rates for Benton and Franklin Counties and the Tri-Cities are not significantly different from the rate for the State of Washington.

The effects of long-term exposure to low-level radiation at the Hanford Site have been studied by numerous investigators and are summarized in Savitz (1983). Following detailed consideration of exposure definition, classification of health outcomes, latency, the statistical methods employed, and selection biases, Savitz concludes the following:

- Total cancers are unrelated to radiation exposure among workers at the Hanford Site.
- Multiple myeloma and pancreatic cancer show a positive association with radiation dose based on a few highly exposed cases (i.e., not low-dose effects).
- The relationship of radiosensitive cancers in the aggregate to radiation exposure is unresolved.

The U.S. Department of Energy has an extensive long-term program for monitoring the radiation exposure of workers at the Hanford Site. Analysis of these data will continue in order to determine the effects of occupational exposure to radiation.

Long-term health risks are discussed in the issue on repository safety, Section C.5.11 of this appendix.

Information on public health is not included in the final Environmental Assessment. Additional review and consideration will be undertaken on public health issues if the reference repository location is recommended for site characterization. A section on public health may be included in an environmental impact statement to be prepared following site characterization.

Issue: Population density

Many comments were received regarding the proximity of the site to highly populated areas. Several expressed concern with the lack of definition for "low population density," "remote," and "proximity."

Table C.7-2. Infant mortality rate for Benton and Franklin Counties and the State of Washington for 1977 and 1982.

Location	1977		1982	
	Number of deaths	Infant mortality rate*	Number of deaths	Infant mortality rate*
Washington State	696	12.2	744	10.7
Benton County	16	10.8	14	6.5
Richland	7	15.0	5	9.6
Kennewick	8	14.9	6	6.4
Franklin County	4	5.3	13	13.9
Pasco	4	9.6	10	17.4

NOTE: Taken from Beare (1978) and Jennings et al. (1982).
*Infant mortality rate is based on number of deaths of infants under one year of age per 1,000 live births.

Others expressed concern with the discussion of "high daytime population" and "vicinity". Four of the comments suggested that the conclusion regarding population density and distribution be reassessed in the final Environmental Assessment.

Response

As discussed in the General Siting Guidelines (DOE, 1984a), the objective of the qualifying condition on population density and distribution (960.5-2-1(a)) is to limit the radiation dose to members of the public, both within highly populated areas and unrestricted areas. The final Environmental Assessment, in Subsection 6.4.1.4, addresses radiation dose to members of the public from normal and abnormal operations. The maximum dose from a bounding normal operational situation to an individual hypothetically residing at the Hanford Site boundary (24 kilometers (16 miles)) would be 0.001 millirem per year. This dose is a small fraction of the limits allowable under the requirements specified in Section 960.5-1(a) of the General Siting Guidelines (DOE, 1984a). In the analysis of dose consequences from a bounding accident situation, the maximum exposed individual was hypothetically located on Route 240, 1.6 kilometers (1 mile) from the potential release. The estimated 70-year, whole-body dose commitment for the accident is 1.2 millirem to this individual. Therefore, radiation dose to members of the public, both in hypothetical highly populated areas (assumed to be the Hanford Site

boundary) and the unrestricted areas (i.e, along Route 240), are small in comparison to the limits allowable under the requirements specified in Section 960.5-1(a)(1) of the General Siting Guidelines (DOE, 1984a).

The favorable conditions under population density and distribution (DOE, 1984a; 960.5-2-1) discuss a low population density in the general region of the site and remoteness of the site from highly populated areas. From the definition of "highly populated areas" in the General Siting Guidelines (DOE, 1984a), it can be inferred that an area with a population density lower than the mean value for the continental United States has a low population density. The mean population density of the continental United States is 29 persons per square kilometer (76 persons per square mile). The population density of the area within an 80-kilometer (50-mile) radius of the Hanford Meteorological Station on the reference repository location is 17 persons per square kilometer (43 persons per square mile) (Fig. C.7-1). Within the general vicinity of the reference repository location (i.e., within a 6.5-kilometer (4-mile) radius of the Hanford Meteorological Station, which encompasses the 200 East and 200 West Operations Areas) (Fig. C.7-2) there are no permanent residents; however, there are approximately 3,500 U.S. Department of Energy contractor employees. This number of individuals is equivalent to a permanent population of 885 individuals.* The equivalent population density in the general vicinity of the reference repository location is 7 persons per square kilometer (18 persons per square mile). Within 16 kilometers (10 miles) of the Hanford Meteorological Station, there are 110 residents and 4,800 U.S. Department of Energy contractor employees. This is equal to a permanent population of 1,214, resulting in a population density of 1.5 persons per square kilometer (4 persons per square mile). Therefore, there is a low population density in the general region and vicinity of the reference repository location when compared to the mean population density of the continental United States.

$$*3{,}500 \text{ Workers} \times \frac{\text{Resident}}{168 \text{ Hours/Week}} \times \frac{42.5 \text{ Hours/Week}}{\text{Worker}} = 885 \text{ Residents}$$

where

$$\text{Resident} = \frac{7 \text{ Days}}{\text{Week}} \times \frac{24 \text{ Hours}}{\text{Day}} = 168 \text{ Hours/Week}$$

$$\text{Worker} = \frac{5 \text{ Days}}{\text{Week}} \times \frac{8.5 \text{ Hours}}{\text{Day}} = 42.5 \text{ Hours/Week}$$

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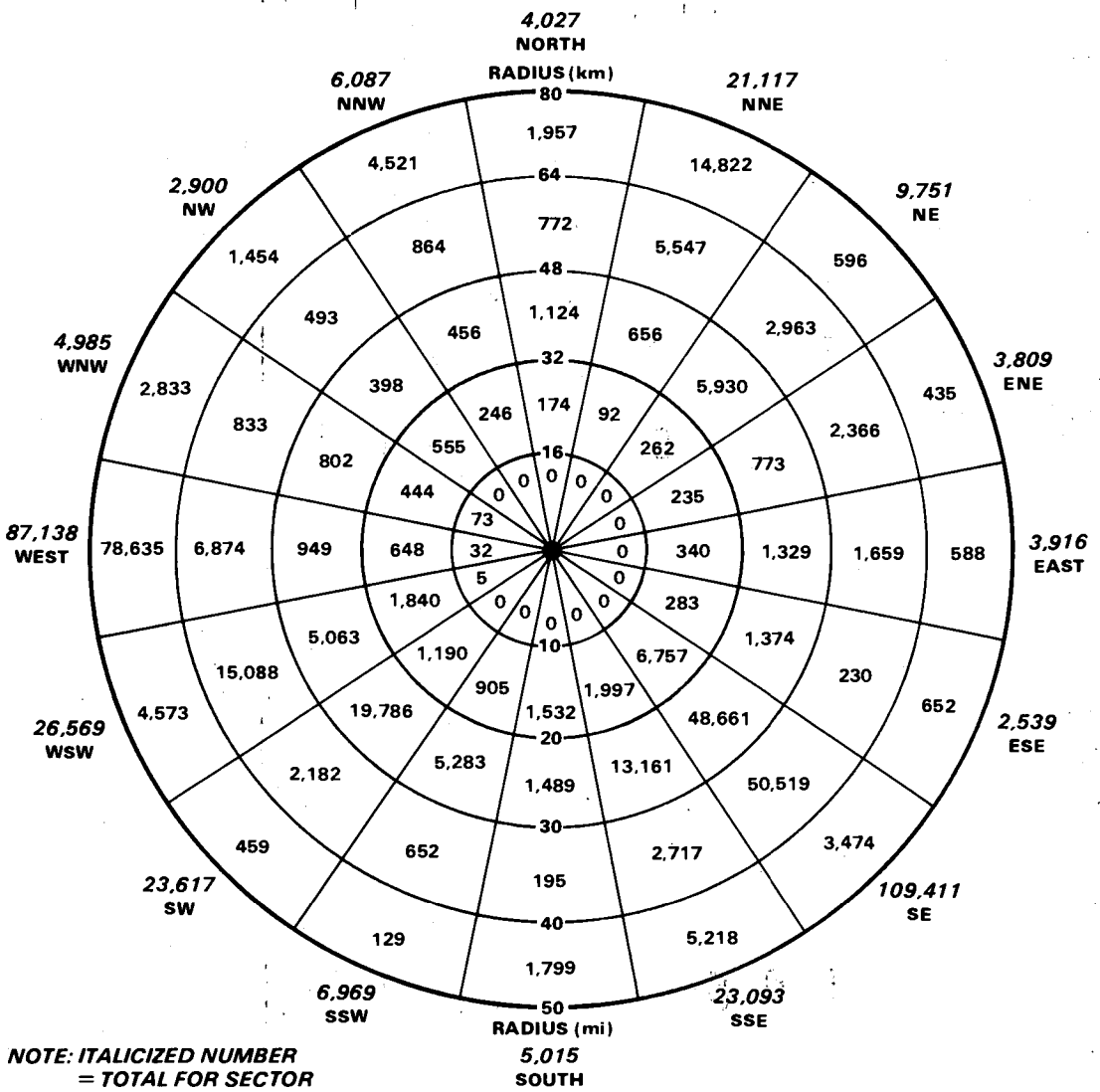

RING km (mi)	0-16 (0-10)	16-32 (10-20)	32-48 (20-30)	48-64 (30-40)	64-80 (40-50)	TOTAL 0-80 (0-50)
POPULATION	110	17,500	107,234	93,954	122,145	340,943

RING km (mi)	0-16 (0-10)	0-32 (0-20)	0-48 (0-30)	0-64 (0-40)	0-80 (0-50)
POPULATION DENSITY PERSONS PER km^2 (mi^2)	0.1 (0.3)	5 (14)	17 (44)	17 (43)	17 (43)

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Figure C.7-1. Distribution of residential population in an 80-kilometer (50-mile) radius of the Hanford Meteorological Station by population grid sector for 1980 (after Sommer et al., 1981, p. 11).

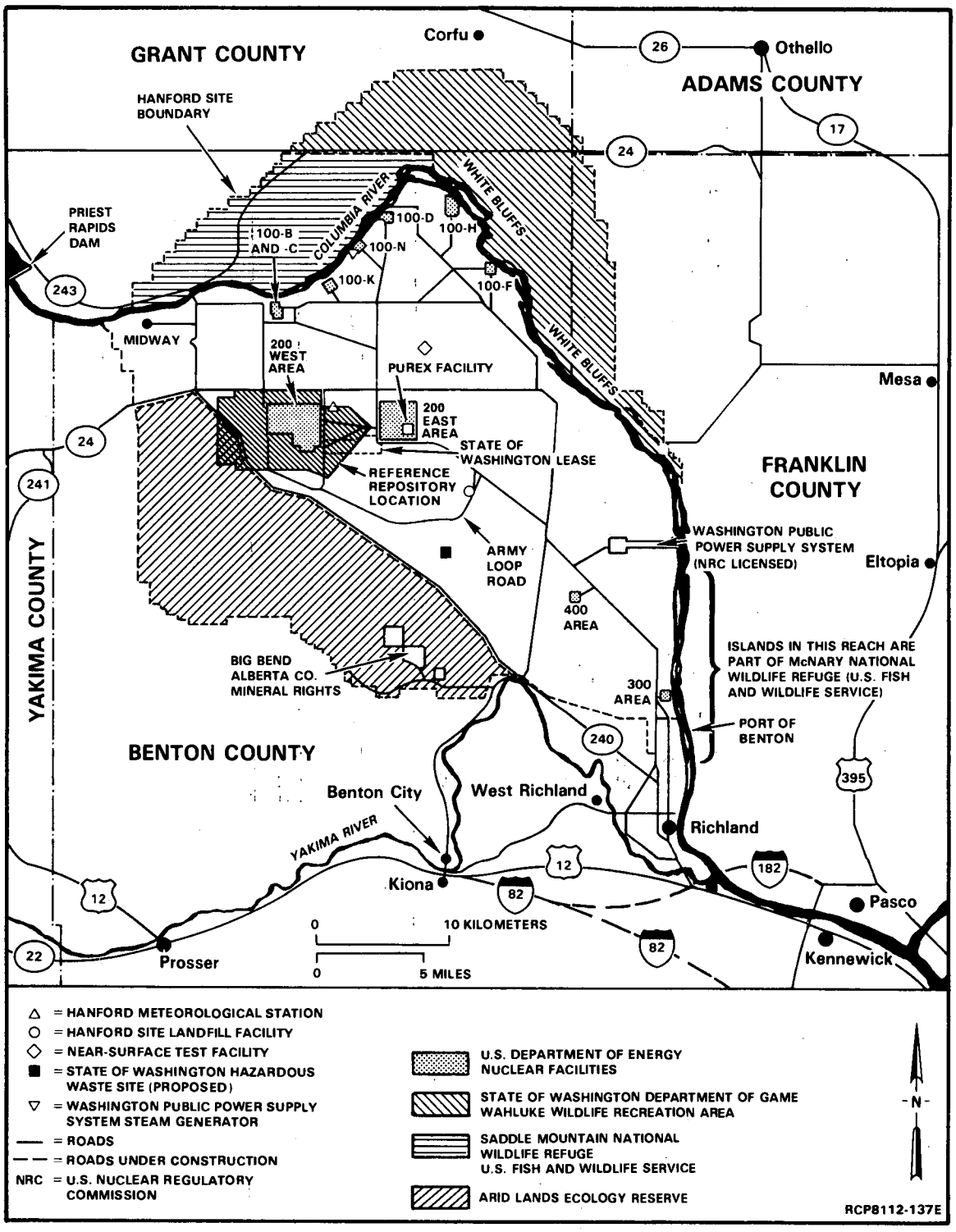

Figure C.7-2. Operations areas within the vicinity of the reference repository location.

The General Siting Guidelines (DOE, 1984a) do not provide a definition for remoteness of the site. The U.S. Nuclear Regulatory Commission, however, in 10 CFR 100 (NRC, 1984; Subsection 100.11) and Regulatory Guide 4.7 (NRC, 1975) does provide guidelines for determining a "low population zone" and a "population center distance." Based on these guidelines remoteness of the site is inferred. The "low population zone," as stated in 10 CFR 100 (NRC, 1984; Subsection 100.11), is determined as such that an individual located at any point on its boundary who is exposed to the radioactive cloud resulting from the postulated fission product release* (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 25 rem or total radiation dose in excess of 300 rem to the thyroid from iodine exposure.**

The consequences of such an accident would be much more severe than any postulated for a nuclear waste repository. However, although not completely analogous to a repository situation, in the absence of more appropriate guidance from either the General Siting Guidelines (DOE, 1984a) or the U.S. Nuclear Regulatory Commission, these criteria are used to evaluate the "low population zone" and subsequently, the remoteness of the site.

Review of the previous discussion on radiation dose to an individual during an accident shows that the individual located 1.6 kilometers (1 mile) from the point of release receives a dose much lower than that used to define the "low population zone." Therefore, for conservatism, the guidance in Regulatory Guide 4.7 (NRC, 1975) is used where, based on past experience, the U.S. Nuclear Regulatory Commission has found that a distance of 4.8 kilometers (3 miles) to the outer boundary of the "low population zone" is usually adequate (NRC, 1984; Section 4.7-9). From this information, the "population center distance" (i.e., the distance to the nearest boundary of a densely populated center) must, according to the U.S. Nuclear Regulatory Commission, be calculated as 1.33 times the distance to the outer boundary of the "low population zone" (NRC, 1984; Subsection 100.11), or 6.4 kilometers (4 miles).

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*The fission product release assumed for these calculations should be based on a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events, that would result in potential hazards not exceeded by those from any accident considered credible.

**The doses set forth in these site-criteria guides are not intended to imply that these numbers constitute acceptable limits for emergency doses to the public under accident conditions. Rather these have been set forth as reference values, which can be used in the evaluation of reactor sites with respect to potential reactor accidents of exceedingly low probability of occurrence and low risk of public exposure to radiation.

As shown in Figure C.7-1, there are no highly populated areas within 16 kilometers (10 miles) of the reference repository location. Therefore, it is concluded that the reference repository location is remote from highly populated areas.

The potentially adverse conditions under population density and distribution (DOE, 1984a; 960.5-2-1) discuss (1) high residential, seasonal, or daytime population density within the projected site boundary, and (2) proximity of the site to highly populated areas, or to areas having at least 1,000 individuals in an area 1.6 kilometers by 1.6 kilometers (1 mile by 1 mile) as defined by the most recent decennial count of the United States census. There is no residential or seasonal population within the projected site boundary (i.e, the 46-square-kilometer (18-square-mile) reference repository location). There are, however, 700 daytime workers (and an additional 700 shift workers) within the reference repository location; this equates to a daytime population density of 15 persons per square kilometer (39 persons per square mile). This is a low population density compared to the mean value for the continental United States, which is 29 persons per square kilometer (76 persons per square mile).

As previously discussed, the reference repository location is remote from highly populated areas.

Subsections 6.2.1.2.3 and 6.2.1.2.4 of the final Environmental Assessment reflect changes to the discussion of the remoteness of the site from highly populated areas and daytime population.

Issue: Proximity to affected Indians

Nine comments stated the Draft Environmental Assessment did not adequately discuss the proximity of the reference repository location to the affected Indian Tribes and ceded lands. Three comments suggested the addition of such a discussion; two suggested the inclusion of a map of ceded lands; and two comments stated that the reference repository location is too close to Indian lands.

Response

The treaties of 1855 (Treaty with the Nez Perces, 1855; Treaty with the Yakima, 1855; Treaty with the Walla Walla, Cayuse, etc., 1855) established three reservations. One reservation was established in Nez Perce country for the Nez Perce Indians; the second was in Yakima country for the Yakima Indians and the tribes and band from The Dalles to Okanogan; and the third was in the Umatilla Valley for the Cayuse, Walla Walla, and Umatilla Indians. These treaties also gave the tribes exclusive rights to take fish in streams on the respective reservations, as well as rights to fish at all usual and accustomed places off the respective reservations. The rights to erect temporary buildings, together with the privilege of hunting, gathering roots and berries, and pasturing horses and cattle on open and unclaimed land off the respective reservations were also

provided. These rights form the basis for the current status of the Tribes as affected per the definition in the Nuclear Waste Policy Act of 1982.

Section 3.6.6 of the Draft Environmental Assessment discussed the affected Indian Tribes. A discussion of the affected Indian Tribes and the reservation settings has been added in the final Environmental Assessment in Subsection 3.6.6.1 and 3.6.6.2. Fisheries resources are discussed in Subsection C.7.2.2, Ecosystems, of this appendix.

Issue: Emergency response

Five comments questioned the adequacy of emergency response planning. Three of these comments stated that existing U.S. Department of Energy emergency response plans for the Hanford Site need to be carefully scrutinized because it is unclear how these plans could be expanded to cover a nuclear waste repository. The other two comments stated concerns about planning requirements and liability, and planning requirements and scheduling, respectively.

Response

As stated in the Draft Environmental Assessment, the U.S. Department of Energy has a radiological emergency response plan (DOE, 1982) that was developed based on criteria included in DOE Order 5500.3 (DOE, 1981) and NUREG 0654/FEMA REP-1 Rev. 1 (NRC, 1980). The objectives of this plan are to ensure the following:

- Effective coordination of emergency activities among all organizations having a response role.
- Notification and recommendations to onsite personnel and the public in the event of a serious radiological emergency.
- Continued assessment of actual or potential radiological accident consequences both onsite and offsite.
- Effective implementation of emergency measures to protect onsite personnel and the public.
- Continued maintenance of an adequate state of emergency preparedness.

During site characterization, this emergency response plan would be reviewed in detail to determine if specific aspects of the plan need to be expanded to cover a repository.

The U.S. Department of Energy is currently negotiating with the State of Washington in the consultation and cooperation agreement process (see issue on mitigation in this appendix section). A preliminary agreement on

emergency response states: "In the event that the Hanford Site is recommended for construction of a repository, the U.S. Department of Energy will prepare emergency response plans covering both facility operations at the repository and transportation of nuclear material to and from the repository."

An expanded Subsection 6.2.1.2.5 of the final Environmental Assessment states that during site characterization the Hanford Site emergency response plan will be reviewed in detail to determine if specific aspects of the plan need to be expanded to cover a repository.

Issue: Mitigation

Seven comments were received regarding mitigation assistance and planning. It was suggested that the mitigation discussion be expanded with emphasis placed on early assistance and planning.

Response

The Nuclear Waste Policy Act of 1982 addresses the importance of early planning and assistance for impact mitigation relative to repository-siting activities. As required by this act, the U.S. Department of Energy has been providing funds to the State of Washington and negotiating with the State to develop a consultation and cooperation agreement. This agreement will include provisions dealing with impact mitigation and financial assistance.

The Nuclear Waste Policy Act of 1982 was signed into law on January 7, 1983, and in a letter dated February 2, 1983, the U.S. Department of Energy notified the Governor of the State of Washington of the potential consideration of the Hanford Site as a repository site. In April 1983, the Secretary of Energy made available, pursuant to the Nuclear Waste Policy Act of 1982, financial assistance to the State of Washington for review of Basalt Waste Isolation Project activities. Over 2.8 million dollars in funds has been awarded to state agencies, including the Energy Facility Site Evaluation Council, the Department of Ecology, and the Joint Legislative Committee on Science and Technology.

In fiscal year 1985, the U.S. Department of Energy funded both the executive and legislative branches in the State of Washington. The Department of Ecology was awarded $1,433,697.

Funds are expended by the Department of Ecology for the following:

- Organizing and staffing the State program.
- Developing a consultation and cooperation agreement.
- Conducting monthly meetings of the Nuclear Waste Board and the Nuclear Waste Advisory Council.

- Developing a public information program.
- Providing an overview of the U.S. Department of Energy siting activities and reports.
- Working with other organizations and Federal and State agencies involved in the repository siting issue.

The Washington State Joint Legislative Committee on Science and Technology has used its financial assistance for the following tasks:

- Providing information to legislators.
- Conducting briefings.
- Providing staff support to legislators.
- Analyzing U.S. Department of Energy documents.
- Publishing a newsletter.
- Analyzing local government impacts associated with a repository.

Almost 3.5 million dollars in funds has been awarded to the Yakima Indian Nation, the Confederated Tribes of the Umatilla, and Nez Perce Tribe since 1983. The funds were allocated for the tribes' participation in the review of the Basalt Waste Isolation Project.

Financial assistance provided under the Nuclear Waste Policy Act of 1982 is subjected to the requirements of the U.S. Office of Management and Budget. Grantees are audited periodically and are required to file semiannual performance reports.

The U.S. Department of Energy also has provided financial assistance to the National Governors' Association and the National Confererce of State Legislatures to disseminate information to the members, form working groups to address high-level waste, make recommendations to the U.S. Department of Energy, review U.S. Department of Energy documents, and provide forums for discussion of implementation of the Nuclear Waste Policy Act of 1982.

The Nuclear Waste Board of the State of Washington and the U.S. Department of Energy have, over the past 2 years, been negotiating a consultation and cooperation agreement. The purpose of the agreement is to ensure the right of independent review by the State of Washington and monitoring of the U.S. Department of Energy activities as they relate to siting a nuclear waste repository at the Hanford Site. The agreement is still in draft form and even though there are some issues that have not been satisfactorily resolved, the scope of the agreement gives some indication the U.S. Department of Energy intends to work closely with the

State in the planning and development of a repository. The following issues relevant to this planning and development are being negotiated in the process.

- Onsite and offsite studies and investigations.
- Consultation.
- Response to State objections, concerns, and comments.
- Access to information.
- Conflict resolution.
- Financial assistance.
- Impact assistance.
- Public involvement.
- Utilization of available expertise, joint review, and monitoring.
- Liability.
- Transportation.
- Emergency response.

The discussion in Subsection 5.2.3.5 has been expanded in the final Environmental Assessment to address monitoring and mitigation. Plans for monitoring and corrective actions during site characterization have also been added to Subsection 4.1.2.2.

Issue: Quantify socioeconomic effects

Many commenters stated that the Draft Environmental Assessment did not contain sufficient information to adequately assess economic effects on the local communities. Several reviewers said that a breakdown of workforce requirements by local and nonlocal labor should be provided. Other comments stated that an attempt should be made to quantify revenues to local business and government and the resulting benefits to the communities. Four comments requested quantification of economic effects that would result from site-characterization activities. Two were concerned with training and funding personnel to maintain and monitor the repository after closure. In addition, there was concern that a discussion of the planning and consultation process among the various affected governments is lacking.

Response

The Draft Environmental Assessment discussion of potential socioeconomic impacts was a conservative analysis. Impacts were also estimated assuming that 75 percent of the nonmining jobs and 25 percent of the mining jobs are taken by local workers. The potential impact on local hiring depends on a number of factors, including the level of local unemployment at the time, the level of underemployment (persons not in the labor force who may decide to work), the mix of appropriate skills available in the labor force at the time of the hiring, and the role of local unions in determining who works on which jobs. The economic effect on jobs and revenue to the local communities, as discussed in Section 5.2.3 of the Draft Environmental Assessment and detailed in Cluett et al. (1984), is at an appropriate level of detail, given the relatively small impacts that

are projected. The Draft Environmental Assessment was based on available data; more detailed studies will be conducted during site characterization if the site is recommended.

Impacts on businesses were not precisely quantified in the Draft Environmental Assessment. Rather, the indirect and induced effects of direct employment in support of the repository and the local expenditures from wages and resource purchases were accounted for in the indirect employment multiplier used in the economic base model. This multiplier is based on the actual historical experience associated with the economic and business growth in the local area due to the growth of the Washington Public Power Supply System, the U.S. Department of Energy, and the agriculture sector. The analysis also reflects the different indirect effects experienced during the economic decline in the area since 1981. During that decline, some local businesses folded and others are struggling to survive. In a fluctuating economy it is difficult to project several years ahead to say which businesses would be affected. However, during the growth phase of the repository construction and early operation, much of the impact on local businesses would take the form of reviving existing depressed businesses. New business formation and further business growth beyond the level of activity experienced in 1981 is expected to take many years to achieve. A more detailed assessment of socioeconomic impacts due to repository activities will be developed if the Hanford Site is recommended for detailed site characterization. A more detailed assessment of socioeconomic conditions projected for the duration of site characterization has been included in Section 4.2.2 of the final Environmental Assessment.

Maintenance and monitoring of the site is considered part of the repository design activity (see Section 5.1 of the final Environmental Assessment). Funding for these activities is provided for by the Nuclear Waste Policy Act of 1982.

The planning and consultation process among the various affected governments is discussed in the issue on mitigation under this appendix section and in Section 5.2.3 of the final Environmental Assessment.

The conclusion on the qualifying condition under socioeconomic impacts siting guideline (DOE, 1984a; 960.5-2-6(a)), Subsection 6.2.1.7.12 of the final Environmental Assessment, has been changed from a Level 4 finding to a Level 3 finding to reflect limitations in the currently available data base and the need to gather more data during site characterization.

Issue: Impact on regional industries

The impact that locating a repository on the Hanford Site would have on the region economic base, especially agricultural, fisheries, and tourist industries, was the subject of numerous comments. Of particular concern was the possible perception of consumers that products from this region could be contaminated, thereby resulting in loss of markets. Also

of concern was the possible perception of contamination in the region resulting in loss of tourism and a decline in real estate values throughout the areas. Another concern was the impact that locating a repository on the Hanford Site would have on the diversification of the Tri-Cities economy and the attractiveness of the Pacific Northwest to new business ventures.

Response

Tourism is one of the fastest growing (and least understood) sectors in the State of Washington economy. Although tourism is an important component in the overall economic development strategy for the State, measurement of the economic benefits of tourism is difficult. The Tourism Development Division of the State of Washington is currently revising its methodology regarding attribution of expenditures, jobs created, payroll, and gross business receipts to tourism. Hence, only rough estimates of the economic value of tourism for the State and the region are provided here (for 1983).

According to the most recent Washington Travel and Tourism Report (Tanner, 1984), tourism-related employment accounted for 80,000 direct jobs with a payroll of 600 million dollars annually. It is estimated that over 3 billion dollars of expenditures were made in Washington State by tourists in 1983, 425 million dollars of which was spent by foreign visitors. The importance is further underscored by the contribution tourism makes to the State treasury. With a contribution of 110 million dollars in State taxes, tourism is the third largest source of State revenues.

For analytical purposes, the Division of Tourism has divided the State into eight geographical regions. The Hanford Site study region is located in the southwest tourism region of the State, Region 1, which consists of Adams, Asotin, Benton, Columbia, Franklin, Garfield, Walla Walla, and Whitman Counties. Tourism-related employment in the region in 1983 totaled 6,956 persons in the hotels and motels and eating and drinking establishments. Compared to the other State regions, Region 1 employment was just over five percent of State total tourism-related employment. Expenditures in the region related to tourism were similar to employment in proportion to the overall State tourism economy.

Agriculture is the predominant land use in the six-county region near the Hanford Site (Table C.7-3). Over 75 percent of the land area in the region is in agricultural-related uses, compared to less than 40 percent statewide. The State of Washington ranks first among all states in the production of hops, spearmint oil, sweet cherries, and apples. It ranks second in the production of potatoes, peppermint oil, pears, prunes and plums, grapes, green peas (processing), and carrots (processing). The study region is a major producer for sweet cherries (100 percent of Washington production in 1982), potatoes (94 percent of Washington production), corn for grain (94 percent of Washington production), mint (95 percent of Washington production), prunes and plums (92 percent of Washington production), apples (58 percent of Washington production),

Figure C.7-3. Farmlands in the six-county region surrounding the Hanford Site for the years 1974, 1978, and 1982.

Location	Number of farms	Area in farmlands		Percent of land area	Value of land and buildings	
		1,000 hectares	1,000 acres		current $/hectare	current $/acre
1974						
Adams County	699	464	1,147	94.6	541	219
Benton County	990	292	721	65.4	751	304
Franklin County	767	243	601	74.9	889	360
Grant County	1,479	438	1,082	63.2	941	381
Walla Walla County	735	326	806	99.8	810	328
Yakima County	4,095	715	1,767	64.7	1,735	702
Total in region	8,765	2,478	6,124	77.1	944	382
Total in state	29,410	6,743	16,662	39.1	754	305
Total in United States	2,314,013	411,592	1,017,030	44.9	830	336
1978						
Adams County	698	474	1,172	96.7	983	398
Benton County	1,038	278	686	62.2	1,693	685
Franklin County	799	247	610	76.0	1,618	655
Grant County	1,665	497	1,228	71.7	1,737	703
Walla Walla County	752	313	773	95.7	1,567	634
Yakima County	4,300	698	1,726	63.2	1,977	800
Total in region	9,252	2,507	6,195	77.6	1,596	646
Total in state	37,730	6,881	17,002	39.9	1,628	659
Total in United States	2,478,642	416,718	1,029,695	45.4	1,552	628
1982						
Adams County	714	468	1,156	94.0	1,384	560
Benton County	1,296	274	677	61.7	2,296	929
Franklin County	856	256	633	79.5	2,182	883
Grant County	1,799	450	1,113	65.4	2,268	918
Walla Walla County	824	305	755	93.5	2,357	954
Yakima County	4,581	694	1,715	62.5	2,434	985
Total in region	10,070	2,448	6,048	76.1	2,155	872
Total in state	36,080	6,665	16,470	38.7	2,305	933
Total in United States	2,400,370	420,293	1,038,530	45.8	1,955	791

NOTE: Taken from data by the Bureau of Census (BOC, 1978, 1982).

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pears (52 percent of Washington production), and wheat (46 percent of Washington production) (Table C.7-4). In terms of market value of agricultural products sold, the six-county region accounts for over 50 percent of the State total value. Although the Hanford Site region is one of two major fruit-growing regions in the State, over 75 percent of the regional market value is due to sales in grains (or field crops) and livestock, poultry, and related products (BOC, 1981, 1984; State of Washington, 1984a).

In 1982, over 33 percent of the agricultural land in the State of Washington was irrigated. Of the 2,429,250 irrigated hectares (6,002,592 acres) in the State, nearly one-half were in the six-county study region. The number of irrigated hectares in the region has grown slightly between 1978 and 1982; whereas, the State has declined in overall hectares irrigated. Within the six-county region, the proportion of agricultural land irrigated varies from a low of 33 percent in Yakima County to a high of 73 percent in Grant County.

Fisheries is a significant component in economy of the State of Washington. In 1983, the total value (processed) of sea products in the State was nearly 166 million dollars, a decrease of 20 percent over the value of the catch for the previous year. The decline was the result of a significant drop in the salmon industry, generally the mainstay within fisheries of the State, accounting for over one-half of the total processed value. In 1983, the processed value of salmon fisheries accounted for only 22 percent of the total State value (State of Washington, 1984b). The Columbia River System, which flows through the Hanford Site study region, is an important fisheries area in the State, both for salmon and other anadromous fish.

It is assumed that three conditions must be present to negatively affect consumer purchases of agricultural or fisheries products from near a repository: (1) The consumer must be able to clearly identify the product with the locality in which it was grown, (2) the consumer must be aware that a nuclear waste repository is located in the region where the product is grown, and (3) the consumer must relate the existence of a repository with a health hazard that is transmitted through the food chain.

Much of the agricultural products from the Hanford Site surrounding area are exported to western Washington, to other states, or abroad, and it is not clear how closely the exported products are identified with the Hanford Site region in the minds of most consumers. In addition, radioactive materials have been managed at the Hanford Site for the past 40 years with no apparent adverse impact on agricultural markets, fisheries, or tourism, even though there have been several well-publicized radioactive releases to the environment. Similarly, waste-management activities at the Hanford Site have had no identifiable effects on real estate values in the region. The many attributes of an area that serve to attract new business are complex and varied. That which may attract some businesses (e.g., proximity to agriculture) may be of little or no interest to other businesses. Although all may agree that quality of life is an important aspect in choosing a place to live and work, the definition of "quality of life" is as varied as each individual.

Table C.7-4. Cropland harvested for main crops in 1978 and 1982 in the six-county region surrounding the Hanford Site. (sheet 1 of 3)
Values are given in hectares (acres).

Crop	Adams County	Benton County	Franklin County	Grant County	Walla Walla County	Yakima County	Total for region	Total for State
				1978				
Wheat	168,000 (416,000)	80,000 (198,000)	55,000 (137,000)	88,000 (218,000)	105,000 (261,500)	31,600 (78,200)	511,400 (1,263,700)	1,178,000 (2,910,000)
Barley	2,950 (7,300)	360 (900)	1,700 (4,200)	6,100 (5,100)	7,400 (8,200)	4,900 (12,200)	23,400 (57,900)	71,600 (177,000)
Corn for grain	1,500 (3,600)	3,500 (8,700)	5,100 (12,700)	10,000 (24,800)	280 (700)	5,100 (12,700)	25,600 (63,200)	26,000 (65,000)
Dry edible beans	870 (2,150)	(a) (a)	2,370 (5,850)	6,170 (15,250)	(a) (a)	(a) (a)	(b) (b)	11,000 (28,000)
Potatoes	6,300 (15,500)	9,700 (24,000)	10,000 (24,700)	12,500 (30,900)	2,400 (5,900)	650 (1,600)	41,500 (102,600)	44,000 (109,000)
Apples	264 (653)	1,671 (4,130)	197 (488)	1,923 (4,753)	85 (210)	19,768 (48,847)	23,910 (59,081)	46,639 (115,244)
Cherries	23 (58)	1,008 (2,491)	76 (189)	215 (531)	0 (0)	2,256 (5,574)	3,579 (8,843)	5,518 (13,635)
Pears	24 (60)	157 (388)	(a) (a)	138 (340)	0 (0)	3,936 (9,725)	(b) (b)	8,518 (21,048)
Peaches	8 (19)	169 (418)	27 (66)	40 (100)	0 (0)	643 (1,589)	887 (2,192)	887 (2,192)
Prunes	0 (0)	250 (619)	6 (14)	21 (51)	0 (0)	507 (1,253)	784 (1,937)	784 (1,937)

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Table C.7-4. Cropland harvested for main crops in 1978 and 1982 in the six-county region surrounding the Hanford Site. (sheet 2 of 3)
Values are given in hectares (acres).

Crop	Adams County	Benton County	Franklin County	Grant County	Walla Walla County	Yakima County	Total for region	Total for State
				1978 (cont.)				
Apricots	4 (10)	17 (41)	(a) (a)	8 (21)	0 (0)	112 (276)	(b) (b)	310 (767)
Mint	630 (1,550)	1,600 (3,900)	380 (950)	2,400 (5,900)	0 (0)	12,000 (30,000)	17,100 (42,300)	17,500 (43,200)
Green peas	0 (0)	320 (800)	0 (0)	1,200 (3,000)	7,700 (19,000)	0 (0)	9,200 (22,800)	30,400 (75,100)
Carrots	0 (0)	60 (150)	220 (550)	320 (800)	200 (500)	100 (250)	910 (2,250)	1,800 (4,500)
Grapes	3 (8)	250 (619)	6 (14)	21 (51)	0 (0)	507 (1,253)	784 (1,937)	938 (2,318)
				1982				
Wheat	150,000 (372,000)	67,800 (167,600)	64,800 (160,100)	93,400 (230,900)	94,600 (233,700)	33,600 (83,100)	504,800 (1,247,400)	1,089,000 (2,690,000)
Barley	28,700 (71,000)	5,700 (14,000)	13,600 (33,500)	12,300 (30,500)	5,300 (13,000)	5,300 (13,000)	70,800 (175,000)	344,000 (850,000)
Corn for grain	4,400 (11,000)	18,600 (46,000)	5,700 (14,000)	11,700 (29,000)	3,800 (9,400)	5,300 (13,000)	49,500 (122,400)	52,600 (130,000)
Dry edible beans	1,300 (3,200)	(a) (a)	1,100 (2,700)	3,600 (8,800)	(a) (a)	(a) (a)	(b) (b)	6,500 (16,000)
Potatoes	6,500 (16,000)	7,100 (17,600)	10,200 (25,200)	12,800 (31,650)	2,300 (5,800)	600 (1,400)	39,500 (97,650)	42,100 (104,000)

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Table C.7-4. Cropland harvested for main crops in 1978 and 1982 in the six-county region surrounding the Hanford Site. (sheet 3 of 3)
Values are given in hectares (acres).

Crop	Adams County	Benton County	Franklin County	Grant County	Walla Walla County	Yakima County	Total for region	Total for State
Apples	500 (1,237)	3,073 (7,593)	1,227 (3,032)	5,038 (12,448)	758 (1,872)	23,813 (58,841)	34,409 (85,023)	58,936 (145,630)
Cherries	27 (68)	916 (2,263)	226 (558)	380 (938)	31 (77)	2,350 (5,807)	3,930 (9,711)	5,778 (14,277)
Pears	23 (56)	250 (617)	82 (202)	227 (561)	0 (0)	3,911 (9,664)	4,500 (11,100)	8,692 (21,477)
Peaches	(a) (a)	129 (319)	82 (202)	39 (96)	14 (34)	513 (1,267)	(b) (b)	1,131 (2,796)
Prunes	0 (0)	300 (736)	16 (39)	65 (161)	15 (37)	478 (1,181)	872 (2,154)	949 (2,345)
Apricots	0 (0)	36 (89)	(a) (a)	34 (83)	0 (0)	105 (260)	(b) (b)	347 (857)
Mint	360 (900)	1,600 (4,000)	0 (0)	1,100 (2,700)	0 (0)	4,370 (10,800)	7,400 (18,400)	7,810 (19,300)
Green peas	0 (0)	0 (0)	610 (1,500)	1,800 (4,400)	5,900 (14,600)	0 (0)	8,300 (20,500)	26,600 (65,600)
Carrots	0 (0)	60 (150)	490 (1,200)	320 (800)	0 (0)	0 (0)	870 (2,150)	1,600 (4,000)
Grapes	0 (0)	4,006 (9,898)	634 (1,566)	350 (865)	(a) (a)	4,728 (11,684)	(b) (b)	10,817 (26,728)

NOTE: Based on data from Bureau of Census (BOC, 1978, 1982) and State of Washington (1980, 1984a).
[a]Data not released for reason of disclosure.
[b]Total cannot be given due to disclosure.

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Although not expected, there may be some temporary impacts on agricultural, fisheries, or tourism markets due to the perception of consumers concerning a repository. If impacts occur, they are expected to be short-lived and minimal. Effective monitoring programs at the repository are expected to provide convincing evidence to the public that there will not be any adverse impact on the regional industries (see issue on repository safety in Section C.5.11 of this appendix). Extensive public participation and the review process are also expected to help preclude impacts. Further studies will be initiated should the reference repository location be recommended for characterization.

Section 3.4.1 of the final Environmental Assessment has been expanded to address agriculture as an important land use in the area surrounding the Hanford Site. The potential for impacting this land use has been incorporated into Section 5.2.3.6.

Issue: Expand area for socioeconomic analysis

Twenty-four commenters suggested that socioeconomic and cultural effects of locating a nuclear waste repository on the Hanford Site may be experienced in areas beyond Benton and Franklin Counties. Two commenters stated that the socioeconomic and cultural studies should be expanded to include the reservation and ceded lands of the Confederated Tribes of the Umatilla Indian Reservation. Other commenters expressed concern regarding the economic effect on components of the State of Washington outside of the study area. Several of those commenters specifically requested that an economic damage analysis be provided in the final Environmental Assessment.

Response

As discussed in Section 3.6 of the Draft Environmental Assessment, the study region expected to experience the major impacts from locating a nuclear waste repository at the Hanford Site comprises those areas that have been most affected by employment and demographic changes in the recent past. Historical employment data for employees of the Basalt Waste Isolation Project revealed that 92.5 percent of the employees settled within the study area. The study region includes Richland, Pasco, Kennewick, West Richland, Benton City, and the contiguous unincorporated areas. For the purpose of the Draft Environmental Assessment, the study region was expanded to include Benton and Franklin Counties. In Section 5.2.3 of the Draft Environmental Assessment, the expected effects in social conditions, community services, economic conditions, and fiscal conditions and government structure were considered a joint product of the employment requirements for the repository and labor supply in the region. Impacts outside the Benton-Franklin Counties region are expected to be negligible and, therefore, difficult to quantify or measure. Additional socioeconomic studies, which would serve to further address these issues, are planned during site characterization, should the reference repository location be recommended. Results of these studies would be included in the draft environmental impact statement issued when a single repository site is selected from the three sites to be characterized.

The purpose of this environmental assessment is to serve as the basis for decisions on site nomination as required by the Nuclear Waste Policy Act of 1982. To this end, the reference repository location is evaluated against the General Siting Guidelines (DOE, 1984a) to determine if it is suitable for development as a nuclear waste repository. The General Siting Guidelines alone, as agreed to by the U.S. Nuclear Regulatory Commission, are sufficient to screen the sites. The General Siting Guidelines do not address the economic effect on the State, specifically economic damage analysis. However, although this analysis is not included in the final Environmental Assessment, the U.S. Department of Energy will complete such a study following the issuance of the final Environmental Assessment.

Issue: Consequences of contamination

Many reveiwers expressed concern with the consequences of possible contamination of major aquifers, the Columbia River, and agricultural lands. Several comments stated that contamination of the major aquifers and the Columbia River would be devastating to the economy of the region. Others were concerned with the possible impact on the quality of life, including the impact on drinking-water supplies. Several comments questioned the advisability of risking potential contamination of agricultural land. One questioned the discussion under the socioeconomic disqualifying condition and stated that postclosure arguments were inappropriate for a preclosure condition. Two other comments suggested changing the finding on this disqualifying condition from Level 2 to Level 1. One comment stated that the reference repository location should be disqualified based on potential contamination of water supplies.

Response

The U.S. Department of Energy is engaged in a rigorous siting process to locate a nuclear waste repository that meets the requirements of both the U.S. Nuclear Regulatory Commission (10 CFR 60; NRC, 1985) and the U.S. Environmental Protection Agency (40 CFR 191; EPA, 1985). As described in the Draft Environmental Assessment (see Subsection 6.4.1.3), preclosure safety assessment will be performed in the context of a risk-management plan. The probabilities of accidents occurring that could impact safety will be established, as will the potential consequences of the subsequent chain of events. These analyses of probabilities and consequences will yield a measure of the risk or danger to the public. A risk-management plan will be used to reduce unacceptable levels of risk.

Postclosure risk is discussed in the issue on repository safety in Section C.5.11 of this appendix.

It is true the disqualifying condition under socioeconomic impacts (DOE, 1984a; 960.5-2-6(d)) is part of a preclosure siting guideline; however, the condition requires the analysis of the impact of repository closure on water quality and quantity. The discussion of postclosure conditions is inappropriate and will be deleted from the final Environmental Assessment. A discussion concerning degradation of water quality

and reduction of ground-water quantity related to the construction, operation, and closure of a repository at the reference repository location has been added to Subsection 6.3.1.1 of the final Environmental Assessment.

C.7.4.1 Miscellaneous

Thirteen comments were received addressing miscellaneous socioeconomic conditions. These comments included concerns regarding land use impacts, emphasis on socioeconomic impacts, secondary sector employment, uncertainty in labor force estimates, impacts following closure, unemployment, and economic projections.

Issue: Land use impacts

One comment stated the Draft Environmental Assessment should have addressed the likelihood of site-characterization activities being conducted outside U.S. Department of Energy lands.

Response

As discussed in Subsection 4.1.1.4.2 of the Draft Environmental Assessment, new wells may be drilled outside the Hanford Site to obtain head data that are considered critical. Requirements for these wells are being considered as part of the planning for site characterization. There are no plans to drill on the State of Washington leasehold lands.

Issue: Deemphasize socioeconomic impacts

Two comments stated that socioeconomic impacts should be deemphasized.

Response:

Planning and assistance for socioeconomic impact mitigation relative to repository siting activities is required not only by the Nuclear Waste Policy Act of 1982 but also by the General Siting Guidelines (DOE, 1984a). Deemphasizing the identification of these potential impacts would not satisfy these requirements (see issue on mitigation under this appendix section.)

Issue: Secondary sector employment

Two comments requested more information on secondary sector employment.

Response

The ratio of indirect jobs to direct jobs of 1.2 is based on the economy of Benton and Franklin Counties during the period of growth

between 1973 and 1981 (Cluett et al., 1984). During this period, primary jobs were estimated to have increased by approximately 17,000 compared to approximately 19,600 jobs in the secondary sector (i.e., 1.2 secondary sector jobs for every primary sector job). This indirect-to-direct ratio is judged to be the best available proxy for the expected growth in secondary sector jobs during the construction and operation of the exploratory shaft.

Whether the newly created jobs in the secondary sector are taken by local people or by newcomers, they are expected to mirror the types of secondary jobs that were created during previous periods of growth in this area. Between 1973 and 1981, increasing employment in the primary sector of approximately 11 percent per year resulted in average annual employment growth of 6.6 percent in manufacturing and service-based industries, 6 percent in the government sector, and approximately 9 percent in the retail-wholesale sector (Cluett et al., 1984).

Issue: Labor-force estimates

One comment suggested that the uncertainty in the labor-force estimates be assessed.

Response

The labor force, as defined by economists and as used in the Draft Environmental Assessment, refers to currently employed persons or persons who are unemployed and looking for a job. The labor force size in Benton and Franklin Counties is estimated to have peaked at 83,000 persons in 1981 and declined by approximately 8,800 persons between 1981 and 1984, a 10.6 percent decline. Labor force estimates are affected by several factors; thus, labor force size is hard to forecast. The socioeconomic assessment in the Draft Environmental Assessment was based on forecasts of employment size that in turn were dependent on assumptions about employment changes in the primary sectors (principally projections of employment at the Hanford Site and future agriculture sector activity) and related changes in the secondary sectors of the economy of the area.

Even if employment and labor-force projections are in error, the size of the labor force in this area is large enough that projected employment due to siting a repository at the Hanford Site would be relatively small. In estimating the labor-force size, even a margin of error of 10,000 (which is highly unlikely) would have only a small effect on the relative impact of a peak repository work force of approximately 1,100 persons.

If by "labor force" the commenter means the "work force," or number of workers expected to be needed to perform the construction and operation tasks called for by the repository conceptual design, then the uncertainty in estimates has a different basis. Work-force estimates have been developed by the architect-engineers who have examined each of the tasks that must be carried out over the life of the repository. The repository

design, the tasks required to construct and operate the repository, and the schedule for those tasks are subject to change. Therefore, the total work force figures and their distribution over time, as well as the individual skill requirements, could change.

While it is difficult to estimate the degree of uncertainty in the current estimate of work-force size, it would be possible to estimate the change in socioeconomic impacts of a doubling in the peak size of the work force, which is a highly unlikely outcome. The Draft Environmental Assessment provided a likely estimate of peak population increase in the area of approximately 1,700 persons in 1995. This estimate takes into account primary and secondary employment and family dependents, and assumes that many of the jobs will be filled by the local unemployed or underemployed. If that estimate were doubled, to 3,400 persons in the peak year, the relative effect would still be only approximately 2 percent of the projected baseline population size in that year. Therefore, although the uncertainty in the work-force estimate is unknown, should it even increase by as much as 100 percent, the implication for the estimates of socioeconomic impacts would be negligible.

Issue: Impacts following closure

One comment requested that the final Environmental Assessment include a discussion of the expected impacts during and following repository closure.

Response

The current repository schedule (see Fig. 5-1 of the final Environmental Assessment) assumes a total preclosure time of 90 years with the maximum work force occurring during construction and into operations. During this time period, a monitoring and mitigation program will be in place to continually project work-force requirements to aid local planners in making decisions regarding the community. Just as no project is intended to have an infinite life span, closure of the repository after 90 years can be expected by the local community and planned for accordingly.

Issue: Unemployment

One commenter in effect stated that the only benefit of selecting the Hanford Site was because of jobs, but the reviewer believed the repository would increase unemployment as a result of a large number of job seekers coming into the area.

Response

The creation of jobs is not a criterion for selecting the reference repository location for site characterization. The General Siting Guidelines (DOE, 1984a) are used as the basis for this decision (see Section 6.1 of the Draft Environmental Assessment). Further, it is not likely that there would be a "big" migration of workers for a construction project requiring a peak work force of only 1,100 persons.

Issue: Economic projections

Five commenters suggested that the socioeconomic information should be updated to reflect the Pacific Northwest Power Council projected economic facts surrounding industrial development in the Pacific Northwest.

Response

In the recently released draft report by the Northwest Planning Power Council (1985), projections are provided only for the regional and State level; this tends to limit their applicability to counties. The Northwest Planning Power Council projects a temporary population decline for Washington State between 1985 and 1990 for the low-growth scenarios only. Also, basic employment is projected to decline for the low-growth scenario only, offset by secondary employment growth projected for all scenarios during the next 20 years. Projections for the high-, medium-, and medium-low-growth scenarios are far more optimistic for employment and population growth. It appears that the projections in the Draft Environmental Assessment were within the boundaries of the population and employment scenarios given by the Northwest Planning Power Council. In terms of specific industries, the Northwest Planning Power Council low growth or declining growth projections for agriculture are not comparable with the projections in the Draft Environmental Assessment. This inconsistency is related to assumptions made concerning development of the second phase of the Columbia Basin Irrigation project and differences between agricultural trends specific to the State and those specific to the Columbia Basin counties. This inconsistency will be addressed during the site-characterization monitoring program if the reference repository location is recommended for site characterization.

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C.8 EASE AND COST OF SITING, CONSTRUCTION, OPERATION, AND CLOSURE

This section addresses comments about the problems and costs of constructing, operating, and closing the repository. It focuses on the evaluation of guidelines related to the engineering and design of the repository and how those guidelines are used to evaluate the system guideline for ease and cost of repository development. This evaluation draws heavily on the baseline description of the site and the repository system in Section C.4. In contrast to Section C.7, which focuses on the effects of site characterization and repository development, this section, like Sections C.5 and C.6, focuses on the evaluation of site suitability on the basis of the siting guidelines.

C.8.1 SURFACE CHARACTERISTICS

Comments assigned to this section have been cross-referenced to and discussed in Subsection C.4.1.2.

C.8.2 ROCK CHARACTERISTICS

Comments on rock characteristics dealt with the following six major issues:

- C.8.2.1, Water inflow.
- C.8.2.2, Thermally induced fracturing.
- C.8.2.3, Rock support and maintenance.
- C.8.2.4, Flexibility as to the depth, configuration, and location of the underground repository.
- C.8.2.5, Worker safety.
- C.8.2.6, Inclusion of D. White review of the Basalt Waste Isolation Project in the Environmental Assessment, Worker Safety Combined Effects.

Additional comments and responses on rock characteristics appear in Section C.5.2 of this appendix.

C.8.2.1 Water inflow

Thirty-three comments were received on water inflow. Individual comments dealt with the high-pressure flows on penetration of flow tops and along discontinuities within basalt flow interiors, the potential

during drilling or repository construction for intersecting zones of undetected porosity, high water inflows flooding the repository in minutes, the response time for stopping such flooding leaks, water flow along joints, cracks, and (or) faults potentially allowing the site to flood, the possible need for massive dewatering, and the U.S. Department of Energy underestimating the possibility of such catastrophic flooding. These comments are divided into the following issues, each of which is addressed in this subsection:

- Water inflow during construction.
- Adequacy of discussion of freezing and grouting techniques.
- Influence of seismicity on ground-water flow.
- Water-pressure influence on stability.
- Isolation characteristics.

Issue: Water inflow during construction

Commenters were concerned that high inflows of water during construction and the activities of the reference repository location might prevent or at least hinder the safe operation of the repository.

Response

Penetration of flow tops by the drift or development headings can be avoided by forward-probing exploratory drill holes and by using the vesicular zone as a marker horizon to control the vertical location of the excavations within the desired portion of the dense interior.

Hydrologic studies (Baker, 1985) show that a borehole intersecting a 10-meter- (33-foot-) thick flow top would produce 0.07 cubic meter (18.5 gallons) per minute after 1 minute and approximately 0.04 cubic meter (10 gallons) per minute steady state, assuming values of hydraulic conductivity 10^{-7} meter (3×10^{-7} foot) per second, storativity 10^{-5}, and head 900 meters (2,950 feet). Even the worst-case scenario of the drift penetrating the full 10-meter- (33-foot-) thick top flow with 100 times greater hydraulic conductivity (10^{-5} meter (3×10^{-5} foot) per second) would produce 0.21 cubic meter per second (3,400 gallons per minute) after 1 minute, decreasing to 0.11 cubic meter per second (1,800 gallons per minute) after 100 minutes. However, recognizing the vesicular zone as a marker horizon and maintaining the drifts and developments below, or within, the vesicular zone ensures that there will be approximately 20 meters (65 feet) or more of flow interior between the excavations and the flow top.

Probing holes would not be required to intersect the top flow, although some will be drilled to the flow top to confirm the thickness of dense interior between the flow top and the vesicular zone. Holes drilled for locating the vertical position of the repository will be directed at locating the vesicular zone. This zone has a permeability of approximately 10^{-11} meter (3×10^{-11} foot) per second or lower (except

for one test in borehole DC-16A where 10^{-8} meter (3×10^{-8} foot) per second was recorded). In this horizon, inflows to the borehole would be minimal (less than 0.00003 cubic meter per second (0.5 gallon per minute)) or allow location of anomalous water-bearing zones in advance of excavation. Anomalous water-bearing zones could be inclined fault zones or zones where changes in interflow structure cause increased vertical permeability. Such zones will either be grouted off before excavation using long forward-probing holes or sealed after excavation using short holes. Even the worst-case scenarios with water inflows of 0.22 cubic meter per second (3,400 gallons per minute) are well within existing pumping capabilities and do not require equipment or procedures that are not well developed in the mining and tunneling industries. Engineering measures such as providing for sumps underground are relied on to minimize peak pumping capacity.

Flooding of the repository is considered highly unlikely. Massive dewatering is not expected. Water inflow will be addressed further and a discussion included in the environmental impact statement prepared for repository construction if the reference repository location is recommended as a site for a repository.

Subsections 6.3.3.2.6.2, 6.3.3.2.9, and 6.3.3.2.10.3 of the final Environmental Assessment have been updated to include additional information on inflow (e.g., 0.22 cubic meter per second (3,400 gallons per minute)) (Baker, 1985).

Issue: Adequacy of discussion of freezing and grouting techniques

Commenters stated concerns that the Draft Environmental Assessment (DOE, 1984b) did not fully address freezing methods, grouting techniques, and the longevity of grout materials in the repository environment.

Response

The Draft Environmental Assessment included a limited discussion of drill-and-blast shaft-sinking methods, including the use of freezing as a means of ground-water control. These methods are not currently preferred. If the reference repository location is recommended for characterization and if during characterization these methods appear more beneficial than the currently preferred drilled shaft approach, they will be addressed for license application.

Grouting techniques and longevity of grout methods were not discussed in the Draft Environmental Assessment because they are considered existing technology. The longevity of various grout materials for postclosure is currently being studied and will be further addressed during site characterization should the reference repository location be recommended for characterization.

Issue: Influence of seismicity on water inflow

Commenters felt that potential changes in inflow rates could result from seismically induced changes in head and (or) hydraulic conductivity.

Response

Changes in inflow due to seismicity would be addressed during site characterization. At the present time, significant seismic activity at the repository horizon is given a low probability (see Seismicity Subsection 6.3.1.7.1 of the Draft Environmental Assessment).

Issue: Water-pressure influence on stability

A concern was stated that potential rock bursts could occur due to water pressures of 9.7 megapascals (1,400 pounds-force per square inch) acting on highly fractured or brecciated portions of the basalt flows.

Response

Rock bursts due to high water pressures (9.7 megapascals (1,400 pounds-force per square inch)) acting on highly fractured or brecciated portions of basalt flow are not considered likely because of the low permeability of the undisturbed dense interior of the basalt flows and the relatively high permeability of the damaged basalt around the excavations. The forward probing and grouting, as necessary, should ensure an acceptable pressure gradient between the flow tops and development openings in areas of high vertical permeability. This problem of water-pressure-induced rock failure can be overcome, somewhat, by providing drainage holes behind the rock-support system to a depth of 2 to 3 meters (6 to 8 feet) with grouting beyond this immediate perimeter.

Issue: Isolation characteristics

Commenters questioned whether there is a possibility that, if high water inflows occur, the isolation characteristics of the rock may not be as good as indicated in the geohydrology section of the Draft Environmental Assessment.

Response

If, on excavation to the repository depth, high water inflow was shown to be a prevalent condition, then the isolation characteristics of the candidate location would not be as favorable as indicated in the geohydrology section of the Environmental Assessment (see Subsection 6.3.1.1).

Current assessment of the reference repository location (see Section 6.4.2) indicates that the isolation characteristics of the candidate site exceed those required by the regulatory criteria. These determinations are based on evidence that indicates the typical conditions expected to be encountered within the repository flow typically would

generate relatively minor amounts of water considering the overall facility. Locally, however, geologic features (such as faults or shear zones) are expected to be encountered and could produce zones of high water inflow. The flow interior is not expected to yield significant amounts of water and is not relied on for isolation for long-term repository performance assessment. If, or when, high water inflows are experienced, the nature and extent of the feature producing the inflow would require investigation. The repository design layout relies on the lateral extent of the Cohassett flow horizon to be sufficiently flexible to allow areas that are marginally acceptable to be rejected for waste placement. If local high water inflows are not subdued with time or are otherwise apparently interconnected to extensive water-bearing zones, grouting or sealing of the areas would be warranted to avoid inflow or prevent inflow from continuing. These types of measures are considered to be within reasonably available technology and would be relied on to avoid high water inflow or prevent such inflow from becoming a problem or jeopardizing the safety of the underground work force.

C.8.2.2 Thermally induced fracturing

Several comments discussed fracturing from postemplacement heat generation. These comments are divided into the following issues, and are addressed in this subsection:

- Spalling, shattering, or fracturing of basalt.
- Unknown effects of temperature on basalt.
- Thermal effects on joint infill material.
- Low thermal expansion.
- Extent of thermally induced fractures.
- Plasticity and hydrothermal fracturing.

Additional comments related to the fracturing effect on conductivity are treated in Section C.5.3 of this appendix.

Issue: Spalling, shattering, or fracturing of basalt

Commenters stated that thermal energy introduced with waste emplacement could cause spalling, shattering, or fracturing.

Response

Spalling, shattering, or fracturing during thermal loading of the rock is considered a low-probability event for basalt. Experiments at the Near-Surface Test Facility included higher heating rates and higher temperature than expected at the repository, with no spalling or shattering. The combination of thermally induced and in situ stress-induced spalling will be evaluated during the exploratory shaft testing, and if a problem is identified, either the heat loads will be decreased or the borehole liners enhanced. Temperatures above 200°C (392°F) are not expected away from the immediate vicinity of the waste canister.

The full-scale heater tests at the Near-Surface Test Facility resulted in peak temperatures of greater than 600°C (1,112°F) with no significant degradation. Laboratory tests on basalt up to 200°C (392°F) show no reduction in compressive strength with tests up to 300°C (572°F) showing only a slight reduction (up to 20 percent reduction in strength). At this time, more testing of basalt in the 300°C (572°F) range is planned both in the laboratory and at depth (when the exploratory shaft is complete).

Theoretical analysis relying on numerical models indicates that fracturing, or fracture extension, and joint slip, or joint opening, resulting from the heat generated from the waste is expected in the immediate vicinity of the canisters and in an annulus around the repository emplacement rooms. To evaluate the extent of potential fracturing (or nonlinear stress-strain response) Raymond Kaiser Engineers, Inc./Parsons Brinckerhoff Quade & Douglas, Inc. (RKE/PB, 1984) and Mitchell (1986) made calculations with both closed-form solutions for circular holes (emplacement holes) and finite-element thermomechanical computer codes for analysis of stress and displacement around the emplacement room. Rock-mass strength estimates were based on laboratory test data for intact basalt, reduced in value to account for the jointing in the basalt flow in a manner demonstrated by Rosengren and Jaeger (1968). For a repository in the Cohassett flow, the analysis predicted that the thermally induced fracturing around the emplacement room is limited to 18 centimeters (7 inches), which is within the damaged zone caused during excavation, and within 7 centimeters (2.8 inches) for the emplacement holes.

Thermally induced fracturing caused by expansion of fluids in vesicles has been evaluated and found to be unlikely because of pressure bleed off to nearby hydraulically connected joints. Darcian flow through the intact basalt is sufficient to dissipate the potential pressures generated by differential expansion of fluid-filled vesicles (also refer to response to Subsection C.5.3.1 of this appendix).

Subsections 6.3.1.3.6 and 6.3.3.2.8 of the final Environmental Assessment have been modified and emphasize the Near-Surface Test Facility full-scale heater test observations, laboratory studies, and numerical analysis results. These studies indicate that thermally induced dynamic shattering and spalling are not likely and that fracturing is expected to be limited under expected repository conditions.

Issue: Unknown effects of temperature on basalt

A concern was stated that effects of high temperatures on rock are unknown or not demonstrated by testing.

Response

The thermal and thermomechanical properties of basalt are reasonably well known from both laboratory studies and field testing at the

Near-Surface Test Facility. This level of understanding is not sufficient for repository design or license application; therefore, should the reference repository location be recommended for characterization, additional laboratory and in situ tests would be conducted during the site-characterization phase.

Issue: Thermal effects on joint infill material

Commenters felt that the effect of water liberation from heated infill material and subsequent lubrication of joints would affect ground-support problems.

Response

The condition of and response to heating of the joint infill material is poorly quantified at this time. Joint mapping during drilling and construction of the Exploratory Shaft Test Facility will provide significant data on joint conditions. Joint infill dehydration after waste emplacement could be beneficial and could compensate for thermal expansion. Lubrication of these cooling joints cannot be excluded but has not been demonstrated at this time. This post waste-emplacement phenomenon can be partially evaluated during the site-characterization phase, should the reference repository location be recommended for characterization. The ground-support system in the emplacement rooms would be designed to compensate for this possibility and the effects of thermal stress.

Issue: Low thermal expansion

Commenters were concerned that the favorable condition discussed in Subsection 6.3.1.3.4 of the Draft Environmental Assessment is present for only one (low thermal expansion) of three qualifying conditions.

Response

The favorable condition in Subsection 6.3.1.3.4 of the Draft Environmental Assessment (DOE, 1984a; 960.4-2-3(b)(2)) did include three conditions, but from the phrasing of the sentence, if the site meets only one of the conditions, the site is acceptable. This interpretation of the phrasing was common to all of the draft environmental assessments (i.e., salt, tuff, and basalt). Basalt has a relatively low thermal expansion coefficient and, therefore, meets the favorable condition.

Issue: Extent of thermally induced fractures

A concern was stated that no discussion of the fractures generated due to differential stress created around a mine opening, of how heat affects the formation of stress fractures, or of the possibility that thermal fractures will penetrate the flow tops was provided in the Draft Environmental Assessment.

Response

Fractures are expected to be developed due to stress redistribution during mining and due to thermally induced stress changes, but these fractures are expected to be confined to the rock immediately surrounding the excavations. The rock-support system will be designed to support rock in the damaged rock zone. The waste-emplacement density will be sufficiently low that the performance of the repository is within acceptable limits in that thermally induced fractures are limited to the damaged rock zone. Modeling indicates that for the conditions in the Cohassett flow the thermally induced fracturing would be limited to approximately 21 centimeters (8.3 inches) in the crown of the opening, which is within the zone damaged during the excavation method.

The likelihood of thermally induced fractures intersecting the flow top is considered low because the Cohassett flow is sufficiently thick to provide a 15-meter (46-foot) buffer of flow interior. This is felt to be thick enough to provide a natural barrier between the containers and the flow top.

Issue: Plasticity and hydrothermal fracturing

Commenters felt that deficiencies exist in the position of the U.S. Department of Energy on thermal properties of basalt, so the final Environmental Assessment should include a thorough discussion of plasticity and hydrothermal fracturing.

Response

Plasticity was not discussed in the Draft Environmental Assessment because it was not considered a dominant mode of deformation in the host rock. Under the stress and temperature conditions at the repository horizon, basalt is a hard, brittle rock with deformation controlled by the intact basalt and preexisting joints. Hydrothermal fracturing has a low probability of occurring under the temperatures and pressures expected at the repository horizon. Hydrothermally induced fractures from fluid-filled vesicles is discussed in Subsection C.5.3.1 of this appendix.

Additional information is presented in Subsections 6.3.1.3.6 and 6.3.3.2.8 of the final Environmental Assessment, where the potential for thermally induced fractures and other physical phenomena are discussed.

C.8.2.3 Rock support and maintenance

Six comments were received concerning rock support and maintenance. These comments are divided into the following issues, each of which is addressed in this subsection:

- Difficulty in maintaining support in low-quality ground.
- Possibility of extensive maintenance.

- Effect of temperature on rock-support performance.
- Cost of support.

Issue: Difficulty in maintaining support in low-quality ground

A concern was stated that rock support and maintenance of the repository openings may be difficult in zones of low-quality rock, vesicular zones, and flow tops.

Response

The expected ground-support requirements in poor ground, vesicular zones, or flow tops were not addressed specifically in the Draft Environmental Assessment because waste emplacement was not expected in these zones. Should developments intersect zones of poor rock quality, rock support would be installed as required by the conditions experienced. This could range from increased bolting (increased bolt length, bearing capacity, and (or) reduced bolt spacings), increased shotcrete thickness and reinforcement, or installation of other support systems such as steel sets.

The vesicular zone in the Cohassett flow is characterized as having the same structure as the colonnade but with higher unconnected porosity than in the interior. The permeability is a little higher (typically 10^{-11} meter (3×10^{-11} foot) per second compared to 10^{-13} meter (3×10^{-13} foot) per second for the dense interior), but the intact rock strength is lower. The stress in the zone is unknown but can be assumed to be lower than in the dense interior because of its lower elastic modulus. From these considerations, Barton (1986) has estimated that the support requirements in the vesicular zone are bolts on 0.8-meter (3-foot) centers plus 5 centimeters (2 inches) of fiber-reinforced shotcrete. These requirements are somewhat higher than that expected for the colonnade portion of the flow and about the same as that of the entablature. These support requirements are not excessive and indicate that mining through or in the vesicular zone is not significantly different than that expected in the dense interior. The current plan is to use the vesicular zone as a marker bed to vertically locate developments at approximately the mid-height of the Cohassett flow. This method of determining location within the flow could reduce the potential for intersecting a flow top or flow bottom and thus deserves additional attention.

Subsections 6.3.3.2.4 and 6.3.2.7 of the final Environmental Assessment have been expanded to include discussions of ground support and maintenance in the vesicular zone.

Issue: Possibility of extensive maintenance

Commenters felt that the possibility of extensive maintenance of the underground openings is not eliminated by the Barton Q-system classification, the rock mass rating system, or the case histories given.

Response

The "excavation support ratio" of the Barton et al. (1974) system can be used to ensure that a conservative, stable, minimum maintenance support system is selected. Barton (1986) used a conservative excavation support ratio of 1.0, which is typically used for sensitive civil structures (see p. 6-192 of the Draft Environmental Assessment). Had Barton used an excavation support ratio of 3.0, no support would be required but increased maintenance would be required with time. In this case, the U.S. Department of Energy elected to be conservative in the support system and take the "not present" position with regard to the favorable condition relating to minimal or no support (see Subsection 6.3.3.2.4 of the Draft Environmental Assessment), but then took the "not present" position in the potentially adverse condition on maintenance (see Subsection 6.3.3.2.7 of the Draft Environmental Assessment). Additional understanding of the amount of maintenance required for underground openings would be provided by site-characterization activities.

Issue: Effect of temperature on rock-support performance

Commenters stated concerns that the Draft Environmental Assessment does not address the decreased performance of concrete and rock bolts due to temperature and increased thermal loads.

Response

Performance of rock bolts, shotcrete, concrete, and resins under thermal loads are not well defined at this time. A significant effort would be required during the site-characterization phase to evaluate suitable specific rock-support system components for the Basalt Waste Isolation Project.

Issue: Cost of support

A concern was stated that the Draft Environmental Assessment does not address the cost of extra support for rock openings and the safety of the openings.

Response

The cost of extra support for the rock openings has not been addressed at this stage of the repository design. The rock-support system of rock bolts and shotcrete is common in many underground excavations and is not considered excessively expensive. Additional support may be required in localized zones of poorer rock quality but the cost of support for these zones and the extent of these zones relative to the areas where rock bolts and shotcrete are required cannot be estimated at this time. However, a wide variety of support systems exists within reasonably available technology to provide safe working conditions.

The design method for selection of the support system is based on experience from many other safe underground excavations used in mining and civil construction; hence, the repository openings, as designed, should be sufficiently safe for the operational period. The ground-support system will be constantly monitored and inspected, and in areas of concern, remedial action will be taken if excessive movement occurs.

C.8.2.4 Flexibility as to the depth, configuration, and location of the underground repository

The issue of sufficient host-rock thickness and lateral intent to allow flexibility in locating the underground repository is important to both the postclosure and preclosure rock characteristics.

Response

See Subsection C.5.3.2 of this appendix for a discussion on those comments concerned with sufficient flexibility of the flow horizon.

C.8.2.5 Worker safety

Numerous comments were received regarding worker safety. These comments are divided into the following issues:

- Rock bursts.
- High ground-water inflow.
- High rock temperature.
- Methane gas.
- Container retrieval.

The ground-water inflow issue is discussed separately in Subsection C.8.2.1 of this section. Also related to these issues are the comments referencing either the Dr. Don White paper or the Health and Energy Institute report, both of which address the same rock characteristics important to worker safety. These comments are addressed in Subsection C.8.2.6 of this section.

Issue: Rock bursts

Minimizing the risk of rock bursts was a frequent concern of the commenters.

Core discing or poker chipping at the Hanford Site is indicative of high stresses and potential rock-bursting. High and uneven stresses measured at depth also are indicative of rock bursting problems and

suggest potential safety problems for construction workers as well as the possibility of postemplacement high temperatures and induced stresses causing rock bursts or shattering.

Response

Rock bursting, as described by massive rapid collapse of openings, is not expected based on the evaluation of Blake (1984). However, small-scale spalling of rock at the face, usually after blasting and before installation of the rock-support system, can be expected. The rock-support system of bolts and shotcrete has been successful in other situations in controlling this type of minor failure and ensuring the safety of workers in mine operations (Saito et al., 1983; Barton, 1986). Core discing generally is indicative of high in situ stresses but does not preclude safe construction in such areas. Discing and higher in situ stresses have been observed or measured in many tunnels and underground mining projects that have been successfully completed (e.g., Kan Estu tunnel in Japan (Saito et al., 1983) and mining at depth in South Africa (Vasey, 1983)).

The final Environmental Assessment includes an expanded description of discings, spalling, and stress measurements (hydraulic fracturing) data in Subsections 6.3.3.2.4 and 6.3.3.2.6.

Issue: High rock temperatures

Commenters were concerned that high rock temperatures potentially require refrigeration and may pose potential safety problems for workers.

Response

Mining in areas where rock temperatures are higher than that expected at the reference repository location are quite common in the mining industry. Techniques, including refrigeration of drilling fluids and ventilation air, are well developed and will be used during construction of the repository at the Hanford Site. No worker safety problems due to the high rock temperature are expected. The working temperature will be controlled to approximately 27°C (80°F) wet-bulb temperature, which is in compliance with the limits set by the American Conference of Government Industrial Hygienists (ACGIH, 1982).

The technology necessary for controlling the temperature of working environments is common (see, for example, Lambrechts, 1967; Graves and Stroh, 1972). Many mines around the world operate in a production mode with rock temperatures above 65°C (140°F), which is higher than that expected at the Cohassett flow (Hartman et al., 1982). For example, rock temperatures in excess of 54°C (130°F) have been reported at the Homestake mine in South Dakota (Thimons et al., 1985). Six more examples of hot mines are listed in the Draft Environmental Assessment. Lambrechts (1967) and Graves and Stroh (1972) detail ventilation design methods

developed for the deep, hot, South African gold mines. The upper level for successful mining has been placed by White (1955) at 80°C (176°F), a full 11°C (52°F) above the expected repository temperature.

Table 6-24 in the final Environmental Assessment includes other examples of mining in areas with high rock temperatures.

Issue: Methane gas

A concern was stated that methane gas, which is explosive, may be released during excavation.

The Draft Environmental Assessment failed to discuss how high temperatures would affect the release of methane into the repository and if methane gas would possibly interact with the canister, thus accelerating corrosion and forming complexation with the radionuclides, inhibiting their retardation by the clay minerals.

Response

Methane release is a phenomenon associated with ground-water inflow, which is discussed in Subsection C.8.2.1 of this section. Methane production is expected to be low in comparison with other mining experiences in coal and salt as presented in the Draft Environmental Assessment.

With the recent refinement in the estimated ground-water inflow, the estimated uniform methane inflow rate has been correspondingly re-estimated. The repository design ventilation system is expected to provide 191 times more fresh air than needed to dilute the methane to less than 0.25 percent. The Draft Environmental Assessment, Figure 6-12, shows the range of methane gas concentrations for which the mixture is flammable or explosive. This indicates that concentrations of approximately 6 percent of methane are necessary for either an explosive or flammable mixture. Even during unexpected high water inflow (maximum estimated water-inflow rate of 0.22 cubic meter per second (3,400 gallons per minute)), the methane would be diluted to below the 0.25-percent concentration level. For comparison, given the methane concentrations expected and total ventilation quantities, water inflows up to 118 liters per second (18,700 gallons per minute) could be experienced and still be below the 0.25-percent concentration.

The effect of increased temperature on methane production has not been directly addressed because it is not expected to pose a significant problem in repository operations. This has been established for the following reasons:

- The calculation for methane release conservatively assumes that all methane contained in the water is liberated.
- During construction, all regions of water inflow will be grouted off, thereby minimizing the ground-water inflow and methane release to the underground openings.

- The ventilation requirements to further cool an emplacement room prior to human intrusion are significant and sufficient to dilute methane or other gases.

- The ventilation requirements during construction are sufficient to dilute an expected or unusual gas inflow (see Subsection 6.3.3.2.6 of the final Environmental Assessment).

- Methane release is associated with pressure and temperature change in the ground water. Repository construction will reduce the pressure in the immediate vicinity of the opening, but because of the low permeability of the dense interior, the pressure change in the flow tops where the majority of the ground water is located is expected to be small. Maximum temperatures in the flow tops are expected in the range of 100 to 120°C (212 to 248°F). Around the canister, higher temperatures are expected but ground-water availability is low. The combined effects of pressure and temperature change on methane production will be further evaluated during the site-characterization phase, should the reference repository location be recommended for characterization.

Interaction of methane with radionuclides only is possible with radiolysis in the waste package environment. This concern is discussed in Subsection C.5.2.2 of this appendix.

The final Environmental Assessment contains updated gas inflow estimates in Subsection 6.3.3.2.6.2.

Issue: Container retrieval

Commenters felt that the retrieval of a breached container is a potentially hazardous problem. Related concerns discussed the loss of monitoring capabilities and the ability to take corrective measure if a leak should occur due to earthquake damage or rock failure. There would also be a health risk to miners working at the repository if such a leak should occur.

Response

The radionuclide safety hazards will be kept to a minimum by design of the container and emplacement holes, by design of the canister retrieval system, and by monitoring of a statistically meaningful number of emplacement holes in the confirmation testing facility and throughout the repository. Breaching of a container is an extremely low-probability event, given that the canister is designed with a life of over 1,000 years and with the estimated mean time for waste release over 6,000 years (see pp. 6-243 through 6-256 of the Draft Environmental Assessment).

Earthquake damage can be expected to be small if the epicenter is located some distance from the repository; if the earthquake is located in close proximity to the repository, it may be considered comparable to a

large rock burst. The potential for such a local event is low (Blake, 1984), but should such an event occur, monitoring capabilities may be affected and ground-water inflow could increase. The repository design will address such low-probability occurrences and will design pumping capacity or provide emergency backup capability as necessary.

C.8.2.6 Inclusion of D. White review of the Basalt Waste Isolation Project in the Draft Environmental Assessment, worker safety combined effects

Numerous comments were received that fall into this subsection. These comments are addressed in the following issues:

- Flexibility, rock bursts, and combinations of rock bursts, geologic inhomogeneities, and high rock temperatures.
- The additional effect of hot water and methane on constructibility.

Issue: Flexibility, rock bursts, and combinations of rock bursts, geologic inhomogeneities, and high rock temperatures

Many of the concerns had direct quotations from a 1983 paper written by White, which was included as an appendix to Health and Energy Institute report (Makhijani and Tucker, 1985).

Response

The report by D. White published in June 1983 was based on data available to White and the National Research Council, National Academy of Science as of June 1981 (National Academy of Sciences-National Research Council, 1983). Since that time, significant data gathering, engineering studies, and clarification of licensing and site-selection procedures have occurred that may resolve or change the perspective of comments made by White. The conclusions of White that related to rock characteristics will be discussed individually and then additional concerns raised by Makhijani and Tucker (1985) will be addressed.

White made five conclusions, three related to rock characteristics, one related to hydrology, and one related to geochemistry. The three conclusions related to rock characteristics were as follows:

- "The area is not geologically favorable relative to some other potential sites. Active tectonic deformation is still occurring; shallow earthquakes are frequent but small. The best available part of the basalt sequence is in the 'uniform' center of the Umtanum flow, 47 $\pm$ 5 meters thick, near the axis of the Cold Creek Syncline. However, vertical and horizontal inhomogeneities are likely to occur (initial flow irregularities, later folding, and possibly numerous faults). Altitude changes in boundaries of the

'uniform' flow center, rising and falling with inhomogeneities, will be very difficult to predict in advance of mining, thereby risking unpredicted encroachments on permeable flow margins and faulted offsets."

- "Performance of the Umtanum during repository construction is especially critical. The region has been and probably still undergoing extensive north-south horizontal stress, probably causing the unusual degree of intense spalling of hard drill core into 'discs' or 'poker chips' as thin as 0.5 centimeters (National Academy of Sciences-National Research Council, 1983, Ch. 6) as the rock is penetrated by the core bit. This phenomenon has not been adequately recognized in previous Basalt Waste Isolation Project studies and has not been recognized in other basalts, at least to this extreme degree. The discing is probably a forewarning that 'rock bursting' (sudden collapse of rock margins during excavation) may be difficult or even impossible to control at reasonable costs."

- "Effects of rock bursting (or exaggerated yielding), inhomogeneities in the Umtanum's central zone (changing in altitude with advancing construction), and constructing a repository at such high initial temperatures (approximately 57°C or higher and only 40°C below planned canister surface temperature), may each be individually tractable; but all in combination may be intolerable in cost of money, time, energy, and loss of lives, especially if rock bursting is frequent and difficult to predict."

The first conclusion reached by White relates to the issue of flexibility in siting the repository. Subsequent to the time of White's study, other studies, tests, and drilling programs have been conducted and the Cohassett flow has been selected as the candidate horizon. With the emphasis on the Cohassett flow as the candidate horizon, some of the concerns raised by White must be reduced. The Cohassett flow is thicker than the Umtanum flow, is stronger, and has lower stress. This issue is addressed in Subsection C.5.3.2 of this appendix and concludes that the reference repository location provides adequate vertical and lateral flexibility for the siting of the repository.

The second conclusion addressed the Umtanum flow but is equally applicable to the Cohassett flow. Since 1981, the Basalt Waste Isolation Project has continued to analyze the stress conditions at the Basalt Waste Isolation Project both from direct hydraulic fracturing stress measurements (Kim et al., 1984) and from stress indicators such as core discing (Lehnhoff et al., 1982), borehole spalling (Paillet, 1985), and microearthquakes (Rohay and Davis, 1983) and to relate that to underground excavation experience throughout the world (Blake, 1984; Barton, 1986; and Voss, 1984). The conclusions of these studies are reflected in the Draft Environmental Assessment and are further clarified in Subsection C.8.2.5 of this section. Core discing in itself does not mean that construction

need be "difficult or even impossible to control at reasonable cost" (White, 1983). Discing has been observed in drill holes in basalts where subsequent construction has been successful (Saito et al., 1983; Bai et al., 1983).

The third conclusion indicated that rock bursting, inhomogeneities and construction under high initial temperatures may each be individually tractable but all in combination may be intolerable. This opinion is not supported by underground mining experience where inhomogeneity, high initial rock temperatures, and high initial stresses have been often encountered and overcome. The South African gold mining industry is one with more unfavorable conditions in terms of temperature and stress, yet successful mining has been ongoing for nearly a century. The large rock burst encountered in South Africa are associated with high-extraction mining, which would not be typical of an underground repository where the extraction ratio (amount of rock excavated compared to amount of rock in the excavation horizon) is expected to be less than 20 percent. High rock temperatures are addressed in the Draft Environmental Assessment (Subsection 6.3.3.2.6.2) and in Subsection C.8.2.5 of this section, and engineering technology is available to ensure acceptable working conditions (temperatures less than 27°C (80°F)) throughout the repository.

Issue: The additional effect of hot water and methane on constructibility

Some commenters requested that the effect of hot water and methane and the adverse effects identified by White should be addressed.

Response

The Health and Energy Report (Makhijani and Tucker, 1985) adds two additional phenomena to those identified by White: the potential for "substantial seepage of hot water from the copious aquifers above it" and "the release of methane gas contained in the water into the mine" as further complications to mine safety and health. These two issues are addressed in Subsections C.8.2.1 and C.8.2.5 of this section and are interrelated to the ground-water inflow estimates. Following the logic presented in Subsection C.5.3.2 of this appendix, with the repository located within the Cohassett flow interior and by using the vesicular zone as a marker bed, the potential for an inadvertent intersection with the top flow or permeable member is greatly reduced.

Worst-case scenarios of the intersection of the flow top during development indicate only modest ground-water inflow with maximum short-term flows of up to 0.21 cubic meter per second (3,400 gallons per minute). However, exploratory drilling and grouting, if necessary, should limit water inflow to the entire repository to about 0.0063 cubic meter per second (100 gallons per minute). This inflow is not expected to be noticeable and may be removed by the ventilation air, resulting in an essentially dry underground environment. The ventilation air requirements (to exhaust equipment exhaust fumes and to cool the workings) will provide sufficient air volume to dilute the methane gas to Mine Safety and Health Administration standards (MSHA, 1983).

The difficulty of mining under conditions of high temperature, high stress potential, high water, and gas inflow are recognized, but mining procedures and precautionary measures should ensure that safe conditions are maintained. High temperatures will not be an operational problem because a requirement of the ventilation system is to keep the working face and all operational areas below 27°C (80°F). Ground-water inflow will be minimized by the following:

- Maintaining the openings near the middle of the Cohassett flow, thereby ensuring a barrier of approximately 18 meters (59 feet) of low-permeability host rock that will effectively eliminate the possibility of intersecting a flow top or flow bottom structure.

- Forward-probing holes will be used to evaluate areas of potentially high ground-water inflow and to assess the need for grouting. Grouting both in long forward holes before excavation and in radial holes after excavation will be used to minimize ground-water inflow.

The potential for rock bursts has been discussed by Blake (1984) and Barton (1986) and both agree that minor spalling-type events are possible during, or immediately after, excavation. The installation of rock bolts and shotcrete should control such events in order to provide a safe and stable working environment. Monitoring during construction will provide an indication of adequacy of the support system and additional layers of shotcrete can be applied in areas where ground movement persists.

The conditions encountered during the breakout at the base of the exploratory shaft will provide the first excavation experience at depth in the dense basalts. This experience will reduce the uncertainties and unknowns that presently exist in evaluating worker safety. With presently available data, comparisons with other excavation experience, and the use of existing technology, construction with worker safety appears feasible.

C.8.3 PRECLOSURE HYDROLOGY

This section contains comments received on preclosure hydrology, Subsection 6.3.3.3 of the Draft Environmental Assessment. Concerns raised by commenters are divided into three issues:

- Preclosure shaft sealing.
- Preclosure flash flooding.
- Flood-water impacts.

Issue: Preclosure shaft sealing

One commenter expressed concern regarding ground-water inflow into shafts. A second questioned the statement that shaft and repository construction would not require engineering measures beyond reasonably available technology to accommodate or limit ground-water inflow.

Response

The potential for ground-water inflow through the shafts has been evaluated. Design and construction methods will include provisions for shaft sealing to minimize ground-water inflow and reduce the risk of flooding. Grout placed between the steel liner, which forms the inside diameter of the shafts, and the excavated rock surface isolates the underground facility from major aquifers during the preclosure period. Provisions for such hydraulic sealing were discussed in Subsection 6.3.3.2.6.1 of the Draft Environmental Assessment. Methods used to detect the presence of water prior to shaft breakout and to collect and dispose of ground water during construction and operation were discussed in Subsection 6.3.3.2.6.2. Even though no underground construction on a scale representative of the nuclear waste repository has been attempted in basalt formations at the Hanford Site, the design features and construction techniques to be employed are based on previous underground mining experience under saturated conditions. Although actual conditions to be encountered cannot be predicted with certainty, the range of conditions expected should be accommodated within conventional design and construction methods.

Issue: Preclosure flash flooding

Comments were received regarding flash flooding discussions under preclosure hydrology (see Subsection 6.3.3.3.4 of the Draft Environmental Assessment) and preclosure surface characteristics (see Subsection 6.3.3.1.5 of the Draft Environmental Assessment). A reviewer addressed the apparent lack of consistency between data presented in the Draft Environmental Assessment and the U.S. Department of Energy assessment of the potentially adverse condition under Surface Characteristics (DOE, 1984a; 960.5-2-8(c)) (see Subsection 6.3.3.1.5 of the Draft Environmental Assessment). The commenter stated that consideration should be given to the impacts of the probable maximum flood and to use of this flood as a design basis for assessing the potentially adverse condition. Another comment asked for a reevaluation of the second favorable condition under hydrology (DOE, 1984a; 960.5-2-10(b)(2)) regarding the absence of surface-water systems that could potentially cause flooding of the repository (see Subsection 6.3.3.3.4 of the Draft Environmental Assessment). The basis for this request was the use of a 50-percent breach of Grand Coulee Dam as the design basis. A third comment questioned the lack of data to support existing positions in either Subsections 6.3.3.1.5 or 6.3.3.3.4. This comment was based on an acknowledgement in the Draft Environmental Assessment that potential exists for site flooding and that engineering measures might be required for flood protection. The reviewer stated the findings should be reevaluated or additional supporting data should be included in the final Environmental Assessment.

Response

The U.S. Department of Energy has reevaluated the design basis for flooding and will use the probable maximum flood as a conservative basis

for determining flood paths, rather than the 100-year flood potential used in Subsections 6.3.3.3.4 and 6.3.3.1.5 of the Draft Environmental Assessment. Examination of the area flooded indicates that some surface facilities may lie within the area of a probable maximum flood (see Fig. 3-31, p. 3-68 of the Draft Environmental Assessment). Therefore, the U.S. Department of Energy concurs with the comments and has changed the stance from "present" for the second favorable condition under preclosure hydrology (DOE, 1984a; 960.5-2-10(b)(2)) (see Subsection 6.3.3.3.4 of the final Environmental Assessment) to "not present." In addition, the "not present" stance for the only potentially adverse condition under preclosure surface characteristics (DOE, 1984a; 960.5-2-8(c)) (see Subsection 6.3.3.1.5) has been changed to a "present" position.

The surface facilities that might be affected by a probable maximum flood are located near the edge of the flooded area as shown on Figure 3-31 (p. 3-68 of the Draft Environmental Assessment). Skaggs and Walters (1981) estimated the maximum elevation at which engineered flood protection would be required is approximately 196 meters (645 feet) mean sea level between Cold Creek Valley miles 15.0 and 18.0. Facilities would be located at an elevation of approximately 195 meters (640 feet) mean sea level. Engineered facilities (e.g., berms, channel alteration, dikes, diversions) could be constructed to protect the surface facilities from this potential flooding. However, siting guidelines mandate that failure of any such structures be considered as part of the potentially adverse condition. Thus, credit is not taken for the existence of any engineered components of the repository facilities.

Skaggs and Walters (1981) used 1:62,500 scale topographic maps with 6-meter (20-foot) contour intervals as topograph controls in their flood analyses. The accuracy of these maps, especially considering the large contour interval, can broadly overestimate or underestimate the area to be flooded during a probable maximum flood; therefore, uncertainty exists in the knowledge of the areal extent of a Cold Creek Valley probable maximum flood. A new subsection (4.1.1.7) has been added to the final Environmental Assessment to acknowledge the need for more accurate surveys of the Cold Creek Valley topography. This information will assist in refining flash-flood potential data for the reference repository location and vicinity.

Use of the 50-percent breach of Grand Coulee Dam is considered to be sufficient for determining flood potential from the Columbia River for reasons stated in Subsection C.4.1.2.1.2 of this appendix.

In response to these comments, Subsection 6.3.3.1.5 of the final Environmental Assessment has been rewritten to reflect no credit taken for the absence of this potentially adverse condition regarding surface flooding. In like fashion, no credit now is taken for the presence of the second favorable condition under preclosure hydrology (Subsection 6.3.3.3.4). The subsection has been revised to account for this change.

Issue: Flood-water impacts

A fourth comment stated that consideration should be given to use of a probable maximum flood instead of a 100-year flood, disruption of repository facilities and operations from flooding, occurrence of lesser floods that may extend to surface facilities, use of mitigation measures (flood-control structures) to reduce potential flooding impacts, and potential for radionuclide release to the flood waters.

Response

A probable maximum flood is now the comparison basis for both the potentially adverse condition under preclosure surface characteristics (DOE, 1984a; 960.5-2-8(c)) (see Subsection 6.3.3.1.5 of the Draft Environmental Assessment) and the second favorable condition under preclosure hydrology (DOE, 1984a; 960.5-2-10(b)(2)) (see Subsection 6.3.3.3.4). This is a more conservative position than the use of a 100-year flood. See Subsection C.8.3 (preclosure flash flooding issue) and Subsection C.4.1.2.1.1 of this appendix for additional details and changes reflected in the text of the final Environmental Assessment.

Potential repository facility disruption from flooding was covered in Subsection 6.3.3.3.4 (the second favorable condition under preclosure hydrology). This section plus the figures and text in Subsection 3.3.1.3.3 of the Draft Environmental Assessment (Flood potential) covered the topic of potential road and facility disruptions.

The most conservative comparison relative to the siting guidelines is against a probable maximum flood. If a probable maximum flood does not extend to the repository surface facilities, lesser floods will not.

Credit for mitigating measures or structures is specifically ruled out by the potentially adverse condition discussed in Subsection 6.3.3.1.5 (Preclosure surface characteristics), though it is recognized that such measures could minimize or eliminate flash-flood impact.

A discussion of the potential for radionuclide release from waste canisters in contact with surface water can be found in Appendix A of the final Environmental Assessment.

C.8.4 PRECLOSURE TECTONICS

Comments assigned to this section have been cross-referenced to and discussed in Section C.5.7.

C.8.5 SYSTEM GUIDELINE

Issue: Constructibility cost uncertainty

Several commenters addressed the lack of detailed cost information, and the uncertainties regarding cost estimates for repository construction and operation, especially with respect to the impact of alternative construction methods and alternative designs that may be required as a result of problem conditions that may be encountered. Some of these commenters recommended that cost uncertainties for each project should then be factored into the comparative cost evaluations of each site by the U.S. Department of Energy. Additional commenters identified several technical concerns potentially affecting constructibility (e.g., high in situ stress, thermal effects, and flooding) and asserted that the construction costs could therefore be prohibitive.

Response

Assessments of constructibility, as described in various sections of the Draft Environmental Assessment, are based on the best information available and on previous experience under conditions similar to those assumed for the reference repository location. Should the reference repository location be recommended for site characterization, construction and maintenance of the exploratory shaft facility will provide valuable information relative to repository conditions affecting constructibility. While this information will be extremely important in gaining an understanding of the reference repository location, uncertainties will remain regarding conditions that may be encountered during repository construction and measures necessary to accommodate such conditions. As stated in Subsection 7.3.3.2 of the Draft Environmental Assessment, there are significant uncertainties recognized in current cost estimates for the construction, operation, closure, and decommissioning of a repository. Estimates of the degree of uncertainty in these preliminary cost estimates are not available.

In light of such uncertainties, any attempt to rate candidate sites relative to estimated costs or estimated cost uncertainties would be of questionable value. Consequently, the U.S. Department of Energy has concluded that it is inappropriate to rank candidate sites with respect to costs or cost uncertainties at the environmental assessment stage. Following the site-characterization phase, sufficiently detailed information will have been generated to compare recommended sites relative to estimated costs as a basis for final site selection.

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C.9 GENERAL COMMENTS

This section of the Comment Response Document identifies and addresses several issues that apply to the Draft Environmental Assessment (DOE, 1984b) in general. The comments and concerns in this section, therefore, could not be placed in a single technical issue category of this appendix. Many of these issues dealt with the U.S. Department of Energy philosophy and approach used in preparing the Draft Environmental Assessment and requested that these approaches be modified in the final Environmental Assessment.

A summary of the issues in this section is provided below.

- Disagreements with guideline findings.
- Concerns about scientific integrity and objectivity.
- Human-intrusion potential at the Hanford Site.
- Diversion of commercial nuclear materials for defense purposes.
- Availability and timeliness of references used in the Draft Environmental Assessment.
- Coordination with the Bonneville Power Administration.
- Use of statistics to quantify uncertainty.
- Adoption of the site-selection environmental impact statement by the U.S. Nuclear Regulatory Commission.
- Long-term ground-water monitoring concerns.
- Inconsistencies between the Executive Summary and the text of the Draft Environmental Assessment.
- Moral and ethical implications of the repository at the Hanford Site.
- Independent review of the Basalt Waste Isolation Project.

Issue: Guideline findings

A number of comments were received on the guideline-by-guideline findings discussed in Chapter 6 of the Draft Environmental Assessment. Some commenters identified wording discrepancies between the findings prescribed by the General Siting Guidelines (DOE, 1984a) and findings stated in the Draft Environmental Assessment. Other commenters questioned the level of findings taken. Two commenters requested that the types of information described in Appendix IV of the General Siting Guidelines be specifically identified in the final Environmental Assessment. Another commenter suggested that a finding of "present" or "not present" should be the only response allowed in Chapter 6 of the final Environmental Assessment.

Response

The Draft Environmental Assessment was prepared over a 13-month period while the General Siting Guidelines (DOE, 1984a) were being finalized. The specific wording for guideline findings used the term "available evidence" until the final General Siting Guidelines were issued on December 6, 1984. The term "available" was deleted in Appendix III of the final guidelines, because it was obvious that evidence would have to be available before it could be used to support a guideline finding. The term "available" has been deleted from the final Environmental Assessment when making findings on the qualifying and disqualifying conditions of the General Siting Guidelines.

The concerns related to the level of findings taken on the qualifying condition under surface characteristics (DOE, 1984a; 960.5-2-8(a)) (see Subsection 6.3.3.1.6 of the Draft Environmental Assessment) and the disqualifying condition under Socioeconomics (DOE, 1984a; 960.5-2-6(d)) (see Subsection 6.2.1.7.11) resulted in a reevaluation of those findings. In both cases, it was determined that a more cautious approach would dictate a more conservative position in the final Environmental Assessment. Thus, the final Environmental Assessment indicates a Level 3 finding for the surface characteristics qualifying condition and a Level 1 finding for the socioeconomics disqualifying condition.

Another concern related to guideline findings was a request that Tables 6-A (see p. 6-iii of the Draft Environmental Assessment) and 6-B (see p. 6-v) indicate the specific types of information used in the guideline evaluations. This was not added to the final Environmental Assessment for two reasons. First, Appendix IV of the General Siting Guidelines was intended to be a summary of the types of information to be used when making findings for nomination of sites suitable for characterization. Appendix IV was not intended to be a checklist, as the commenter suggests. This decision is further supported by the first and last sentences of the introduction to Appendix IV. The first sentence stated, "The types of information specified below are those that the DOE expects will be included in the evidence used for evaluations and applications of the guidelines of Subparts C and D at the time of nomination of a site as suitable for characterization." The last sentence stated, "The types of information specified in this appendix will be used except where the findings set forth in Appendix III of this part can be arrived at by reasonable alternative means or the information is not required for the particular site." Thus, the information contained in Appendix IV was not intended for use as a checklist on which each site was to be evaluated. Instead, Appendix IV was intended to indicate the types of information that could be used when evaluating a particular guideline during the site-nomination phase. Second, it was judged that the nearly 350 pages of information and data presented in Chapter 6 of the final Environmental Assessment could not be accurately condensed into one or two tables.

The request for restricting findings on the favorable and potentially adverse conditions of the General Siting Guidelines to "present" or "not present" would not allow the qualifications necessary at this stage of

site nomination and recommendation. Since site characterization will be necessary to unequivocally state that a condition is present or not present, the appropriate qualifiers are still used in the final Environmental Assessment.

Issue: Scientific integrity and objectivity

A number of comments were related to the scientific integrity of the Draft Environmental Assessment. Commenters expressed concern that subjects were treated out of context, discussions were not fully integrated, and that many discussions relied heavily on supporting documents. A statement was made that the only way to answer the scientific questions discussed in the Draft Environmental Assessment is to continue the current investigations with full participation of the State of Washington and its scientific advisors. Finally, a feeling was expressed that optimistic findings were presented that are not supported by independent review agencies.

Response

The U.S. Department of Energy realizes that it is possible for a large document such as the Draft Environmental Assessment to be compromised by treatment of subjects out of context and by poor integration across various subject areas. In this regard, the Draft Environmental Assessment incorporated extensive cross-referencing to aid the reader in identifying related discussions of subjects. In addition, the summaries for Chapters 2 through 6 included matrix tables to indicate where subjects of that particular chapter were discussed in other chapters. The final Environmental Assessment continues these efforts to enhance the integration of technical discussions.

The intent of the Draft Environmental Assessment was to analyze the data and information related to siting a potential repository within the reference repository location at the Hanford Site. This task required that information from many existing documents be summarized or referenced. This was judged to be the optimum approach for most readers who would not desire or need a full and complete discussion of all analyses and conclusions. To facilitate the review of the Draft Environmental Assessment by more technically oriented readers, microfiche copies of each supporting document were provided in public libraries throughout Washington, Oregon, and Idaho (DOE, 1985). In addition, program participants (i.e., the State of Washington, Yakima Indian Nation, Umatilla Indian Tribe, and Nez Perce Indian Tribe) received full sets of the references. Other reviewing agencies, such as the U.S. Nuclear Regulatory Commission, also received sets of the references.

The Nuclear Waste Policy Act of 1982 requires that the U.S. Department of Energy conduct scientific investigations of site suitability and report those findings to various external parties. A draft of the Environmental Assessment was not required by the Nuclear Waste Policy Act of 1982; however, the U.S. Department of Energy decided that the issuance of a final Environmental Assessment without review by the scientific community, program participants, and members of the public

would not have been appropriate. If minimum guidelines for scientific consideration were not met in the Draft Environmental Assessment, it was fully expected that this would be pointed out by the various reviewers and that additions and (or) corrections would be made in the final Environmental Assessment based on specific recommendations by these reviewers. This is not meant to imply that the U.S. Department of Energy issued the Draft Environmental Assessment without conducting a thorough review of the data contained in the document.

On a related note, the Draft Environmental Assessment identified areas of uncertainty and issues for which site conditions were not optimal. This is an example of scientific integrity in the technical conclusions reached in the Draft Environmental Assessment. In areas where questions must be resolved, further study will be required during site characterization to ensure that final answers are available prior to selection of the first repository site. The studies to be conducted during site characterization would be outlined in a site-characterization plan scheduled to be issued in 1986.

Concerns that overly optimistic findings were presented in the Draft Environmental Assessment can best be understood when it is realized that the General Siting Guidelines (DOE, 1984a) contain various levels of findings for the site-selection process. At the site nomination and recommendation stage (before detailed site-characterization activities have been undertaken), a "reasonable but conservative approach" is required since final data are not yet available. Therefore, available data combined with sound technical judgment are required. The Draft Environmental Assessment and final Environmental Assessment have attempted to make honest and accurate findings with the data currently available.

Past reviews of other program documents by the U.S. Nuclear Regulatory Commission, U.S. Geological Survey, and other independent agencies have identified problem areas. These areas have been further discussed in open meetings and modifications to the program have resulted. A comment-by-comment response to concerns about previous Basalt Waste Isolation Project documents would be inappropriate in the final Environmental Assessment.

Issue: Human intrusion

Several commenters expressed concern about the future of a repository at the reference repository location on the Hanford Site. The potential consequences of a bombing attack on the repository during wartime was one concern, while long-term site security beyond 1,000 years and the use of a permanent marker system were other concerns.

Response

Concern for future generations was a primary consideration of the U.S. Congress when it passed the Nuclear Waste Policy Act of 1982. The strategy and plans outlined in this act mandate that nuclear wastes be

disposed of in accordance with standards set by the U.S. Environmental Protection Agency (EPA, 1985) and the requirements of the U.S. Nuclear Regulatory Commission (NRC, 1985).

At the reference repository location at the Hanford Site, wastes would be emplaced approximately 915 meters (3,000 feet) below the surface of the ground. After the repository is closed, it is not expected that the repository would have to be actively guarded against future intrusion.

Permanent markers will be placed on and around the repository as part of repository closure activities. These markers will be designed to warn future generations of the hazardous material beneath the repository operations area. The final design of the markers has not yet been determined; however, it is felt that a pictorial representation (analogous to hieroglyphics) will be used in conjunction with major spoken languages. The materials for the markers will be selected to ensure durability for many years.

The consequences of a nuclear attack on a repository at the Hanford Site have been analyzed by Lee et al. (1978). This study indicates that a number of direct hits with 20 megaton nuclear devices would be required before nuclear wastes in the repository would be exhumed. The probability of this number of direct hits on a single target is extremely low, and the cumulative effects of the nuclear explosions would overwhelm the possible consequences of a breached repository (Lee et al., 1978, pp. 3-6, 3-8, and 4-16).

Issue: Use of commercial nuclear material for defense purposes

Three comments expressed a basic distrust of the U.S. Department of Energy information policies or felt that commercial spent fuel would be diverted to nuclear weapons production at the Hanford Site. In conjunction with this concern, one commenter also felt that the "nuclear burden" of the State of Washington should have been taken into account during the site-selection process.

Response

The U.S. Department of Energy policy regarding the release of public information for the Hanford Site has been stated many times. While it must be recognized that national security-related information cannot be made public, it is clear that accurate information is vital to the public understanding of the role of the Hanford Site in defense activities as well as its potential geologic disposal role. Documents such as the Draft and final Environmental Assessments are designed to provide a detailed account of the process being used to nominate and recommend geologic repository sites. In early 1986, a draft environmental impact statement describing plans for defense wastes will also be issued (see Section C.6.4). The public involvement in the review of these documents is essential for building public confidence and trust in activities at the Hanford Site.

The U.S. Department of Energy has no plans for using spent commercial nuclear fuel as feed material for the Plutonium and Uranium Recovery through Extraction (PUREX) plant.

The U.S. Department of Energy recognizes the important role that the State of Washington has played in past nuclear-related activities. The provisions of the Nuclear Waste Policy Act of 1982 require that the nomination and recommendation of sites to be characterized be based on the technical requirements of the final General Siting Guidelines (DOE, 1984a). Current nuclear-related activities on the Hanford Site are specifically addressed in Subsection 6.2.1.5 (Offsite installations and operations) of the Draft and final Environmental Assessments.

Issue: Availability and timeliness of references

Several commenters expressed concerns that the references used in the Draft Environmental Assessment were not easily accessible for their review or that the locations of references were not publicized properly. It was noted that several reference documents were released in mid-January 1985 after the Draft Environmental Assessment was issued. It was also requested that the U.S. Department of Energy establish a public reading room in Spokane, Washington.

Response

While there was no requirement that references cited in the Draft Environmental Assessment be made available to the public, the U.S. Department of Energy felt that the public review process would be improved if references could be made available. Since the Draft Environmental Assessment referenced approximately 400 supporting documents, it was clear that complete sets of references could not be made available to all reviewers. Therefore, microfiche copies of all references were provided to the State of Washington, Yakima Indian Nation, Umatilla Indian Tribe, the Nez Perce Indian Tribe, the U.S. Nuclear Regulatory Commission, and to public libraries in Washington, Oregon, and Idaho. The public libraries involved in this effort were listed in the "Background Information on the Draft Environmental Assessment" (DOE, 1985).

Several references cited in the Draft Environmental Assessment were issued after the Draft Environmental Assessment was issued. Five out of 400 were issued in mid-January 1985. These documents had been prepared prior to issuance of the Draft Environmental Assessment; however, they had not been reviewed for adherence to document-release procedures. This process was accelerated to minimize any inconvenience to reviewers. Since the other 395 references were available, it is not believed that the review process was seriously hampered by late issuance of five references.

The U.S. Department of Energy is considering establishing a public reading room in Spokane, Washington, but a final decision has not yet been made.

Issue: Coordination with the Bonneville Power Administration

One commenter stated that access to Bonneville Power Administration facilities should not be adversely affected.

Response

The location of the two major power supply facilities of the Bonneville Power Administration (Washington Public Power Supply System operating plant WNP-2 and Hanford Generating Plant) are several kilometers (miles) away from the reference repository location and site-characterization activities are not expected to occur at or near these power-supply facilities. It is not expected that restrictions on access to these facilities would be created by site-characterization or repository-development activities. If such restrictions became necessary or if the Bonneville Power Administration needs access to areas near site-characterization or repository activities, appropriate arrangements would be made.

Issue: Use of statistics to quantify uncertainty

Several commenters were concerned that too much uncertainty was present in the Draft Environmental Assessment and that a statistical analysis was necessary.

Response

Since the selection of three sites for site characterization must be conducted prior to undertaking detailed site-characterization activities, some uncertainties, by definition, will exist. Where uncertainty is present, "reasonable yet conservative" approaches have been used as required by the Nuclear Waste Policy Act of 1982 to ensure that uncertainties are identified. Throughout Chapter 6 of the Draft Environmental Assessment, these uncertainties were explicitly identified for each of the siting guidelines in the sections entitled "Conclusions on qualifying condition."

A statistical analysis was conducted when the various technical inputs were utilized to make a preliminary assessment of the expected performance of the reference repository location. This information has been reviewed and revised in Section 6.4.2 of the final Environmental Assessment.

Issue: Adoption of the environmental impact statement by the U.S. Nuclear Regulatory Commission

One commenter indicated that it would be beneficial if the environmental impact statement prepared by the U.S. Department of Energy after site characterization could be adopted by the U.S. Nuclear Regulatory Commission.

Response

The U.S. Department of Energy agrees with the concept of having the U.S. Nuclear Regulatory Commission adopt the final environmental impact statement after site characterization. This concept is in agreement with provisions contained in the Nuclear Waste Policy Act of 1982. Such an action would assist in meeting the 1998 date for operation of the first repository. The U.S. Department of Energy is currently in the early planning stages of this document. Only one such document will be submitted to the U.S. Nuclear Regulatory Commission to support the selection of the first repository site.

Issue: Long-term ground-water monitoring

Two commenters were concerned that potential ground-water contamination would require ground-water monitoring for centuries, at a huge expense.

Response

A major purpose of the program established by the Nuclear Waste Policy Act of 1982 is to ensure that radioactive materials will not reach the accessible environment in unacceptable quantities. In this regard, the repository will have to comply with the standards set by the U.S. Environmental Protection Agency (EPA, 1985). These standards were developed to require a repository to be "as safe as" a natural uranium ore body. By using containers that last for centuries, long-term ground-water monitoring programs will not be needed.

Issue: Inconsistencies between executive summary and text of the Draft Environmental Assessment

A number of comments were received that pointed out inconsistencies between the executive summary and the text of the Draft Environmental Assessment. These inconsistencies ranged from minor word variations to errors in the executive summary.

Response

The executive summary reflects the contents of the Draft Environmental Assessment in an abbreviated narrative style. Specific word changes should not be construed as a departure from the findings and conclusions contained in the main body of the Draft Environmental Assessment. In some instances, modifications have been made to the body of the final Environmental Assessment. These changes are reflected in the final Executive Summary.

Issue: Moral and ethical implications of a repository at the Hanford Site

One commenter was concerned about the "moral and ethical implications" of a proposed repository at the Hanford Site.

Response

The proposed nomination and recommendation of the reference repository location on the Hanford Site is based on meeting the requirements of the Nuclear Waste Policy Act of 1982. This act required the development of siting guidelines to focus on the technical attributes of a site for a nuclear waste repository. The ethical and moral implications of a potential repository at the Hanford Site are not within the scope of environmental assessments required by the Nuclear Waste Policy Act of 1982.

Issue: Independent review of the Basalt Waste Isolation Project

One comment dealt with a reference quoted several times in the Draft Environmental Assessment. The reference was a letter from D. E. Olesen to A. G. Fremling (Burnham, 1983) that reviewed the Basalt Waste Isolation Project. The commenter was concerned that this was not a truly independent review.

Response

The purpose of citing the review conducted by the Battelle-Pacific Northwest Laboratory was to provide corroborating information to support preliminary conclusions contained in the Draft Environmental Assessment. The review was independent from the standpoint that data were not analyzed by Rockwell Hanford Operations. The final Environmental Assessment did not delete the term "independent."

REFERENCES FOR CHAPTER C.9

Burnham, J. B., 1983. "Basalt Waste Isolation Project Review by Pacific Northwest Laboratory's Review Team" (letter to O. L. Olson, J. H. Anttonen, and A. G. Fremling, U.S. Department of Energy-Richland Operations Office, November 29, 1983).

DOE (U.S. Department of Energy), 1984a. General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories, Title 10, Code of Federal Regulations, Part 960, Washington, D.C.

DOE (U.S. Department of Energy), 1984b. Draft Environmental Assessment, Reference Repository Location, Hanford Site, Washington, DOE/RW-0017, Office of Civilian Radioactive Waste Management, Washington, D.C.

DOE (U.S. Department of Energy), 1985. Background Information on the Draft Environmental Assessment, DOE/RL-85-1, Office of Civilian Radioactive Waste Management, Washington, D.C., pp. 16 and 17.

EPA (U.S. Environmental Protection Agency), 1985. "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Wastes; Final Rules," Title 40, Code of Federal Regulations, Part 191, Federal Register, Vol. 50, p. 38065, Washington, D.C.

Lee, W. W., K. Nair, and G. Smith, 1978. Basalt Waste Isolation Disruptive Event Analysis, RHO-BWI-C-43, Woodward-Clyde Consultants for Rockwell Hanford Operations, Richland, Washington.

NRC (U.S. Nuclear Regulatory Commission), 1985. Disposal of High-Level Radioactive Wastes in Geologic Repositories: Licensing Procedures, Title 10, Code of Federal Regulations, Part 60, Washington, D.C.

Nuclear Waste Policy Act of 1982. Public Law 97-425, 96 Stat. 2201, 42 USC 10101, 1983.

C.10 COMMENT-RESPONSE INDEX

In its Federal Register notice of December 20, 1984, announcing the availability of the draft EAs, the DOE requested that interested parties review the documents and send their comments to the DOE in Washington, D.C. for the comment record. In addition, the DOE held a series of public hearings in the six first-repository States and one adjacent State. The written and oral testimony from these hearings was also included in the formal comment record.

Each letter and the testimony of each hearing participant were assigned a number. The letters and testimony were then reviewed to identify comments, and the comments in each letter were numbered sequentially. Copies of the comments and letters can be seen at the DOE reading rooms in Washington, D.C.; Columbus, Ohio; Las Vegas, Nevada; and Richland, Washington. The individual comments were assigned a classification code that corresponds to a subject area in the comment-response document (CRD). In some cases, a comment was addressed in more than one subject area in the CRD, and these comments were assigned more than one classification code.

This index lists all of the comments that apply to the Hanford draft EA. By using this index, the commenter can find the section of the CRD that discusses the issues raised in his or her comment letter or testimony at a public hearing. The commenters are listed by State. The index lists the commenters alphabetically by their last name, their organizational affiliation where applicable, the number assigned to the letter or testimony, the comment numbers, and the classification number for that comment. If the issues raised by the comment are discussed in more than one section of the CRD, additional classification numbers were assigned and are listed in the second, third and fourth classification columns. Up to four classifications can be listed for each comment.

Thus, to see how the DOE classified the comments and responded to the issues raised in your comment letter or hearing testimony, look up your name under the listing from your State. Under the comment column number you will find a list of the comments the DOE identified in your letter. In the classification column find the classification number(s) assigned to that comment. The classification numbers refer to the sections of the CRD, and the CRD Table of Contents will show the page numbers for the section that discusses the issues raised by your comments.

INDEX DF CDMMENTS DN THE DRAFT ENVIRONMENTAL ASSESSMENT FDR THE HANFDRD SITE

STATE	NAME	DRGANIZATIDN	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Alabama								
	Leonard, R. Michael		02077	00001	C.3.1.2	--	--	--
			02077	00002	C.3.4.4	--	--	--
			02077	00005	C.3.4.4	--	--	--
Alaska								
	Matz, Mike		00306	00001	C.3.1.2	--	--	--
Arizona								
	Campugano, Elizabeth	Friends Southwest Center	00175	00002	C.3.1.2	--	--	--
	Connolly, Marjorie		02675	00001	C.3.1.2	--	--	--
			02675	00003	C.3.1.2	--	--	--
	Coxhead, Richard A.		00409	00001	C.3.4.4	--	--	--
	Dankwort, Rudolf		00413	00001	C.3.4.4	--	--	--
			00413	00002	C.3.4.2.2	--	--	--
	Dugall, Dr. John C.		00104	00001	C.3.4.4	--	--	--
			00104	00003	C.3.4.4	--	--	--
	Evans, Arthur H.		00096	00001	C.3.4.4	--	--	--
	Findlay, III, Robert S.		00253	00001	C.3.4.4	--	--	--
	Hill, Richard C.		01347	00006	C.3.4.4	--	--	--
	Kissock, Kelly	Verde Valley School, Math dept.	01533	00001	C.3.1.2	--	--	--
			01533	00002	C.3.1.2	--	--	--
			01533	00003	C.3.1.2	--	--	--
	Lawson, Duane		01313	00001	C.3.1.2	--	--	--
			01313	00004	C.3.1.2	--	--	--
			01313	00005	C.3.4.4	--	--	--
	Lundquist, Evelyn		01084	00001	C.3.4.4	--	--	--
	Lundstrom, Kristen		00067	00001	C.3.1.2	--	--	--
	McCarty, Doug		00223	00004	C.2.4.1	--	--	--
			00223	00006	C.2.8.1	--	--	--
			00223	00007	C.3.4.3	--	--	--
	McClelland, Brian K.		01353	00001	C.3.4.4	--	--	--
			01353	00002	C.3.4.4	--	--	--
			01353	00004	C.2.1.2	--	--	--
	D'Neill, Colleen		00329	00003	C.3.1.2	--	--	--
	Vicini, Linda M.		00244	00001	C.3.4.4	--	--	--
	Winter, John T.		00310	00001	C.3.1.2	--	--	--
			00310	00003	C.3.4.4	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
California								
	Anonymous		00106	00001	C.3.4.4	--	--	--
	Bacher Jr., Mrs. Frederick A.		00101	00001	C.3.1.2	--	--	--
			00101	00005	C.3.4.4	--	--	--
	Ballsun, C.		00075	00001	C.3.4.4	--	--	--
	Berke, Eleanor		00351	00001	C.3.4.4	--	--	--
			00351	00002	C.3.1.2	--	--	--
	Bock, A.J.	American Rock Art Research Assoc	01056	00001	C.3.4.4	--	--	--
	Bridenbecker, Robert H.	Southern CA Edison Co.	01351	00001	C.2.3.3	--	--	--
			01351	00002	C.4.1	C.2.7	--	--
			01351	00005	C.2.8.3	C.4.3	--	--
			01351	00006	C.2.4.1	--	--	--
	Cameron, Lillian S.		00115	00001	C.3.4.4	--	--	--
			00115	00005	C.3.4.4	--	--	--
	Campbell, Todd		00267	00001	C.3.4.4	--	--	--
	Durbin, Emily	Sierra Club	01221	00009	C.3.1.2	--	--	--
	Geisler, Dorothy		00073	00001	C.3.4.4	--	--	--
			00073	00004	C.3.4.4	--	--	--
			00073	00005	C.2.8.1	--	--	--
	Goodman, Michael		00222	00001	C.3.4.4	--	--	--
			00222	00002	C.2.8.3	--	--	--
	Gross, Caroline		00225	00001	C.2.8.1	--	--	--
			00225	00002	C.3.1.2	--	--	--
	Gunsky, Frederic R.		00068	00001	C.3.3.1	--	--	--
	Holladay, Kevin		01060	00001	C.3.1.2	--	--	--
			01060	00002	C.3.4.4	--	--	--
	Jett, Dr. Stephen C.	Univ. Cal. Geog. Dept	00016	00002	C.3.4.4	--	--	--
	Jones-Johnson, Ola Mae		00027	00001	C.3.4.4	--	--	--
	Jones-Smith, Aree		00023	00001	C.3.4.4	--	--	--
	Jones-Smith, Willie Lou		00032	00001	C.3.4.4	--	--	--
	Lundholm, Mrs. A. N.		02108	00001	C.2.5.2	--	--	--
	Martin, Frankie and Bob		00107	00001	C.3.4.4	--	--	--
	McCreery, Scott		01133	00001	C.3.4.4	--	--	--
	Mitchell, Mrs. Barbara A.		00179	00005	C.3.1.2	--	--	--
	Moore, Carey		00019	00001	C.3.4.4	--	--	--
	Moore, Willie		00025	00001	C.3.4.4	--	--	--
	Moore, Kelvin		00033	00001	C.3.4.4	--	--	--
	Moore, Sr., Albert B.		00018	00001	C.3.4.4	--	--	--
	Moore-Loud, Gloria D.		00039	00001	C.3.4.4	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
California (continued)								
	Moore-Parker, Laura		00024	00001	C.3.4.4	--	--	--
	Moore-Robinson, Annie		00026	00001	C.3.4.4	--	--	--
	Oman, Barbara		02704	00001	C.3.1.2	--	--	--
			02704	00002	C.3.4.4	--	--	--
	Parkins, Cheryl		01062	00001	C.3.4.4	--	--	--
	Patterson, Wendy Bents		02610	00001	C.3.1.2	--	--	--
			02610	00003	C.3.1.2	--	--	--
	Poland, Roscoe A.	Conservation Call	00198	00002	C.3.1.2	--	--	--
	Preyer, Bernard		02700	00001	C.3.4.4	--	--	--
			02700	00002	C.3.1.2	--	--	--
	Ramsey, Rande		01194	00003	C.3.1.2	--	--	--
			01194	00004	C.3.4.4	--	--	--
	Ready, James P.	The James P. Ready Co.	01577	00001	C.3.1.2	--	--	--
	Rittenhouse, Jan		00328	00002	C.3.1.2	--	--	--
	Robertson, Marilyn		01579	00001	C.3.4.4	--	--	--
	Ryall, Marjorie M.		00117	00001	C.3.4.4	--	--	--
			00117	00006	C.3.4.4	--	--	--
	Saretsky, Richard D.		00279	00002	C.3.1.2	--	--	--
	Sawyer, Benjamin		02701	00001	C.3.4.4	--	--	--
			02701	00002	C.3.1.2	--	--	--
			02701	00003	C.2.8.1	--	--	--
	Schuster, Megan H.		00439	00002	C.3.1.2	--	--	--
	Skews, Geoff		00133	00005	C.3.1.2	--	--	--
	Stansfield, Elaine	Ecology Ctr. of So. California	00059	00001	C.3.4.4	--	--	--
			00059	00002	C.2.1.1	--	--	--
			00059	00003A	C.2.7	--	--	--
			00059	00003B	C.3.4.2.1	--	--	--
			00059	00038	C.2.8.1	C.2.8.2	--	--
	Swanson, John R.		00446	00001	C.3.4.4	--	--	--
	Wasson, Glenn E.		00254	00003	C.3.4.4	--	--	--
			00254	00004	C.2.3.1	--	--	--
			00254	00005	C.2.6.1	--	--	--
			00254	00006	C.2.8	--	--	--
			00254	00007	C.2.1	--	--	--
			00254	00008	C.3.4.4	--	--	--
			00254	00011	C.2.8.2	--	--	--
			00254	00012	C.2.8.2	--	--	--
			00254	00013	C.2.8.2	--	--	--

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STATE	NAME	ORGANIZATIDN	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
California (continued)								
	Weatherwax, Robert K.	Sierra Energy & Risk Assessment	01366	00001	C.3.4	--	--	--
			01366	00002	C.3.4.3	--	--	--
			01366	00003	C.3.4.3	--	--	--
			01366	00004	C.3.4	--	--	--
			01366	00005	C.3.4.3	--	--	--
			01366	00006	C.3.4.2	--	--	--
			01366	00007	C.3.4.3	--	--	--
			01366	00008	C.3.4.3	--	--	--
			01366	00009	C.3.3	--	--	--
			01366	00010	C.3.4.1	--	--	--
			01366	00011	C.3.4.3	--	--	--
	Webster, Donald B.		00613	00001	C.3.4.4	--	--	--
	Yasuda, Don		00443	00001	C.3.4.4	--	--	--
	York, Jennifer		00060	00001	C.2.8.1	--	--	--
			00060	00001A	C.3.1.2	--	--	--
			00060	00001B	C.2.7	--	--	--
Colorado								
	Adams, Cass		01178	00001	C.3.4.4	--	--	--
	Adams, Craig		01304	00001	C.3.1.2	--	--	--
			01304	00002	C.2.2	--	--	--
	Anderson, John and Leanna		00527	00003	C.3.1.2	--	--	--
	Anderson, Virginia S.		00581	00001	C.3.1.2	--	--	--
	Anderst, Daryl		00318	00001	C.3.1.2	--	--	--
	Andy, Charles		00562	00001	C.2.1.1	--	--	--
	Anonymous		01184	00001	C.3.1.2	--	--	--
	Auerlah, Catherine E.		00601	00001	C.3.4.4	--	--	--
	Bartley, Ben		00565	00001	C.3.4.4	--	--	--
	Bedwell, Jackie		00636	00001	C.3.4.4	--	--	--
			00636	00002	C.3.4.4	--	--	--
	Below, Joan A.		00594	00001	C.3.1.2	--	--	--
	Benjamin, Laurie		00350	00001	C.3.4.4	--	--	--
	Bennett, Sandy		01049	00001	C.3.1.2	--	--	--
	Bernard, Joan		00307	00001	C.3.1.2	--	--	--
	Bertram, Diane		00410	00001	C.3.4.4	--	--	--
	Biggers, John		01371	00002	C.3.1.2	--	--	--
	Binkowski, David J.		00634	00002	C.7.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Colorado (continued)								
	Bloom, Claudia		00260	00002	C.3.4.4	--	--	--
	Bly, Karel S.		01141	00001	C.3.1.2	--	--	--
	Bomer, Frances		00559	00001	C.3.1.2	--	--	--
	Borkovec, Rick		01256	00001	C.3.1.2	--	--	--
			01256	00003	C.3.1.2	--	--	--
	Borowski, Ann		01377	00002	C.3.1.2	--	--	--
	Borton, Perry		01334	00002	C.3.1.3	--	--	--
	Boss, Roger		01336	00002	C.3.1.3	--	--	--
	Boyce, Cheryl		00584	00001	C.3.1.2	--	--	--
	Brainerd, Alice		00346	00001	C.3.4.4	--	--	--
			00346	00002	C.2.8.1	--	--	--
	Breazzano, Debra		00558	00001	C.3.1.2	--	--	--
	Brown, Keri		00596	00001	C.3.1.2	--	--	--
	Burpee, Elizabeth		00586	00003	C.2.8.1	--	--	--
	Byerly, Alan		00549	00001	C.3.1.2	--	--	--
	Byerly, Gay Porter		01303	00001	C.3.1.2	--	--	--
			01303	00002	C.3.1.2	--	--	--
			01303	00003	C.3.1.2	--	--	--
	Carney, Jerry & Jennifer S.		00078	00001	C.3.4.4	--	--	--
			00078	00007	C.3.1.2	--	--	--
			00078	00009	C.3.4.4	--	--	--
	Clark, Caroline		01349	00001	C.3.1.2	--	--	--
	Coff, Harry E.		01182	00003	C.2.1.1	--	--	--
	Cole, Sally J.		01138	00001	C.3.1.2	--	--	--
			01138	00003	C.3.1.2	--	--	--
	Cook, Jane M.		00607	00001	C.3.4.4	--	--	--
	Cooper, Sandra H.		00660	00004	C.3.1.2	--	--	--
	Cunningham, Hartley, Timothy & Janice		00385	00003	C.3.4.4	--	--	--
	Dailey, Carolyn J.	Fort Lewis College	00655	00001	C.3.4.4	--	--	--
			00655	00003	C.3.1.2	--	--	--
	Dobben, Talie		01046	00001	C.3.1.2	--	--	--
	Dowell, Bill, Marcia & Ryan		01546	00001	C.3.1.2	--	--	--
			01546	00002	C.3.1.2	--	--	--
	Dyson, Rick		01064	00001	C.3.1.2	--	--	--
	Engman, Shelley		00572	00001	C.3.1.2	--	--	--
	Ewert, Daniel,Alex & Krista		01559	00001	C.3.4.4	--	--	--
	Farnsworth, Pam		00441	00001	C.3.1.2	--	--	--
			00441	00002	C.3.1.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Colorado (continued)								
	Fay, Thomas		01223	00001	C.3.1.2	--	--	--
			01223	00002	C.3.1.2	--	--	--
	Fay, Janet M.		02255	00001	C.3.1.2	--	--	--
	Ferst, F.		01185	00002	C.3.1.2	--	--	--
			01185	00003	C.2.3	--	--	--
			01185	00004	C.2.3	--	--	--
	Fitzpatrick,Jr., Joseph W.		01309	00001	C.3.1.2	--	--	--
			01309	00003	C.3.1.2	--	--	--
	Fogarty, Steven		00569	00001A	C.3.4.4	--	--	--
			00569	00001D	C.3.4.4	--	--	--
	Fogg, Peter L.		01123	00002	C.2.4.1	--	--	--
			01123	00004	C.3.1.2	--	--	--
			01123	00006	C.3.1.2	--	--	--
			01123	00008	C.3.1.2	--	--	--
			01123	00009	C.3.1.1	--	--	--
			01123	00010	C.3.4.4	--	--	--
			01123	00011	C.3.4.4	--	--	--
	Fowler, Catherine		00566	00001	C.3.1.2	--	--	--
	Fowler, Jessica		00606	00001	C.3.4.4	--	--	--
	Fox, Genevieve		00577	00001	C.3.4.4	--	--	--
			00577	00002	C.3.1.2	--	--	--
	Frankel, Miriam		01345	00004	C.2.4.1	--	--	--
	Friedman, Margaret		00615	00001	C.3.4.4	--	--	--
	Friedman, Jonathan		01089	00001	C.3.4.4	--	--	--
	Geraghty, Matt		00428	00001	C.3.1.2	--	--	--
	Gibbons, Mary Jo & John		01561	00001	C.3.4.4	--	--	--
	Gobhardt, Larry		01375	00002	C.3.1.2	--	--	--
	Goodtimes, Art	Telluride Times	02186	00001	C.3.4.4	--	--	--
	Goswick, Jeffrey		00603	00001	C.3.4.4	--	--	--
			00603	00002	C.2.8.2	--	--	--
	Gray, Douglas E.		01179	00001	C.3.1.2	--	--	--
	Grayson, Marie		00085	00001	C.3.1.2	--	--	--
			00085	00002	C.3.1.2	--	--	--
	Green, Douglas J.		00654	00001	C.2.8.2	--	--	--
			00654	00002	C.3.4.4	--	--	--
	Gregory, Lee		00215	00001	C.3.4.4	--	--	--
	Gronwall, Raymond J.		00348	00001	C.3.1.2	--	--	--
			00348	00005	C.2.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Colorado (continued)								
			00348	00006	C.2.4.1	--	--	--
	Groth, Mark and Kathy		00414	00002	C.3.1.2	--	--	--
	Groves, Anthony		01176	00001	C.3.1.2	--	--	--
			01176	00003	C.3.1.2	--	--	--
	Gruer, Mary K.		01177	00001	C.3.4.4	--	--	--
	Gudavski, LeCindra		00545	00001	C.3.1.2	--	--	--
	Hackl, Diane		00602	00001	C.3.4.4	--	--	--
	Hannegan,Jr., David W.		01159	00005	C.2.8.2	--	--	--
			01159	00006	C.2.8.1	--	--	--
	Hart, Robert L. & Linda P.		00289	00001	C.3.1.2	--	--	--
	Hassan, Peter C.		00637	00002	C.3.4.4	--	--	--
	Heitzer, Mark		01330	00002	C.3.1.3	--	--	--
	Hempel, Paul		01189	00001	C.3.1.2	--	--	--
	Hinchman, John S.	Bent. St Vrain Partners Inc.	01310	00001	C.3.1.2	--	--	--
			01310	00002	C.3.1.2	--	--	--
			01310	00003	C.3.1.2	--	--	--
	Hines, LeAnne		00444	00001	C.3.4.4	--	--	--
	Humphrey, Peter		02075	00005	C.3.4.4	--	--	--
	Jackson, Cathy		01332	00002	C.3.1.3	--	--	--
	Jernigan, Richard		01257	00001	C.3.1.2	--	--	--
			01257	00003	C.3.1.2	--	--	--
	Johnson, Nina		00371	00001	C.3.1.2	--	--	--
	Johnson, Misti		01255	00001	C.3.1.2	--	--	--
			01255	00003	C.3.1.2	--	--	--
	Jones, Charles A.	Allied Bendix Aerospace	02660	00001	C.2.7	--	--	--
	Kaempfer, Suzanne H.		00013	00001	C.3.1.2	--	--	--
			00013	00004	C.3.4.4	--	--	--
	Kapushion, Nettie		01376	00002	C.3.1.2	--	--	--
	Kelly, Allen L.		02078	00002	C.3.4.4	--	--	--
	Kiklevich, Roark, Eric & Abby		01548	00001	C.3.1.2	--	--	--
			01548	00002	C.3.1.2	--	--	--
	Kinnear, Sharyl A.		01137	00001	C.2.2.1	--	--	--
			01137	00005	C.2.4.1	--	--	--
	Kirk, Allison		01059	00001	C.3.4.4	--	--	--
			01059	00003	C.3.4.4	--	--	--
			01059	00004	C.2.4.1	--	--	--
	Kornreich, Scott K.		01225	00002	C.3.1.2	--	--	--
	Kovanic, Ronald		01374	00002	C.3.1.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Colorado (continued)								
	Kurtz, Frederick W.		01254	00001	C.3.1.2	--	--	--
			01254	00003	C.3.1.2	--	--	--
	Kurtz, Robyn		01378	00002	C.3.1.2	--	--	--
	Lamm, Governor Richard	State of Colorado	01398	00001	C.2.4.1	--	--	--
			01398	00002	C.2.4.1	--	--	--
			01398	00003	C.2.4.1	--	--	--
			01398	00004	C.3.4.3	--	--	--
			01398	00005	C.2.4.1	--	--	--
			01398	00006	C.2.4.1	7.3	--	--
			01398	00007	C.3.4.2.2	--	--	--
			01398	00008	C.2.4.1	--	--	--
			01398	00009	C.2.4.1	--	--	--
			01398	00010	C.2.4.1	--	--	--
	Landing, Sharon A.		00415	00001	C.3.4.4	--	--	--
	Larsen, Suzanne		01204	00001	C.3.1.2	--	--	--
			01204	00003	C.3.1.2	--	--	--
	Lehman, Dale E.	Fort Lewis College	00118	00001	C.2.1.1	--	--	--
			00118	00002A	C.3.4.3	--	--	--
			00118	00002B	C.2.1.1	--	--	--
			00118	00002C	C.2.1.1	--	--	--
			00118	00004	C.3.4.4	--	--	--
			00118	00006	C.3.4.2.2	--	--	--
			00118	00007	C.3.4.2.2	--	--	--
	Lehmann, Scott K.	Univ. of Colorado, Boulder	00503	00001	C.3.1.2	--	--	--
			00503	00005	C.3.1.2	--	--	--
			00503	00006	C.3.4.4	--	--	--
	Lucas, David		00405	00001	C.3.4.4	--	--	--
			00405	00003	C.3.1.2	--	--	--
	M., D.		00639	00001	C.2.8.1	--	--	--
	Magyar, John and Mike		02661	00001	C.3.4.4	--	--	--
			02661	00007	C.3.1.2	--	--	--
	Margolis, Barbara E.		00082	00001	C.3.4.4	--	--	--
	Marsh, Tobin		00571	00002	C.3.1.2	--	--	--
	Marshall, Katherine J.		00548	00001	C.3.1.2	--	--	--
	Martin, James B.	Environmental Defense Fund	01259	00001	C.2.1.1	--	--	--
			01259	00002	C.2.4.1	--	--	--
			01259	00003	C.2.4.1	--	--	--
			01259	00004	C.2.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Colorado (continued)								
			01259	00005	C.3.1.2	--	--	--
			01259	00006	C.3.1.2	--	--	--
			01259	00007	C.2.4.1	--	--	--
			01259	00008	C.2.4.1	--	--	--
			01259	00009	C.2.4.1	--	--	--
			01259	00010	C.5.7	--	--	--
			01259	00011	C.2.4.1	--	--	--
			01259	00012	C.2.4.1	--	--	--
			01259	00013	C.2.4.1	--	--	--
			01259	00014	C.2.4.1	--	--	--
			01259	00015	C.2.4.1	--	--	--
			01259	00016	C.2.4.1	--	--	--
			01259	00017	C.2.4.1	--	--	--
			01259	00018	C.2.4.1	--	--	--
			01259	00019	C.2.4.1	--	--	--
			01259	00020	C.2.4.1	--	--	--
			01259	00021	C.2.4.1	--	--	--
			01259	00022	C.2.4.1	--	--	--
	Mattina, Carol		01047	00001	C.3.1.2	--	--	--
	Mattox, Paul		00638	00001	C.3.1.2	--	--	--
	May, Jeffrey		00311	00001	C.3.4.4	--	--	--
			00311	00003	C.3.4	--	--	--
	Maynard, Andrea G.		00153	00001	C.3.1.2	--	--	--
	McCool, Lewis		02182	00001	C.3.4.4	--	--	--
			02182	00005	C.7.2	--	--	--
			02182	00006	C.7.2	--	--	--
			02182	00007	C.7.2	--	--	--
	McFarland, Kristy		01287	00001	C.3.4.4	--	--	--
	McIlellan, Rosalind		01331	00002	C.3.1.3	--	--	--
	McNabb, Donald		01145	00001	C.3.4.4	--	--	--
	Mears, Mike		01547	00001	C.3.1.2	--	--	--
			01547	00002	C.3.1.2	--	--	--
	Miller, Kathy		01063	00001	C.3.1.2	--	--	--
	Monash, Jessica		02611	00001	C.3.1.2	--	--	--
			02611	00003	C.3.1.2	--	--	--
			02611	00019	C.3.4	--	--	--
	Montfredo, Steven		01373	00002	C.3.1.2	--	--	--
	Morehouse, Don		01312	00001	C.3.1.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Colorado (continued)								
			01312	00002	C.3.1.2	--	--	--
	Muhlbeim, Robert John		00319	00001	C.3.1.2	--	--	--
			00319	00002	C.3.1.2	--	--	--
	Muller, Fred R.		01180	00001	C.3.4.4	--	--	--
	Mullhauser, Amy		00658	00001	C.3.4.4	--	--	--
	Nabil, David		01572	00001	C.3.1.2	--	--	--
			01572	00002	C.3.1.2	--	--	--
	Nailling, Elizabeth		02257	00001	C.3.4.4	--	--	--
	Najaft, Melinda		00561	00001	C.3.1.2	--	--	--
	Nall, Chris		00354	00001	C.3.4.4	--	--	--
			00354	00002	C.3.1.2	--	--	--
	Nichell, David		00568	00001	C.3.1.2	--	--	--
	Nowlin, Dawn		01329	00002	C.3.1.3	--	--	--
	Oberling, Bill		01562	00001	C.3.4.4	--	--	--
	Palmer, Alice G. & Mark F.		01318	00001	C.3.1.2	--	--	--
			01318	00003	C.3.1	--	--	--
	Papp, Lawrence A.		00557	00004	C.3.1.2	--	--	--
			00557	00005	C.3.1.2	--	--	--
	Pearson, Mark D.		01337	00002	C.2.4.1	--	--	--
			01337	00006	C.3.1.2	--	--	--
			01337	00007	C.3.1.2	--	--	--
	Pehowski, Paula		00412	00001	C.3.4.4	--	--	--
	Peineiaro, John		01191	00001	C.3.4.4	--	--	--
	Pena, Mayor Frederico	City and County of Denver	02115	00001	C.2.4.1	--	--	--
			02115	00002	C.2.4.1	--	--	--
			02115	00003	C.2.4.1	--	--	--
			02115	00004	C.2.4.1	--	--	--
			02115	00005	C.2.4.1	--	--	--
	Petersen, Paul		01201	00001	C.3.4.4	--	--	--
			01201	00002	C.3.1.2	--	--	--
			01201	00003	C.2.4.1	--	--	--
	Pettit, S.		00598	00001	C.3.1.2	--	--	--
	Phillips, Sue		00604	00001	C.3.4.4	--	--	--
	Phillips, Jeff		01188	00001	C.3.1.2	--	--	--
	Pond, Timothy C.		00578	00001A	C.3.1.2	--	--	--
	Robnett, Douglas B.		02071	00001	C.3.4.4	--	--	--
	Rolphe, Timothy M.		01560	00001	C.3.4.4	--	--	--
	Roof, Steven R.		00236	00003	C.3.1.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Colorado (continued)								
	Ruckel, H. Anthony	Sierra Club Legal Defense Fund	01358	00019	C.3.1.2	--	--	--
	Salek, P.		01051	00001	C.3.1.2	--	--	--
	Salk, Joy L.		00560	00001	C.3.1.2	--	--	--
	Shaw, Karyl L.		00605	00001	C.3.4.4	--	--	--
			00605	00003	C.3.1.2	--	--	--
	Shinn, Joyce A.		01300	00001	C.3.4.4	--	--	--
			01300	00002	C.3.4.4	--	--	--
			01300	00003	C.3.4.4	--	--	--
			01300	00004	C.3.4.4	--	--	--
	Slater, Mark		00406	00001	C.3.4.4	--	--	--
			00406	00003	C.3.1.2	--	--	--
	Somrak, Mary Jo & Michael		01379	00002	C.3.1.2	--	--	--
	Spence, Robin E.		01564	00001	C.3.4.4	--	--	--
	Spezia, John W.		00012	00001	C.3.4.4	--	--	--
			00012	00002	C.3.1.2	--	--	--
	Spivak, Paul		00579	00002	C.3.1.2	--	--	--
	Stansberry, Donna		01192	00001	C.3.1.2	--	--	--
	Stokes, Wendy L.		00284	00002	C.2.8.1	--	--	--
	Street, Marianna		01050	00001	C.3.1.2	--	--	--
	Sucherman, Kathy		00147	00001	C.3.4.4	--	--	--
	Sweeney, Chris		01045	00001	C.3.1.2	--	--	--
	Tausehn, Guy		00576	00001	C.3.4.4	--	--	--
			00576	00002	C.3.4.4	--	--	--
	Thomas, Jan		01277	00001	C.3.4.4	--	--	--
	Tuchyna, DeeAnn R.		00661	00001	C.3.1.2	--	--	--
	Tyzzer, Andrew		01563	00001	C.3.4.4	--	--	--
	Vanderbeek, Gerard J.		00352	00001	C.3.4.4	--	--	--
			00352	00004	C.2.4.1	--	--	--
	Vick, Ronald E.		00609	00001	C.3.4.4	--	--	--
			00609	00003	C.3.4.4	--	--	--
	Vogler, Harry W.		00420	00001	C.3.4.4	--	--	--
	Vosley, M.		01048	00001	C.3.1.2	--	--	--
	Wackewitz, Frances A.		00282	00001	C.3.4.4	--	--	--
	Walker, Robin		00640	00001	C.3.1.2	--	--	--
	Walker, Jeannette		01220	00001	C.3.1.2	--	--	--
			01220	00002	C.2.2	--	--	--
	Weiner, Kathleen		01087	00001	C.3.4.4	--	--	--
	Welch, Thomas E.		01258	00001	C.3.1.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Colorado (continued)								
			01258	00003	C.3.1.2	--	--	--
	West, David		00630	00001	C.3.1.2	--	--	--
	Wiggans, Tamara		02181	00003	C.2.4.1	--	--	--
			02181	00004	C.2.3.2	--	--	--
	Will, Dale		00458	00001	C.3.4.4	--	--	--
			00458	00003	C.2.8.2	--	--	--
	Worthington, Michael		01105	00001	C.3.4.4	--	--	--
			01105	00002	C.3.4.4	--	--	--
	Wurtz, Tom		02116	00001	C.3.1.2	--	--	--
	Yanz, John & Bonnie		01308	00001	C.3.1.2	--	--	--
			01308	00003	C.3.1.2	--	--	--
	Zinn, Sonya		01106	00001	C.3.1.2	--	--	--
			01106	00003	C.3.1.2	--	--	--
	Zinn, Lennard		01174	00001	C.3.1.2	--	--	--
Connecticut								
	Ceraso/Huang, Jane/William	Yale Env. Litigation Program	00523	00001	C.3.1.2	--	--	--
			00523	00002	C.5.11	--	--	--
			00523	00004	C.8.3	--	--	--
			00523	00006	C.2.2	--	--	--
			00523	00007	C.5.2	--	--	--
			00523	00008	C.5.2	--	--	--
			00523	00012	C.2.7	--	--	--
			00523	00015	C.7.4	C.7.3	--	--
			00523	00017	C.2.7	--	--	--
			00523	00018	C.2.1.1	--	--	--
	Hughes, Mrs. John Farrel		00069	00001	C.3.4.4	--	--	--
	Shesler, Alysia		00220	00001	C.3.4.4	--	--	--
			00220	00002	C.2.3.2	--	--	--
District of Columbia								
		U.S. Nuclear Reg. Commission	02679	00047	C.4.3	--	--	--
			02679	00048	C.4.1.2.1	--	--	--
			02679	00049	C.5.1	--	--	--
			02679	00050	C.9	--	--	--
			02679	00051	C.9	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			02679	00052	C.5.1	--	--	--
			02679	00053	C.5.1	--	--	--
			02679	00054	C.5.1	--	--	--
			02679	00055	C.4.3	--	--	--
			02679	00056	C.4.3	--	--	--
			02679	00057	C.5.11	--	--	--
			02679	00058	C.3.4.3	--	--	--
			02679	00059	C.5.7	--	--	--
			02679	00060	C.4.2.2	--	--	--
			02679	00061	C.4.3	--	--	--
			02679	00062	C.4.3	--	--	--
			02679	00089	C.2.1.1	--	--	--
	Bedker, Ervin	Department of Air Force	01074	00005	C.2.4.1	C.6.4	--	--
	Bentsen, Senator Lloyd	U.S. Senate Comm on Environment	01399	00001	C.2.7	--	--	--
			01399	00003	C.2.7	--	--	--
			01399	00006	C.2.3.1	--	--	--
			01399	00008	C.2.1.1	--	--	--
			01399	00009	C.2.7	--	--	--
			01399	00010	C.2.7	--	--	--
			01399	00011	C.3.1.1	--	--	--
			01399	00018	C.3.1.2	--	--	--
			01399	00026	C.2.7	--	--	--
	Berick, David	Environmental Policy Institute	01385	00001	C.3.3	--	--	--
			01385	00005	C.2.1.1	--	--	--
			01385	00006	C.3.1.1	--	--	--
			01385	00007	C.2.2	--	--	--
			01385	00008A	C.2.7.1	--	--	--
			01385	00008B	C.2.7.1	--	--	--
			01385	00009A	C.3.1.2	--	--	--
			01385	00009B	C.3.1.1	--	--	--
			01385	00010	C.3.1.2	--	--	--
			01385	00011	C.2.2.1	--	--	--
			01385	00012A	C.2.2.1	--	--	--
			01385	00012B	C.2.7	--	--	--
			01385	00012C	C.3.1.1	--	--	--
			01385	00012D	C.3.1.1	--	--	--
			01385	00012E	C.3.1.2	--	--	--
			01385	00012F	C.2.7	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01385	00013	C.3.3	--	--	--
			01385	00014	C.3.3	--	--	--
			01385	00015	C.3.3	--	--	--
			01385	00016A	C.2.7	--	--	--
			01385	00016B	C.2.4.1	--	--	--
			01385	00016C	C.2.4.1	--	--	--
			01385	00016D	C.2.4.1	--	--	--
			01385	00017	C.2.6.1	--	--	--
			01385	00018	C.3.4.3	7.3	--	--
			01385	00019	C.2.4.1	--	--	--
			01385	00020	C.2.4.1	--	--	--
			01385	00021	C.3.4.2.2	C.3.4.3	--	--
			01385	00022A	C.2.6.1	--	--	--
			01385	00022B	C.2.4.1	--	--	--
			01385	00023A	C.2.5.1	--	--	--
			01385	00023B	C.2.4.1	--	--	--
			01385	00024	C.2.4.1	--	--	--
			01385	00025	C.2.4.1	--	--	--
	Berick, David	Environmental Policy Institute	01387	00001	C.2.1.1	--	--	--
			01387	00005	C.2.1.1	--	--	--
			01387	00006	C.3.1.1	--	--	--
			01387	00007	C.2.2	--	--	--
			01387	00008A	C.2.7.1	--	--	--
			01387	00008B	C.2.7.1	--	--	--
			01387	00009	C.2.2.1	--	--	--
			01387	00010	C.3.1.2	--	--	--
			01387	00011	C.2.2.1	--	--	--
			01387	00012A	C.2.2.1	--	--	--
			01387	00012B	C.2.2.1	--	--	--
			01387	00012C	C.3.1.1	--	--	--
			01387	00012D	C.3.1.1	--	--	--
			01387	00012E	C.3.3	--	--	--
			01387	00012F	C.2.2.1	--	--	--
			01387	00013	C.3.3	--	--	--
			01387	00014	C.3.3	--	--	--
			01387	00015	C.3.3	--	--	--
			01387	00016A	C.2.7	--	--	--
			01387	00016B	C.2.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01387	00016C	C.2.4.1	--	--	--
			01387	00016D	C.2.4.1	--	--	--
			01387	00017	C.2.6.1	--	--	--
			01387	00018	C.3.4.3	C.7.3	--	--
			01387	00019	C.2.4.1	--	--	--
			01387	00020	C.2.4.1	--	--	--
			01387	00021	C.2.4.1	C.3.4.3	--	--
			01387	00022A	C.2.6.1	--	--	--
			01387	00022B	C.2.4.1	--	--	--
			01387	00023A	C.2.4.1	--	--	--
			01387	00023B	C.2.4.1	--	--	--
			01387	00024	C.2.4.1	--	--	--
			01387	00025	C.2.4.1	--	--	--
	Berick, David	Environmental Policy Institute	01388	00001	C.3.3.2	--	--	--
			01388	00002	C.2.1.1	--	--	--
			01388	00005	C.2.1.1	--	--	--
			01388	00006	C.3.1.1	--	--	--
			01388	00007	C.2.2	--	--	--
			01388	00008A	C.2.7.1	--	--	--
			01388	00008B	C.2.7.1	--	--	--
			01388	00009	C.2.2.1	--	--	--
			01388	00010	C.3.1.2	--	--	--
			01388	00011	C.2.2.1	--	--	--
			01388	00012A	C.2.2.1	--	--	--
			01388	00012B	C.2.2.1	--	--	--
			01388	00012C	C.3.1.1	--	--	--
			01388	00012D	C.3.1.1	--	--	--
			01388	00012E	C.3.3	--	--	--
			01388	00012F	C.2.2.1	--	--	--
			01388	00013	C.3.3	--	--	--
			01388	00014	C.3.3	--	--	--
			01388	00015	C.3.3	--	--	--
			01388	00016A	C.2.7	--	--	--
			01388	00016B	C.2.4.1	--	--	--
			01388	00016C	C.2.4.1	--	--	--
			01388	00016D	C.2.4.1	--	--	--
			01388	00017	C.2.6.1	--	--	--
			01388	00018	C.3.4.3	C.7.3	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01388	00019	C.2.4.1	--	--	--
			01388	00020	C.2.4.1	--	--	--
			01388	00021	C.2.4.1	C.3.4.3	--	--
			01388	00022A	C.2.6.1	--	--	--
			01388	00022B	C.2.4.1	--	--	--
			01388	00023A	C.2.5.1	--	--	--
			01388	00023B	C.2.4.1	--	--	--
			01388	00024	C.2.4.1	--	--	--
			01388	00025	C.2.4.1	--	--	--
	Berick, David	Environmental Policy Institute	01389	00001	C.3.3.2	--	--	--
			01389	00002	C.2.1.1	--	--	--
			01389	00005	C.2.1.1	--	--	--
			01389	00006	C.3.1.1	--	--	--
			01389	00007	C.2.2	--	--	--
			01389	00008A	C.2.7.1	--	--	--
			01389	00008B	C.2.7.1	--	--	--
			01389	00009	C.2.2.1	--	--	--
			01389	00010	C.3.1.2	--	--	--
			01389	00011	C.2.2.1	--	--	--
			01389	00012A	C.2.2.1	--	--	--
			01389	00012B	C.2.2.1	--	--	--
			01389	00012C	C.3.1.1	--	--	--
			01389	00012D	C.3.1.1	--	--	--
			01389	00012E	C.3.3	--	--	--
			01389	00012F	C.2.2.1	--	--	--
			01389	00013	C.3.3	--	--	--
			01389	00014	C.3.3	--	--	--
			01389	00015	C.3.3	--	--	--
			01389	00016A	C.2.7	--	--	--
			01389	00016B	C.2.4.1	--	--	--
			01389	00016C	C.2.4.1	--	--	--
			01389	00016D	C.2.4.1	--	--	--
			01389	00017	C.2.6.1	--	--	--
			01389	00018	C.3.4.3	7.3	--	--
			01389	00019	C.2.4.1	--	--	--
			01389	00020	C.2.4.1	--	--	--
			01389	00021	C.2.4.1	C.3.4.3	--	--
			01389	00022A	C.2.6.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01389	00022B	C.2.4.1	--	--	--
			01389	00023A	C.2.5.1	--	--	--
			01389	00023B	C.2.4.1	--	--	--
			01389	00024	C.2.4.1	--	--	--
			01389	00025	C.2.4.1	--	--	--
	Berick, David	Environmental Policy Institute	01386	00001	C.2.1.1	--	--	--
			01386	00005	C.2.1.1	--	--	--
			01386	00006	C.3.1.1	--	--	--
			01386	00007	C.2.2	--	--	--
			01386	00008A	C.2.7.1	--	--	--
			01386	00008B	C.2.7.1	--	--	--
			01386	00009	C.2.2.1	--	--	--
			01386	00010	C.3.1.2	--	--	--
			01386	00011	C.2.2.1	--	--	--
			01386	00012A	C.2.2.1	--	--	--
			01386	00012B	C.2.2.1	--	--	--
			01386	00012C	C.3.1.1	--	--	--
			01386	00012D	C.3.1.1	--	--	--
			01386	00012E	C.3.3	--	--	--
			01386	00012F	C.2.2.1	--	--	--
			01386	00013	C.3.3	--	--	--
			01386	00014	C.3.3	--	--	--
			01386	00015	C.3.3	--	--	--
			01386	00016A	C.2.7	--	--	--
			01386	00016B	C.2.4.1	--	--	--
			01386	00016C	C.2.4.1	--	--	--
			01386	00016D	C.2.4.1	--	--	--
			01386	00017	C.2.6.1	--	--	--
			01386	00018	C.3.4.3	--	--	--
			01386	00019	C.2.4.1	--	--	--
			01386	00020	C.2.4.1	--	--	--
			01386	00021	C.2.4.1	C.3.4.3	--	--
			01386	00022A	C.2.6.1	--	--	--
			01386	00022B	C.2.4.1	--	--	--
			01386	00023A	C.2.5.1	--	--	--
			01386	00023B	C.2.4.1	--	--	--
			01386	00024	C.2.4.1	--	--	--
			01386	00025	C.2.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
	Blakey, L. H.	Department of Army, Plan. Div.	02065	00001	C.7.2	--	--	--
			02065	00002	C.4.1.3	--	--	--
			02065	00003	C.4.1.3	--	--	--
			02065	00004	C.4.1.3	--	--	--
			02065	00005	C.4.1.3	--	--	--
			02065	00006	C.7.2.6	--	--	--
			02065	00007	C.7.1.1	--	--	--
			02065	00008	C.7.2	--	--	--
			02065	00009	C.6.4	--	--	--
			02065	00010	C.4.1.3	--	--	--
			02065	00011	C.7.1.1	--	--	--
			02065	00012	C.4.3	--	--	--
			02065	00013	C.4.3	--	--	--
			02065	00014	C.7.2	--	--	--
			02065	00015	C.7.2	--	--	--
			02065	00016	C.7.2.2	--	--	--
			02065	00017	C.7.2	--	--	--
			02065	00018	C.7.2	--	--	--
			02065	00019	C.7.2	--	--	--
			02065	00020	C.4.1.3	--	--	--
			02065	00021	C.7.2.5	--	--	--
			02065	00022	C.7.2.4	--	--	--
			02065	00023	C.7.2.6	--	--	--
			02065	00024	C.7.3	--	--	--
			02065	00025	C.7.4	--	--	--
			02065	00026	C.2.7	--	--	--
			02065	00027	C.3.1.1	C.9	--	--
			02065	00028	C.3.1.1	--	--	--
			02065	00029	C.5.7	--	--	--
			02065	00030	C.4.2.1	--	--	--
			02065	00031	C.7.2	--	--	--
			02065	00032	C.4.2.1	--	--	--
			02065	00033	C.3.1.2	--	--	--
			02065	00034	C.3.3	--	--	--
			02065	00035	C.3.1.3	--	--	--
			02065	00036	C.5.7	--	--	--
			02065	00037	C.4.1.2	--	--	--
			02065	00038	C.4.1	--	--	--

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INDEX OF COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HANFORD SITE

STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION - FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			02065	00039	C.4.1.1	--	--	--
			02065	00040	C.5.7	--	--	--
			02065	00041	C.5.7	--	--	--
			02065	00042	C.5.7	--	--	--
			02065	00043	C.5.7	--	--	--
			02065	00044	C.4.1.2.2	--	--	--
			02065	00045	C.3.1.1	--	--	--
			02065	00046	C.3.1.3	--	--	--
			02065	00047	C.4.1	--	--	--
			02065	00048	C.4.1	--	--	--
			02065	00049	C.4.1	--	--	--
			02065	00050	C.5.7	--	--	--
			02065	00051	C.5.7	--	--	--
			02065	00052	C.5.7	--	--	--
			02065	00053	C.5.1	--	--	--
			02065	00054	C.4.1.2.1	--	--	--
			02065	00055	C.4.1.2.2	--	--	--
			02065	00056	C.5.7	--	--	--
			02065	00057	C.4.2.1	--	--	--
			02065	00058	C.4.2.2	--	--	--
			02065	00059	C.7.2	--	--	--
			02065	00060	C.5.11	--	--	--
			02065	00061	C.5.11	--	--	--
			02065	00062	C.5.1	--	--	--
			02065	00063	C.5.1	--	--	--
			02065	00064	C.5.1	--	--	--
			02065	00065	C.5.11	--	--	--
			02065	00066A	C.3.1.1	--	--	--
			02065	00066B	C.5.1	--	--	--
			02065	00067	C.5.5	--	--	--
			02065	00069	C.5.7	--	--	--
			02065	00070	C.5.7	--	--	--
			02065	00071	C.5.7	--	--	--
			02065	00072	C.5.7	--	--	--
			02065	00073	C.5.7	--	--	--
			02065	00074	C.5.8	--	--	--
			02065	00075	C.5.3	--	--	--
			02065	00076	C.8.2	--	--	--

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INDEX OF COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HANFORD SITE

STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			02065	00077	C.3.1.1	C.9	C.8.2	--
	Blanchard, Bruce	U.S. Dept. of Interior	02123	00001	C.2.7	--	--	--
			02123	00002	C.2.1.1	--	--	--
			02123	00004	C.2.3.3	--	--	--
			02123	00005	C.3.4.4	--	--	--
			02123	00006	C.3.4.4	--	--	--
			02123	00007	C.3.4.3	--	--	--
			02123	00008	C.3.4.3	--	--	--
			02123	00009	C.3.4.3	--	--	--
			02123	00010	C.3.4.1	--	--	--
			02123	00011	C.3.4.1	--	--	--
			02123	00012	C.3.4.1	--	--	--
			02123	00013	C.3.4.3	--	--	--
			02123	00014	C.3.4.1	--	--	--
			02123	00015	C.3.4.1	--	--	--
			02123	00016	C.3.4.3	--	--	--
			02123	00017	C.3.4.1	--	--	--
			02123	00018	C.3.4.1	--	--	--
			02123	00019	C.3.4.1	--	--	--
			02123	00020	C.3.4.1	--	--	--
			02123	00021	C.3.4.1	--	--	--
			02123	00022	C.3.4.3	--	--	--
			02123	00023	C.3.4.1	--	--	--
			02123	00024	C.3.4.1	--	--	--
			02123	00025	C.3.4.1	--	--	--
			02123	00026	C.3.4.1	--	--	--
			02123	00027	C.3.4.1	--	--	--
			02123	00028	C.3.4.1	--	--	--
			02123	00029	C.3.4.1	--	--	--
			02123	00030	C.3.4.1	--	--	--
			02123	00031	C.3.4.1	--	--	--
			02123	00032	C.3.4.1	--	--	--
			02123	00033	C.3.4.1	--	--	--
			02123	00034	C.3.4.2.1	--	--	--
			02123	00035	C.3.4.2.1	--	--	--
			02123	00036	C.3.4	--	--	--
			02123	00037	C.3.4.2.3	--	--	--
			02123	00039	C.2.7	--	--	--

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INDEX OF COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HANFORD SITE

STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			02123	00040	C.2.7	--	--	--
			02123	00041	C.2.7	--	--	--
			02123	00047A	C.2.4.1	--	--	--
			02123	00047B	C.3.1.2	--	--	--
			02123	00067	C.6.1	--	--	--
			02123	00068	C.3.3.2	--	--	--
	Blanchard, Bruce	U.S. Dept. of Interior	01598	00001	C.2.7	--	--	--
			01598	00004	C.2.3.3	--	--	--
			01598	00005	C.3.4.4	--	--	--
			01598	00006	C.3.4.4	--	--	--
			01598	00007	C.3.4.3	--	--	--
			01598	00008	C.3.4.3	--	--	--
			01598	00009	C.3.4.3	--	--	--
			01598	00010	C.3.4.1	--	--	--
			01598	00011	C.3.4.1	--	--	--
			01598	00012	C.3.4.1	--	--	--
			01598	00013	C.3.4.3	--	--	--
			01598	00014	C.3.4.1	--	--	--
			01598	00015	C.3.4.1	--	--	--
			01598	00016	C.3.4.3	--	--	--
			01598	00017	C.3.4.1	--	--	--
			01598	00018	C.3.4.1	--	--	--
			01598	00019	C.3.4.1	--	--	--
			01598	00020	C.3.4.1	--	--	--
			01598	00021	C.3.4.1	--	--	--
			01598	00022	C.3.4.3	--	--	--
			01598	00023	C.3.4.1	--	--	--
			01598	00024	C.3.4.1	--	--	--
			01598	00025	C.3.4.1	--	--	--
			01598	00026	C.3.4.1	--	--	--
			01598	00027	C.3.4.1	--	--	--
			01598	00028	C.3.4.1	--	--	--
			01598	00029	C.3.4.1	--	--	--
			01598	00030	C.3.4.1	--	--	--
			01598	00031	C.3.4.1	--	--	--
			01598	00032	C.3.4.1	--	--	--
			01598	00033	C.3.4.1	--	--	--
			01598	00034	C.3.4.2.1	--	--	--

INDEX OF COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HANFORD SITE

STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01598	00035	C.3.4.2.1	--	--	--
			01598	00036	C.3.4.2	--	--	--
			01598	00037	C.3.4.2.3	--	--	--
			01598	00039	C.2.7	--	--	--
			01598	00040	C.2.7	--	--	--
			01598	00041	C.2.7	--	--	--
			01598	00043	C.4.1.4	--	--	--
			01598	00045	C.3.4.2.2	--	--	--
			01598	00046	C.3.4.1	--	--	--
			01598	00047A	C.3.4.1	--	--	--
			01598	00047B	C.3.4.1	--	--	--
			01598	00047C	C.3.4.1	--	--	--
			01598	00048	C.3.4.1	--	--	--
			01598	00049	C.3.4.3	--	--	--
			01598	00053	C.3.4.3	--	--	--
			01598	00055C	C.3.4.3	--	--	--
			01598	00056	C.3.4.3	--	--	--
			01598	00057	C.2.7	--	--	--
			01598	00058	C.3.1.2	--	--	--
			01598	00059	C.2.7	--	--	--
			01598	00060	C.2.7	--	--	--
			01598	00199	C.3.4.3	--	--	--
			01598	00200	C.2.8.3	--	--	--
			01598	00217	C.2.7	--	--	--
			01598	00245	C.3.4.4	--	--	--
			01598	00246	C.3.4.1	--	--	--
			01598	00247	C.3.4.1	--	--	--
			01598	00248	C.3.4.1	--	--	--
			01598	00249	C.3.4.1	--	--	--
			01598	00250	C.3.4.1	--	--	--
			01598	00251	C.3.4.2.2	--	--	--
			01598	00252	C.2.4.1	--	--	--
			01598	00253	C.2.7	--	--	--
			01598	00254	C.2.7	--	--	--
			01598	00255	C.2.7	--	--	--
			01598	00256	C.2.7	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01598	00257	C.2.7	--	--	--
			01598	00258	C.2.7	--	--	--
			01598	00259	C.2.7	--	--	--
			01598	00260	C.2.7	--	--	--
			01598	00261	C.2.7	--	--	--
			01598	00262	C.2.7	--	--	--
			01598	00263	C.2.7	--	--	--
			01598	00264	C.2.7	--	--	--
			01598	00321	C.3.4.3	--	--	--
			01598	00326	C.3.1.2	--	--	--
			01598	00328A	C.3.4.1	--	--	--
			01598	00335	C.3.3.1	--	--	--
	Blanchard, Bruce	U.S. Dept. of Interior	02122	00001	C.2.7.4	--	--	--
			02122	00002	C.2.1.1	--	--	--
			02122	00004	C.2.3.3	--	--	--
			02122	00005	C.3.4.4	--	--	--
			02122	00006	C.3.4.4	--	--	--
			02122	00007	C.3.4.3	--	--	--
			02122	00008	C.3.4.3	--	--	--
			02122	00009	C.3.4.3	--	--	--
			02122	00010	C.3.4.1	--	--	--
			02122	00011	C.3.4.1	--	--	--
			02122	00012	C.3.4.1	--	--	--
			02122	00013	C.3.4.3	--	--	--
			02122	00014	C.3.4.1	--	--	--
			02122	00015	C.3.4.1	--	--	--
			02122	00016	C.3.4.3	--	--	--
			02122	00017	C.3.4.1	--	--	--
			02122	00018	C.3.4.1	--	--	--
			02122	00019	C.3.4.1	--	--	--
			02122	00020	C.3.4.1	--	--	--
			02122	00021	C.3.4.1	--	--	--
			02122	00022	C.3.4.3	--	--	--
			02122	00023	C.3.4.1	--	--	--
			02122	00024	C.3.4.1	--	--	--
			02122	00025	C.3.4.1	--	--	--
			02122	00026	C.3.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			02122	00027	C.3.4.1	--	--	--
			02122	00028	C.3.4.1	--	--	--
			02122	00029	C.3.4.1	--	--	--
			02122	00030	C.3.4.1	--	--	--
			02122	00031	C.3.4.1	--	--	--
			02122	00032	C.3.4.1	--	--	--
			02122	00033	C.3.4.1	--	--	--
			02122	00034	C.3.4.2.1	--	--	--
			02122	00035	C.3.4.2.1	--	--	--
			02122	00036	C.3.4.2	--	--	--
			02122	00037	C.3.4.2.3	--	--	--
			02122	00039	C.2.7	--	--	--
			02122	00040	C.2.7	--	--	--
			02122	00041	C.2.7	--	--	--
			02122	00046	C.2.7	--	--	--
			02122	00047	C.2.7	--	--	--
	Blanchard, Bruce	U.S. Dept. of Interior	01565	00001	C.2.7	--	--	--
			01565	00002	C.2.1.1	--	--	--
			01565	00004	C.2.3.3	--	--	--
			01565	00005	C.3.4.4	--	--	--
			01565	00006	C.3.4.4	--	--	--
			01565	00007	C.3.4.3	--	--	--
			01565	00008	C.3.4.3	--	--	--
			01565	00009	C.3.4.3	--	--	--
			01565	00010	C.3.4.1	--	--	--
			01565	00011	C.3.4.1	--	--	--
			01565	00012	C.3.4.1	--	--	--
			01565	00013	C.3.4.3	--	--	--
			01565	00014	C.3.4.1	--	--	--
			01565	00015	C.3.4.1	--	--	--
			01565	00016	C.3.4.3	--	--	--
			01565	00017	C.3.4.1	--	--	--
			01565	00018	C.3.4.1	--	--	--
			01565	00019	C.3.4.1	--	--	--
			01565	00020	C.3.4.1	--	--	--
			01565	00021	C.3.4.1	--	--	--
			01565	00022	C.3.4.3	--	--	--
			01565	00023	C.3.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01565	00024	C.3.4.1	--	--	--
			01565	00025	C.3.4.1	--	--	--
			01565	00026	C.3.4.1	--	--	--
			01565	00027	C.3.4.1	--	--	--
			01565	00028	C.3.4.1	--	--	--
			01565	00029	C.3.4.1	--	--	--
			01565	00030	C.3.4.1	--	--	--
			01565	00031	C.3.4.1	--	--	--
			01565	00032	C.3.4.1	--	--	--
			01565	00033	C.3.4.1	--	--	--
			01565	00034	C.3.4.2	--	--	--
			01565	00035	C.3.4.2.1	--	--	--
			01565	00036	C.3.4.2	--	--	--
			01565	00037	C.3.4.2.3	--	--	--
			01565	00039	C.2.7	--	--	--
			01565	00040	C.2.7	--	--	--
			01565	00041	C.2.7	--	--	--
			01565	00043	C.2.7	--	--	--
	Blanchard, Bruce	U.S. Dept. of Interior	01599	00001	C.2.7	--	--	--
			01599	00002	C.2.1.1	--	--	--
			01599	00004	C.2.3.3	--	--	--
			01599	00005	C.3.4.4	--	--	--
			01599	00006	C.3.4.1	--	--	--
			01599	00007	C.3.4.1	--	--	--
			01599	00008	C.3.4.3	--	--	--
			01599	00009	C.3.4	--	--	--
			01599	00010	C.3.4.1	--	--	--
			01599	00011	C.3.4.1	--	--	--
			01599	00012	C.3.4.1	--	--	--
			01599	00013	C.3.4	--	--	--
			01599	00014	C.3.4.1	--	--	--
			01599	00015	C.3.4.1	--	--	--
			01599	00016	C.3.4.1	--	--	--
			01599	00017	C.3.4.1	--	--	--
			01599	00018	C.3.4.1	--	--	--
			01599	00019	C.3.4.1	--	--	--
			01599	00020	C.3.4.1	--	--	--
			01599	00021	C.3.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01599	00022	C.3.4.3	--	--	--
			01599	00023	C.3.4.1	--	--	--
			01599	00024	C.3.4.1	--	--	--
			01599	00025	C.3.4.1	--	--	--
			01599	00026	C.3.4.1	--	--	--
			01599	00027	C.3.4.1	--	--	--
			01599	00028	C.3.4.1	--	--	--
			01599	00029	C.3.4.1	--	--	--
			01599	00030	C.3.4.1	--	--	--
			01599	00031	C.3.4.1	--	--	--
			01599	00032	C.3.4.1	--	--	--
			01599	00033	C.3.4.1	--	--	--
			01599	00034	C.3.4.2.1	--	--	--
			01599	00035	C.3.4.2.1	--	--	--
			01599	00036	C.3.4.2	--	--	--
			01599	00037	C.3.4.2.3	--	--	--
			01599	00039	C.2.7	--	--	--
			01599	00040	C.2.7	--	--	--
			01599	00041	C.2.7	--	--	--
			01599	00047B	C.3.4.1	--	--	--
			01599	00047C	C.3.4.1	--	--	--
			01599	00048	C.3.4.1	--	--	--
			01599	00050A	C.4.1.2.1	C.3.4.1	--	--
			01599	00062	C.3.1.1	--	--	--
			01599	00066	C.4.1.4	C.7.3	--	--
			01599	00068	C.3.1.1	--	--	--
			01599	00069	C.3.4.1	--	--	--
			01599	00070A	C.3.4.1	--	--	--
			01599	00070B	C.3.4.1	--	--	--
			01599	00070C	C.3.4.1	--	--	--
			01599	00071	C.3.4.1	--	--	--
			01599	00072	C.3.4.2.1	--	--	--
			01599	00076	C.3.4.3	--	--	--
			01599	00078	C.3.4.3	--	--	--
			01599	00078C	C.3.4.3	--	--	--
			01599	00079	C.3.4.3	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01599	00081	C.2.7	--	--	--
			01599	00082	C.2.7	--	--	--
			01599	00083	C.2.7	--	--	--
			01599	00208	C.3.1.1	--	--	--
			01599	00209	C.2.8.3	--	--	--
			01599	00216	C.2.7	--	--	--
			01599	00217	C.2.7	--	--	--
			01599	00226	C.2.7	--	--	--
			01599	00246	C.3.4.1	--	--	--
			01599	00247	C.3.4.1	--	--	--
			01599	00248	C.3.4.1	--	--	--
			01599	00249	C.3.4.1	--	--	--
			01599	00250	C.3.4.1	--	--	--
			01599	00251	C.3.4.2.2	--	--	--
			01599	00252	C.2.4.1	--	--	--
			01599	00252B	C.3.4.2.2	--	--	--
			01599	00264	C.2.7	--	--	--
	Blanchard, Bruce	U.S. Dept. of Interior	01566	00002	C.2.1.1	--	--	--
			01566	00003	C.2.7	--	--	--
			01566	00004	C.2.3.3	--	--	--
			01566	00005	C.3.4.4	--	--	--
			01566	00006	C.3.4.1	--	--	--
			01566	00007	C.3.4.3	--	--	--
			01566	00008	C.3.4.3	--	--	--
			01566	00009	C.3.4	--	--	--
			01566	00010	C.3.4.1	--	--	--
			01566	00011	C.3.4.1	--	--	--
			01566	00012	C.3.4.1	--	--	--
			01566	00013	C.3.4	--	--	--
			01566	00014	C.3.4.1	--	--	--
			01566	00015	C.3.4.1	--	--	--
			01566	00016	C.3.4.1	--	--	--
			01566	00017	C.3.4.1	--	--	--
			01566	00018	C.3.4.1	--	--	--
			01566	00019	C.3.4.1	--	--	--
			01566	00020	C.3.4.1	--	--	--
			01566	00021	C.3.4.1	--	--	--
			01566	00022	C.3.4.3	--	--	--

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INDEX OF COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HANFORD SITE

STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01566	00023	C.3.4.1	--	--	--
			01566	00024	C.3.4.1	--	--	--
			01566	00025	C.3.4.1	--	--	--
			01566	00026	C.3.4.1	--	--	--
			01566	00027	C.3.4.1	--	--	--
			01566	00028	C.3.4.1	--	--	--
			01566	00029	C.3.4.1	--	--	--
			01566	00030	C.3.4.1	--	--	--
			01566	00031	C.3.4.1	--	--	--
			01566	00032	C.3.4.1	--	--	--
			01566	00033	C.3.4.1	--	--	--
			01566	00034	C.3.4.2.1	--	--	--
			01566	00035	C.3.4.2.1	--	--	--
			01566	00036	C.3.4.2.3	--	--	--
			01566	00037	C.2.3.2	--	--	--
			01566	00038	C.2.7	--	--	--
			01566	00039	C.2.7	--	--	--
			01566	00040	C.2.7	--	--	--
			01566	00042	C.4.1.2.2	--	--	--
			01566	00043	C.5.11	--	--	--
			01566	00044	C.8.2	--	--	--
			01566	00045	C.9	--	--	--
			01566	00048	C.4.1	--	--	--
			01566	00051	C.4.1	--	--	--
			01566	00052	C.4.1	--	--	--
			01566	00053	C.5.7	--	--	--
			01566	00057	C.4.1	--	--	--
			01566	00058	C.4.1	--	--	--
			01566	00061	C.4.1	--	--	--
			01566	00063	C.4.1	--	--	--
			01566	00064	C.4.1	--	--	--
			01566	00065	C.4.1	--	--	--
			01566	00066	C.4.1	--	--	--
			01566	00068	C.4.1	--	--	--
			01566	00069	C.5.7	--	--	--
			01566	00070	C.4.1	--	--	--
			01566	00071	C.5.7	--	--	--
			01566	00072	C.4.1	--	--	--

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INDEX OF COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HANFORD SITE

STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01566	00073	C.4.1	C.5.7	--	--
			01566	00074	C.4.1	--	--	--
			01566	00075	C.5.7	--	--	--
			01566	00076	C.4.1	--	--	--
			01566	00077	C.5.7	--	--	--
			01566	00078	C.5.7	--	--	--
			01566	00079	C.4.1.2.2	--	--	--
			01566	00080	C.4.1.2.2	--	--	--
			01566	00081	C.4.1.2.2	--	--	--
			01566	00082	C.4.1.2.2	--	--	--
			01566	00083	C.4.1.2.2	C.5.7	--	--
			01566	00084	C.4.1.2.2	--	--	--
			01566	00085	C.4.1.2.2	--	--	--
			01566	00086	C.4.1.2.2	--	--	--
			01566	00087	C.7.2	--	--	--
			01566	00088	C.4.1.3	--	--	--
			01566	00089	C.4.2.1	--	--	--
			01566	00090	C.6.4	--	--	--
			01566	00091	C.4.1.2	--	--	--
			01566	00092	C.9	C.7.4	--	--
			01566	00093	C.5.11	--	--	--
			01566	00094	C.5.1	--	--	--
			01566	00095	C.5.11	--	--	--
			01566	00096	C.5.1	--	--	--
			01566	00097	C.5.1	--	--	--
			01566	00098	C.5.1	--	--	--
			01566	00099	C.5.1	--	--	--
			01566	00100	C.5.1	--	--	--
			01566	00101	C.5.1	--	--	--
			01566	00102	C.5.1	--	--	--
			01566	00103	C.5.1	--	--	--
			01566	00104	C.5.1	--	--	--
			01566	00105	C.5.1	--	--	--
			01566	00106	C.5.11	--	--	--
			01566	00107	C.5.1	--	--	--
			01566	00108	C.5.1	--	--	--
			01566	00109	C.5.1	--	--	--
			01566	00110	C.5.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01566	00111	C.5.1	--	--	--
			01566	00112	C.5.1	--	--	--
			01566	00113	C.4.1	--	--	--
			01566	00114	C.5.7	--	--	--
			01566	00115	C.5.7	--	--	--
			01566	00117	C.5.7	--	--	--
			01566	00118	C.4.1	--	--	--
			01566	00119	C.5.7	--	--	--
			01566	00120	C.5.7	--	--	--
			01566	00121	C.5.11	--	--	--
			01566	00122	C.5.11	--	--	--
			01566	00123	C.3.4	--	--	--
			01566	00124	C.3.4	--	--	--
			01566	00125	C.3.4	--	--	--
			01566	00126	C.3.4	--	--	--
			01566	00127	C.3.4	--	--	--
			01566	00128	C.3.4	--	--	--
			01566	00129	C.3.4	--	--	--
			01566	00130	C.3.4	--	--	--
			01566	00131	C.3.4	--	--	--
			01566	00132	C.3.4	--	--	--
			01566	00133	C.3.4	--	--	--
			01566	00134	C.3.4	--	--	--
	Blanchard, Bruce	U.S. Dept. of Interior	01567	00001	C.2.7	--	--	--
			01567	00002	C.2.1.1	--	--	--
			01567	00004	C.2.3.3	--	--	--
			01567	00005	C.3.4.4	--	--	--
			01567	00006	C.3.4.4	--	--	--
			01567	00007	C.3.4.3	--	--	--
			01567	00008	C.3.4.3	--	--	--
			01567	00009	C.3.4.3	--	--	--
			01567	00010	C.3.4.1	--	--	--
			01567	00011	C.3.4.1	--	--	--
			01567	00012	C.3.4.1	--	--	--
			01567	00013	C.3.4.3	--	--	--
			01567	00014	C.3.4.1	--	--	--
			01567	00015	C.3.4.1	--	--	--
			01567	00016	C.3.4.3	--	--	--

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INDEX OF COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HANFORD SITE

STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01567	00017	C.3.4.1	--	--	--
			01567	00018	C.3.4.1	--	--	--
			01567	00019	C.3.4.1	--	--	--
			01567	00020	C.3.4.1	--	--	--
			01567	00021	C.3.4.1	--	--	--
			01567	00022	C.3.4.3	--	--	--
			01567	00023	C.3.4.1	--	--	--
			01567	00024	C.3.4.1	--	--	--
			01567	00025	C.3.4.1	--	--	--
			01567	00026	C.3.4.1	--	--	--
			01567	00027	C.3.4.1	--	--	--
			01567	00028	C.3.4.1	--	--	--
			01567	00029	C.3.4.1	--	--	--
			01567	00030	C.3.4.1	--	--	--
			01567	00031	C.3.4.1	--	--	--
			01567	00032	C.3.4.1	--	--	--
			01567	00033	C.3.4.1	--	--	--
			01567	00034	C.3.4.2.1	--	--	--
			01567	00035	C.3.4.2.1	--	--	--
			01567	00036	C.3.4.4	--	--	--
			01567	00037	C.2.3.2	--	--	--
			01567	00038	C.2.7	--	--	--
			01567	00039	C.2.7	--	--	--
			01567	00040	C.2.7	--	--	--
	Browning, Robert E.	U.S. Nuclear Reg. Commission	02734	00001	C.4.1.2.2	--	--	--
	Buren, Mindy A.	LeBoeuf, Lamb, Leiby, & MacRae	02252	00001	C.2.4.1	--	--	--
			02252	00002	C.2.4.1	--	--	--
			02252	00003	C.2.4.1	--	--	--
			02252	00004	C.2.4.1	--	--	--
			02252	00005	C.2.4.1	--	--	--
			02252	00006	C.2.4.1	--	--	--
			02252	00007	C.2.4.1	--	--	--
			02252	00008	C.2.4.1	--	--	--
			02252	00009	C.2.4.1	--	--	--
			02252	00010	C.2.4.1	--	--	--
			02252	00011	C.2.4.1	--	--	--
			02252	00012	C.2.4.1	--	--	--
			02252	00013	C.2.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			02252	00014	C.2.4.1	--	--	--
			02252	00015	C.2.4.1	--	--	--
			02252	00016	C.2.4.1	--	--	--
			02252	00017	C.2.4.1	--	--	--
			02252	00018	C.2.4.1	--	--	--
			02252	00019	C.2.4.1	--	--	--
			02252	00020	C.2.4.1	--	--	--
			02252	00021	C.2.4.1	--	--	--
			02252	00022	C.2.4.1	--	--	--
			02252	00023	C.2.4.1	--	--	--
			02252	00024	C.2.4.1	--	--	--
			02252	00025	C.2.4.1	--	--	--
			02252	00026	C.2.4.1	--	--	--
			02252	00027	C.2.4.1	--	--	--
			02252	00028	C.2.4.1	--	--	--
			02252	00029	C.2.4.1	--	--	--
			02252	00030	C.2.4.1	--	--	--
			02252	00031	C.2.4.1	--	--	--
			02252	00032	C.2.4.1	--	--	--
			02252	00033	C.2.4.1	--	--	--
			02252	00034	C.2.4.1	--	--	--
			02252	00035	C.2.4.1	--	--	--
			02252	00036	C.2.4.1	--	--	--
			02252	00037	C.2.4.1	--	--	--
			02252	00038	C.2.4.1	--	--	--
			02252	00039	C.2.4.1	--	--	--
			02252	00040	C.2.4.1	--	--	--
			02252	00041	C.2.4.1	--	--	--
			02252	00042	C.2.4.1	--	--	--
			02252	00043	C.2.4.1	--	--	--
			02252	00044	C.2.4.1	--	--	--
			02252	00045	C.2.4.1	--	--	--
			02252	00046	C.2.4.1	--	--	--
			02252	00047	C.2.4.1	--	--	--
			02252	00048	C.2.4.1	--	--	--
			02252	00049	C.2.4.1	--	--	--
	Davis, John G.	U.S. Nuclear Reg. Commission	01037	00008	C.3.4.2.3	--	--	--
			01037	00137	C.3.4.3	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECONO	THIRO	FOURTH
District of Columbia (continued)								
			01037	00139	C.7.3	--	--	--
	Oavis, John G.	U.S. Nuclear Reg. Commission	01038	00001	C.5.11	--	--	--
			01038	00002	C.5.1	--	--	--
			01038	00003	C.5.2	--	--	--
			01038	00004	C.5.7	--	--	--
			01038	00005	C.5.8	--	--	--
			01038	00006	C.8.2	C.5.3	--	--
			01038	00007	C.4.3	--	--	--
			01038	00008	C.4.3	--	--	--
			01038	00009	C.3.4.2.3	--	--	--
			01038	00010	C.3.4.3	--	--	--
			01038	00011	C.4.1.3	--	--	--
			01038	00012	C.7.3	--	--	--
			01038	00013	C.5.11	--	--	--
			01038	00014	C.5.2	--	--	--
			01038	00015	C.2.7	--	--	--
			01038	00016	C.5.2	C.4.3	--	--
			01038	00017	C.2.7	--	--	--
			01038	00018	C.2.7	--	--	--
			01038	00019	C.4.1	--	--	--
			01038	00020	C.4.1.2	--	--	--
			01038	00021	C.4.1.2	--	--	--
			01038	00022	C.5.7	--	--	--
			01038	00023	C.5.7	--	--	--
			01038	00024	C.4.1.2.2	--	--	--
			01038	00025	C.3.1.3	--	--	--
			01038	00026	C.5.7	--	--	--
			01038	00027	C.3.1.3	--	--	--
			01038	00028	C.3.1.3	--	--	--
			01038	00029	C.3.1.3	--	--	--
			01038	00030	C.9	--	--	--
			01038	00031	C.4.1.3	--	--	--
			01038	00032	C.4.1.1	--	--	--
			01038	00033	C.4.1.2	--	--	--
			01038	00034	C.4.1.3	--	--	--
			01038	00035	C.4.1.2	--	--	--
			01038	00036	C.4.1.3	--	--	--
			01038	00037	C.4.1.2	--	--	--

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INDEX OF COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HANFORD SITE

STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01038	00038	C.4.1.3	--	--	--
			01038	00039	C.5.7	--	--	--
			01038	00040	C.5.7	--	--	--
			01038	00041	C.4.1.2	--	--	--
			01038	00042	C.5.7	--	--	--
			01038	00043	C.5.7	--	--	--
			01038	00044	C.5.7	--	--	--
			01038	00045	C.5.7	--	--	--
			01038	00046	C.5.7	--	--	--
			01038	00047	C.4.1.2.1	--	--	--
			01038	00048	C.4.1.2.2	--	--	--
			01038	00049	C.4.1.2.2.	--	--	--
			01038	00050	C.4.1.2.2	--	--	--
			01038	00051	C.4.1.2.2	--	--	--
			01038	00052	C.4.1.2.2.	--	--	--
			01038	00053	C.5.11	--	--	--
			01038	00054	C.4.1.2.2	--	--	--
			01038	00055	C.4.1.2.2	--	--	--
			01038	00056	C.4.1.2.2.	--	--	--
			01038	00057	C.4.1.3	--	--	--
			01038	00058	C.6.4	--	--	--
			01038	00059	C.7.2	--	--	--
			01038	00060	C.4.1.3	--	--	--
			01038	00061	C.7.2.3	--	--	--
			01038	00062	C.4.2.1.4.	--	--	--
			01038	00063	C.4.2.2	--	--	--
			01038	00064	C.7.2.6	--	--	--
			01038	00065	C.4.2.1.4	--	--	--
			01038	00066	C.7.2.2	--	--	--
			01038	00067	C.7.2	--	--	--
			01038	00068	C.7.2.2	--	--	--
			01038	00069	C.7.2.3	--	--	--
			01038	00070	C.7.2.5	--	--	--
			01038	00071	C.7.2	--	--	--
			01038	00072	C.6.4	--	--	--
			01038	00073	C.4.3	--	--	--
			01038	00074	C.7.2.2	--	--	--
			01038	00075	C.7.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01038	00076	C.4.3	--	--	--
			01038	00077	C.7.2	--	--	--
			01038	00078	C.7.2	--	--	--
			01038	00079	C.6.4	--	--	--
			01038	00080	C.7.2.3	--	--	--
			01038	00081	C.7.2.5	--	--	--
			01038	00082	C.7.2.5	--	--	--
			01038	00083	C.7.3	--	--	--
			01038	00084	C.2.4.1	--	--	--
			01038	00085	C.2.4.1	--	--	--
			01038	00086	C.7.4	--	--	--
			01038	00087	C.2.1.2	C.7.4	--	--
			01038	00088	C.5.2	C.4.3	--	--
			01038	00089	C.9	--	--	--
			01038	00090	C.6.2	--	--	--
			01038	00091	C.7.2.3	--	--	--
			01038	00092A	C.7.2.3	--	--	--
			01038	00092B	C.7.3	--	--	--
			01038	00093	C.6.2	--	--	--
			01038	00094	C.7.2.3	--	--	--
			01038	00095	C.4.1.3	--	--	--
			01038	00096	C.7.4	--	--	--
			01038	00097	C.7.3	--	--	--
			01038	00098	C.5.11	--	--	--
			01038	00099	C.5.11	--	--	--
			01038	00100	C.5.1	--	--	--
			01038	00101	C.5.1	--	--	--
			01038	00102	C.5.1	--	--	--
			01038	00103	C.5.1	--	--	--
			01038	00104	C.5.1	--	--	--
			01038	00105	C.5.1	--	--	--
			01038	00106	C.5.1	--	--	--
			01038	00107	C.5.1	--	--	--
			01038	00108	C.9	--	--	--
			01038	00109	C.5.1	--	--	--
			01038	00110	C.5.1	--	--	--
			01038	00111	C.5.1	--	--	--
			01038	00112	C.5.2	C.4.3	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01038	00113	C.5.2	--	--	--
			01038	00114	C.5.2	C.4.3	--	--
			01038	00115	C.5.2	--	--	--
			01038	00116	C.5.2	C.5.11	--	--
			01038	00117	C.4.3	--	--	--
			01038	00118	C.4.1.2.2	--	--	--
			01038	00119	C.4.3	--	--	--
			01038	00120	C.5.2	--	--	--
			01038	00121	C.5.2	--	--	--
			01038	00122	C.4.3	--	--	--
			01038	00123	C.4.3	--	--	--
			01038	00124	C.5.3	--	--	--
			01038	00125	C.5.4	--	--	--
			01038	00126	C.5.4	--	--	--
			01038	00127	C.5.7	--	--	--
			01038	00128	C.5.7	--	--	--
			01038	00129	C.5.7	--	--	--
			01038	00130	C.5.7	--	--	--
			01038	00131	C.5.7	--	--	--
			01038	00132	C.5.7	--	--	--
			01038	00133	C.5.7	--	--	--
			01038	00134	C.5.7	--	--	--
			01038	00135	C.5.7	--	--	--
			01038	00136	C.5.7	--	--	--
			01038	00137	C.5.7	--	--	--
			01038	00138	C.5.7	--	--	--
			01038	00139	C.5.8	--	--	--
			01038	00140	C.5.8	--	--	--
			01038	00141	C.5.8	--	--	--
			01038	00142	C.5.8	--	--	--
			01038	00143	C.5.8	--	--	--
			01038	00144	C.5.8	--	--	--
			01038	00145	C.5.8	--	--	--
			01038	00146	C.5.11	C.5.2	--	--
			01038	00147	C.5.11	--	--	--
			01038	00148	C.8.3	--	--	--
			01038	00149	C.5.3	--	--	--
			01038	00150	C.8.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01038	00151	C.4.3	--	--	--
			01038	00152	C.4.3	--	--	--
			01038	00153	C.8.2	--	--	--
			01038	00154	C.8.2	--	--	--
			01038	00155	C.5.3	--	--	--
			01038	00156	C.8.2	--	--	--
			01038	00157	C.8.2	--	--	--
			01038	00158	C.8.2	--	--	--
			01038	00159	C.5.7	--	--	--
			01038	00160	C.5.7	--	--	--
			01038	00161	C.5.7	--	--	--
			01038	00162	C.5.7	--	--	--
			01038	00163	C.5.7	--	--	--
			01038	00164	C.6.5	--	--	--
			01038	00165	C.5.11	--	--	--
			01038	00166	C.5.11	--	--	--
			01038	00167	C.5.11	--	--	--
			01038	00168	C.5.11	C.5.2	--	--
			01038	00169	C.5.2	--	--	--
			01038	00170	C.5.2	--	--	--
			01038	00171	C.5.11	--	--	--
			01038	00172	C.5.11	C.4.3	--	--
			01038	00173	C.5.11	--	--	--
			01038	00174	C.5.11	--	--	--
			01038	00175	C.5.2	--	--	--
			01038	00176	C.5.11	--	--	--
			01038	00177	C.4.3	--	--	--
			01038	00178	C.5.11	--	--	--
			01038	00179	C.5.2	--	--	--
			01038	00180	C.4.3	--	--	--
			01038	00181	C.5.2	--	--	--
			01038	00182	C.5.2	C.5.11	--	--
			01038	00183	C.5.11	--	--	--
			01038	00184	C.5.11	--	--	--
			01038	00185	C.5.11	--	--	--
			01038	00186	C.5.11	--	--	--
			01038	00187	C.5.11	--	--	--
			01038	00188	C.5.11	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01038	00189	C.5.11	--	--	--
			01038	00190	C.5.2	--	--	--
			01038	00191	C.5.11	C.5.2	--	--
			01038	00192	C.5.11	--	--	--
			01038	00193	C.5.11	--	--	--
			01038	00194	C.5.11	--	--	--
			01038	00195	C.5.11	--	--	--
	Davis, John G.	U.S. Nuclear Reg. Commission	01039	00011	C.3.4.2.3	--	--	--
			01039	00012	C.3.4.3	--	--	--
			01039	00015	C.7.3	--	--	--
			01039	00199	C.3.4.1	--	--	--
			01039	00200	C.2.7	--	--	--
	Davis, John G.	U.S. Nuclear Reg. Commission	01040	00005	C.5.3	C.8.2	--	--
			01040	00010	C.3.4.2.3	--	--	--
			01040	00011	C.3.4.3	--	--	--
			01040	00014	C.7.3	--	--	--
			01040	00168	C.3.4.1	--	--	--
			01040	00169	C.3.4.1	--	--	--
			01040	00170	C.3.4.1	--	--	--
	Davis, John G.	U.S. Nuclear Reg. Commission	01041	00013	C.3.1.3	C.3.4.2.3	--	--
			01041	00014	C.3.4.3	--	--	--
			01041	00015	C.3.1.2	--	--	--
			01041	00018	C.7.3	--	--	--
			01041	00214	C.3.4.1	--	--	--
			01041	00215	C.3.4.1	--	--	--
	Davis, John G.	U.S. Nuclear Reg. Commission	01042	00009	C.8.3	C.3.4.2.3	--	--
			01042	00011	C.3.4.3	--	--	--
			01042	00012	C.3.1	C.2.7	--	--
			01042	00013	C.2.4.1	--	--	--
			01042	00014	C.3.1	C.2.7	--	--
			01042	00015	C.4.1.3.1	C.2.7	--	--
			01042	00076	C.2.4.1	C.7.3	--	--
			01042	00077	C.2.4.1	C.7.3	--	--
			01042	00094	C.2.4.1	C.7.3	--	--
			01042	00192	C.2.8.3	C.6.5	--	--
			01042	00207	C.3.4.1	--	--	--
	Davis, John G.	U.S. Nuclear Reg. Commission	01043	00013	C.3.4.2.3	--	--	--
			01043	00014	C.3.4.3	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01043	00020	C.3.1.2	--	--	--
			01043	00105	C.2.4.1	--	--	--
			01043	00218	C.3.4.1	C.5.11	--	--
			01043	00219	C.3.4.1	--	--	--
	Davis, John G.	U.S. Nuclear Reg. Commission	01044	00011	C.3.4.2.3	--	--	--
			01044	00012	C.3.4.3	--	--	--
			01044	00014	C.7.3	--	--	--
			01044	00015	C.2.7	--	--	--
			01044	00200	C.3.4.1	--	--	--
			01044	00201	C.3.4.1	--	--	--
	Davis, John G.	U.S. Nuclear Reg. Commission	01036	00157	C.3.4.2.3	--	--	--
			01036	00158	C.3.4.3	--	--	--
	Finamore, Barbara	Natural Res Defense Council	01244	00001	C.2.6.1	--	--	--
			01244	00002	C.2.1.1	--	--	--
			01244	00003	C.2.6.1	--	--	--
			01244	00004	C.2.6.1	--	--	--
			01244	00005	C.2.6.1	--	--	--
			01244	00006	C.2.6.1	--	--	--
			01244	00007	C.2.6.1	--	--	--
			01244	00008	C.2.4.1	--	--	--
			01244	00009	C.2.4.1	--	--	--
			01244	00010	C.2.4.1	--	--	--
			01244	00011	C.2.4.1	--	--	--
			01244	00012	C.2.4.1	--	--	--
			01244	00013	C.2.4.1	--	--	--
			01244	00014	C.2.6.1	--	--	--
			01244	00015	C.2.7	--	--	--
			01244	00016	C.2.1.1	--	--	--
	Garrison, Roy F.	U.S. Dept. of Energy	01677	00001	C.2.8.2	--	--	--
	Hirsch, Allan	U.S. Env. Protection Agency	01397	00001	C.3.4.3	--	--	--
			01397	00002	C.3.4.3	--	--	--
			01397	00003	C.3.4.1	--	--	--
			01397	00004	C.3.4.1	--	--	--
			01397	00005	C.3.4.3	--	--	--
			01397	00006	C.3.4.3	--	--	--
			01397	00007	C.7.3	C.2.4.1	--	--
			01397	00008	C.2.7	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01397	00009	C.2.7	--	--	--
			01397	00068	C.3.4.3	--	--	--
			01397	00093	C.3.1.2	--	--	--
			01397	00094	C.6.4	--	--	--
			01397	00095A	C.5.7	--	--	--
			01397	00095B	C.5.3	--	--	--
			01397	00095C	C.5.11	--	--	--
			01397	00095D	C.5.8	--	--	--
			01397	00095E	C.7.2.2	--	--	--
			01397	00095F	C.7.3	--	--	--
			01397	00096	C.7.4	C.7.2	--	--
			01397	00097	C.2.7.1	C.4.1.3	--	--
			01397	00098	C.5.11	--	--	--
			01397	00100	C.7.2	--	--	--
			01397	00101	C.7.4	C.6.4	--	--
			01397	00102	C.4.1.2.2	--	--	--
			01397	00103	C.3.1.3	--	--	--
			01397	00104	C.4.1.2.2	--	--	--
			01397	00105	C.6.4	--	--	--
			01397	00106	C.4.1	--	--	--
			01397	00107	C.5.7	--	--	--
			01397	00108	C.5.7	--	--	--
			01397	00109	C.4.1.2.1	--	--	--
			01397	00110	C.4.1.2.1	--	--	--
			01397	00111	C.6.4	--	--	--
			01397	00112	C.4.1.3	--	--	--
			01397	00113	C.4.1.3	--	--	--
			01397	00114	C.4.1.3	--	--	--
			01397	00115	C.4.2.1	--	--	--
			01397	00116	C.4.2.2	--	--	--
			01397	00117	C.5.7	C.8.2	--	--
			01397	00118	C.8.2	--	--	--
			01397	00119	C.5.3	--	--	--
			01397	00120	C.7.1.1	--	--	--
			01397	00121	C.7.2	--	--	--
			01397	00122	C.4.2.1	--	--	--
			01397	00123	C.4.2.2	--	--	--
			01397	00124	C.4.3	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01397	00125	C.7.2	--	--	--
			01397	00126	C.7.2	--	--	--
			01397	00127	C.7.3	--	--	--
			01397	00128	C.7.3	--	--	--
			01397	00129	C.2.4.1	--	--	--
			01397	00130	C.7.3	--	--	--
			01397	00131	C.6.4	--	--	--
			01397	00132	C.7.2	--	--	--
			01397	00133	C.7.2	--	--	--
			01397	00134	C.7.3	--	--	--
			01397	00135	C.7.3	--	--	--
			01397	00136	C.7.3	--	--	--
			01397	00137	C.7.3	--	--	--
			01397	00138A	C.7.2	--	--	--
			01397	00138B	C.7.2	--	--	--
			01397	00139	C.5.1	--	--	--
			01397	00140	C.4.1.1	--	--	--
			01397	00141	C.5.4	--	--	--
			01397	00142	C.5.7	--	--	--
			01397	00143	C.5.7	--	--	--
			01397	00144	C.8.2	--	--	--
			01397	00145	C.5.7	--	--	--
			01397	00146	C.5.7	--	--	--
			01397	00147	C.6.5	--	--	--
			01397	00148	C.6.5	--	--	--
			01397	00149	C.5.11	--	--	--
			01397	00150	C.5.11	--	--	--
			01397	00151	C.4.1	--	--	--
			01397	00152	C.5.7	--	--	--
			01397	00153	C.5.7	--	--	--
			01397	00154	C.4.1.2	--	--	--
			01397	00155	C.4.1.2.2	--	--	--
			01397	00156	C.4.1.2.2	--	--	--
			01397	00157	C.6.4	--	--	--
			01397	00158	C.7.2	--	--	--
	Hodel, Secretary Donald	U.S. Dept. of Energy	01716	00001	C.2.8.2	--	--	--
	Kearney, John J.	Edison Electric Institute	01275	00001	C.2.2.1	--	--	--
			01275	00002	C.2.7	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01275	00003	C.2.7	--	--	--
			01275	00004	C.3.3	--	--	--
			01275	00005	C.3.4.3	--	--	--
			01275	00006	C.2.7	--	--	--
			01275	00007	C.3.4.3	--	--	--
			01275	00008	C.3.4.3	--	--	--
			01275	00009	C.6.6	C.5.11	C.5.11	C.3.4.4
			01275	00010	C.5.1	C.5.11	C.3.4.4	--
			01275	00011	C.2.7	--	--	--
			01275	000121	C.3.4.3	--	--	--
			01275	00015	C.8.2	C.2.7	--	--
			01275	00016	C.2.7	--	--	--
			01275	00017	C.2.1.1	--	--	--
			01275	00019	C.7.4	--	--	--
			01275	00020	C.9	--	--	--
			01275	00021	C.9	--	--	--
			01275	00022	C.5.11	--	--	--
			01275	00023	C.5.11	--	--	--
			01275	00024	C.5.11	--	--	--
			01275	00025A	C.5.2	--	--	--
			01275	00025B	C.5.3	--	--	--
			01275	00026	C.3.4.4	--	--	--
			01275	00027	C.7.2.6	--	--	--
			01275	00028	C.7.2.6	--	--	--
			01275	00029	C.7.2	--	--	--
			01275	00030	C.5.1	--	--	--
			01275	00031	C.9	--	--	--
			01275	00032	C.5.1	--	--	--
			01275	00033	C.4.1	--	--	--
			01275	00034	C.2.7	--	--	--
			01275	00038	C.2.7	--	--	--
			01275	00049	C.2.7	--	--	--
			01275	00051	C.2.7	--	--	--
			01275	00073	C.2.7	--	--	--
			01275	00075	C.2.7	--	--	--
			01275	00096	C.2.7	--	--	--
			01275	00097	C.4.3	--	C.4.2.2	--
			01275	00099	C.7.1.1	C.7.2.3	C.7.2.3	C.7.1.1

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
			01275	00105	C.4.3	--	--	--
			01275	00106	C.8.2	C.6.5	--	--
			01275	00107	C.5.7	C.5.7	--	--
			01275	00112	C.5.11	C.5.11	C.5.11	--
			01275	00114	C.2.7	--	--	--
			01275	00115	C.2.7	--	--	--
			01275	00116	C.2.8.2	--	--	--
			01275	00117	C.3.4.1	-	--	--
			01275	00118	C.3.4.4	--	--	--
			01275	00119	C.3.4.3	--	--	--
			01275	00120	C.3.4.3	--	--	--
			01275	00121	C.3.4.3	--	--	--
			01275	00126	C.9	--	--	--
			01275	00129	C.2.7	--	C.5.7	--
	Kearns, Artis		01440	00003	C.2.4.1	--	--	--
			01440	00004A	C.2.8	--	--	--
			01440	00004B	C.2.4.1	--	--	--
	Magnees, III, Col. Thomas H.	Dept. of Army Corps of Engineers	02697	00023	C.2.4.1	--	--	--
	Martin, Terri	National Parks & Cons. Assoc.	02195	00001	C.3.4.4	--	--	--
			02195	00009	C.3.4.4	--	--	--
	Parker, Frank L.	National Research Council	02669	00001	C.3.4.3	--	--	--
			02669	00002	C.3.4.3	--	--	--
			02669	00003	C.3.4.3	--	--	--
			02669	00004	C.3.4.3	--	--	--
			02669	00005	C.3.4.3	--	--	--
			02669	00006	C.3.4.3	--	--	--
			02669	00007	C.3.4.3	--	--	--
			02669	00008	C.3.4.3	--	--	--
			02669	00009	C.3.4.3	--	--	--
			02669	00010	C.3.4.3	--	--	--
			02669	00011	C.3.4.3	--	--	--
			02669	00012	C.3.4.3	--	--	--
			02669	00013	C.3.4.3	--	--	--
			02669	00014	C.3.4.3	--	--	--
			02669	00015	C.3.4.4	--	--	--
			02669	00016	C.3.4.3	--	--	--
			02669	00017	C.3.4.3	--	--	--
	Santman, L.D.	U.S. Dept. of Transportation	01568	00001	C.2.4.1	C.7.3	--	--

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District of Columbia (continued)								
			01568	00002	C.2.4.1	--	--	--
			01568	00003	C.2.4.1	--	--	--
			01568	00004	C.2.4.1	--	--	--
			01568	00005	C.2.4.1	--	--	--
			01568	00006	C.2.4.1	--	--	--
			01568	00007	C.2.4.1	--	--	--
			01568	00008	C.2.4.1	--	--	--
			01568	00009	C.2.4.1	--	--	--
			01568	00010	C.2.4.1	--	--	--
			01568	00011	C.2.4.1	--	--	--
			01568	00012	C.2.4.1	--	--	--
			01568	00013	C.2.4.1	--	--	--
			01568	00014	C.2.4.1	--	--	--
			01568	00015	C.2.4.1	--	--	--
			01568	00016	C.2.4.1	--	--	--
			01568	00017	C.2.4.1	--	--	--
			01568	00018	C.2.4.1	--	--	--
			01568	00022	C.2.7	--	--	--
			01568	00028	C.7.3	--	--	--
Severance, Owen		Natl. Parks & Conservation Assoc.	01276	00001	C.3.1.2	C.3.1.3	--	--
			01276	00002	C.3.1.3	--	--	--
			01276	00003	C.3.1.3	--	--	--
			01276	00004	C.3.1.3	--	--	--
			01276	00008	C.3.1.3	--	--	--
			01276	00010	C.3.1.3	--	--	--
			01276	00018A	C.3.1.3	--	--	--
			01276	00026	C.3.1.3	--	--	--
			01276	00032	C.2.8.3	--	--	--
			01276	00034	C.2.6.1	--	--	--
			01276	00055	C.2.8.2	--	--	--
Shiflet, Thomas		U.S. Dept. of Agriculture	01238	00001	C.6.6	C.5.11	C.2.7	--
			01238	00002	C.2.2.1	C.7.1.1	C.7.2	--
			01238	00003	C.4.1.1	C.4.1	C.4.1.1	--
			01238	00033	C.3.4.4	--	--	--
			01238	00034	C.5.11	--	--	--
			01238	00035	C.4.1.2	--	--	--
			01238	00036	C.7.2	--	--	--
			01238	00037	C.7.2.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
District of Columbia (continued)								
	Smith, David W.		00040	00001	C.2.1.1	--	--	--
			00040	00002	C.2.1.1	--	--	--
	Stennis, John	U.S. Senate	01680	00001	C.3.1.2	--	--	--
	Swift, Congressman Al	U.S. House of Representatives	02617	00001	C.3.1.2	C.7.2	--	--
			02617	00002	C.2.1.1	--	--	--
			02617	00003	C.7.4	--	--	--
			02617	00004	C.3.1	--	--	--
			02617	00005	C.3.1.2	--	--	--
			02617	00006	C.3.1.1	--	--	--
			02617	00007	C.5.7	C.4.1	--	--
			02617	00008	C.5.11	--	--	--
			02617	00009	C.5.11	--	--	--
			02617	00010	C.3.1.2	--	--	--
			02617	00011	C.3.1.2	--	--	--
	Yeager, Brooks B.	Sierra Club	01239	00001	C.2.1.1	--	--	--
			01239	00002	C.2.2	--	--	--
			01239	00003A	C.3.1.1	--	--	--
			01239	00003B	C.3.1.2	--	--	--
			01239	00004	C.3.1.2	--	--	--
			01239	00005	C.3.1.2	--	--	--
			01239	00006	C.3.1.2	--	--	--
			01239	00007	C.3.1.3	--	--	--
			01239	00008	C.2.4.1	C.7.3	--	--
			01239	00009	C.2.6.1	--	--	--
			01239	00010	C.9	--	--	--
			01239	00011	C.5.1	--	--	--
			01239	00012	C.8.2	--	--	--
			01239	00013	C.2.6.3	6.4	--	--
Florida								
	Holloway, Mrs. Anita		00555	00001	C.3.1.2	--	--	--
	Laping, Mrs. T.		00062	00001	C.3.4.4	--	--	--
	Votoe, Deborah		02691	00001	C.7.2	--	--	--
	Williams,Jr., J.W.	Florida Power & Light Company	01556	00001	C.2.4.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Georgia								
	Sokol, Jean	The Wilderness Society	00652	00004	C.3.4.4	--	--	--
	Yarbrough, Mrs. J.C.		00083	00001	C.3.1.2	--	--	--
			00083	00002	C.3.4.4	--	--	--
			00083	00003	C.2.8.3	--	--	--
Idaho								
	Anonymous	C.A.N.W.E	01162	00001	C.2.3.1	--	--	--
			01162	00002	C.2.4.1	--	--	--
			01162	00003	C.2.4.1	--	--	--
			01162	00004	C.2.4.1	--	--	--
			01162	00005	C.7.3	--	--	--
			01162	00006	C.2.8.3	--	--	--
	Brower, Cheryl		02609	00001	C.3.1.2	--	--	--
			02609	00004	C.3.1.2	--	--	--
	Funderburg, Robert D.	State of Idaho	00173	00001	C.2.4.1	--	--	--
			00173	00002	C.2.4.1	--	--	--
			00173	00003	C.2.4.1	--	--	--
			00173	00004	C.2.4.1	--	--	--
	Hall, S.J.		00150	00001A	C.2.4.1	--	--	--
			00150	00001B	C.7.3	--	--	--
			00150	00001C	C.5.11	--	--	--
	Hanson, Wes & Gertie		01142	00001	C.2.4.1	--	--	--
			01142	00002	C.5.11	--	--	--
			01142	00003	C.2.3.1	--	--	--
	Patchin, Margaret		01149	00001	C.2.4.1	--	--	--
	Pinkham, Allen V.	Nez Perce Tribal Exec. Comm.	01253	00001	C.2.7	--	--	--
			01253	00002	C.7.4	--	--	--
			01253	00003	C.2.5.2	--	--	--
			01253	00004	C.3.4.4	--	--	--
			01253	00005	C.2.6.1	--	--	--
			01253	00006	C.2.5.1	--	--	--
			01253	00007	C.6.4	--	--	--
			01253	00008	C.2.7	--	--	--
			01253	00009	C.9	--	--	--
			01253	00010	C.9	--	--	--
			01253	00011	C.9	--	--	--
			01253	00012	C.9	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Idaho (continued)								
			01253	00013	C.9	--	--	--
			01253	00014	C.9	--	--	--
			01253	00015	C.2.1.2	--	--	--
			01253	00016	C.4.1	--	--	--
			01253	00017	C.4.1.2.1	--	--	--
			01253	00018	C.4.1.2.2	--	--	--
			01253	00019	C.4.1.2.2	--	--	--
			01253	00020	C.4.1.2.2	--	--	--
			01253	00021	C.3.1.3	--	--	--
			01253	00022	C.4.1.2.2	--	--	--
			01253	00023	C.4.1	--	--	--
			01253	00024	C.4.1	--	--	--
			01253	00025	C.4.1	--	--	--
			01253	00026	C.4.1	--	--	--
			01253	00027	C.4.1	C.5.7	--	--
			01253	00028	C.4.1.2.2	--	--	--
			01253	00029	C.4.1.2.1	--	--	--
			01253	00030	C.4.1.2.1	--	--	--
			01253	00031	C.4.1.2.2	--	--	--
			01253	00032	C.4.1.2.2	--	--	--
			01253	00033	C.4.1.2.2	--	--	--
			01253	00034	C.4.1.2.2	--	--	--
			01253	00035	C.4.1.2.2	--	--	--
			01253	00036	C.4.1.2.2	--	--	--
			01253	00037	C.4.1.2.2	--	--	--
			01253	00038	C.4.1.2.2	--	--	--
			01253	00039	C.4.1.2.2	--	--	--
			01253	00040	C.4.1.2.2	--	--	--
			01253	00041	C.4.1.2.2	--	--	--
			01253	00042	C.5.11	--	--	--
			01253	00043	C.4.1.2.2	--	--	--
			01253	00044	C.6.4	--	--	--
			01253	00045	C.7.4	--	--	--
			01253	00046	C.7.2	--	--	--
			01253	00047	C.4.1.3	--	--	--
			01253	00048	C.7.2	--	--	--
			01253	00049	C.4.1.3	--	--	--
			01253	00050	C.7.2	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Idaho (continued)								
			01253	00051	C.7.2	--	--	--
			01253	00052	C.4.1.3	--	--	--
			01253	00053	C.6.4	--	--	--
			01253	00054	C.6.4	--	--	--
			01253	00055	C.6.4	--	--	--
			01253	00056	C.6.4	--	--	--
			01253	00057	C.7.3	--	--	--
			01253	00058	C.7.4	--	--	--
			01253	00059	C.7.4	C.6.2	--	--
			01253	00060	C.7.4	--	--	--
			01253	00061	C.4.2.1	--	--	--
			01253	00062	C.5.8	--	--	--
			01253	00063	C.4.2.1	--	--	--
			01253	00064	C.4.2.1	--	--	--
			01253	00065	C.4.2.1	--	--	--
			01253	00066	C.4.2.1	--	--	--
			01253	00067	C.5.11	--	--	--
			01253	00068	C.4.2.2	--	--	--
			01253	00069A	C.7.1.1	--	--	--
			01253	00069B	C.4.1.3	--	--	--
			01253	00069C	C.7.1.1	--	--	--
			01253	00070	C.7.1.1	--	--	--
			01253	00071	C.7.1.1	--	--	--
			01253	00072	C.4.3	--	--	--
			01253	00073	C.4.3	--	--	--
			01253	00074	C.7.2.2	--	--	--
			01253	00075	C.4.3	--	--	--
			01253	00076	C.5.2.	--	--	--
			01253	00077	C.7.4	--	--	--
			01253	00078	C.2.4.1	--	--	--
			01253	00079	C.2.4.1	--	--	--
			01253	00080	C.7.3	--	--	--
			01253	00081	C.7.3	--	--	--
			01253	00082	C.6.5	--	--	--
			01253	00083	C.4.3	--	--	--
			01253	00084	C.7.2	--	--	--
			01253	00085	C.7.3	--	--	--
			01253	00086	C.5.1	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Idaho (continued)								
			01253	00087	C.5.11	--	--	--
			01253	00088	C.5.1	--	--	--
			01253	00089	C.5.11	--	--	--
			01253	00090	C.5.1	--	--	--
			01253	00091	C.5.2	--	--	--
			01253	00092	C.5.2	--	--	--
			01253	00093	C.4.3	--	--	--
			01253	00094	C.5.3	--	--	--
			01253	00095	C.8.2	--	--	--
			01253	00096	C.5.2	--	--	--
			01253	00097	C.5.4	--	--	--
			01253	00098	C.5.7	--	--	--
			01253	00099	C.5.7	--	--	--
			01253	00100	C.5.7	--	--	--
			01253	00101	C.7.2	--	--	--
			01253	00102	C.6.5	--	--	--
			01253	00103	C.3.4.1	--	--	--
			01253	00104	C.3.4.1	--	--	--
			01253	00105	C.3.4.1	--	--	--
			01253	00106	C.3.4.1	--	--	--
			01253	00107	C.3.4.1	--	--	--
			01253	00108	C.7.3	--	--	--
			01253	00109	C.7.3	--	--	--
			01253	00110	C.7.3	--	--	--
			01253	00111	C.7.3	--	--	--
			01253	00112	C.3.4.3	--	--	--
	Robinson, Mary & Dwight		01585	00001	C.2.4.1	--	--	--
			01585	00002	C.2.6.2	--	--	--
Illinois								
	Dinelli, Wayne	DuPage Audubon Society	00149	00001	C.3.4.4	--	--	--
	Gursh, Marla Kay		00161	00001	C.3.1.2	--	--	--
			00161	00002	C.3.1.2	--	--	--
	McGuire, Margaret A.		00052	00001	C.3.4.4	--	--	--
	Rice, Larry		00172	00001	C.3.1.2	--	--	--
	Smith, Jill Janine		00146	00001	C.3.1.2	--	--	--
	Speron, Sam J.		00302	00001	C.3.4.4	--	--	--

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STATE	NAME	ORGANIZATION	LETTER NUMBER	COMMENT NUMBER	CLASSIFICATION FIRST	SECOND	THIRD	FOURTH
Illinois (continued)								
			00302	00002	C.3.4.4	--	--	--
	Tsiang, Margaret		01071	00001	C.3.4.4	--	--	--
	Warble, Steve		01066	00001	C.3.4.4	--	--	--
	Wyatt, John J.	Illinois Central Gulf	01740	00001	C.2.8.2	--	--	--
Indiana								
	Read, Charlotte J.	Save the Dunes Council	00048	00001	C.3.1.2	--	--	--
Kansas								
		Boy Scouts of America,Pack 3	02736	00001	C.3.1.2	--	--	--
	Klann, Erik		02737	00001	C.3.1.2	--	--	--
	Moore-Anderson, Carol J.		00034	00001	C.3.4.4	--	--	--
	Moore-Fleming, Delores B.		00036	00001	C.3.4.4	--	--	--
	Moore-Jones, Joan E.		00037	00001	C.3.4.4	--	--	--
	Russell, Derek		02738	00001	C.3.1.2	--	--	--
	Sperry, Theodore M.		00080	00001	C.3.1.2	--	--	--
	Tyseh, Nathan		02739	00001	C.3.1.2	--	--	--
Kentucky								
	Kelly, James C.		00197	00001	C.3.4.4	--	--	--
			00197	00004	C.3.1.2	--	--	--
Louisiana								
	Anonymous		02178	00004	C.3.1.2	--	--	--
			02178	00005	C.2.4.1	--	--	--
			02178	00006	C.2.4.1	--	--	--
			02178	00007	C.2.4.1	--	--	--
		Bienville Parish Police Jury	02175	00001	C.3.1.2	--	--	--
			02175	00002	C.2.1.1	--	--	--
			02175	00003	C.2.4.3	--	--	--
			02175	00007	C.2.1.1	--	--	--
			02176	00001	C.3.1.2	--	--	--
			02176	00006	C.3.1.2	--	--	--
			02176	00008	C.2.3.2	--	--	--