Rockwell Hanford Operations

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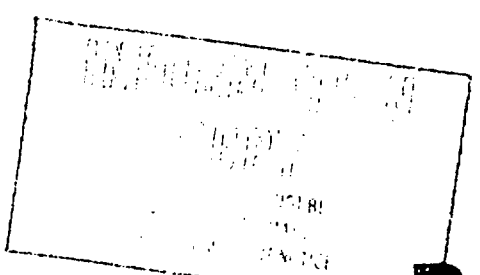
Abstract

This document represents a recapitulation of the specific State of Washington concerns (as presented in a report prepared by their contractor, Golder Associates, Incorporated) pertinent to the Site Characterization Report. Additionally, it includes BWIP dispositions and responses to those comments, and serves as a vehicle to ensure that these comments will be tracked through to resolution as site characterization proceeds.

This document contains no new technical data or analyses and, therefore, does not require formal peer review as specified in BOP A-22.



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STATUS OF THE STATE OF WASHINGTON CONCERNS (VIA GOLDER ASSOCIATES, INC. FINAL REPORT) PERTAINING TO THE SITE CHARACTERIZATION REPORT

FOREWORD

The Basalt Waste Isolation Project (BWIP) is part of the national effort by the U.S. Department of Energy (DOE) to identify a site suitable for a nuclear waste repository. The objective of the BWIP is to assess whether or not a nuclear waste repository can be sited in the basalts beneath the Hanford Site. Studies to date on the project are summarized in the BWIP Site Characterization Report (SCR) which was submitted by the DOE to the State of Washington in November 1982.

The purpose of the SCR was to provide the status of the preliminary site characterization work and identify the data yet to be obtained for detailed site characterization. The plans for acquiring the needed data during the detailed site characterization phase were also included in the SCR. The SCR focused on the preliminary geology and hydrology studies and included some of the initial work in the development of nuclear waste packages and repository-engineering studies. Special emphasis was placed on the early work in development of performance standards for radionuclide release that would be required of the geologic, waste package, and repository systems.

The State of Washington reviewed the SCR and submitted comments to the DOE in a letter report dated May 24, 1983.* In this letter report, the State of Washington and its geotechnical consultant, Golder Associates, Inc. (GAI), offered a detailed chapter-by-chapter critique of the SCR in the following format:

- Executive Summary
- Synopsis
- Summary of Technical Content Presented by the DOE in the SCR
- GAI Evaluation of Technical Adequacy of the SCR.

In order to systemmatically respond to the State of Washington (and GAI) comments, the DOE produced disposition/response tables. The tables listed verbatim each specific concern raised in the letter report. In addition, the DOE presented its disposition (agreement, disagreement, or need for further clarification) regarding each comment and followed with a narrative explanation of the disposition, including commitments to resolve the comment at defined points in the next site characterization document, the Site Characterization Plan (SCP).

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*Gould, S. E. Nuclear Waste Policy and Review Council State of Washington Department of Ecology, "Comments of the State of Washington on the U.S. Department of Energy Site Characterization Report for the Basalt Waste Isolation Project," (letter to R. L. Morgan, Project Director, Nuclear Waste Policy Act Project Office, May 24, 1983).

These disposition/response tables were submitted in draft form by the DOE to the State of Washington in October 1983. A meeting of the DOE, State of Washington, and GAI was held on February 10, 1984, in order to attain concensus on the documented comments, disposition, and responses. The compilation that follows represents this concensus. It is intended to comprise a tool that systemmatically approaches resolution of the State of Washington comments and concerns as site characterization proceeds and the SCP is prepared.

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CHAPTER 2 (REPOSITORY SITING PROCESS)

ITEM REFERENCE: Section 2.1, page 2-1, paragraph 3

GAI COMMENT: "In GAI's opinion, the site selection methodology presented by DOE in Chapter 2 of the SCR has the following limitations:

- The site selection methodology used by DOE was constrained at the outset by the requirement that only basalts underlying the Hanford Reservation, and to a minor extent the Pasco Basin, would be the focus of the repository siting effort. As a result, although DOE may have identified a qualified or suitable basalt site(s) within the Hanford Reservation, they may not have identified the best basalt site(s) within the Hanford Reservation, the State of Washington, or the continental U.S. It must be emphasized however that the site selection methodology needs only to produce a qualified site, and not necessarily the best site."

STATUS: Agreed

BWIP RESPONSE: The U.S. Department of Energy's (DOE's) overall plan for selecting sites is presented in its public draft, national siting plan.* In this plan, DOE has outlined several approaches to identify starting points for screening. One of these approaches is to identify federally owned lands, such as the Hanford Site, that have been committed to nuclear activities and may have suitable host rock. Input regarding the intent of this approach, i.e., to identify a potentially "qualifiable" site rather than the "best" site, will be added to Chapter 2 of the Site Characterization Plan (SCP).

ITEM REFERENCE: Section 2.3, pages 2-5 and 2-6, paragraph 4

GAI COMMENT: "GAI's [sic] believes that the application of the site selection methodology is inconsistent. Two examples of inconsistencies are the considerations of environmental impacts and new data within the methodology. Although DOE states that one of its major siting objectives is to minimize adverse environmental impacts, no weight is given in the final siting decision to environmental considerations. Although certain environmental factors have been considered in area screening, GAI believes that by not considering environmental impacts in the final siting decision DOE is implying that all

*U.S. DOE, 1982, National Plan for Siting High-Level Radioactive Waste Repositories and Environmental Assessment: Public Draft, DOE/NWTS-4, DOE/EA-151, National Waste Terminal Storage Program, Battelle Memorial Institute, Columbus, Ohio (February 1982).

candidate sites are environmentally equivalent and/or that environmental protection is not a siting factor but rather may be a design factor. Similarly, DOE does not consider new data in their siting methodology. This is evidenced by the continuation of shaft activities at the reference repository location in spite of the drilling results of the principal borehole, which showed only about 85 feet of dense basalt. If this thickness had been input into the decision process, then presumably the current reference repository location would have been rejected. DOE avoids this eventuality by shifting its focus to the Middle Sentinal Bluffs as a candidate repository horizon. As stated earlier, the consequence of the inconsistencies in the siting process may be small, provided the reference repository location proves to be a qualified site."

STATUS: Agreed

BWIP RESPONSE: While environmental factors are clearly viewed to be important in the site selection of a nuclear waste repository, they were not found to be good discriminators except during the early stages of screening. The environmental factors are similar for all candidate sites on the Hanford Site and, as such, were not discriminators for the ranking of candidate sites. Application of environmental guidelines as set forth in the Nuclear Waste Policy Act of 1982* and in the final version of the Proposed General Guidelines for Recommendation of Sites for Nuclear Waste Repositories: Proposed Rule** (10 CFR Part 960) will be done in the Environmental Assessment.

We agree that new data are not considered in the siting methodology. Because of the weighting of lineament and thickness criteria, the substitution of a thick Grande Ronde Basalt flow, other than the Umtanum flow, as the reference horizon is not expected to alter the results of the siting process. The thick flow top in the Umtanum flow at the RRL-2 site does not preclude the possibility of the Umtanum flow as a candidate repository horizon in the reference repository location (RRL) inasmuch as the horizon meets the minimum thickness of dense interior at the principal borehole (RRL-2).

ITEM REFERENCE: Section 2.3, page 2-6, paragraph 2

GAI COMMENT: "In GAI's opinion, the selection methodology is subjective. For example, DOE assigns twelve times more importance to the distance from a lineament than to the groundwater traveltime from the repository to the environment, and has assigned no weight to the environmental impacts of project

*Public Law 97-425, Nuclear Waste Policy Act of 1982, January 7, 1983.
**U.S. Nuclear Regulatory Commission, Disposal of Radioactive Wastes in Geologic Repositories; Licensing Procedures, 10 CFR 60, June 30, 1983.

development. Although the relative weighting is clearly subjective and subject to differences in technical opinion, the consequences on the defensibility of the siting process should be minimal provided the RRL is subsequently shown to be qualified."

STATUS: Disagreed

BWIP RESPONSE: The importance assigned to the distance from linears does not imply that this measure is inherently more "important" than groundwater traveltime. Importance relates only to a consistent basis for comparing the sites while taking the differences between sites and the tradeoffs into account. Determination of the weight or "importance" of measures is determined by a systematic evaluation of professional judgment.*

Lineaments represent potential structural features that may have an impact on waste isolation and, due to their aerial distribution and a preliminary interpretation of their significance, were judged to be good discriminators. Groundwater traveltime differences between sites were minimal and, therefore, not good discriminators.

ITEM REFERENCE: Section 2.3, page 2-6, paragraph 3

GAI COMMENT: "In conclusion, GAI believes that given DOE's requirement to constrain the potential site to the Hanford Reservation and the minimal site specific data related directly to performance which was available, the siting process could not have been conducted in any other significantly different manner. However, the siting process does not, in GAI's opinion, address the likelihood of subsequently demonstrating that the selected site will be licensable."

STATUS: Agreed

BWIP RESPONSE: The results of the screening and ranking that lead to the selection of the RRL does not represent an assessment that the site meets the draft siting guidelines (Proposed General Guidelines for Recommendation of Sites for Nuclear Waste Repositories, Proposed Rules (10 CFR Part 960) or those called for in the Nuclear Waste Policy Act of 1982 (PL97-425, January, 1983). Application of these guidelines to the BWIP will be made in the Environmental Assessment to be prepared at a later date. The screening and ranking process merely recommends that the RRL and the preferred candidate horizon be the site and basalt flow to which these guidelines are applied.

*Kenny, R. L. and H. Raiffa, Decisions with Multiple Objectives, John Wiley and Sons, Inc., New York, New York (1976).

CHAPTER 3 (GEOLOGY)

ITEM REFERENCE: Section 3.1, page 3-1, paragraph 4

GAI COMMENT: "In GAI's opinion, the geologic data presented by DOE in Chapter 3 of the SCR is accurate, sufficient, and comprehensive, except (as recognized by DOE) regarding the stratigraphy and lithology, including lateral variability, of the candidate repository horizons. Furthermore, based on the presented data, GAI concurs in general with DOE's present geologic interpretations."

STATUS: Agreed

BWIP RESPONSE: Additional stratigraphic and lithologic data will be presented in the SCP, Chapter 3. Plans for additional geologic work will be presented in Chapter 13.

ITEM REFERENCE: Section 3.3, page 3-5, paragraph 1

GAI COMMENT: "In GAI's opinion, the geologic conditions of the site should be adequately assessed, especially as a basis for repository design, (e.g., depth and thickness of the repository horizon, including the potential variability over the area of interest) and to establish the geometric framework for the groundwater model. Thus, the lateral geologic variability of basalt flows should be assessed not only for the candidate repository horizon(s), but also for those horizons which will affect performance."

STATUS: Agreed

BWIP RESPONSE: Data collected and analyzed since the publication of the Site Characterization Report (SCR) will be presented in Chapter 3 of the SCP. Additional work required to address this concern will be reflected in our plans in Chapter 13 of the SCP.

ITEM REFERENCE: Section 3.3, page 3-5, paragraph 2

GAI COMMENT: "In GAI's opinion, the large body of geologic data presented (and referenced) by DOE and DOE's interpretations are adequate for the purpose of an SCR, with the qualification (as noted by DOE in the SCR) that additional data need to be acquired regarding stratigraphy and lithology of the candidate repository horizons and all horizons where a geologic understanding is necessary to predict groundwater transport conditions. GAI believes that this

additional information is necessary to predict groundwater transport conditions. GAI believes that this additional information is necessary to improve understanding of intraflow structures and thereby allow refinement of design and performance parameters. Secondarily, GAI believes that the attractiveness of the RRL for subsurface mineral exploration should be reassessed in light of recent exploratory oil and gas drilling within the region."

STATUS: Agreed

BWIP RESPONSE: Additional data needs on stratigraphy and lithology of the preferred candidate horizon and on all horizons as required for groundwater transport predictions and plans for securing these data are presented in Chapter 13 of the SCR.

The BWIP is closely monitoring oil/gas exploration in the area surrounding the Pasco Basin. The petroleum companies are currently investigating anticlinal structures. The RRL is in a syncline and, based upon Shell Oil Company exploration, is not interpreted to be a desirable area for future exploration. Upon the release of Shell Oil Company data, an updated assessment of the relative attractiveness of resource exploration in the Pasco Basin will be made. Reference to exploration activities will be made in Section 3.9.2 of the SCP.

CHAPTER 4 (GEOENGINEERING)

ITEM REFERENCE: Section 4.3, page 4-4, paragraph 4, item 1

GAI COMMENT: "The use of a linear stress failure criterion (i.e., Mohr-Coulomb in terms of cohesion and friction angle) to describe strength of rock (intact, discontinuities, or rock mass) and linear elastic parameters (Young's modulus and Poisson's ratio) to describe deformability are generally poor approximations of rock's typical non-linear nature, and thus result in additional uncertainty."

STATUS: Agreed

BWIP RESPONSE: The conceptual design, discussed in the SCR, was prepared to meet a specific purpose dictated by the DOE. This purpose was to establish budgets and schedules for congressional funding. Many decisions were made to complete the conceptual repository design without the benefit of engineering trade studies which would reflect licensing considerations. The design process does provide ample opportunity for upgrading and incorporating changes as additional information becomes available. The decision to use linear elastic analysis for describing strength or deformability has not been made. A more sophisticated rock mass nonlinear constitutive model will be developed from the results of the block test at the Near-Surface Test Facility (NSTF) and load-deformation results from laboratory triaxial testing of intact and jointed specimens for various confinement pressures. In addition, a discrete block model analysis of a jointed columnar basalt is being considered as a method for establishing the load-deformation response of the rock mass for various confinement stresses. Future evaluations of rock mass strength will be based on a nonlinear representation of the failure envelope and not from a single strength value or from a linear failure envelope. An initial estimate of a rock mass failure envelope will be established by factorizing the laboratory strength results of intact rock to account for the presence of discontinuities in the rock mass. Later attempts will be made to verify or improve the failure criteria based on results from large-diameter triaxial laboratory testing of jointed specimens, in situ field testing and observations, and discrete block modeling of proposed excavations. The methodology described above will be elaborated upon in Section 10.5 of the SCP.

ITEM REFERENCE: Section 4.3, page 4-4, paragraph 4, item 2

GAI COMMENT: "There is much more scatter in the strength and deformability measurements on intact rock from laboratory test [sic] especially for the Umtanum (Table 4-2, Figure 4-2), than would be expected from natural variability, which suggests that either the samples used may not have been representative (e.g., containing fractures) or that testing errors may have occurred."

CHAPTER 4 (GEOENGINEERING)

STATUS: Agreed

BWIP RESPONSE: Discussions relating to the strength and deformability scatter are included in the SCR Section 4.1.3. The large scatter in strength and deformability measurements for the Umtanum flow are expected to be due to a lack of adequate pre- and post-test-specimen visual characterization. Jointed specimens were probably tested and classified as intact. Presently, the pre-test-specimen visual characterization has been improved and the post-test-specimen visual characterization capability has been improved by stiffening the loading system and providing for strain-control loading near the peak strength.

Preliminary analysis of the RRL strength and deformability results show noticeably less scatter. This information will be contained in Chapter 4 of the SCP.

ITEM REFERENCE: Section 4.3, page 4-5, item 1

GAI COMMENT: "The deformation modulus values determined from the borehole jacking method are suspect in that the scale of the sample is small and strongly affected by undetected joints; there is wide scatter in the results (Table 4-4) probably due to such joints and the results are somewhat inconsistent (low in comparison with other generally more reliable tests, e.g., flatjack tests)."

STATUS: Agreed

BWIP RESPONSE: Deformation module values from the flat jack test and the jointed block test are considered more reliable than the borehole jacking tests. Correlation between all methods will be presented in the SCP.

ITEM REFERENCE: Section 4.3, page 4-5, item 2

GAI COMMENT: "The determination of stress in the wall of an opening by the single-slot flatjack test using vibrating wire stressmeters entails significant uncertainty as shown in the wide range of results (Figure 4-6); although the deformation modulus determined by the flatjack test has been reported, the method by which this determination was made (apparently non-standard) has not been discussed."

STATUS: Agreed

BWIP RESPONSE: There are uncertainties involved in measuring stress around openings using the vibrating wire stress meter. The single slot test at step 1 of the jointed block test was not intended to measure the stress

redistribution around the tunnel opening. The objectives of Step 1 of the block test were to:

- Determine preliminary mass properties as a function of pressure and temperature
- Evaluate rock instruments and test techniques for use in followup thermomechanical field tests
- Provide test data for use in finalizing the instrument layout and test design for Step 2 of the block test.

The test yielded the information on stress redistribution as a byproduct. Further clarification of the reliability of the data and the test method will be included in Section 4.3.2 of the SCP.

ITEM REFERENCE: Section 4.3, page 4-5, item 3

GAI COMMENT: "The determination of peak shear strengths for individual discontinuities by triaxial lab tests (Tables 4-6 and 4-7) include some aberrant results, specifically inconsistent trends (in DC-8/1, 112.1 and DC-8/1, 100.2 the stress ratio at failure should monotonically decrease towards a residual value with increasing confining stress; these results suggest possible test errors) and unrealistically low results (in DC-4/1, 111.9 and DC-4/1, 123.2 the results indicate either a very weak undetected infilling material, e.g., clay, or possible test errors)."

STATUS: Agreed

BWIP RESPONSE: Tables 4-6 and 4-7 in Section 4.3.3 of the SCR generally show a decrease in the coefficient of friction with an increase in confinement stress. However, there are a few exceptions to these expected results. The increase in coefficient of friction with confining stress could be due to the roughness or curvature of the joint causing a different effective friction coefficient as deformation across the joint proceeds. These tests were conducted on somewhat irregular surfaces. The specimen DC-4/1,111.9 that indicated low friction angles is described as "some amygdules partially filled with silky, fibrous zeolite, probably natrolite or thomsonite; fractures at various angles to core axis." The other low result, DC-4/1,123.2, is described as "several tight airviplanar fractures and veins of silica minerals and montmorillonite up to 0.08 inches (2 mm) wide at 25° to core axis; less fractures approximately parallel to core axis." With this sample, it is possible that dehydration of the montmorillonite occurred at 100°C, so the tests above this temperature reflect shearing of different materials. In the SCP, details of joint infillings will be presented where possible.

CHAPTER 4 (GEOENGINEERING)

ITEM REFERENCE: Section 4.3, page 4-5, item 4

GAI COMMENT: "The heat flow properties are not properly defined, in that specific heat and mass heat capacity appear to have been used interchangeably; although the definition of specific heat is essentially correct, it is dimensionless (mass heat capacity has the dimensions shown) and the definition of thermal diffusivity in terms of specific heat is incorrect (it should be in terms of mass heat capacity). This confusion leads one to suspect data regarding this property."

STATUS: Agreed

BWIP RESPONSE: The comment on nomenclature and dimensions is valid and the confusion will be corrected in the SCP.

ITEM REFERENCE: Section 4.3, page 4-5, item 5

GAI COMMENT: "The determination of in situ stresses by hydraulic fracturing involves significant uncertainties, especially in the maximum horizontal stress and to a lesser extent, in the minimum horizontal stress, due to the assumptions involved. The assumption that no fluid intrudes into the rock prior to fracturing may be invalid so that the actual pore pressure is not known, as assumed."

STATUS: Agreed

BWIP RESPONSE: The assumptions used in hydraulic fracturing data analysis and the uncertainties associated with the method will be discussed in Section 4.6 of the SCP.

ITEM REFERENCE: Section 4.3, page 4-5, item 5

GAI COMMENT: "Also the assumption that the stress parallel to the borehole (i.e., the vertical stress) is the intermediate principal stress and has no effect on the results (so that [a] fracture will initiate and propagate in a plane along the axis of the borehole perpendicular to the minimum principal stress) may be invalid. Rather, it has been concluded that the vertical stress is the minor principal stress so that, although the crack initiates parallel to the axis of borehole, it may twist undetected to a plane perpendicular to both the axis of the borehole and the vertical stress (rather than the minimum horizontal stress), as suggested by the horizontal cracks in the borehole wall (Figure 4-19)."

CHAPTER 4 (GEOENGINEERING)

STATUS: Open

BWIP RESPONSE: The vertical stress was not assumed to be the intermediate principal stress. It was assumed to be one of the principal stresses. The test results indicate that the vertical stress calculated by the weight of overburden is the least (minimum) principal stress. We would like to discuss this comment with GAI to better understand the intent.

ITEM REFERENCE: Section 4.3, page 4-5, item 5

GAI COMMENT: "Also, the summary of test results (Table 4.11) is inconsistent with the typical example test results (Figure 4.17 and 4.18), which suggests additional uncertainty in the data; interestingly, the shut-in pressure shown in the typical example test results is approximately equal to the vertical overburden pressure, which would also suggest that the crack may have propagated in a horizontal plane."

STATUS: Disagreed

BWIP RESPONSE: No inconsistency exists between the data presented in Table 4.11 and the Figures 4.17 and 4.18. It should be noted that the shut-in pressure shown in the Figure 4.18 is the pressure measured on the surface, and, therefore, less the hydraulic head.

ITEM REFERENCE: Section 4.3, page 4-5, item 5

GAI COMMENT: "In addition, the in situ stress determinations made at NSTF (Table 4-12) differ significantly in magnitude between methods (overcoring versus hydrofracturing), and the orientations derived from both methods are perpendicular to those observed in DB-15 and DC-12 and to what would be expected from the anticlinal structure, again suggesting additional uncertainty in the data."

STATUS: Agreed

BWIP RESPONSE: The potential causes of the difference between the principal stress magnitudes obtained in the NSTF by the two measurement methods will be explained in Section 4.6 of the SCP. The discrepancy between the principal stress orientations in the near surface and at depth is attributed to the effect of topography which is also called the "skin effect."

Further explanation will be included in Section 4.6 of the SCP.

CHAPTER 4 (GEOENGINEERING)

ITEM REFERENCE: Section 4.3, page 4-6, paragraph 2, item 1

GAI COMMENT: "Regarding determination of mechanical properties of discontinuities, direct shear tests could have been performed on core and on large scale samples obtained from the NSTF and exposures."

STATUS: Agreed

BWIP RESPONSE: Future laboratory testing plans include both direct-shear testing of jointed core and large-diameter triaxial testing of jointed specimens to be obtained from the NSTF and Exploratory Shaft sites. These test plans will be addressed in Section 14.3 of the SCP.

ITEM REFERENCE: Section 4.3, page 4-6, paragraph 1, item 2

GAI COMMENT: "Regarding determination of rock mass mechanical characteristics (strength and deformability), there are empirical methods available for assessing these as well as analytical models which combine the more easily determined behavior of the components (intact rock, discontinuities, and pore fluid). Such methods which often entail significant uncertainty, could have been used to estimate and then partially verify the characteristics."

STATUS: Agreed

BWIP RESPONSE: Future plans include the use of a rock mass classification system and numerical modeling analyses (discrete block modeling method and finite element method) to help verify the rock mass strength and deformability characterization as established from the methodology presented in the previous item. These will be addressed in Chapter 14 of the SCP.

ITEM REFERENCE: Section 4.3, page 4-6, paragraph 1

GAI COMMENT: "Regarding the determination of rock mass thermal properties, the single-slot flatjack test data could have been used."

STATUS: Agreed

BWIP RESPONSE: Rock mass thermal properties, thermal conductivity, have been determined from back analysis of the single-slot flat jack test and will be included in Section 4.5 of the SCP. The deformation response of the rock mass is discussed in Section 4.2.

CHAPTER 4 (GEOENGINEERING)

ITEM REFERENCE: Section 4.3, page 4-6, paragraph 1, item 4

GAI COMMENT: "Regarding determination of the in situ stress field, the presence of core discing yields more information than has been presently utilized, and the determination of stresses around an opening (e.g., by single-slot flatjack test) could have been used; standard deformation measurements could have been made to support the determination of stress in the wall at NSTF."

STATUS: Agreed

BWIP RESPONSE: Core discing is an indicator of high stress. It is difficult to obtain quantitative inference regarding the stress magnitude from the core discing information. The stress redistribution around an opening caused by excavation will be assessed by small-scale flat jack tests. Further details on the test plan will be included in Chapter 17 of the SCP.

ITEM REFERENCE: Section 4.3, page 4-6, paragraph 1, item 5

GAI COMMENT: "Observation/monitoring during construction of the NSTF offered an opportunity to accurately assess rock mass characteristics, as well as excavation/support methods under certain conditions."

STATUS: Agreed

BWIP RESPONSE: During the construction of the NSTF, opening stability was observed visually. Tape extensometers were installed in strategic locations in the NSTF during excavation of drifts. Various support methods including steel sets, shotcrete, and friction stabilizer rock bolts (split set) were used. Due to the relatively low-stress level, a meaningful comparison of the support method was difficult to make. A study of excavation and support methods will be made in the Exploratory Shaft Phase II. A description of the plan is included in Chapter 17.

ITEM REFERENCE: Section 4.3, page 4-6 and 4-7, paragraph 2

GAI COMMENT: "Certain significant characteristics... There is also no data regarding the characteristics of intact rock or discontinuities of any horizon

except the Umtanum, middle Sentinel Bluffs, and Pomona, and even in these flows no data has been acquired for the following significant characteristics/relationships:

- Shear strength of intact rock from the middle Sentinel Bluffs and non-entablature zones of the Umtanum
- Residual shear strengths or creep for intact rock in any zone or flow
- Mechanical properties of discontinuities in any flow except the Umtanum, and even in the Umtanum data is available only for peak shear strengths (and not residual shear strengths or stiffnesses)
- Temperature effects on any mechanical properties of middle Sentinel Bluffs
- Thermal properties of intact rock from any but the entablature zones, and even these do not include the effect of confining pressure.or of jointing
- Anisotrophy of properties in any flow or zone (except in the Pomona where modulus anisotropy and heat flow anisotropy in the horizontal plane were determined from borehole jacking and full scale heater tests, respectively)
- Correlation of properties with density/porosity of intact rock or roughness/aperture of discontinuities, or with scale of sample
- Secondary minerals contained within fractures, and the possibly detrimental effects of heat on their mechanical properties."

STATUS: Agreed

BWIP RESPONSE: Data are presently being acquired to adequately address the referenced properties and relationships that are lacking. Those properties or relationships that are not being acquired at this time will be presented as work elements in Section 14.3. The existing data base will be updated in the SCP. Plans for further characterization will be expanded to cover Golder's comment.

ITEM REFERENCE: Section 4.3, page 4-7, paragraph 1

GAI COMMENT: "In addition to ignoring certain significant material characteristics, there is no data (or references) presented by DOE in this chapter regarding in situ temperatures anywhere at Hanford or in situ stresses other than in limited zones in the Umtanum and Roza (eight or more km away) and Pomona (NSTF)."

STATUS: Agreed

BWIP RESPONSE: Hydraulic fracturing tests have been conducted in the principal borehole in the Cohassett and Grande Ronde flows in addition to the Umtanum flow. The test results will be included in Section 4.6 of the SCP. The temperature data will be included in Chapter 10 of the SCP.

CHAPTER 4 (GEOENGINEERING)

ITEM REFERENCE: Section 4.3, page 4-7, paragraph 2

GAI COMMENT: "DOE's plans for future testing are only alluded to here (see SCR Chapter 17 - Site Characterization Program). It is GAI's opinion that this additional testing should produce high quality data (i.e., with low uncertainty) and result in a comprehensive and sufficient data base, which can be readily and defensibly interpreted and then applied to repository design/construction. It is especially important that rock mass characteristics (especially strength) of the repository horizon(s), as well as all other affected zones, and the in situ stress field be adequately assessed, using data from a variety of available sources. This will require access (by exploratory shaft) and subsequent in situ testing. Suitable site-specific correlations should be developed between the significant characteristics (e.g., rock mass strength) and more easily measured physical properties (e.g., joint spacing, orientation, aperture), so that these physical properties can be determined over wide areas to assess the variability of the rock mass characteristics. Predictive performance models should also be site-verified. In terms of test details, as developed at NSTF, the conditions (especially stresses) at depth may be very different so that conclusions drawn from NSTF regarding test methodology may be invalid; e.g., although flatjacks worked well at NSTF, they may not have sufficient capacity to reestablish high stresses, whereas overcoring may be more reliable at such higher stresses."

STATUS: Agreed

BWIP RESPONSE: Chapter 17 will be completely updated based on the Exploratory Shaft (ES) Test Plan which is in preparation. This test plan will address those concerns raised by Golder.

ITEM REFERENCE: Section 4.3, page 4-8, paragraph 1

GAI COMMENT: "Due to the deficiencies in the existing geoengineering data base, DOE has justifiably been reluctant to draw conclusions regarding geoengineering, i.e., interpretation and application. However, in GAI's opinion, these deficiencies should not preclude preliminary interpretations of the existing geoengineering judgment; i.e., the deficiencies in the existing geoengineering data base (especially uncertainty in individual data) should first be assessed and then the data combined in a coherent manner consistent with accepted engineering principles. This interpretation should assess and incorporate all sources of uncertainty (including possible errors/biases in data and ignorance), as well as natural variability, preferably in the form of probability distributions for each characteristic/relationship. Statistical distributions of data, as presented by DOE, may be misleading in predicting or estimating the actual distribution of values of characteristics, as the data

on which they are based may be biased and insufficient. Where the data base is insufficient (e.g., complete ignorance or lack of data), there would clearly be large uncertainty (expressed as a wide probability distribution). Due to natural variability, there will in any case be residual uncertainty in the value even as the deficiencies in the data base are eliminated."

STATUS: Agreed

BWIP RESPONSE: The problems associated with insufficient data are being rectified by virtue of additional data collection and analysis (completed after the publication of the SCR) and expected future data. Any new data, with proper statistical interpretations, will be included in the SCP.

ITEM REFERENCE: Section 4.3, page 4-8, paragraph 2

GAI COMMENT: "The estimated geoengineering characteristics of the rock mass (i.e., mechanical and thermal/thermomechanical characteristics, as well as the effects of temperature on the mechanical characteristics, and in situ stress and temperature), including uncertainty, will be applied to repository design and construction. This application to repository design has only been implied in this chapter - (see Chapter 10 - Repository Design). However, it appears that intact rock characteristics, which may be significantly different than the appropriate rock mass characteristics (especially strength and deformability), have been used by DOE in the conceptual design. If this is the case, DOE's conceptual design has been based on generally unconservative assessments of material characteristics. For example, DOE's conclusion that neither support or rock bursting will be a problem may be invalid. Also, there are empirical procedures, based not only the limited experience in basalt presented, which are available for excavation/support design, but have not been discussed by DOE. It is GAI's opinion that the degree of natural jointing will significantly affect performance and thus design, which has apparently not been fully appreciated by DOE. For example, increasing and flattening the span of underground openings in response to the perceived in situ stress field may be inadvisable due to the nature of jointing at BWIP. Detrimental loosening of the rock mass may also occur if the excavation/support procedures are not carefully controlled, both in tunnels and horizontal waste emplacement holes (if used)."

STATUS: Agreed

BWIP RESPONSE: The conceptual design discussed in the SCR, was prepared to meet a specific purpose dictated by the DOE. The purpose was to establish budgets and schedules for congressional funding. Many decisions were made to complete the conceptual repository design without the benefits of engineering

trade studies that would reflect licensing considerations. The design process does allow ample opportunity for upgrading and incorporating changes as additional information becomes available. The difference between rock mass and intact rock characteristics is fully recognized. The final repository design plan is to base the design on in situ rock mass characteristics, and the observational data on tunnel stability will be obtained from the ES test program.

The initial assessment of the support requirements and stability was made using empirical procedures developed by Hoek.* The detailed discussion of this analysis will be presented in Section 4.6.4.

*Hoek, E., "Geotechnical Design of Large Openings at Depth," Proc. of the Rapid Excavation and Tunneling Conference, San Francisco, California (1981).

CHAPTER 5 (HYDROGEOLOGY)

ITEM REFERENCE: Section 5.3, page 5-4, paragraph 3

GAI COMMENT: Hydraulic Parameters. "Field measurements of horizontal hydraulic conductivity have been made only in small-diameter coreholes using packer techniques. Holes have first been cored using bentonite drilling mud which could tend to plug the formation and decrease the measured hydraulic conductivity. The actual effects of using bentonite are not known currently, although DOE asserts that holes have been adequately developed to remove all mud. Resulting values are essentially spot measurements representative only of the immediate area around the corehole and not necessarily the hydrogeologic unit on a large scale. No reliable bulk (large scale) measurements of this parameter exist. In addition, no field measurements of vertical hydraulic conductivity have been made."

STATUS: Agreed

BWIP RESPONSE: Detailed plans for large-scale testing to obtain conductivity data (horizontal and vertical) will be provided in the Drill and Test Plan and discussed in Chapter 13 of the SCP. A test to examine the effects of drilling fluid on high-permeability zones has been conducted in DC-12 and will be documented in the SCP. A test to determine the effects of mud on low-permeability zones is planned for DB-2. Large-scale multiwell interference tests are being planned at wells DC-16, -19, -20, -22, and RRL-2 to gather bulk conductivity data.

ITEM REFERENCE: Section 5.3, page 5-4, paragraph 4

GAI COMMENT: "Field measurements of effective porosity and dispersivity have been conducted in only one flow top interval in a dual borehole set located outside of the RRL. Results are uncertain due to non-standard test responses. However, the approximate value of effective porosity from the test (i.e. 10^{-4}) does not correspond to the value used in the performance modeling assessments (i.e., 10^{-2}). This difference alone could result in the overprediction of traveltimes by a factor of 100."

STATUS: Agreed

BWIP RESPONSE: Additional testing to obtain adequate effective porosity data will be described in the Drill and Test Plan and discussed in Chapter 13 of the SCP. A nonconservative value for the effective porosity was used in the SCR for traveltime calculations. Results presented in the SCP will be accompanied by a discussion and justification for the assumptions used.

CHAPTER 5 (HYDROGEOLOGY)

ITEM REFERENCE: Section 5.3, page 5-4, paragraph 5

GAI COMMENT: "Matrix diffusion, which is potentially a very positive aspect of waste containment at the Hanford Site, has not been measured or even considered, based upon the information presented by DOE in SCR Chapter 5. This process has been shown to be significant in granitic rock, resulting in an effective retardation of solutes by diffusion into the rock matrix from fractures. GAI believes that this effect should be considered at Hanford and that measurement of matrix diffusion is realistic based upon current technology."

STATUS: Agreed

BWIP RESPONSE: We would like to have discussions with GAI to better understand their suggestion. Matrix diffusion will be considered in the BWIP site characterization program. The BWIP Drill and Test Plan and Chapter 13 of the SCP will address this topic.

ITEM REFERENCE: Section 5.3, page 5-5, paragraph 1

GAI COMMENT: "A problem related to measurement of hydraulic parameters is that of determining whether measured values are representative at a scale appropriate for performance modeling. Existing data indicate extremely wide variations in measured parameters (e.g., horizontal hydraulic conductivity) which may be the result of natural variation or nonrepresentative tests (i.e., test volumes are too small). In either case, GAI believes that it is not currently possible to predict or interpolate parameter values between measured locations with a reasonable degree of certainty. Because of the uncertainties in hydraulic parameters, it is not currently possible, in GAI's opinion, to predict traveltimes with any reasonable level of confidence."

STATUS: Agreed

BWIP RESPONSE: Chapter 13 of the SCP will be modified to include a framework under which uncertainties will be assessed. Hydraulic data will be collected at several scales (single-borehole tests, interference tests, and large-scale interference tests) in order to determine the appropriate values to use in performance models. Initial analyses will be performed to utilize data collected at a small scale (single- and dual-borehole scale) in determining the proper values to use in large-scale modeling. Chapter 13 of the SCP will discuss these tests and analyses of the data.

CHAPTER 5 (HYDROGEOLOGY)

ITEM REFERENCE: Section 5.3, page 5-5, paragraph 2

GAI COMMENT: "Many of the problems related to parameter uncertainty could be solved by utilizing large-scale testing techniques instead of small-scale borehole techniques. It is standard procedure in hydrogeologic investigations to utilize multiple-hole pump tests to determine horizontal and vertical hydraulic conductivity in layered systems. Large-scale tests result in bulk parameter values rather than spot values and yield valuable information about aquifer continuity and hydrogeologic barriers. However, although the Hanford Site has the advantage of being testable on a large scale by standard techniques (e.g., multiple hole pump tests), DOE plans for supplementing the hydrologic data base (see SCR Chapter 13 - Site Issues and Plans) indicate that single-hole tests will continue to be the fundamental testing method at Hanford. Four dual-borehole sets and two multiple-hole sets are planned, but only one of the proposed multiple-hole tests is located near the RRL and its scale is small with respect to the repository dimensions. GAI has low confidence in the reliability of existing hydraulic parameters and does not believe the currently proposed testing program will be adequate to produce a sufficient data base on hydraulic parameters, as is needed to defensibly predict the repository's performance."

STATUS: Agreed

BWIP RESPONSE: Plans for extensive, large-scale tests will be given in the Drill and Test Plan and discussed in Chapter 13 of the SCP. Future characterization activities center around first establishing a piezometric baseline and then conducting large-scale pump tests with multiple observation points. These tests will be configured to determine the three dimensional nature of the groundwater flow system. The large-scale tests will be located within the RRL at wells DC-16, -19, -20, -22, and -28. Details of the testing will be addressed in the BWIP Drill and Test Plan.

ITEM REFERENCE: Section 5.3, page 5-5, paragraph 3 - page 5-6, paragraph 1

GAI COMMENT: Hydraulic Head. "Measurements of hydraulic head have been made by DOE primarily using packer technology rather than permanent piezometer completions. It is GAI's opinion and experience that long-term monitoring in permanent installations is necessary to determine representative hydraulic heads. Short-term measurements in packed-off intervals are subject to effects from packer leakage, the existence of the open hole above the packer interval, and transient effects introduced by drilling.

CHAPTER 5 (HYDROGEOLOGY)

GAI believes that the distribution of measured hydraulic head supports several different interpretations of the groundwater flow system, not just DOE's interpretation as presented in the SCR. For instance, the quality of head data is not sufficient to determine whether flow is going north or south from the RRL. This problem is compounded by the fact that observed horizontal and vertical hydraulic gradients in the Pasco Basin are apparently low, thus small errors in measurement could introduce significant differences in the flow system interpretation.

DOE proposes to continue to collect head measurements during the drill and test sequence and although it is assessing the need for time-variant measurements, no plans are presented for installation of reliable devices for long-term head measurements. GAI considers the existing data inadequate and does not believe the proposed plans will yield the accurate head information needed to formulate conceptual models and calibrate performance models."

STATUS: Agreed

BWIP RESPONSE: Extensive piezometric monitoring will be developed in the RRL. The groundwater monitoring plan will describe the planned facilities. Chapter 13 of the SCP will describe how the facilities will be used. Three piezometric monitoring locations are planned; each monitors nine horizons. Multiport installations will be provided at at least two locations (more locations will be provided after qualifying the equipment for monitoring heads in basalts). Monitored head data will be supplemented with existing and additional point-in-time head data. Details of the piezometric baseline data collection will be presented in the Groundwater Monitoring Plan.

ITEM REFERENCE: Section 5.3, page 5-6, paragraphs 2 and 3

GAI COMMENT: Hydrogeologic Boundaries. "Large-scale discontinuities (including the Cold Creek and the Gable Mountain-Umtanum Ridge structures) and small-scale discontinuities (including inverted fans and fracture zones) are known to exist in the Pasco Basin. However, hydrogeologic characteristics and effects of discontinuities in the Pasco Basin are currently unknown because no hydrogeologic tests to investigate these features have been conducted by DOE. DOE plans to evaluate the Cold Creek structure using a multiple-hole pump test in the Cold Creek Valley and the Gable Mountain-Umtanum Ridge structural zone by a single corehole. No plans are presented to test other potential hydrogeologic boundaries.

CHAPTER 5 (HYDROGEOLOGY)

GAI considers the current data related to hydrogeologic boundaries insufficient and the proposed plans inadequate to produce the level of information needed in performance assessments. It is GAI's opinion that conventional multiple-hole tests would provide much of the needed information. GAI expects that small-scale features could potentially increase the bulk vertical hydraulic conductivity several orders of magnitude higher than is currently assumed by DOE."

STATUS: Agreed

BWIP RESPONSE: The facilities to perform the large-scale tests and piezometric monitoring discussed above will also be used to evaluate the significance of geologic structures near the RRL. Plans for performing these tests will be discussed in Chapter 13 of the SCP. The tests will utilize large-scale pumping with multiple observation wells to investigate the location and hydrologic significance of any boundaries within the radius of influence of the pump wells. The RRL will be stressed in this fashion with three pump wells that have overlapping radii of influence to achieve high resolution with respect to determination of boundaries both within the RRL and near the RRL.

ITEM REFERENCE: Section 5.3, page 5-6, paragraphs 5 and 6.

GAI COMMENT: Conceptual Groundwater Models. "In GAI's opinion, data presented by DOE in the SCR do not support a unique conceptual model of the groundwater flow system. For example, current data could be used to support a system with significant vertical permeability, with areally discontinuous layers, or with flow dominated by the effects of hydrogeologic barriers.

GAI considers the acquisition of reliable long-term hydraulic heads and the use of large-scale hydrogeologic tests essential to further refinement of the conceptual flow system model. This is particularly important if the lateral geologic variability of intraflow structure is taken into account. However, GAI believes it is unlikely that the DOE's proposed testing program, as presented in the SCR, will yield the required information."

STATUS: Agreed

BWIP RESPONSE: A full range of conceptual models will be considered by the BWIP in preparation for making a license application. These models will be described in Chapter 5 of the SCP. Chapter 13 of the SCP will give the framework under which these models will be evaluated. The head monitoring and large-scale hydrologic testing activities described above will be used to assess the validity of the various conceptual models that could be inferred from the existing data.

CHAPTER 5 (HYDROGEOLOGY)

ITEM REFERENCE: Section 5.3, page 5-7, paragraph 1

GAI COMMENT: Hydrochemistry. "Hydrochemistry data in the SCR are not, in GAI's opinion, presented in a normal scientific format. Lacking are the description of sampling methods, the listing of basic data and the presentation of data in unbiased graphical summaries. GAI considers conclusions relating to the low degree of vertical groundwater mixing, which have been supposedly drawn from this data, to be premature. Further considerations should be given to potential vertical mixing based upon the determination of hydraulic parameters and gradients. GAI does not believe that hydrochemistry alone can be used to support the conclusion that vertical mixing is insignificant.

Several other hydrochemical interpretations are questionable in GAI's opinion. For example, holes DC-14 and DC-15 (located near the Columbia River) are cited as examples of low vertical mixing because sharp chemical breaks occur within the vertical profile between the Wanapum and Grande Ronde. Hole DC-12 (located near the RRL) exhibits no major chemical breaks between the Wanapum and Grande Ronde, though this is not given as evidence for significant vertical leakage."

STATUS: Agreed

BWIP RESPONSE: Chapter 13 of the SCP will be expanded to provide a framework under which hydrochemical investigations will be used to support hydraulic investigations to characterize the groundwater flow system. A solids characterization program to determine the chemical characteristics of the flow tops will be implemented. The solids chemistry will then be used along with hydrochemical information to geochemically model the reaction paths possible in the groundwater flow system. The geochemical model obtained will be applied to flow system models obtained from hydraulic testing to assess the validity of the hydraulic model. Details of the hydrochemical program describing data collection and analyses will be presented in a geochemical testing plan.

ITEM REFERENCE: Section 5.3, page 5-7, paragraph 2

GAI COMMENT: "...Another problem is lack of correction in Carbon-14 ages for the effects of methanogenesis and the failure to consider models of geochemical evolution."

STATUS: Open

BWIP RESPONSE: We would like to discuss the correction of carbon-14 data with GAI in order to better understand their suggestion.

CHAPTER 6 (GEOCHEMISTRY)

ITEM REFERENCE: Section 6.1, page 6-1, paragraph 3, item 2

GAI COMMENT: "In order to improve DOE's understanding of the groundwater chemistry affecting waste package corrosion, significantly more data needs to be acquired. Additionally, DOE's predictions of repository pH and Eh are far more uncertain than previously acknowledged due to observed inconsistencies in the measurement of pH as a function of temperature."

STATUS: Agreed

BWIP RESPONSE: Since the SCR was published in November 1982, many additional analyses of groundwaters from new and existing boreholes within the Hanford Site have been made. Data from these samples will be included in Section 5.1 of the SCP. However, it is recognized by the BWIP that additional hydrochemical data are required.

Currently, estimates of pH in the repository horizons are based upon data from six boreholes (not every horizon has been sampled at each borehole). Nearly all of these data fall within the range of 9.5 ± 0.6. In the RRL, pH values for the Cohassett and Umtanum flow tops from borehole RRL-2 are 9.71 and 9.45, respectively. While pH generally increases with depth in groundwaters from the Saddle Mountains to the Grande Ronde Formations, no quantitative pH-temperature relationship is implied.

The BWIP currently is investigating the effect of pH on canister corrosion rates, and preliminary results suggest that the lower pH observed in basalt-water hydrothermal experiments at 300°C does not compromise the waste package design. For example, corrosion tests conducted at both 150° and 250°C in which low-carbon steel was in contact with solutions of pH 6.0 and 9.75 suggest that the difference in corrosion rate over this range of pH is very small and will not necessitate modification of the waste package design.

Golder Associates is correct concerning the uncertainties in measured Eh values. The BWIP currently is addressing the question of Eh and is formulating a plan to obtain defensible estimates of this parameter. A more comprehensive discussion of Eh in these groundwaters will be included in Section 6.4 of the SCP. For example, tests are planned to determine Eh buffering capacity of the backfill and the disturbed rock zone.

CHAPTER 6 (GEOCHEMISTRY)

ITEM REFERENCE: Section 6.1, page 6-1, paragraph 3, item 3

GAI COMMENT: "There is considerable uncertainty in DOE's assumptions regarding the presence of oxygen in the vicinity of the waste package when resaturation occurs; the result being an uncertainty in the corrosion environment that the waste package will be subjected to in a repository at Hanford."

STATUS: Disagreed

BWIP RESPONSE: The approach being used for the waste package design is to use "best estimates" of expected conditions and performance, evaluate the effects of the uncertainties, and then establish a design margin to adequately cover the uncertainties. In the case of canister corrosion, the effects of uncertainties are presented in the reference cited.* The results of the analysis show that, regardless of the time of resaturation and return of Eh to ambient conditions, the effect on the amount of lifetime canister corrosion is negligible.

ITEM REFERENCE: Section 6.1, page 6-2, item 1

GAI COMMENT: "DOE has apparently no relevant data on the chemistry of waste form and package materials in an environment relevant to a basalt repository, and this lack of data introduces considerable uncertainty into the ongoing package design effort."

STATUS: Disagreed

BWIP RESPONSE: The SCP will include updated data on site-specific basalt/groundwater (Section 6.2) and waste/barrier/rock (Section 11.4) hydrothermal interaction experiments. The data is obtained from experiments that are performed using Umtanum and Cohassett flow basalt and synthetic Grande Ronde Basalt groundwater. The experiments are performed over a temperature range of 100° to 300°C (the expected repository temperature range) and pressures of 30 MPa (the maximum repository pressure) to simulate the range of actual repository conditions. In October 1983, experiments using fully radioactive borosilicate glass and actual spent fuel will be initiated to assess the effects of radiation on waste package component interactions.

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*Anderson, W. J., Conceptual Design Requirements for Spent Fuel, High-Level Waste, and Transuranic Waste Packages, RHO-BW-ST-25 P (October 1982).

CHAPTER 6 (GEOCHEMISTRY)

ITEM REFERENCE: Section 6.1, page 6-2, item 2

GAI COMMENT: "DOE has no relevant data on the solubility of radionuclides under geochemical and environmental conditions anticipated in a repository at Hanford, and as a result, cannot technically defend an assessment of repository performance which takes credit for solubility without acknowledgement of very large uncertainties."

STATUS: Agreed

BWIP RESPONSE: The section on radionuclide solubilities (Section 6.4.1) will be greatly modified and expanded in the SCP (as Section 6.5.2). Modifications will take advantage of recent estimates of key radionuclide solubilities based upon thermodynamic analyses and experimental solubility measurements currently in progress. The BWIP is aware of the temperature dependence of radionuclide solubilities. Although meaningful theoretical estimates of solubilities at elevated temperatures are not possible (with the possible exception of uranium and plutonium) experimental studies at 60°C are in progress, and this research will be expanded to higher temperatures in the future. In addition, the Barrier Materials Test Plan* includes provision for a hot cell testing program that will yield data on the solubility of radionuclides under hydrothermal conditions. The cited quotation from the SCR (page 6-6; para- graph 1) is correct for many key radionuclides. The theoretical framework on which this statement is based will be presented in Chapter 11 of the SCP.

ITEM REFERENCE: Section 6.1, page 6-2, item 3

GAI COMMENT: "DOE has only very limited geochemical sorption data taken under marginally relevant conditions, and thus cannot technically defend a performance analysis of a repository which takes credit for sorption in basalt until substantially more data is acquired."

STATUS: Disagreed

BWIP RESPONSE: The sorption data presented in Section 6.4.2 of the SCR are only a very small fraction of existing sorption data that are relevant to a repository in basalt. Many thousands of sorption measurements covering a wide range of values for significant sorption parameters have been completed. These parameters include groundwater composition, pH, Eh, temperature, radionuclide concentration, and time. Many solid sorbants have been studied,

*Rockwell Hanford Operations, Barrier Materials Test Plan, Draft SD-BWI-TP-022, Richland, Washington (1984).

including geological solids (basalt, secondary minerals, interbed materials, basalt flowtops, and altered basalts) and engineered solids (backfill materials). The radionuclides studied are those with long half-lives with large inventories in the waste and those expected to have relatively high solubilities and/or sorb weakly. Both reducing and oxidizing conditions have been used for these measurements, and temperatures have been varied from 23°C to 150°C. Section 6.4.2 of the SCR will be expanded in the SCP (Section 6.5.3) to include summaries of new data for expected conditions in the near-field and far-field of a repository in basalt. Additional references will also be cited in this section.

ITEM REFERENCE: Section 6.1, page 6-2, item 4

GAI COMMENT: "Discussion of natural analogs has little relevance to a nuclear waste repository in basalt unless such analogies can be demonstrated to have equivalent environmental conditions."

STATUS: Agreed

BWIP RESPONSE: The severe limitation of all natural analogs to a nuclear waste repository in basalt (NWRB) is that no natural analog can be shown, or is likely to be shown, to exactly reproduce all the various environmental conditions (i.e., temperature, radiation field, composition of waste forms and barrier materials, etc.) of an NWRB. The advantage of natural analogs is that they represent "natural experiments" over geologic time periods that are similar to those called out in federal regulatory criteria. Thus, the SCP will clearly state that natural analog studies should be referred to as qualitative indicators to what may happen in an NWRB and that results from such analogs need to be reviewed in concert with laboratory tests that do reproduce equivalent repository conditions. Field studies of existing alteration within the Hanford Site basalt, perhaps the truest representation of a natural analog for an NWRB, will also be included in the SCP (Section 6.6).

CHAPTER 7 (SURFACE HYDROLOGY)

ITEM REFERENCE: Section 7.3, page 7-5, paragraph 2

GAI COMMENT: "However, it is within the realm of possibility, although remote, that intense flash-flooding along Cold Creek could affect a repository at the RRL, possibly resulting in disruption of operations and contamination of surface water in Cold Creek which could reach the Yakima River. DOE, based on the lack of discussion presented in SCR Chapter 7, has apparently not assessed the plausibility and consequence of such an event. In GAI's opinion, this should be assessed by DOE within the scope of the evaluation of surface water hydrology. Thus, the detailed resolution of topographic relief within the vicinity of the RRL, which is required to determine whether migitation measures are appropriate, should be undertaken by DOE."

STATUS: Agreed

BWIP RESPONSE: Sufficient topographic data for 1 to 2 ft contouring is already available within the RRL by virtue of various geophysical survey transects performed by BWIP. This data will be contoured, and additional cross-channel surveys will be performed. This information will then be used to reassess the areal extent of flooding of various frequencies within Cold Creek and, hence, the potential impact upon repository construction and operation. These plans will be discussed in Chapter 13 of the SCP.

CHAPTER 9 (ENVIRONMENTAL, LAND-USE AND SOCIOECONOMIC CHARACTERISTICS)

ITEM REFERENCE: Section 9.1, page 9-1, paragraph 3

GAI COMMENT: "In GAI's opinion, the information compiled by DOE in Chapter 9 of the SCR appears to be accurate, sufficient, and comprehensive. However, GAI has identified the following four potential issues pertaining to environmental, land-use and socioeconomic characteristics, which in their opinion should be resolved:"

ITEM REFERENCE: Section 9.1, page 9-1, paragraph 3

GAI COMMENT: Item 1. "The levels of radioactive contamination currently existing at the RRL, and the potential for unacceptable contamination of public roads and for the unacceptable radiation exposure of workers as a result of site development activities, such as those ongoing which are associated with the construction of a shaft."

STATUS: Disagreed

BWIP RESPONSE: The radionuclide concentrations, to which this item refers, were discrete samples from which general conclusions cannot be drawn. More recent representative data will be included in Chapter 9 of the SCP. The potential for unacceptable contamination and exposure are beyond the scope of the SCP and will be discussed in the Environmental Report submitted with the License Application.

ITEM REFERENCE: Section 9.1, page 9-1, paragraph 3

GAI COMMENT: Item 2. "The discrepancies in the DOE presentations as to the RRL, whether it extends into the 'Arid Lands Ecology Reserve' which bounds the southwestern edge of Hanford, and the appropriateness of that designation if found to include parts of the Reserve."

STATUS: Agreed

BWIP RESPONSE: Figure 9.1 of the SCR erroneously shows the Arid Lands Ecology Reserve separated from the reference repository location. This figure will be corrected. The RRL boundaries are subsurface projections; there are no plans for surface disruptions on the Arid Lands Ecology Reserve.

CHAPTER 9 (ENVIRONMENTAL, LAND-USE AND SOCIOECONOMIC CHARACTERISTICS)

ITEM REFERENCE: Section 9.1, page 9-1, paragraph 3

GAI COMMENT: Item 3. "The absence of an accounting of the potential public risks and social burdens associated with transportation activities in the development and operation of a repository at Hanford."

STATUS: Disagreed.

BWIP RESPONSE: The purpose of Chapter 9 is to provide a summary of environmental, land-use, and socioeconomic characterjstics of the Hanford Site region. As part of this summary, major transportation facilities are discussed. The potential public risks and social burdens associated with transportation activities are beyond the scope of the SCR and will be discussed in the Environmental Report submitted with the License Application.

ITEM REFERENCE: Section 9.1, page 9-1, paragraph 3

GAI COMMENT: Item 4. "The absence of an accounting of the potential social burdens associated with the transient construction work force that would accompany the construction of a repository at Hanford."

STATUS: Disagreed

BWIP RESPONSE: Section 9.3 of the SCP will provide a summary of the socioeconomic characteristics of the Hanford Site region. The potential social burdens associated with the transient construction work force is beyond the scope of the SCP and will be discussed in the Environmental Report submitted with the License Application.

CHAPTER 10 (REPOSITORY DESIGN)

ITEM REFERENCE: Section 10.1, page 10-2, paragraph 2

GAI COMMENT: "...GAI believes that DOE should present a detailed description of the design process which will be used to finalize the conceptual design prior to a license application for construction authorization and subsequently during construction. Detailed layouts are not appropriate at this time since there is not sufficient specific data available on geologic variability and hence geoengineering parameters. However, the criteria or methodology for making ongoing design decisions (e.g., planned design contingencies) should be addressed..."

STATUS: Agreed

BWIP RESPONSE: The design procedure that encompasses all site characterization data (in site and laboratory test data) and is influenced from the other deep structures in highly stressed rock will be improved during the conceptual design update. It is recognized that no standard procedure is available and that each designer uses differing methods. Prior to license application, a detailed description of the design process, the inputs, the analysis, the validation, etc., will be developed. This process will solicit input from the technical community via workshops and will involve presentation of these procedures at symposia. Peer review will also be an important component of the process.

ITEM REFERENCE: Section 10.1, page 10-3, item 2

GAI COMMENT: "Insufficient (and in some cases outdated) information has been presented regarding backfilling and sealing. Especially, the objectives/criteria for backfill/seals have not been defined, nor is the schedule for backfilling clear..."

STATUS: Agreed

BWIP RESPONSE: The 10 CFR 60 performance objectives pertaining to the sealing of shafts and boreholes and of the underground facility will be identified in the SCP Section 10.8. A preliminary functional design criterion for the seal system will be stated in that section. A backfilling schedule will be given in Section 10.7.3.

ITEM REFERENCE: Section 10.1, page 10-3, item 2

GAI COMMENT: "...The design of backfill/seals, and the associated construction methods to achieve that design and the test methods to verify that design and assess especially their long-term performance, have not been adequately

discussed. Although DOE asserts that they will backfill/seal all openings, it should be pointed out that there is no mandatory requirement for backfill."

STATUS: Agreed

BWIP RESPONSE: Preconceptual design descriptions of seals for shafts, boreholes, and the openings of the underground facility, as well as for backfill, will be presented in Secton 10.8. Conceptual design is scheduled for completion in 1984, at which time details of the design, including construction methods, will be available. Design testing of repository seals and backfill is required by 10 CFR 60 only after the start of repository construction (see 10 CFR 60, Section 60.142). While current plans do not include full-scale development testing of complete seals in situ prior to construction license application, the BWIP seal field testing program is currently being reevaluated in view of the high potential value of such testing. Long-term performance assessment of seals and backfill will also be addressed. The comment that backfilling of all openings is not mandatory is noted and will be incorporated in the SCP.

ITEM REFERENCE: Section 10.2, page 10-2, paragraph 3

GAI COMMENT: "The current design of underground openings may not be conservative in some respects, in that intact rock strengths at room temperature, rather than the appropriate (and much lower) rock mass strengths at elevated temperatures, have been used to establish allowable stresses in the basalt."

STATUS: Agreed

BWIP RESPONSE: The use of the intact rock strength is not conservative, but the method of analysis used, namely linear thermoelastic analysis, overestimates the stresses in jointed rock mass. Therefore, it is not yet clear that the overall design is not conservative. The effect of temperature on the rock mass strength is not established at this time.

ITEM REFERENCE: Section 10.2, page 10-2, paragraph 3

GAI COMMENT: "The current design of underground openings may not be conservative in some respects, in that contrary to DOE design criteria, overstressed zones will probably occur in many places, including the corners of placement rooms, around the essentially square reaming access drifts, and at the intersection of underground openings."

STATUS: Agreed

CHAPTER 10 (REPOSITORY DESIGN)

BWIP RESPONSE: It is recognized that overstressed zones will occur at intersections of boreholes and rooms and at room intersections. At these locations, the rock support will be enhanced (e.g., thicker shotcrete, higher density of rock bolts, or concrete linings). Such detail was not included in the conceptual design at this time. The design criteria will be upgraded as the design process is better defined. The design process will include criteria to ensure a conservative design.

ITEM REFERENCE: Section 10.2, page 10-2, paragraph 3

GAI COMMENT: "The current design of underground openings may not be conservative in some respects, in that the in situ stresses may be higher than those assumed by DOE for the design of underground openings."

STATUS: Agreed

BWIP RESPONSE: The current best estimate of the ratio of the maximum in situ horizontal stress to the vertical stress is 2.3:1. It is suggested that this value will be used in the updated conceptual design to be initiated in FY 1984. Improved estimates of the in situ stress will be made when access to the repository horizon is available, i.e., during the Phase II testing at the Exploratory Shaft. A detailed plan for in situ stress measurement will be included in Chapter 17. Contingency plans will be developed to assess design alternatives if the ratio is greater than 2.3:1.

ITEM REFERENCE: Section 10.2, pages 10-2 and 10-3, paragraph 4

GAI COMMENT: "Intraflow geological variability, and thus predictability, especially regarding the geometry of the dense zone, is considered to be a significant issue, and it is not clear how contingencies for these potential conditions will be incorporated at this time."

STATUS: Agreed

BWIP RESPONSE: The layout of the repository can be altered during construction to accommodate areas where the variability of the geology makes sections of a waste storage panel, whole panel, or one side of the repository unacceptable. Criteria will be established to identify areas where unacceptable conditions exist. Procedures will be implemented during construction to monitor the stability of the repository openings and groundwater flow as well as exploratory drilling to determine the thickness of the dense interior of basalt. Conceptual methods of accommodating geologic variability will be discussed in Section 10.5.

CHAPTER 10 (REPOSITORY DESIGN)

ITEM REFERENCE: Section 10.3, page 10-10, paragraph 1

GAI COMMENT: "The analyses used by DOE to assess the induced stresses are apparently simplified and have not considered stress concentrations which will occur at many places. GAI believes that rock bursting may be a problem at such high stress conditions."

STATUS: Agreed

BWIP RESPONSE: For the conceptual design, linear elastic analysis was used; this overestimates the stresses. Nonlinear analysis and experience at the NSTF indicate that these high stresses do not develop. Rock reinforcement will be used to support the rock in local areas of stress concentration. Considerations will be made in the design of repository openings and waste storage panel layout to avoid excessive strain energy accumulation in the rock mass. Rock bursts that have occurred during shaft sinking or tunnel excavation in similar rock types under high stress conditions have been minor and can be controlled by installation of rock support, as soon as possible, or by distressing. The joints in the basalt at depth are expected to relieve the high stress concentrations and minimize the occurrence of burst during construction. The BWIP does not believe this will be a problem. The Exploratory Shaft and the tests planned at depth will demonstrate the stress redistribution in the jointed rock mass. Section 10.5.1 and Section 10.5.5 in the SCP will address these points.

ITEM REFERENCE: Section 10.3, page 10-9, paragraphs 2 and 3

GAI COMMENT: "GAI believes that, although a detailed design is not required in the SCR, the design should be sufficiently described in the SCR so as to identify those site conditions which are critical to the design and performnce, and thus should be focused on in site characterization prior to license application. Hence, conceptual design of a repository is necessary to identify information needs and evaluate the adequacy of the site characterization plans. The current lack of data is such as to limit the supportable detail of the design. This limitation will not be entirely removed at the time of the initial license application for construction authorization. Presuming a site is granted a construction authorization, the design will have to be capable of responding to a variety of geological and geoengineering conditions. The breadth of these conditions will be a function of the natural variability actually encountered."

STATUS: Agreed

CHAPTER 10 (REPOSITORY DESIGN)

BWIP RESPONSE: A draft topical report (not formally issued) was prepared in 1980 by the Architect-Engineer describing the site characterization data required for the repository. This report will be updated prior to initiating the upgraded conceptual design which is scheduled to start in the last quarter of CY 1984. A statement will be added to Section 10.5.5 of the SCP identifying the plans and schedules for the development of the required site characterization data.

ITEM REFERENCE: Section 10.3, page 10-9, paragraph 3

GAI COMMENT: "A conceptual design of the underground portion of a repository at Hanford must detail a discussion of the range of natural conditions currently anticipated from existing data. In addition, the conceptual design should detail the decision process which will allow actual data to be incorporated in the design process (i.e., by modification) and into construction. This process should include design objectives and analyses, as a minimum."

STATUS: Agreed

BWIP RESPONSE: The final design of the repository will be such that modification of the layout and design will not be necessary within a reasonable range of geologic, hydrologic, and geotechnical conditions. That range of conditions will be evaluated in the design and during performance assessment studies. However, the possibility of external variation in conditions that could affect the acceptance/rejection of a location, panel, or side of the repository will be considered. Further detailed discussion will be included in Section 10.5.4.3.

ITEM REFERENCE: Section 10.3, page 10-10, paragraph 2

GAI COMMENT: "It is not apparent to GAI how the rock support system was designed, and what support pressure is expected and whether that will be sufficient. Similarly, regarding shafts, neither the support system (during and after construction) nor the allowable design stress in zones other than the entablature through which the shaft will pass have been discussed by DOE. However, GAI believes that the issue of shaft design can be relatively easily resolved."

STATUS: Agreed

CHAPTER 10 (REPOSITORY DESIGN)

BWIP RESPONSE: Rock support design was based on the Barton et al.* Q system modified to take into account the increased stresses induced by thermal loads. This was applied to the placement rooms, but, for the reaming rooms, it was assessed that early backfilling of these rooms would supply sufficient support pressure. The access drifts are not subject to significant thermally induced stress changes during their operational life. Therefore, no modification of the rock support design method was necessary.

Further investigation is warranted on:

- the ground support system
- backfilling procedures
- shaft liner removal.

However, these matters are either related to procedure or detailed design and will be addressed in the updated conceptual design report. The shaft lining is designed to withstand the full hydrostatic pressure behind the lining. This is much higher than the rock loads, even for very weak materials. In the latest version of the conceptual design, all shafts are sunk by drilling and the lining floated into position. These changes will be incorporated into the SCP.

ITEM REFERENCE: Section 10.3, page 10-10, paragraph 1

GAI COMMENT: "The current design presented in the SCR is not necessarily conservative in several key areas. Specifically, GAI believes that (1) DOE's maximum allowable design stress is too high (i.e., unconservative) and (2) this maximum allowable design stress will be exceeded in many locations."

STATUS: Agreed

BWIP RESPONSE: As stated in the previous response (Section 10.2, page 10-10, paragraph 3), the use of intact rock strength is not conservative, but the method of analysis (linear thermoelastic analysis) is conservative since it overestimates the stresses in the rock mass. Nonlinear analysis, using a more realistic constitutive relationship such as the one being developed in the Jointed Block Test conducted in the NSTF, is planned before updated conceptual design is finalized. A further elaboration of this will be made in Section 10.5.1 of the SCP.

*Barton, N., R. Sein, and J. Lunde, "Engineering Classification of Rock Masses for the Design of Tunnel Support," Rock Mechanics, 6(4):189-236 (1974).

CHAPTER 10 (REPOSITORY DESIGN)

ITEM REFERENCE: Section 10.3, page 10-10, paragraph 1

GAI COMMENT: "GAI believes that the maximum allowable design stress should be set at a value significantly below the rock mass strength at elevated temperatures, and not just below the much higher intact rock strength at room temperature."

STATUS: Agreed

BWIP RESPONSE: This question relates to the question on the "detailed description of the design process," Section 10.1, page 10.2, paragraph 2, and to the question of "overstressed zones will probably occur in many places," Section 10.2, page 10.2, paragraph 3. The GAI comment may, however, not be appropriate if nonlinear analysis is used in the design. Then, at certain locations, the rock mass strength may be exceeded; stability and safety can be ensured if the region of nonlinear behavior does not expand and rock support is used to reinforce the rock.

ITEM REFERENCE: Section 10.3, page 10-10, paragraph 2

GAI COMMENT: "...GAI does not understand either why or how the support system will be removed prior to backfilling..."

STATUS: Agreed

BWIP RESPONSE: Section 10.8 of the SCR will be revised to reflect that the removal of rock support components at seal plug locations in the underground facility will depend on the effect of such actions on excavation stability, including impacts on safety and constructibility, as well as repository isolation performance impacts. It is not expected that rock support will be removed from portions of the underground facilities where only backfilling is required.

ITEM REFERENCE: Section 10.3, page 10-10, paragraph 2

GAI COMMENT: "...GAI again does not understand why or how (without causing stability problems) the shaft liner will be removed prior to sealing..."

STATUS: Agreed

CHAPTER 10 (REPOSITORY DESIGN)

BWIP RESPONSE: Current design concepts call for the removal of the shaft seal liner only in the area of seal plug emplacement. Temporary support may be required until the seals are in place. Shaft intervals between seal plugs will be backfilled.

ITEM REFERENCE: Section 10.3, page 10-11, paragraph 1

GAI COMMENT: "...Although GAI agrees with DOE that exploratory drifts and pilot holes during construction are useful in this regard, GAI believes that insufficient details are presented regarding how and where they will be performed and, most importantly, how the results will subsequently be incorporated in planned design contingencies."

STATUS: Agreed

BWIP RESPONSE: The details of planned exploration in advance of mining and contingency planning have not been fully developed. Section 10.6.3 of the SCP will be revised to include a statement to this effect and will identify a schedule of when this information will be available.

ITEM REFERENCE: Section 10.3, page 10-11, paragraph 2, item 1

GAI COMMENT: "Regarding the layout of underground openings

- The relationship of the exploratory shaft to the repository layout, especially to the experimental panel, is not clear."

STATUS: Agreed

BWIP RESPONSE: At this time the repository has not been precisely located. Therefore, the relationship has not been established.

ITEM REFERENCE: Section 10.3, page 10-11, paragraph 2

GAI COMMENT: "Regarding layout of underground openings, the orientation of the repository with respect to the in situ stresses is shown (see SCR Figure 10-2) as 60 degrees from stated DOE criteria, i.e., the line of shafts should be oriented at about N30°E instead of E-W."

STATUS: Agreed

CHAPTER 10 (REPOSITORY DESIGN)

BWIP RESPONSE: The main accessways of the underground facility and the line of shafts at the surface of the site will be oriented parallel to the direction of the maximum horizontal in situ stresses. The available data (from draft SCP, Section 4.6) indicate that this direction is approximately N7°E.

ITEM REFERENCE: Section 10.3, page 10-11, paragraph 2, item 2

GAI COMMENT: "Regarding construction of underground openings:

- 200 feet long horizontal waste emplacement holes are assumed by DOE to be the longest which can be constructed and have waste emplaced, although no justification has been presented. Indeed, the back reaming techniques to be used in construction have not yet been developed and tried."

STATUS: Agreed

BWIP RESPONSE: Section 10.4 will be rewritten and will clarify that waste emplacement concepts are being studied further and that development testing needs will be identified during these studies. This comment has also been made by the U.S. Nuclear Regulatory Commission (NRC).

ITEM REFERENCE: Section 10.3, page 10-11, paragraph 2, item 2

GAI COMMENT: "- The feasibility of tunnel boring machines or other mechanical excavators for use in constructing underground openings has not been discussed."

STATUS: Agreed

BWIP RESPONSE: A statement will be added to Section 10.6.2 identifying the status of tunnel boring machine (TBM) investigations and will point out that an engineering study is currently in progress that is studying the feasibility of TBMs and identifying development requirements.

ITEM REFERENCE: Section 10.3, page 10-11, paragraph 2, item 2

GAI COMMENT: "- Potential problems with stability during shaft construction in less competent zones has not been discussed. It will be difficult to extrapolate the

results of the smaller diameter, totally blind-bored exploratory shaft to the proposed mixed construction methods of the larger diameter access shafts."

STATUS: Agreed

BWIP RESPONSE: Discussion of stability during shaft construction will be included in Section 10.6 of the SCP.

ITEM REFERENCE: Section 10.3, page 10-11, paragraph 2, item 3

GAI COMMENT: "Regarding waste emplacement, the dimensions of the waste packages have not been given, except for a 12.5 foot length (see SCR Figure 10-5) for which 17 packages will not fit in a 200-foot long hole..."

STATUS: Agreed

BWIP RESPONSE: Section 10.4 of the SCP is being rewritten; complete and correct waste package dimensions will be included.

ITEM REFERENCE: Section 10.3, page 10-11, paragraph 2, item 3

GAI COMMENT: "...GAI suspects that the density was picked as being the maximum (and not necessarily the optimum, as stated by DOE) number possible per hole. This high density of waste packages might cause high temperatures in the waste packages and immediately adjacent materials..."

STATUS: Open

BWIP RESPONSE: The basis for this comment is not readily apparent, but the revised Section 10.4 of the SCP will clarify that:

- Canisters per hole is based on what will fit.
- Hole pitches are based on rock stress limits.
- Calculations confirmed that temperature limits were not exceeded.

The BWIP would like to clarify this comment with GAI.

ITEM REFERENCE: Section 10.3, page 10-11, item 3

GAI COMMENT: "GAI suggests that the waste package support systems may cause accelerated waste package corrosion/degradation and should be evaluated as part of the optimization studies."

CHAPTER 10 (REPOSITORY DESIGN)

STATUS: Agreed

BWIP RESPONSE: The potential for accelerating waste package corrosion/degradation will be evaluated for alternative emplacement concepts. Waste package corrosion/degradation mechanisms will be addressed in Chapter 11.

ITEM REFERENCE: Section 10.3, page 10-11, item 4

GAI COMMENT: "Regarding activities in the experimental panel, which DOE states will continue through the operation period, GAI believes that some of these activities may be required to be completed prior to license application, rather than after construction authorization, as implied by DOE."

STATUS: Agreed

BWIP RESPONSE: This part of Section 10.4 is being rewritten and will clarify that the experimental panel is not intended to provide license application data and will provide additional detail regarding the purpose of the panel. The Exploratory Shaft-Phase II program, which has been extensively expanded, covers those investigations to be completed prior to the construction license application.

ITEM REFERENCE: Section 10.3, page 10-12, item 1

GAI COMMENT: "Regarding dewatering, although pump stations are said to be located in Shaft No. 5, there is no discussion by DOE of dewatering the repository, i.e., the rate of inflow expected and how it will be collected."

STATUS: Agreed

BWIP RESPONSE: Additional discussion of the subsurface water disposal system will be provided in Section 10.2.

ITEM REFERENCE: Section 10.3, page 10-12, item 3

GAI COMMENT: "Regarding surface facilities, no justification is given by DOE for allowable foundation loads and no seismic design information has been discussed; indeed, the relationship of allowable bearing pressure to the size of the foundation has not been discussed. Also, it is not clear how and where non-radioactive wastes will be disposed of on-site, as stated by DOE."

STATUS: Agreed

CHAPTER 10 (REPOSITORY DESIGN)

BWIP RESPONSE: The basic approach to be used to safeguard against a seismic event will be identified in Section 10.2. Also, the methods and means for onsite disposal of nonradioactive wastes will be included in Section 10.2.

ITEM REFERENCE: Section 10.3, page 10-12, paragraph 1, item 1

GAI COMMENT: "Regarding backfilling, GAI has the following concerns:

When and why will backfilling occur? DOE states in one section that no backfilling will occur until after all excavation has occurred, partly because the basalt transport shaft will be used to transport backfill, and in another place that no backfilling will occur until after the 50-year retrievability period. Elsewhere (see SCR Figure 10-14), the option of backfilling immediately after emplacement is contemplated. Still elsewhere, DOE concludes that based on undefined thermal analyses, backfill must be deferred at least 10 years in order to keep backfill temperatures within the criteria, which have not been justified. Can, in fact, backfilling occur at the same time as waste emplacement in the same or different panels with the given ventilation system? Backfilling at the rate of one panel per year appears to be slow. How will panels be sealed off after waste emplacement and prior to backfilling? If backfilling is deferred, then water in the panel and the effects of cooling on the heated rock mass (i.e., opening of discontinuities) may become problems."

STATUS: Agreed

BWIP RESPONSE: A preliminary backfilling schedule that is consistent with requirements for repository emplacement operations and retrievability will be presented in Section 10.7.3 of the SCP. Sealing of panels after waste emplacement and prior to backfilling, including questions of the effects of panel ventilation and drainage on repository isolation performances, will also be addressed.

ITEM REFERENCE: Section 10.3, page 10-12, paragraph 1, item 2

GAI COMMENT: "How will backfill be placed and compacted? Although DOE states that holes will be pneumatically backfilled, the procedures are not discussed, especially their problems with respect to adequate QA/QC..."

STATUS: Agreed

BWIP RESPONSE: A description of quality assurance involvement in scoping and monitoring test demonstrations is provided in Chapter 18 of the SCP. Inspectability, a primary quality assurance concern, is to be addressed during

preparation of detailed test plans and implementing procedures. Subsequent backfill working procedures, not required to be prepared until completion of all developmental testing, will contain adequate process and quality control provisions to ensure proper placement. These will be covered in progress reports subsequent to SCP transmittal.

ITEM REFERENCE: Section 10.3, page 10-12, paragraph 1, item 2

GAI COMMENT: "...The procedures presented for backfilling the rooms are based on room dimensions (20 feet high) for vertical emplacement of waste; a traveling shield 20 feet wide may not be feasible. Will similar procedures be used for other underground openings, and how will these activities be ventilated? Why is an aluminum fill used, and it is left in or removed?"

STATUS: Agreed

BWIP RESPONSE: The backfill emplacement procedure described in SCR Section 10.7.2 was preconceptual in nature. More advanced design concepts will be presented in the SCP, together with requirements for their development.

ITEM REFERENCE: Section 10.3, page 10-12, paragraph 1, item 3

GAI COMMENT: "What type of backfill will be used and why? Although a mixture of crushed basalt and bentonite (pellets and powder) is specified, the relative amounts or size distributions are not discussed, and the reason for using bentonite in the room not presented (e.g., high sorption, etc.)."

STATUS: Agreed

BWIP RESPONSE: Additional information relative to candidate backfill materials and plans for material selection and development will be presented in Section 10.7 or 10.8. However, it is noted that detailed compositions and particle size distributions will not be available until the first quarter of CY 1985.

ITEM REFERENCE: Section 10.3, page 10-12, paragraph 1, item 4

GAI COMMENT: "How will long-term performance of backfill be adequately assessed during the operating period, much less prior to initial license application?"

STATUS: Agreed

CHAPTER 10 (REPOSITORY DESIGN)

BWIP RESPONSE: The approach taken during the operating period to long-term performance assessment of backfill is expected to differ little from the current approach: laboratory testing and long-term performance modeling of materials. Plans for selection of sealing materials will be described in Section 10.8. Much of the information required for shaft and underground facility backfill will be obtained as a byproduct of waste package packing materials development.

ITEM REFERENCE: Section 10.3, page 10-13, paragraph 1

GAI COMMENT: "Regarding retrieval, GAI believes that DOE should identify the potential conditions which might dictate retrieval of some or all waste packages, and discuss the process by which decisions regarding retrieval will be made..."

STATUS: Agreed

BWIP RESPONSE: Potential conditions that might dictate retrieval of some or all waste packages, and the process by which decisions regarding retrieval will be made, will be discussed in Section 10.6 of the SCP.

ITEM REFERENCE: Section 10.3, page 10-13, paragraph 1

GAI COMMENT: "...Some consideration should be given as to how retrieval can be safely and effectively carried out under potentially adverse conditions. Specifically, GAI believes that retrieval of defective waste packages could be relatively difficult with long horizontal waste emplacement holes..."

STATUS: Agreed

BWIP RESPONSE: Section 10.4 of the SCP will point out that retrievability, even under adverse conditions, will be a factor in evaluations of alternative waste emplacement concepts.

ITEM REFERENCE: Section 10.3, page 10-13, paragraph 3, item 1

GAI COMMENT: "Regarding seals, GAI has the following concerns:

In defining preliminary seal requirements

- dispersion and diffusion have been ignored
- the computer code FLOW is undefined

- uncertainties are ignored
- how individual radionuclides are considered is not clear
- explicit redundancy of barriers (for conservatism) has not been considered.

STATUS: Agreed

BWIP RESPONSE: The derivation of a preliminary seal subsystem performance requirement based on performance assessment of the complete repository system and the 10 CFR 60 performance objectives will be described in Section 10.8 of the SCP. Groundwater flow up the repository shafts was calculated using an idealized network flow model. The roles of dispersion and diffusion and the consideration of individual radionuclides in this analysis will be described. The "FLOW" in SCR Figure 10-16 does not refer to a complete computer code but rather to groundwater flow in general. Elements of conservatism and uncertainty in the analysis will be noted.

ITEM REFERENCE: Section 10.3, page 10-13, paragraph 3, item 2

GAI COMMENT: "The seal design(s) are not apparent. For example, how will disturbed zones or boreholes be sealed? Why have different types of "structural" barriers (e.g., concrete and basalt blocks with mortared joints) been mixed in the same design? The dimensions presented are unjustified (e.g., for the sand-clay plug, see SCR Figure 10-14b), and in some cases may be outdated (e.g., tunnel diameter of 23 feet). Although used interchangeably (see SCR Figure 10-14b), compressed bentonite blocks and mortared basalt blocks are very different. How will contact grouting occur?"

STATUS: Agreed

BWIP RESPONSE: Preconceptual design descriptions of seals for shafts, boreholes, and the openings of the underground facility, as well as for backfill, will be presented in Section 10.8 of the SCP. The ungraded conceptual design is scheduled for completion in CY 1984. Due to inherent difficulty in the analysis of this damage, accurate characterization of the damaged rock zone will require field testing. In situ rock mechanical and hydraulic field testing in the Exploratory Shaft will contribute significantly to damaged rock zone characterization. The SCR Figures 10-17 and 10-18 no longer reflect BWIP planning and will not appear in the SCP.

CHAPTER 10 (REPOSITORY DESIGN)

ITEM REFERENCE: Section 10.3, page 10-13, paragraph 3, item 3

GAI COMMENT: "How will long term seal performance be assessed? Will there be any seal demonstration, such as a shaft seal demonstration in the exploratory shaft, and if so when (e.g., prior to initial license application)? Even so, the long-term performance will be difficult to assess."

STATUS: Agreed

BWIP RESPONSE: Long-term seal performance, specifically, the potential degradation in seal performance over the lifetime of the repository (thousands of years), will be assessed through laboratory testing and long-term performance modeling of seal materials. Design testing of repository seals and backfill is required by 10 CFR 60 only after the start of repository constructon (see 10 CFR 60 Section 60.142). While current plans do not include full-scale development testing of complete seals in situ prior to construction license application, the BWIP seal field testing program is currently being reevaluated in view of the potential value of such testing. A statement to this effect will be added to Section 10.8.2 of the SCP.

CHAPTER 11 (WASTE PACKAGE)

ITEM REFERENCE: Section 11.3, page 11-4, paragraph 1

GAI COMMENT: "In GAI's opinion, there are several critical issues with regard to the DOE waste package effort as presented in the SCR, specifically in the following areas:

- The types of wastes that may be disposed of in a repository at Hanford"

STATUS: Agreed

BWIP RESPONSE: Any waste form considered by the DOE for disposal in the NWRB will be fully tested under site-specific conditions before it is accepted for disposal. Waste forms presently planned for hydrothermal testing include commercial and defense high-level waste borosilicate glass, as well as spent fuel. Testing of radioactive borosilicate glass and actual spent fuel was begun in October 1983 (Section 11.4.5 of the SCP). The DOE is currently addressing the problem of defining reference transuranic (TRU) waste forms. As soon as these reference materials are defined, the BWIP will initiate hydrothermal interaction testing of these waste forms under site-specific conditions to determine their suitability for disposal in a repository at the Hanford Site.

ITEM REFERENCE: Section 11.3, page 11-4, paragraph 1

- "The absence of relevant waste form data"

STATUS: Agreed

BWIP RESPONSE: The SCP will include current data from continuing site-specific basalt/groundwater (Section 6.4.3) and waste/barrier/basalt groundwater (Section 11.4.5) hydrothermal interaction experiments. The data will be reported from experiments that are being performed using Umtanum and Cohassett flow basalt and synthetic Grande Ronde Basalt groundwater. The experiments are being performed over a temperature range of 100° to 300°C (the expected repository temperature range) and pressures of 30 MPa (the maximum possible repository pressure) to simulate the range of actual repository conditions. In October 1983, hot cell experiments, using radioactive borosilicate glass and actual spent fuel, was initiated to assess the effects of radiation on waste package component interactions and waste form performance (Section 11.4.5).

CHAPTER 11 (WASTE PACKAGE)

ITEM REFERENCE: Section 11.3, page 11-4, paragraph 1

"• The predictions of the corrosion environments that packages may be exposed to [as a result of possible overestimates of backfill resaturation time]."

STATUS: Disagreed

BWIP RESPONSE: The current reference waste package conceptual design provides a canister corrosion allowance based on the conservative assumption that backfill saturation with groundwater occurs immediately upon repository closure.

The "backfill resaturated" Period IV reference in Figure 11-12 of the SCR will be deleted.

ITEM REFERENCE: Section 11.3, page 11-4, paragraph 1

"• The removal of waste package design conservatism by DOE [due to the absence of relevant data on waste package component performance under site specific conditions]."

STATUS: Disagreed

BWIP RESPONSE: It is true that there are insufficient materials performance data to substantiate final design of the waste package. The estimates used to assess preliminary design requirements were based on conservative interpretation of the available data. Applying a greater or lesser degree of conservatism in waste package design would have virtually no influence on the suitability of the repository site. In the case of the waste package conceptual design, the greater portion of the canister thickness is for structural support rather than for a corrosion allowance. The conservatism of the structural criteria (by a factor of about 4) provides an added thickness margin for corrosion. Establishing the appropriate conservatism to apply to design must be based not only on the magnitude of uncertainty of information but also on the effect of the uncertainty on performance. These factors were used to evaluate the adequacy of conservatism applied to waste package conceptual design.

CHAPTER 11 (WASTE PACKAGE)

ITEM REFERENCE: Section 11.3, page 11-4, paragraph 1

"• The unsupported assumptions used by DOE to support waste package development"

STATUS: Agreed

BWIP RESPONSE: The waste package preliminary performances analyses considered the following processes:

- resaturation of backfill
- corrosion of canister and resulting containment time
- waste form dissolution
- radionuclide transport through backfill and near-field host rock
- radionuclide sorption in backfill and near-field host rock.

The performance assessment was based on the data available at that time and assumptions that were judged to be conservative for the processes listed above. These analyses revealed the more important processes and parameters and provided guidance for the present ongoing research programs. These programs are now providing and will continue to provide an expanding data base for use in design and performance analyses.

CHAPTER 12 (PERFORMANCE ASSESSMENT)

ITEM REFERENCE: Section 12.1, page 12-1, paragraph 3, item 1

GAI COMMENT: "Significant apparent uncertainties are associated with all existing numerical groundwater flow models of the Pasco Basin and reference repository location. The numerical sophistication of the numerical codes is high, but the most significant uncertainty is in the validity of the conceptual groundwater flow model. These uncertainties include:

- uncertainties in the existing data due to testing methodology
- uncertainties due to natural variability of critical hydrogeologic and geochemical parameters
- uncertainties due to largely unknown boundary conditions
- uncertainties in the modeling which couples thermomechanical effects on mass tranpsort."

STATUS: Agreed

BWIP RESPONSE: Groundwater traveltimes were calculated in the SCR for the purpose of a preliminary evaluation of the value of detailed site characterization. Neither the data nor the extent of analysis presented in the SCR are adequate for licensing purposes. The groundwater traveltimes may be overestimated or underestimated. In spite of deficiencies and uncertainties, the BWIP believes sufficient confidence exists to proceed with detailed site characterization. Work is currently under way to estimate the impact of data uncertainty on groundwater traveltime predictions. The SCP will clarify the above points in Section 12.4.1.

ITEM REFERENCE: Section 12-1, page 12-2, item 1

GAI COMMENT: "DOE recognizes major uncertainties in the data base and numerical models and presents a methodology based on systematic and conservative analysis that provide bounding estimates of radionuclide migration. In GAI's opinion, this is unlikely to provide a clear and defensible analysis of site performance, and a more rigorous approach to uncertainty analysis would be preferred."

STATUS: Agreed

BWIP RESPONSE: The wording in the SCR was intended to convey the intent of pursuing a rigorous uncertainty analysis to the degree possible as well as performing conservative, bounding calculations where necessary or appropriate.

CHAPTER 12 (PERFORMANCE ASSESSMENT)

The intent of the SCR is supported by the following statement from the Draft Site Characterization Analysis* (DSCA): "The staff expects that a classic probabilistic risk analysis (based on rigorous probability determinations) of the repository may be neither possible nor necessary, and that determinations of compliance with the numerical criteria may depend in part on expert judgement for items such as conceptual models, scenarios, scenario probabilities, estimated parameter values, boundary locations, and uncertainties. For example, it is expected that numerical models will be used to estimate the consequences of specific scenarios, and will take into account the uncertainties associated with the behavior of the repository within those scenarios. However, it is expected that estimations of the probabilities of the occurrence of the scenarios, and the uncertainties associated with the data pertaining to the scenarios, will be based in part on expert judgement." (DSCA, page 9-4). Section 12.2.1 of the SCP will be expanded to explain this approach in more detail.

ITEM REFERENCE: Section 12.1, page 12-2, paragraph 1, item 2

GAI COMMENT: "The approach to comprehensive risk assessment outlined has not been adequately followed to date by DOE. Model studies are neither comprehensive nor demonstrably conservative, and the conclusions on radionuclide releases are not adequately represented in the context of the stated uncertainties in the models and data. More confidence in the numerical results is implied than is demonstrated by DOE."

STATUS: Agreed

BWIP RESPONSE: There are some strong elements of conservatism in the studies summarized in the SCR. Most of the studies were designed to provide a "best estimate" of conditions from the standpoint of the regulatory guidance available at the time. Section 12.2.1 of the SCP will be rewritten to state that one of the principal applications of long-term performance analyses is to guide the site characterization effort so as to reduce uncertainties.

ITEM REFERENCE: Section 12.1, page 12-2, paragraph 1, item 3

GAI COMMENT: "The results of performance assessment studies to date are based on DOE's existing numerical groundwater model. Until such time that a unique

*U.S. Nuclear Regulatory Commission, Draft Site Characterization Analysis of the Site Characterization Report for the Basalt Waste Isolation Project, NUREG-0960, 2 Volumes, Washington, D.C. (March 1983).

groundwater model can be defensibly developed by measured data, performance analyses should include a range of groundwater models incorporating the various identified components of uncertainty."

STATUS: Agreed

BWIP RESPONSE: Development of a defensible conceptual groundwater model is necessary input for numerical models in performance assessment. It was thought that this point was made in the SCR. The relationship between the conceptual model and the performance assessment models will be explicitly detailed in Section 12.3 of the SCP.

ITEM REFERENCE: Section 12.1, page 12-2, paragraph 1, item 3

GAI COMMENT: "Since performance analyses will be required to defend the requirement or adequacy of the data base at the time of a license application, and presumably prior to this time, erroneous conclusions may have been drawn by using overly optimistic estimates of data."

STATUS: Open

BWIP RESPONSE: In the traveltime calculations GAI performed for the DSCA, extreme values of individual measurements were used without evidence that such values were really extensive. Such a procedure is overly pessimistic and somewhat speculative. The GAI analysis should be the subject of detailed discussions with BWIP.

ITEM REFERENCE: Section 12.3, page 12-7, paragraph 2

GAI COMMENT: "Because performance assessment is the means by which DOE will predict whether or not the site and design will protect and maintain the health, safety, and well being of the public, it is GAI's opinion that repository performance analysis must be comprehensive and technically unassailable."

STATUS: Agreed

BWIP RESPONSE: The BWIP agrees. This philosophy reflects BWIP beliefs and will be reflected in the SCP.

ITEM REFERENCE: Section 12.3, page 12-7, paragraph 3

GAI COMMENT: "While DOE indicates that resolution of performance issues will be achieved using predictive models for groundwater flow and radionuclide transport and that proof of compliance with the technical criteria and

regulations will depend on the reliability of numerical models to predict system performance, it is GAI's opinion that, although this general philosophy is appropriate, DOE has not adequately demonstrated in the SCR how certain key elements of the modeling process will be evaluated. Specifically, GAI is concerned with DOE's approach to predictive modeling, defining release scenarios and treating uncertainties, as discussed below."

STATUS: Agreed

BWIP RESPONSE: Section 12.2 of the SCP will be expanded to explain how key elements of the modeling process will be evaluated.

ITEM REFERENCE: Section 12.3, page 12-7, paragraph 4

GAI COMMENT: "In the SCR, DOE lists a large number of potential release scenarios, but presents no discussion of which are plausible for the Hanford Site or their probability of occurrence. In GAI's opinion, the approach to comprehensive risk assessment outlined in the SCR has not been followed through to date by DOE because a defensible identification of plausible disruptive event scenarios for the Hanford Site has not been completed. Also, events which may damage the waste package and/or the engineered barrier system after the repository is decommissioned, and their effects on release rates, are not considered by DOE. Rather, the emphasis is entirely on disruptive events that may affect the transport of waste through the geologic system."

STATUS: Agreed

BWIP RESPONSE: Detailed description of the rationale and framework of the methodology utilized by the BWIP to identify, characterize, and select disruptive scenarios will be described in Section 12.2 of the SCP. Results achieved to date in terms of disruptive scenarios selected for detailed parametric and release risk consequence analysis will be noted. The methodology used to identify potential disruptions to isolation performance of a Hanford Site repository has considered (1) potential uncertainties and omissions of site characterization, (2) dynamics of natural systems, (3) perturbations of baseline conditions due to construction and operation of a repository, and (4) potential disruptions resulting from human intrusion.

ITEM REFERENCE: Section 12.3, page 12-8, paragraph 1

GAI COMMENT: "While DOE recognizes that major uncertainties exist in both the data base and in the use of numerical models, these uncertainties are not explicitly discussed nor is an attempt made to quantify them. In fact, DOE implies that a rigorous application of uncertainty analysis methods cannot be

used to demonstrate compliance. It is GAI's opinion that the SCR does not use conservative parameters and assumptions. Further, in GAI's opinion, the alternative methodology presented in the SCR, i.e., that of 'systematic and conservative analyses that provide bounding estimates of radionuclide migration', will not provide a clear and defensible analysis of site performance unless:" For the following items also see BWIP reponses to Section 12.1, page 12-2, item 1 and Section 12.1, page 12-2, item 2.

"• The range of data used is demonstrated to be representative of all field measurements"

STATUS: Open

BWIP RESPONSE: The precise intent of this statement is not completely clear. While the BWIP agrees with the statement in general terms, if it includes the use of extreme values of hydraulic conductivity without evidence of spatial correlation the BWIP would disagree. Further clarification is needed from GAI.

ITEM REFERENCE: Section 12.3, page 12-8, paragraph 1

"• The spatial variation of discrete data points is quantified"

STATUS: Agreed

BWIP RESPONSE: Sections 12.4.1 and 12.4.5 of the SCP will address such topics in some detail.

ITEM REFERENCE: Section 12.3, page 12-8, paragraph 1

"• All credible conceptual geological/hydrological models are evaluated on a common basis, using alternative interpretations of the available data"

STATUS: Agreed

BWIP RESPONSE: The BWIP is in strong agreement on this point. Plans for accomplishing this will be addressed in Chapter 16 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-8, paragraph 1

"• The uncertainties or 'conservatisms' in the mathematical models are explicitly defined and evaluated, i.e., the effect of a given parameter on the results should be determined."

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STATUS: Agreed

BWIP RESPONSE: The BWIP is also in complete agreement on this point. This is a major objective of the sensitivity studies underway or planned. Additional discussions of such sensitivity studies will be incorporated into Sections 12.3 and 12.4 and also Chapter 16 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-8, paragraph 2

GAI COMMENT: "DOE presents methods by which these points can be addressed, including code benchmarking and verification for numerical models and statistical techniques for data analysis. The extent to which these techniques have been used is not, however, specified in the SCR."

STATUS: Agreed

BWIP RESPONSE: The listing of computer codes in Chapter 12 presents a brief discussion of the codes that have been used in previous BWIP studies and codes that may be used in performance assessment. This list will be reduced in the SCP to reflect primary candidates. A more rigorous discussion of the selection, evaluation, testing (verification, benchmarking, and validation), and incorporation of those codes into the system model will also be documented in Chapters 12 and 16 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-8, paragraph 2

GAI COMMENT: "In particular, the performance analysis results are determined using one geologic/hydrologic interpretation (conceptual model), with relatively small differences in the data inputs."

STATUS: Disagreed

BWIP RESPONSE: Substantially different far-field conceptual models were used in the various performance assessment precursors summarized in Section 12.4.1 of the SCR. The hydraulic head values in the Grande Ronde Basalt were assumed to be much higher than later values measured for most of the far-field studies. This assumption had significant impact upon the vertical head gradient and, hence, streamline orientation and traveltimes. The BWIP does agree (and it will be acknowledged in the SCP) that an adequate conceptual model of the basalt groundwater flow system has not yet been developed. Reasonable alternative conceptual models based upon up-to-date data need to be developed and evaluated on a common basis.

CHAPTER 12 (PERFORMANCE ASSESSMENT)

ITEM REFERENCE: Section 12.3, page 12-8, paragraph 3

GAI COMMENT: "In GAI's opinion, a rigorous approach to uncertainty analysis is a more comprehensive and technically defensible approach to predicting repository performance. While parametric and sensitivity analyses can certainly provide boundary solutions, the extent to which these solutions are conservative may not be readily apparent. It is also noted that the methodology presented by DOE has not been applied to analyses completed to date and presented in the SCR."

STATUS: Open

BWIP RESPONSE: The BWIP suspects that the major difference between GAI and the BWIP on this point is a matter of semantics. The BWIP does intend to apply uncertainty analysis methods and techniques in a vigorous manner. The word "rigorous" can mean sufficient data in space and time will be obtained to completely determine various statistical parameters. It can be envisioned that the cost/benefit ratio of such an approach could sharply decline (or even become negative) prior to reaching what some statisticians would call "rigorous" levels. While the extent of conservatism of some solutions may not be readily apparent, if a consensus (or near consensus) is reached in the responsible technical community that the solutions are conservative, then closure will have been achieved. While it would be attractive, in principal, to eliminate judgment and opinion via a fully statistical approach, it is BWIP opinion that the data requirements would be prohibitive on the one hand and not cost effective on the other. The BWIP believes, from reviewing the GAI comments as a whole, that there is no substantial disagreement on this point; however, additional clarification and discussion with GAI is needed to assure that this is indeed the case.

ITEM REFERENCE: Section 12.3, page 12-8, paragraphs 4 and 5

GAI COMMENT: "However, the information presented in the SCR does not clearly address several important issues:

- Which computer codes will be used by DOE in its system model for performance analyses of the Hanford site?
- What steps are being taken to validate those models to be used?
- What rules will be applied to convert field data to system model data?"

STATUS: Agreed

CHAPTER 12 (PERFORMANCE ASSESSMENT)

BWIP RESPONSE: An expanded discussion of the past use of code verification and benchmarking and the use of statistical techniques will be added to Section 12.3 of the SCP. Plans to show how uncertainty will be tracked from data gathering throughout analyses will be addressed in Chapter 16 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-8, paragraph 6

GAI COMMENT: "DOE indicates that this work is ongoing. The performance analyses presented in the SCR have involved only a very small number of the codes listed. It is GAI's opinion that the SCR should indicate:

- The type of analysis and level of detail that DOE believes is necessary for each step of the performance analysis
- The codes which are best suited to dealing with these defined steps
- The system model preferred by DOE and likely to be used for performance assessment."

STATUS: Agreed

BWIP RESPONSE: An expanded discussion of the key chemical and physical processes, their role in the various geometrical regions, and candidate codes for each will be added to Section 12.3 of the SCP. Plans for testing, documenting, and integrating the chosen codes into a system model will be discussed in Chapter 16 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 1, item 1

GAI COMMENT: "(1) Regarding the far-field performance assessment (hydrologic only) presented by DOE, it is GAI's opinion that there are several points of concern regarding DOE's interpretation of the groundwater system at Hanford:

- The conceptual model presented in the SCR does not account adequately for the effects of structural and stratigraphic discontinuities that are recognized (by DOE) in the Columbia River Basalts. The oversimplification of the hydrogeologic system in the SCR makes the validity of DOE's numerical model so uncertain that little confidence can be placed on current estimates of groundwater traveltime."

STATUS: Disagreed

BWIP RESPONSE: The conceptual model does lack definition of the effects of structural and stratigraphic discontinuities. The impact of such features

upon groundwater traveltimes and radionuclide fluxes in terms of the proposed regulatory standards at the accessible environment is not, in the opinion of the BWIP, sufficient to make the results of the numerical model "so uncertain that little confidence can be placed upon current estimates of groundwater traveltime."

Low hydraulic head gradients and the direction of the vertical hydraulic head gradient near and in the RRL contribute to long traveltimes to major structural features such as the Gable-Umtanum anticline. Where stratigraphic or structural features might create higher hydraulic conductivities and shorter traveltimes, they would also create larger effective porosities and longer traveltimes.

It is the opinion of the BWIP that a fair degree of confidence can be placed in the ranges of estimates for far-field traveltimes as presented in the SCR in terms of how they compare to the NRC-proposed standard of 1,000 yr minimum traveltime from the disturbed zone to the accessible environment. Additional explanation and rationale will be incorporated into Section 12.4.1 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 2, item 2

GAI COMMENT: "There are large uncertainties in the value of hydraulic parameters presented in the SCR, due to

- no measured values of vertical hydraulic conductivity or matrix diffusion"

STATUS: Agreed

BWIP RESPONSE: Measured values of vertical hydraulic conductivity are lacking in the SCR. The latest information on measured vertical hydraulic conductivity values will be presented in Chapter 5 of the SCP. The basis for the latest estimates of vertical hydraulic conductivities of modeling proposed will be explained in some detail in Section 12.4 of the SCP. The need or lack of need for field measurements of matrix diffusion will be addressed in Section 12.4.3 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 2, item 2

"- only one measure of effective porosity and dispersivity"

STATUS: Agreed

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BWIP RESPONSE: The lack of field measurements of effective porosity increases uncertainty. It is well known that dispersivity values are highly scale dependent, becoming larger as the measurement distance is increased. The impact of limited field measurements will be included in the expanded discussion on uncertainty in Section 12.4.5 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 2, item 2

"- Only single-hole tests and no large-scale tests"

STATUS: Agreed

BWIP RESPONSE: Large-scale tests are planned and will help to reduce uncertainties (see Chapters 5 and 13).

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 2, item 2

"- large non-systematic variations in measured parameter values from single-hole tests"

STATUS: Disagreed

BWIP RESPONSE: Such variations strongly suggest a low spatial correlation in the measured values compared to the size of the domain being modeled. If the range of correlation is small compared to the modeled domain (in this case, 10 km (6.2 mi)) and sufficient data exist to properly calculate a mean, then that mean would be the correct value to use in calculating the "best estimate" of groundwater traveltime. This topic will be addressed in some detail in Section 12.4.1 and 12.4.5 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 2, item 2

"- complex distribution of measured hydraulic data."

STATUS: Agreed

BWIP RESPONSE: The distribution of head values in the Cold Creek Syncline is less complex than for the Pasco Basin as a whole, as expected. All data suggest relatively low hydraulic gradients in the vicinity of the RRL. Such low apparent gradients make determination of hydraulic head trends more difficult. Additional head data is needed but is not expected to dramatically change the range of traveltime estimates.

CHAPTER 12 (PERFORMANCE ASSESSMENT)

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 2, bullet 3

GAI COMMENT: "Existing models presented by DOE are uncalibrated because of insufficient hydraulic head data, and thus the predicted results cannot be considered defensible. Reference to other modeling efforts by DOE contractors to support the prediction of long groundwater travel times is indefensible since all modeling has been done with the same basic data set."

STATUS: Disagreed

BWIP RESPONSE: While the quantity and distribution of head data presented in the SCR are insufficient to produce what the BWIP would consider a satisfactorily calibrated model, categorizing the range of predicted traveltimes as "indefensible" based upon the lack of head data goes too far. The range of assumed and interpreted values in the various far-field studies was rather large, ranging from near-vertical groundwater movement in the Pacific Northwest Laboratory (PNL) study to near-horizontal groundwater movement in the most recent Rockwell Hanford Operations (Rockwell) study. There were also substantial differences in average hydraulic conductivity values. While such differences indicate less than precise knowledge of the groundwater system, the fact that all calculated traveltimes were much longer than the NRC proposed standard is, in the opinion of the BWIP, signficant. This is not to say that sufficient confidence exists for licensing purposes, but detailed site characterization appears to be warranted. Section 12.4.1 will be rewritten in the SCP to add more recent analyses including a preliminary uncertainty analysis.

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 3

GAI COMMENT: "The SCR does not include any quantitative results of sensitivity studies of groundwater flow of the Hanford site."

STATUS: Agreed

BWIP RESPONSE: Some sensitivity analyses are presented in one of the SCP Chapter 12 references.* Sensitivity analyses and alternative conceptual models are needed. Expanded discussions of far-field sensitivity analysis

*King, I. P., D. B. McLaughlin, W. R. Norton, R. G. Baca, and R. C. Arnett, Parametric and Sensitivity Analysis of Waste Isolation in a Basalt Medium, RHO-BWI-C-94, Resource Management Associates for Rockwell Hanford Operations, Richland, Washington (1981).

will be included in Chapters 12 and 16 of the SCP. Expanded discussions of alternative conceptual models will be added to Chapters 5 and 12 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 3

GAI COMMENT: "DOE planning documents (cited in SCR Chapter 13) indicate that the current level of predictive accuracy for critical hydraulic parameters is very low (e.g., 5 orders of magnitude for vertical hydraulic conductivity)."

STATUS: Agreed

BWIP RESPONSE: The document cited by GAI does indicate that the current level of predictive accuracy for some critical hydraulic parameters is low. These estimates of predictive accuracy were based on engineering judgment, and mainly pertained to parameters determined from small-scale borehole tests. In the modeling studies performed by the BWIP, parameter estimates defined on a scale larger than a borehole test are required. Unless these parameters are perfectly correlated on the scale of the domain being modeled, estimates made on the large scale are more certain than estimates made on the borehole-test scale. Considering the nature of the hydrogeologic parameters used in the BWIP modeling studies, perfect correlation on a large scale (e.g., Cold Creek Syncline) is impossible.

ITEM REFERENCE: Section 12.3, page 12-9, paragraph 3

GAI COMMENT: "Relatively simple parametric studies completed by GAI for the NRC's draft SCA indicate that groundwater travel times from less than 100 to over 100,000 years are possible using the parameter values presented by DOE in the SCR."

STATUS: Disagreed

BWIP RESPONSE: The simple parametric studies presented in the DSCA use extreme values of hydraulic conductivity as if they represented the mean value over the entire distance to the accessible environment. Without evidence of spatial correlation of such extreme values, the BWIP believes such an approach is incorrect and not a meaningful estimate of the range of traveltimes. The BWIP has recently completed a Monte Carlo analysis where the horizontal hydraulic conductivity was varied according to distribution determined from Grande Ronde Basalt flow top hydraulic conductivity measurements. This study will be summarized in Secton 12.4.1 of the SCP.

CHAPTER 12 (PERFORMANCE ASSESSMENT)

ITEM REFERENCE: Section 12.3, page 12-10, paragraph 1

GAI COMMENT: "While DOE recognized (i) the need for a more complete hydrologic characterization of the basalts, (ii) the uncertainties in the existing conceptual model, and (iii) the data deficiencies, a discussion of the impact of these uncertainties is not included in the conclusions drawn on site performance, and DOE states that a high degree of confidence can be placed on predicted groundwater travel times. GAI's opinion is that unless reliable boundary conditions and hydraulic parameters are determined during site characterization and until a defensible conceptual groundwater model is developed, little confidence can be attached to performance assessment results from any numerical code at this time."

STATUS: Agreed

BWIP RESPONSE: While the BWIP agrees with some of the GAI statements, it should be recalled that the primary purpose of the SCR performance assessment was not to develop a single set of defensible predictions of traveltime, but to develop confidence that the traveltime is greater than 1,000 yr. After reviewing the comments by the NRC, GAI, and others on the SCR, the BWIP continues to believe that a basis exists for confidence that the final traveltimes will significantly exceed the proposed standard. However, the word "considerable" on page 12.4-53, paragraph 2, of the SCR, may be misleading and will be changed to "significant." Also, wording in Sections 12.4.1 and 12.4.5 will be changed to focus upon the basis for detailed site character- ization and to avoid the impression of final justification of the basalt site for repository selection.

ITEM REFERENCE: Section 12.3, page 12-9, item 2 and following page 12-10

GAI COMMENT: "Therefore, GAI does not consider this assumption to be conservative."

STATUS: Agreed

BWIP RESPONSE: Detailed analyses of waste package degradation and failure have not been completed to date. Therefore, the assumption cannot be justified as conservative or nonconservative at this time. Current BWIP plans are to design waste packages that will provide for substantially complete containment for up to 1,000 yr with a high reliability (to be determined). In the SCP, the assumption of all waste packages failing simultaneously at 1,000 yr has been modified to include a failure distribution as a function of time. This failure model will be discussed in detail in Section 12.4 of the SCP.

CHAPTER 12 (PERFORMANCE ASSESSMENT)

ITEM REFERENCE: Section 12.3, page 12-10, paragraph 3

GAI COMMENT: "The conclusions made by DOE concerning the retardation of certain nuclides based on high sorptive properties of basalt is therefore not, in GAI's opinion, yet substantiated."

STATUS: Agreed

BWIP RESPONSE: There are uncertainties remaining about the sorption behavior of certain key radionuclides. The SCP, Section 6.5.3, and Chapter 15 will discuss current data and plans, respectively, concerning radionuclide sorption and its associated uncertainties.

ITEM REFERENCE: Section 12.3, page 12-10, paragraph 4

GAI COMMENT: "GAI considers that the results of this work are of limited interest."

STATUS: Agreed

BWIP RESPONSE: This discussion will be deleted and replaced with more realistic and up-to-date results for the SCP.

ITEM REFERENCE: Section 12.3, page 12-10, paragraph 6

GAI COMMENT: "..., it is GAI's opinion that this cannot be considered as a comprehensive performance analysis with respect to compliance with the EPA standard. It is not clear, for example, whether any radionuclides other than C-14 were evaluated."

STATUS: Agreed

BWIP RESPONSE: It is true that only C-14 results were presented in the SCR. However, other radionuclides were analyzed in other studies (e.g. Tc-99 and I-129), but only C-14 was chosen to illustrate the results in the SCR. A discussion of the relative behavior of more than one radionuclide will be included in SCP Sections 12.4.2 and 12.4.3.

CHAPTER 12 (PERFORMANCE ASSESSMENT)

ITEM REFERENCE: Section 12.3, page 12-11, paragraph 1, item 1

GAI COMMENT: "It has not been demonstrated that either a 1,000 year package life or a fractional release rate of 10^{-5} per year is achievable."

STATUS: Agreed

BWIP RESPONSE: These requirements must be met for a repository as stated in NRC Draft 10 CFR 60 and were simply used as assumptions. The SCP Chapters 11 and 15 will discuss, in detail, waste package performance. Chapter 16 of the SCP will discuss plans for detailed modeling of waste package degradation.

ITEM REFERENCE: Section 12.3, page 12-11, paragraph 1, item 2

GAI COMMENT: "Groundwater traveltimes to the accessible environment may be significantly overestimated."

STATUS: Agreed

BWIP RESPONSE: Traveltimes may have been overestimated in the SCR, although they may also have been underestimated. Uncertainties in the hydrologic properties used to calculate traveltimes must be quantified. The BWIP is currently addressing this problem. Section 12.4.5 of the SCP will provide a detailed discussion.

ITEM REFERENCE: Section 12.3, page 12-11, paragraph 1, item 3

GAI COMMENT: "Groundwater flow paths are specific to the model and data used."

STATUS: Agreed

BWIP RESPONSE: The flow paths computed for the near-field zone typify a groundwater flow regime in a multilayer geology with an alternating sequence of confining and transmissive hydrologic units. These results are specific to the data used but independent of the numerical model used. This representation is consistent with the data conceptual model presented in Chapter 5 of the SCR. Alternative conceptual models will be considered in future repository performance analyses.

CHAPTER 12 (PERFORMANCE ASSESSMENT)

ITEM REFERENCE: Section 12.3, page 12-11, paragraph 1, item 4

GAI COMMENT: "Releases of C-14 across the 10 km reference boundary (equal to zero in the results presented) are dominated by the long travel times; alternative groundwater models may be shown to provide more critical releases."

STATUS: Disagreed

BWIP RESPONSE: For a conceptual model consisting of a multilayer geology with an alternating sequence of confining and transmissive hydrologic units, the fastest and most efficient transport path to the accessible environment is along the single flow top. For other conceptual models, for example, a multilayer system with high vertical hydraulic conductivity, the contaminant plume would show significantly greater vertical spreading because of buoyancy driving forces, diffusion, and dispersion. In effect, the arrival of the C-14 at the 10 km (6.2 mi) boundary would be delayed. In addition, C-14 is not considered to be a problem radionuclide (relative to compliance with EPA standards) because of (1) its half-life of 5,730 yr, (2) low initial inventory, and (3) high carbonate concentrations in the groundwater. Moreover, precipitation reactions of a carbonate form may retard the migration of C-14. The BWIP is currently evaluating potential releases of other radioisotopes, such as I-129, that may be more significant. These results will be presented in Section 12.3 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-11, paragraph 2

GAI COMMENT: "...conservatisms in the work have not been adequately demonstrated or supported."

STATUS: Agreed

BWIP RESPONSE: Discussion of long-term performance analysis results in Section 12.4 of the SCP will more carefully detail the areas of conservatism and the justification of modeling assumptions.

ITEM REFERENCE: Section 12.3, page 12-11, paragraph 2

GAI COMMENT: "It is GAI's opinion these two statements are inconsistent."

STATUS: Agreed

CHAPTER 12 (PERFORMANCE ASSESSMENT)

BWIP RESPONSE: The inconsistency will be corrected in SCP. The BWIP agrees that uncertainties remain and these uncertainties will be discussed in SCP Section 12.4.5 of the SCP.

ITEM REFERENCE: Section 12.3, page 12-11, paragraph 3

GAI COMMENT: "It is apparent that release from the engineered system may be required to be treated much more carefully if it is demonstrated that the amount of credit that can be taken from the geologic setting is limited (e.g., due to data or model uncertainties)."

STATUS: Agreed

BWIP RESPONSE: Section 12.4.2 of the SCP will provide details of one approach to estimating engineered system releases.

CHAPTER 13 (SITE ISSUES AND PLANS)

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 2

GAI COMMENT: "In the environmental, land-use and socioeconomic area, it is GAI's opinion that DOE has failed in the SCR to acknowledge at least four site issues:

(1) Potential for radioactive contamination of public roads due to the high levels of radioactive contamination measured in the surface soil and vegetation of the RRL;"

STATUS: Agreed

BWIP RESPONSE: The Status and Plans section for work element S.2.1 in the SCP will be expanded to include new data and plans to answer this comment (see Item Reference 9.1, page 9-1, paragraph 3).

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 2

"(2) the appropriateness of designating portions of the Arid Lands Ecology Reserve to be included in the RRL;"

STATUS: Agreed

BWIP RESPONSE: There are no plans for surface disruption of the Arid Lands Ecology Reserve (see Item Reference 9.1, page 9-1, paragraph 3).

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 2

"(3) The absence of accounting for the potential public risks and social burdens associated with the transportation activities associated with the development and operation of a repository;"

STATUS: Agreed

BWIP RESPONSE: The Status and Plans section for work element S.2.1 in the SCP will be expanded to include plans to address this comment in the Environmental Report submitted with the License Application (see Item Reference, Section 9.1, page 9-1, paragraph 3).

CHAPTER 13 (SITE ISSUES AND PLANS)

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 2

"(4) the absence of accounting of the potential social burdens of the temporary work force associated with constructing a repository."

STATUS: Agreed

BWIP RESPONSE: The Status and Plans section for work element S.2.1 (page 13.3-84 in the SCP) will be expanded to include new data and plans to address this comment in the Environmental Report submitted with the License Application.

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 3, item 1

GAI COMMENT: "The number of large-scale multiple-hole tests is considered inadequate to determine representative hydraulic parameters, particularly horizontal and vertical hydraulic conductivity."

STATUS: Agreed

BWIP RESPONSE: Plans for extensive, large-scale tests will be given in the Drill and Test Plan and discussed in Chapter 13 of the SCP.

ITEM REFERENCE: Section 13.3, page 13-3, paragraph 1

GAI COMMENT: "In GAI's opinion, a set of issues should be identified whose resolution is demonstrated to be both necessary and sufficient for site selection and subsequent licensing, as pertaining to site geology, hydrogeology, surface hydrology, climatology/meteorology/air quality, and environmental/land-use/socioeconomic characteristics. A comprehensive set of work elements should then be identified which, if completed, are both necessary and sufficient to demonstrably resolve these identified issues. Work (both on-going and planned) in this area should then be related solely to the efficient completion of these work elements. Other issues, work elements, or project activities must be considered as superfluous."

STATUS: Disagreed

BWIP RESPONSE: The objective of the DOE is to show the NRC that it can satisfy the 10 CFR 60 criteria. Therefore, the organization of the criteria determined the organization of the work elements. Issues are transient and, therefore, are not good for identifying traceable work elements. The new issues identified by GAI could become work elements associated with 10 CFR 60 criteria or could be incorporated into existing work elements.

CHAPTER 13 (SITE ISSUES AND PLANS)

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 2

GAI COMMENT: "Regarding site issues, it is GAI's opinion that quantification of the variability of the stratigraphy and lithology of the candidate horizons (especially thickness of the dense zone) is a site geology issue that is not given sufficient importance by DOE."

STATUS: Agreed

BWIP RESPONSE: Plans for additional testing and analysis of this variability will be discussed in the SCP. The Drill and Test Plan will be referenced.

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 2

GAI COMMENT: "In the area of site hydrogeology, it is GAI's opinion that determination of a singular, technically defensible conceptual model of groundwater flow is the principal site hydrology issue that DOE has not given sufficient importance."

STATUS: Agreed

BWIP RESPONSE: Discussion of alternate conceptual models and the data needed to determine and defend a single conceptual groundwater flow model will be included in Chapters 5, 12, and 13 of the SCP. The DOE feels that it is premature to identify a single model to be used for licensing purposes.

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 2

GAI COMMENT: "In the area of surface hydrology, it is GAI's opinion that the potential for and characteristics of a flash flood in the Cold Creek is the major site issue which DOE has not addressed."

STATUS: Agreed

BWIP RESPONSE: Plans to make a topographic map of the RRL on a 1- to 2-ft contour interval and to determine the need for flood mitigation structures will be described in Chapter 13 of the SCP.

CHAPTER 13 (SITE ISSUES AND PLANS)

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 3, item 2

GAI COMMENT: "Long-term measurements of hydraulic head at various locations in the Pasco Basin are not planned; permanent piezometer completions are considered necessary."

STATUS: Agreed

BWIP RESPONSE: Extensive piezometric monitoring facilities are being developed in the RRL. The Groundwater Monitoring Plan will describe the planned facilities. Chapter 13 of the SCP will describe how the facilities will be used.

ITEM REFERENCE: Section 13.3, page 13-4, paragraph 3, item 3

GAI COMMENT: "Plans for tests to define hydrogeologic boundaries are considered inadequate; large-scale multiple-hole pump tests are considered necessary."

STATUS: Agreed

BWIP RESPONSE: The facilities to perform the large-scale tests and piezometric monitoring discussed above will also be used to evaluate the significance of geologic structures near the RRL. Plans for performing these tests will be discussed in Chapter 13 of the SCP.

ITEM REFERENCE: Section 13.3, page 13-5, paragraph 1

GAI COMMENT: "Regarding project activities, it is GAI's opinion that no project activities are planned which would resolve the surface hydrology and environmental site issues which GAI has identified. Further, it is GAI's opinion that DOE's presentation of project activities does not provide a high degree of confidence that the work elements identified by DOE will be defensibly and comprehensively completed, because DOE's descriptions of the planned project activities are lacking in detail."

STATUS: Agreed

BWIP RESPONSE: More detailed planning will be provided in Chapter 13 of the SCP, the Drill and Test Plan, and the Groundwater Monitoring Plan.

CHAPTER 14 (GEOENGINEERING AND REPOSITORY DESIGN ISSUES AND PLANS)

ITEM REFERENCE: Section 14.3, page 14-6, paragraph 4

GAI COMMENT: "In GAI's opinion, a set of issues pertaining to geoengineering and repository design should be identified from SCR Chapters 4 and 10, respectively, whose resolution is demonstrated to be both necessary and sufficient for site selection and subsequent licensing. A comprehensive set of work elements should then be identified which, if completed, are both necessary and sufficient to demonstrably resolve these identified issues. Work (both ongoing and planned) in this area should then be related solely to the efficient completion of these work elements. Other issues, work elements, or project activities must be considered as superfluous."

STATUS: Disagreed

BWIP RESPONSE: In the DSCA (see reference on page 50), the NRC analyzed BWIP issues and work elements and compared them to issues developed by the NRC staff and consultants. The NRC findings in Appendix C of the DSCA were that the NRC performance issues and specific issues (technical) appear to correlate well with BWIP issues and work elements. Where the NRC has identified additional issues that were not taken into consideration by the BWIP in preparing the SCR, this input has been integrated into the plans for preparing an SCP and the substance of the NRC issue has been factored into an existing BWIP work element or issue. Furthermore, the NRC specifically has stated "the issues and work elements in the SCR have the same collective technical scope as the site issues developed by the NRC staff (DSCA, page xii, paragraph 3)" and that "the SCR lacks specific information on plans for information gathering in many areas (page xii, paragraph 3)." These details will be provided either in the SCP or by reference to specific test plans. Since the work elements in the SCR were designed to fulfill NRC requirements, which are applicable at different parts of the licensing process, they cannot be focused only on the materials/data/information defined by the Golder comments. However, a review of Chapter 14 to remove superfluous detail that does not focus on work element completion will be carried out as part of the SCP preparation.

ITEM REFERENCE: Section 14.3, page 14-7, paragraph 1

GAI COMMENT: "Regarding geoengineering and repository design issues, those which DOE has identified as being necessary to resolve before the Hanford Site can be considered suitable for licensing have not been shown to be both necessary and sufficient for determining site suitability in the areas of geoengineering and repository design. It is stated that these issues are derived from SCR Chapters 4 and 10 which deal, respectively, with geoengineering

and repository design. However, the derivation of these issues from SCR Chapters 4 and 10 is not obvious to GAI. It is apparent that the four issues identified can be simply restated as the issues of demonstrating stability of underground openings and the safe containment of radionuclides within a repository. Although these may be important issues, there may be other undefined ones, as well."

STATUS: Open

BWIP RESPONSE: The SCR clearly states that an issue is an item of technical controversy and that such issues only provide a focus for the work defined in the BWIP work elements. It is the contention of the BWIP that completion of the work elements identified in the SCR as modified in the SCP will provide necessary and sufficient information to support a license application. The BWIP work elements correlate closely with the NRC issues. The issues identified by the BWIP were never intended to serve the function envisioned by Golder Associates. The BWIP recommends discussing this matter with Golder to understand the perspective of each organization.

ITEM REFERENCE: Section 14.3, page 14-7, paragraph 1

GAI COMMENT: "For example, GAI believes that the thickness of the dense zone of the Umtanum, and the variability of that thickness and of other characteristics, is an issue affecting repository design which must be resolved."

STATUS: Agreed

BWIP RESPONSE: Chapter 13 of the SCP will include plans to determine the expected thickness of the basalt flow selected for construction of the proposed repository. The Horizon Identification Report* uses the variability of the horizon to discriminate between candidate basalt flows because this thickness is important to repository design. Additional borehole data will be obtained from the surface and from the Exploratory Shaft (ES). Work elements in Table 14-2 (pages 14.3-1 through 14.3-29 of the SCR) related to repository design will be revised to include plans which specifically address the impact of horizon thickness on repository design.

*Long, P. E. and WCC, Repository Horizon Identification Report, Draft RHO-SD-BWI-TY-001, Woodward-Clyde Consultants for Rockwell Hanford Operations, Richland, Washington (1984).

CHAPTER 14 (GEOENGINEERING AND REPOSITORY DESIGN ISSUES AND PLANS)

ITEM REFERENCE: Section 14.3, page 14-7, paragraph 1

GAI COMMENT: "Similarly, GAI believes that retrievability and personnel safety, although addressed as work elements, are issues affecting repository design which must be resolved."

STATUS: Agreed

BWIP RESPONSE: Work elements in Chapter 14 of the SCR related to retrievability and personnel safety will be reviewed to ensure that these important questions have been addressed adequately.

ITEM REFERENCE: Section 14.3, page 14-7, paragraph 1

GAI COMMENT: "Also, DOE asserts that there are no issues regarding performance confirmation. However, GAI believes that prediction of long-term performance, which must rely on modeling and cannot otherwise be confirmed, will require modeling verification and explicit incorporation of uncertainties, both in the input and in the model itself."

STATUS: Agreed

BWIP RESPONSE: Work elements R.1.13.B (pages 14.3-38 and -39) and R.1.18.D (page 14.3-42) of the SCR will be rewritten to emphasize the importance of data and model uncertainty. The testing of the computer codes (i.e., verification, benchmarking, and validation or performance confirmation) are designed to resolve or focus these uncertainties. The computer code and/or model test and documentation effort will be consistent with the philosophy outlined in Chapter 16 (i.e., Sections 16.3.2, 16.3.3, 16.4.11, 16.4.13, and 16.4.14). Narrative Section 14.4.13 will be rewritten to highlight BWIP software quality assurance activities, testing, and documentation.

ITEM REFERENCE: Section 14.3, page 14-7, paragraph 2

GAI COMMENT: "Regarding work elements, it is GAI's opinion that if those work elements represent discrete pieces of work that were to be performed, and if these 'work pieces' were defensibly and comprehensively completed, then DOE would likely have a good grasp on geoengineering and repository design. However, most of the work elements presented by DOE are unrelated to the identified issues, again suggesting that the set of issues is not comprehensive.

CHAPTER 14 (GEOENGINEERING AND REPOSITORY DESIGN ISSUES AND PLANS)

Although DOE discusses the status and plans of each identified work element, GAI believes that in many cases:

- The status is overstated, i.e., rather than simply stating what has been done to date, some work elements are explained, justified, and plans presented, all under the heading of status.

- The plans are not clear, i.e., sufficient details are presented regarding how and especially when some work elements will be accomplished.
- The interrelationships of work elements are not clear, i.e.:
  - some work elements are very similar, or even identical
  - cross referencing of some work element is incomplete
  - occasionally, reference has been made to another work element for status/plans, which then simply references back; in at least one case, a work element references itself.
- The priorities of the work elements have not been justified."

STATUS: Agreed

BWIP RESPONSE: Work element status and plans in Chapter 14 of the SCR will be upgraded to eliminate the deficiencies noted. Work element interrelationships will be clarified by rewriting and/or restructuring work elements as appropriate. Work element priorities will be noted in the appropriate SCP chapter work element descriptions.

ITEM REFERENCE: Section 14.3, page 14-7, paragraph 3

GAI COMMENT: "For example, GAI has the following specific comments regarding the identified work elements:

- Regarding site characteristics

  - in situ stresses should be inferred from core discing and backfigured from the monitored response of underground excavations, as well as from other methods; the problems with hydraulic fracturing (see SCR Chapter 4) should be evaluated, and overcoring methods should be emphasized
  - direct testing of the rock mass should be emphasized, as borehole and laboratory tests are generally of too small a scale
  - uncertainties, as well as variability, of the site characteristics should be assessed."

STATUS: Agreed

BWIP RESPONSE: Information needs for the appropriate work elements in Table 14-2 of the SCR will be revised to address the items indicated.

CHAPTER 14 (GEOENGINEERING AND REPOSITORY DESIGN ISSUES AND PLANS)

ITEM REFERENCE: Section 14.3, page 14-8, paragraph 1

GAI COMMENT: "• Regarding analysis of underground openings

- mechanical modeling should include 3-D effects and consider the anisotrophic, non-linear elastic-plastic behavior of the basalt
- uncertainties should be explicity incorporated in the analysis
- limited failure zones around openings are generally acceptable, and should be considered
- monitored test sections where excavation/support systems are tried should be utilized
- modeling, and not just empirical observations, should be used to evaluate rock bursting potential
- effects of ventilation/cooling and heating cycles, and also drying/wetting cycles, should be assessed."

STATUS: Agreed

BWIP RESPONSE: Information needs for the appropriate work elements in Table 14-2 of the SCR will be revised to address the items indicated.

ITEM REFERENCE: Section 14.3, page 14-8, paragraph 1

GAI COMMENT: "• Regarding backfilling/sealing/retrieval

- the objectives of backfill, especially regarding low permeability, have not been justified and should be presented
- the methods for assessing the long-term performance characteristics of backfill and seals should be identified and evaluated
- the stresses acting on, and the criticality of, the densely placed horizontal waste packages should be assessed
- the relationship of the guarded straddle packer (which measures permeabilities) to borehole sealing should be identified
- methods and problems of retrieval should be identified and evaluated."

CHAPTER 14 (GEOENGINEERING AND REPOSITORY DESIGN ISSUES AND PLANS)

STATUS: Agreed

BWIP RESPONSE: Functional requirements for backfill, plans for assessing the long-term performance of backfill and seals, the significance of hot-rock permeability to borehole sealing design and methods and problems of retrieval will be discussed in Section 10.6 of the SCP. Estimated stresses acting on the waste canisters will be stated as design bases in Chapter 11 of the SCP, and criticality will be discussed in Chapter 10.

ITEM REFERENCE: Section 14.3, page 14-8, paragraph 2

GAI COMMENT: "In GAI's opinion, it is not assured that the set of work elements presented by DOE will be adequately completed, and thus issues left unresolved, on the basis of both the lack of detail regarding the plans for work elements and the previously noted deficiencies in the DOE program (see SCR Chapters 4 and 10)."

STATUS: Agreed

BWIP RESPONSE: Tables titled "Work Element Analysis" and accompanying narratives in Chapter 14 of the SCR provide a summary definition of all information needs (characterization, testing, analysis, and perfomance assessment) to support the definition of work element scope and purpose. Additional details will be provided in the SCP either by expanded narratives and tables or by references to test plans that will be made available to the NRC, the State, and others.

ITEM REFERENCE: Section 14.3, page 14-8, paragraph 3

GAI COMMENT: "Regarding project activities, those presented by DOE do not, in GAI's opinion, clarify work elements nor confirm that they will be completed in a defensible manner. Although the applicable work elements which apparently will be completed with each project activity are listed, the project activities' explanations do not, in GAI's opinion, always provide this confidence. Further, it is not apparent how each of the work elements listed are related to the project activities. For example, appropriate data acquired from the ES-Phase I and II test programs will apparently not be incorporated in the rock mechanics data base for repository Title I design (see Figure 14-1). Similarly, it appears that uncertainties in the data base will be neither assessed nor incorporated in analyses. As a secondary concern, it is not apparent in every case when these project activities, and thus the work elements, will be completed. This schedule should depend on when and to what extent the related issues must be resolved, which has not been discussed.

CHAPTER 14 (GEOENGINEERING AND REPOSITORY DESIGN ISSUES AND PLANS)

Based on the information presented by DOE, GAI does not believe that the set of work elements will be completed prior to initial license application. For example, it is not apparent when field tests or demonstrations of backfilling or sealing will be conducted, but it does not appear that they are scheduled for completion prior to construction authorization. This schedule should be clarified as it relates to initial license application."

STATUS: Agreed

BWIP RESPONSE: The project activities section of Chapter 14 of the SCR will be expanded and clarified. The logic charts and accompanying narratives are not intended to serve as a detailed "master schedule or project plan" showing when each work element will be completed. The data/analysis generated by a given work element will provide input not only to the license application, but in an iterative fashion to the design and performance analysis tasks of the project. The project activities in the SCR, which are not a detailed project plan, are meant to provide an overall guide to BWIP activities. It is the intent of the BWIP to provide all information identified in work elements to the degree required to demonstrate reasonable assurance that NRC and U.S. Environmental Protection Agency (EPA) performance objectives, regulations, and standards are met. The planning process for this, and any other project, is an iterative one designed to be responsive to feedback such as provided by the NRC and Golder Associates. As such, project activities will be changed to provide relevant information needed as identified in peer review. Figure 14-2 and work elements in Chapter 14 of the SCR will be revised to clarify that data acquired from the ES test program will be incorporated in the rock mechanics data base for repository Title I design and that uncertainties in the data base will be assessed and incorporated in analyses.

CHAPTER 15 (WASTE PACKAGE AND SITE GEOCHEMISTRY ISSUES AND PLANS)

ITEM REFERENCE: Section 15.3, page 15-5, paragraph 4

GAI COMMENT: "In GAI's opinion, a set of issues should be identified whose resolutions is demonstrated to be both necessary and sufficient for site selection and subsequent licensing, as pertaining to the waste package and site geochemistry. A comprehensive set of work elements should then be identified which, if completed, are both necessary and sufficient to demonstrably resolve these identified issues. Work (both ongoing and planned) in this area should then be related solely to the efficient completion of these work elements. Other issues, work elements, or project activities must be considered as superfluous."

STATUS: Disagreed

BWIP RESPONSE: In the DSCA (see reference on page 50), the NRC analyzed BWIP issues and work elements and compared them to issues developed by NRC staff and consultants. The NRC findings in Appendix C of the DSCA were that the NRC Performance and Specific Issues (technical) appear to correlate well with BWIP Issues and Work Elements. Where the NRC has identified additional issues that were not taken into consideration by the BWIP in preparing the SCR, this input has been integrated into the plans for preparing an SCP, and the substance of the NRC issue has been factored into an existing BWIP work element or issue. Furthermore, the NRC specifically has stated "the issues and work elements in the SCR have the same collective technical scope as the site issues developed by the NRC staff" (DSCA, page xii, paragraph 3) and that "the SCR lacks specific information on plans for information gathering in many areas" (page xii, paragraph 3). These details will be provided either in the SCP, or by reference to specific test plans. Since the work elements in the SCR were designed to fulfill NRC requirements, which are applicable at different parts of the licensing process, they cannot be focused only on the materials/data/information that is defined by the Golder comments. However, a review of Chapter 15 of the SCR to remove redundant or superfluous detail that does not focus on work element completion will be carried out as part of the SCP preparation. Correlation tables will be provided in the SCP or in a separate document, relating NRC DSCA comments (including issues) to the SCP.

ITEM REFERENCE: Section 15.3, page 15-5, paragraph 6

GAI COMMENT: "Regarding waste package and site geochemistry issues, those which DOE has identified as being necessary to resolve before the Hanford Site can be considered suitable for licensing have not been shown to be both

necessary and sufficient for determining site suitability in the areas of geochemistry, waste package and confirmation testing. It is stated that these issues are derived from Chapters 6 and 11 which deal, respectively, with geochemistry and waste package. However, the derivation of these issues in Chapters 6 and 11 is not obvious to GAI. It is apparent that the seven issues identified are secondary to the primary issue of demonstrating the safe containment of radionuclides within a repository. Although this may be the most important issue, there may be other undefined ones, as well. In GAI's opinion DOE does not provide a suitable basis for determining whether resolution of these seven issues is necessary and sufficient to determine acceptability in the waste package and geochemistry areas."

STATUS: Disagreed

BWIP RESPONSE: The introduction to Section 13.1 of the SCR clearly states that, as treated in the SCR, an issue is an item of technical controversy and that such issues only provide a focus for the work defined in the BWIP work elements. It is the position of the BWIP that completion of the work elements identified in the SCR as modified in the SCP will provide necessary and sufficient information to support a license application. The BWIP work elements correlate closely with NRC issues. These issues identified by the BWIP were never intended to serve the function requested by Golder Associates.

ITEM REFERENCE: Section 15.3, page 15-6, paragraph 1

GAI COMMENT: "Regarding work elements it is GAI's opinion that, if those work elements represent discrete pieces of work that were to be performed, and if these work pieces were defensibly and comprehensively completed, then DOE would likely have a good grasp on waste package development and site geochemistry. However, these work elements are evidently not the fundamental pieces of research and development, but rather an additional set of work items exist which have no obvious and direct relationship to the work elements. In GAI's opinion, it is not assured that the set of work elements presented by DOE will be adequately completed, and thus the set of issues will be left unresolved, on the basis of both the lack of detail on the relationship of the work elements to the actual programmatic activities and the previously noted perceived deficiencies in the DOE program (see review of SCR Chapters 6 and 11)."

STATUS: Disagreed

BWIP RESPONSE: It is not clear what the Golder staff means by the statement, "However, these work elements are evidently not the fundamental pieces of research and development, but rather an additional set of work items which

have no obvious and direct relationship to the work elements." The BWIP, in the tables titled "Work Element Analysis" and accompanying narratives within the SCR, has provided a summary definition of all information needs (characterization, testing, analysis, and performance assessment) to support the definition of work element scope and purpose. Additional detail will be provided in the SCP either by expanded narratives and tables or by references to test plans that will be made available to the NRC.

ITEM REFERENCE: Section 15.3, page 15-6, paragraph 2

GAI COMMENT: "Regarding project activities, those presented by DOE do not, in GAI's opinion, clarify work elements nor confirm that they will be completed in a defensible manner. The project activities list applicable work elements which apparently will be completed with project activity. However, the project activities' explanations do not, in GAI's opinion, always provide this confidence. For example, an activity to prepare a hot cell for experiments is listed as partially or completely fulfilling eight work elements. Further, it is not apparent how each of the work elements listed are related to the project activities. As a secondary concern, it is not apparent in every case when these project activities, and thus the work elements, will be completed. This schedule should depend on when and to what extent the related issues must be resolved, which has not been discussed. This schedule should be clarified as it relates to initial license application."

STATUS: Agreed

BWIP RESPONSE: The project activities section of Chapter 15 of the SCR will be expanded and clarified. The logic charts and accompanying narratives were not intended to function as a detailed "master schedule or project plans" showing where each work element will be completed. The data/analysis generated by a given work element will provide input not only to the license application, but in an iterative fashion to the design and performance analysis tasks of the project. The project activities in the SCR, which are not a detailed project plan, are meant to provide an overall guide to BWIP activities. It is the intent of the BWIP to provide all information identified in work elements to the degree required to demonstrate reasonable assurance that NRC and EPA performance objectives, regulations, and standards are met. The planning process for this, and any other project, is an iterative one designed to be responsive to feedback such as that provided by the NRC and Golder Associates. As such, project activities will be changed to provide relevant information needed as identified in peer review.

CHAPTER 15 (WASTE PACKAGE AND SITE GEOCHEMISTRY ISSUES AND PLANS)

ITEM REFERENCE: Section 15.3, page 15-6, paragraph 3

GAI COMMENT: "In conclusion, it is GAI's opinion that sufficient resolution of the seven issues identified by DOE, as well as any others that may arise, in the area of waste package and site geochemistry will be likely through the comprehensive and defensible completion of the work elements listed. However, it is also GAI's opinion that DOE's presentation of issues, work elements and project activities are presented without sufficient detail and explanation. Further, based on descriptions provided for the project activities, it is not clear that DOE will defensibly and comprehensively complete each work element with its current program plans, especially prior to initial license application."

STATUS: Agreed

BWIP RESPONSE: Additional detail will be provided in the SCP or references therein. As was stated above, the BWIP will endeavor to provide a reasonable assurance that regulatory performance objectives will be met at the time of possible license application.

CHAPTER 16 (PERFORMANCE ASSESSMENT ISSUES AND PLANS)

ITEM REFERENCE: Section 16.1, page 16-1, paragraph 2, item 2, bullet 2

GAI COMMENT: "...GAI believes that DOE has neglected issues related to preclosure performance assessment, e.g., in the areas of protection against radiation exposures and retrievability of waste."

STATUS: Agreed

BWIP RESPONSE: The BWIP is in the process of defining its approach to preclosure performance assessment. At the present time, the BWIP has not identified any "preclosure issues." The BWIP will comply with the occupational safety and retrievability requirements set forth in the 10 CFR 60. The SCP will contain the discussion provided in the BWIP Performance Assessment Plan on preclosure performance assessment.

ITEM REFERENCE: Section 16.1, page 16-1, paragraph 2, item 3, bullet 3

GAI COMMENT: "...GAI believes that a defensible approach must include a clear resolution of the treatment of data and modeling uncertainties, which is not adequately addressed by DOE in SCR Chapter 16."

STATUS: Agreed

BWIP RESPONSE: The logic diagram and discussion contained in Section 16.4 of the SCR will be revised to present the iterative and interactive nature of data collection and model development activities. The existing work element S.1.40.D (pages 13.3-71 and -72 of the SCR) on uncertainty analysis will be rewritten to update the BWIP plan towards uncertainty analysis.

ITEM REFERENCE: Section 16.2, page 16-2, paragraph 3

GAI COMMENT: "Preclosure performance assessment activities... This subject and the approach to its resolution are only addressed in summary fashion."

STATUS: Agreed

BWIP RESPONSE: The discussion on preclosure performance assessment activities will be expanded. Work elements P.4.1, P.4.2, P.4.3, and P.4.4 will be rewritten to present more detail on BWIP plans for preclosure performance assessment activities. The narratives for the preclosure activities shown on the logic diagram (Fig. 16-2 of the SCR) will be expanded.

CHAPTER 16 (PERFORMANCE ASSESSMENT ISSUES AND PLANS)

ITEM REFERENCE: Section 16.3, page 16-6, paragraph 1

GAI COMMENT: "Can the uncertainty in the conceptual hydrologic model and data base be reduced (by testing)..."

STATUS: Agreed

BWIP RESPONSE: The rewrite of Section 16.4 of the SCR and the changes that will be made to Figure 16.2 of the SCR will present, in more detail, the BWIP approach to model development and model validation.

ITEM REFERENCE: Section 16.3, page 16-6, paragraph 4

GAI COMMENT: "In GAI's opinion, the satisfactorily demonstration that these two objections can meet should form the basis for at least two additional (preclosure) issues."

STATUS: Agreed

BWIP RESPONSE: The BWIP will satisfy the performance objectives set forth in 10 CFR 60.111a and 10 CFR 60.111b. Both of these items will be addressed in the Preliminary Hazards Analysis Report that will be prepared during FY 84. A discussion of the Preliminary Hazards Analysis report will be contained in Section 16.4.4 of the SCP.

ITEM REFERENCE: Section 16.3, page 16-6, paragraph 4

GAI COMMENT: "...the technical link between many of these work elements and the issues which they are intended to support is neither stated nor obvious..."

STATUS: Agreed

BWIP RESPONSE: The logic diagram and narrative discussion in Chapter 16 of the SCR will be revised. Specific emphasis will be placed upon integrating the revised work element statements into the activity narrative portion of the SCP.

ITEM REFERENCE: Section 16.3, page 16-6, paragraph 5

GAI COMMENT: "...The work elements appear to be oriented towards protection against radiation exposures;...little reference is made to work elements that would support the retrievability issue..."

CHAPTER 16 (PERFORMANCE ASSESSMENT ISSUES AND PLANS)

STATUS: Agreed

BWIP RESPONSE: The discussion on preclosure performance assessment activities discussed in work elements P.4.1, P.4.2, P.4.3, and P.4.4 will be expanded.

ITEM REFERENCE: Section 16.3, pages 16-6 and 16-7, paragraph 6

GAI COMMENT: "...project activities, those presented by DOE...in a logic diagram...do not...sufficiently clarify work elements...nor confirm that they will be completed in a defensible manner."

STATUS: Agreed

BWIP RESPONSE: This item was addressed previously in other BWIP comments, i.e., Section 16.1, page 16-1, paragraph 2, and Section 16.3, page 16-6, paragraph 5, of the SCR.

ITEM REFERENCE: Section 16.3, page 16-7, item 1

GAI COMMENT: "The systems description for post-closure repository performance...contains no reference to the treatment of data uncertainties and their importance to performance assessment..."

STATUS: Agreed

BWIP RESPONSE: A discussion of uncertainty analysis techniques will be included in Sections 16.4.3 and 16.4.14 of the SCP. Work elements that address uncertainty analysis will be identified.

ITEM REFERENCE: Section 16.3, page 16-7, item 2

GAI COMMENT: "...what is more important is the quantification of model uncertainty,..."

STATUS: Agreed

BWIP RESPONSE: The BWIP computer code test program that includes verification and benchmarking is designed to test the computer codes. The approach to verification and benchmark testing will be discussed in the revised work element P.1.2-SC (pages 16.3-2 and -3). Model validation consists of comparing model results against actual data. The Activity Narrative 16.4.13 will discuss the planned BWIP approach to needed validation.

CHAPTER 16 (PERFORMANCE ASSESSMENT ISSUES AND PLANS)

ITEM REFERENCE: Section 16.3, page 16-7, item 3

GAI COMMENT: "...In GAI's opinion, DOE should state which code they expect to validate under in situ conditions, which will be validated using laboratory data alone, and what effect the relative uncertainties are likely to be on performance assessment."

STATUS: Agreed

BWIP RESPONSE: A plan will be prepared for each model that is validated. The plan will specify data requirements and define acceptance criteria. The approach to model validation will be discussed in the SCP.

ITEM REFERENCE: Section 16.3, page 16-7, item 4

GAI COMMENT: "...post-closure repository performance assessments will include post-waste emplacement numerical modeling, uncertainty analysis and consequence analysis. The description...is brief and imprecise..."

STATUS: Agreed

BWIP RESPONSE: The activity will be described in more detail. Narrative activities discussed in Section 16.4 of the SCR will be rewritten.

CHAPTER 17 (SITE CHARACTERIZATION PROGRAM)

ITEM REFERENCE: Section 17.3, page 17-7, paragraph 1, item 1

GAI COMMENT: "Regarding Phase II objectives, information should be obtained during Phase II to allow for repository design and to sufficiently reduce the uncertainty in the site characteristics for performance assessment, as required for a license application for construction authorization."

STATUS: Agreed

BWIP RESPONSE: The Exploratory Shaft Test Plan will detail the Phase II objectives and will be referenced appropriately in the SCP.

ITEM REFERENCE: Section 17.3, page 17-7, paragraph 1, item 2

GAI COMMENT: "Regarding selection of the candidate horizon, the decision process is not presented in sufficient detail; especially, it is not clear how the relative importance of the various characteristics will be determined and weights assessed, nor is it clear whether observed values of characteristics will simply be identified as favorable vs. unfavorable or the relative impact of all possible values considered."

STATUS: Agreed

BWIP RESPONSE: The Horizon Selection Report (see reference on page 77) will detail the candidate selection process, including the identification and weighting of the characteristics used. The report will be referenced appropriately in the SCP.

ITEM REFERENCE: Section 17.3, page 17-7, paragraph 2, item 3

GAI COMMENT: Regarding in situ test facility design - "The layout objectives should be justified, as this will affect operation and test results."

STATUS: Agreed

BWIP RESPONSE: The environment for each of the tests to be performed as part of the ES testing program will be justified in the ES Test Plan. A conceptual layout of the ES facility meeting the environmental requirements of each of the tests will also be presented in the ES Test Plan. The final layout will not be completed until the definitive design phase of ES-Phase II.

CHAPTER 17 (SITE CHARACTERIZATION PROGRAM)

ITEM REFERENCE: Section 17.3, page 17-7, paragraph 2, item 3

GAI COMMENT: "The relationship of the test facility to the actual operating repository should be defined, as this will affect the validity of extrapolating characteristic assessments and may possibly influence repository performance."

STATUS: Agreed

BWIP RESPONSE: A study detailing the location of the ES in relationship to the repository will be conducted during the upgraded repository conceptual design. This study will not be completed until just prior to license application. The present concept is to locate the ES in the repository shaft pillar area. Since the ES location has been selected, the repository layout will be adjusted to incorporate the ES in the shaft pillar area.

ITEM REFERENCE: Section 17.3, page 17-7, paragraph 2, item 3

GAI COMMENT: "The dimensions and orientation have not been discussed, and thus cannot be evaluated."

STATUS: Agreed

BWIP RESPONSE: The dimension of the ES will be included in the ES Title II Design Report which will be available prior to completion of the SCP. The ES Test Plan will include the tentative underground layout for the ES-Phase II. At the time of the SCP publication, additional reference information on the ES will be available regarding the dimension and layout of the ES, both Phase I and Phase II.

ITEM REFERENCE: Section 17.3, page 17-7, paragraph 2, item 3

GAI COMMENT: "A six-foot diameter shaft may be unduly restrictive considering the horizontal drilling and testing to be conducted within it and the amount of subsurface development and testing which must be serviced through it, possibly resulting in scheduling problems and limitations in allowable equipment dimensions; especially, the diverter assembly (or blow out preventor) which will be attached to the porthole may be on the order of two feet long, reducing the room available for drilling and associated activities down to four feet."

CHAPTER 17 (SITE CHARACTERIZATION PROGRAM)

STATUS: Agreed

BWIP RESPONSE: A 6-ft-dia. shaft is restrictive, however, the present shaft inside dimension will allow mounting of the blowout preventer, drilling assembly, and the performance of drilling test holes. Only one hole can be drilled at a time; therefore, there will not be any movement of the shaft cage during a test hole drilling activity. A drilling demonstration is being performed at the NSTF via a 6-ft shaft being drilled into the basalt. This demonstration simulates all aspects of drilling in the ES. The blowout preventer will be checked using high-pressure water in a cased hole at the NSTF. The report of this demonstration will be available prior to completion of the SCP and will be referenced in the SCP.

ITEM REFERENCE: Section 17.3, page 17-7, paragraph 2, item 4

GAI COMMENT: Regarding construction techniques - "The exploratory shaft will be blind bored only, whereas the repository shafts are presently anticipated to be blind bored and drill/blast; hence, only blind-boring at a small scale will be investigated and the shaft constructability question not completely resolved."

STATUS: Agreed

BWIP RESPONSE: An engineering study is presently being conducted on shaft drilling technology for large-bore shafts. The results of this study will be available prior to the completion of the SCP and will be referenced in the SCP. The upgraded conceptual design will use the results of this study as a basis for design of the repository shafts.

ITEM REFERENCE: Section 17.3, page 17-7, paragraph 2, item 4

GAI COMMENT: "The underground facility will apparently (as implied by DOE on SCR page 17.2-3) be excavated as quickly as possible, with in GAI's opinion insufficient concern for monitoring, evaluation of alternative mining techniques, or possible licensing requirements (should the facility become integrated into the repository); hence, potentially valuable and easily available information might not be obtained, and licensing may be complicated should the facility be incorporated in the repository."

STATUS: Agreed

CHAPTER 17 (SITE CHARACTERIZATION PROGRAM)

BWIP RESPONSE: Conventional drill and blast mining techniques will be utilized for the mining of the ES-Phase I shaft station and for the Phase II drifts. Constructability information will be obtained during Phase I and Phase II mining operations. The information to be obtained will be defined in the ES Test Plan which will be referenced in the SCP.

An engineering study is being conducted to compare conventional mining practices to mechanical mining techniques for construction of the repository. This engineering study will be available prior to release of the SCP.

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: Regarding measurement of characteristics - "Hydrologic and waste transport characteristics need to be assessed for all the possibly affected overlying materials, and not just the repository horizon."

STATUS: Agreed

BWIP RESPONSE: Some assessment of possibly affected overlying materials is needed. The detail of such an assessment would normally decline with distance from the repository and will depend upon the degree to which lack of knowledge could impact repository performance. Plans for assessing hydrologic and waste transport characteristics will be addressed in Chapters 13 and 16 of the SCP.

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: "Hydrologic tests are required to define the hydrogeologic boundaries of the system in which the repository may be placed."

STATUS: Agreed

BWIP RESPONSE: To further define boundary conditions for the numerical model, a triangular network of piezometric monitoring stations will be constructed in the RRL. Piezometers will be located in at least nine horizons at each observation well site. When these head data are combined with large-scale measurement of hydrologic properties from multiple borehole tests inside the RRL, a refined definition of any local boundaries will develop. Chapter 10 of the SCP will address the facilities that will be used to help establish the boundary condition for the Cold Creek Syncline model.

CHAPTER 17 (SITE CHARACTERIZATION PROGRAM)

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: "Hydrologic tests in horizontal boreholes (especially for vertical hydraulic conductivity) may not be of sufficient scale to be representative of the rock mass; rather, multiple hole pump tests are needed (see review of the SCR Chapter 13)."

STATUS: Agreed

BWIP RESPONSE: Additional large-scale testing will be conducted, but the specific test design and number of required tests will be based on DC-16 borehole test results. Additional facilities for any additional required testing will be coordinated with monitoring facilities. It is anticipated that two additional pumping wells will be needed which would be located to optimize observation locations including the new piezometer stations described above. The BWIP is striving to have these wells drilled in FY 1984 as soon as the piezometer sites are completed. Chapter 13 of the SCP discusses plans that incorporate large-scale pump tests to help assess the representativeness of small-scale hydrologic tests. Supporting drilling and testing information will be provided in the revised Drill and Test Plan and referenced in the SCP.

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: "During shaft drilling, mud may invade a significant distance into the rock mass, which will substantially reduce and possibly invalidate measured hydraulic conductivities and porosities in that zone."

STATUS: Agreed

BWIP RESPONSE: We agree that the invasion of mud and lost circulation materials into flow tops and interbeds surrounding the ES must be factored into interpreting hydrologic data. These materials can artifically reduce near-field in situ measurement of hydraulic conductivity and effective porosity. This is one of the primary reasons why hydrologic tests in these higher transmissive zones are not a prime objective of the shaft program. Rather, the test emphasis is upon examining low-transmissive rock (flow interiors) where mud invasion is not a problem. The primary site characterization activity that addresses flow top and interbed properties occurs in surface-based boreholes where muds, when used, can be more easily withdrawn and the hole cleaned before fissile test conduction. The location of the portholes to be tested in the ES test program will be included in the ES Test Plan.

CHAPTER 17 (SITE CHARACTERIZATION PROGRAM)

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: "Insufficient information is presented regarding the types of piezometers to be used and how they will be sealed, so that the uncertainty in the measurement of hydraulic heads cannot be evaluated."

STATUS: Agreed

BWIP RESPONSE: A revised test plan for the ES is being written. Within that plan, details are given as to the number, size, location, and overall design of piezometers installed to support in situ testing. In brief, piezometers are planned that surround the large-scale chamber room test and the multiple borehole (cluster) site. Individual piezometers penetrating flow tops and interbeds from the shaft are not a primary data gathering option because of near-field head influences arising from shaft emplacement. Heads measured in such zones will address the effectiveness of the shaft seal. Hydraulic heads considered representative of the potentiometric distributions across the RRL will be measured in surface-drilled piezometers as described in the BWIP Groundwater Monitoring Plan.

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: "The length of horizontal boreholes appears to be limited; these holes should be as long as possible, especially within the repository horizon, so as to characterize a larger volume and reduce extrapolation."

STATUS: Agreed

BWIP RESPONSE: The new test plan for the ES includes plans for constructing long boreholes (approximately 330 m each) cored from the underground workings into the repository horizon. At least two of these holes are planned so as to characterize a much larger rock volume than the 20-m-long boreholes addressed in previous shaft test plans. A detailed discussion will be included in the ES Test Plan which will be referenced in Chapter 17 of the SCP.

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: "At depth, the emphasis should be on overcoring rather than hydrofracturing for in situ stress measurement, due to the possible problems with hydrofracturing in the expected stress conditions (see review of SCR Chapter 4) and the potentially detrimental fracturing which occurs."

CHAPTER 17 (SITE CHARACTERIZATION PROGRAM)

STATUS: Agreed

BWIP RESPONSE: Emphasis will be given on overcoring methods for in situ stress measurements. The hydraulic fracturing method will be used as a redundant or contingent method. A detailed discussion will be included in the ES Test Plan.

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: "In situ tests to assess rock mass strength are not adequately discussed, nor are tests for assessing rock mass modulus and the characteristics of discontinuities, and thus cannot be evaluated."

STATUS: Agreed

BWIP RESPONSE: Rock mass strength will be estimated using empirical methods. Limited in situ rock mass strength tests are being considered in the ES Test Plan. Rock mass modulus will be measured by a number of redundant methods including plate bearing tests, flat jack tests, and borehole-scale deformation tests. Spatial variations of the deformation properties will be assessed by geophysical methods. Joint characteristics will be determined in the laboratory both in small scale and bench scale. Geomechanics logging will be carried out in the entire drift in the ES. Details of the underground testing will be presented in the ES Test Plan.

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 2, item 1

GAI COMMENT: "It is not apparent that natural variability of specific characteristics over the affected volumes will be assessed, i.e., a major factor in assessing the uncertainty and predictability of those characteristics."

STATUS: Agreed

BWIP RESPONSE: The spatial variability of rock properties will be assessed using geophysical methods in addition to core loggings of the long horizontal holes to be drilled in ES drifts. A detailed plan will be presented in Chapter 17 of the SCP. Details of the underground testing will be presented in the ES Test Plan.

CHAPTER 17 (SITE CHARACTERIZATION PROGRAM)

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 3

GAI COMMENT: Regarding sealing - "Verification of the shaft seal/liner will only be obtained at the shaft breakout station in the repository horizon and will only be applicable to the given construction method (i.e., blind-boring in a small diameter shaft), so that the question of shaft sealing will not be totally resolved."

STATUS: Agreed

BWIP RESPONSE: The ES test program will only address the suitability of the cement seal and the anulus between the steel casing and the basalt rock. The purpose of the liner seal integrity testing in the ES test program is to assure the safety to personnel operating in the ES and underground facilities. Present plans are to remove the liner and the grout seal in selected locations upon decommissioning of the shaft and emplacing shaft seals to provide long-term isolation.

ITEM REFERENCE: Section 17.3, page 17-8, paragraph 3

GAI COMMENT: "Insufficient details are provided for decommissioning the test facility, should it be necessary to isolate it from the repository, and thus cannot be evaluated."

STATUS: Agreed

BWIP RESPONSE: The repository has not been precisely located at this time and the relationship of the ES test facility to the repository layout has not been established. If the test facility is sufficiently close to the repository as to play a significant role in repository system waste isolation performance, decommissioning of the test facility excavations will feature sealing measures similar to those to be applied to the shafts and the underground facility of the repository itself (see SCR Section 10.8). Section 17.2.10 of the SCR will be revised to include a discussion of ES decommissioning alternatives. (Note: Decommissioning of the ES in the event that the BWIP site is determined to be unsuitable for a construction license application will be described in Chapter 21 of the SCP.)

CHAPTER 18 (QUALITY ASSURANCE)

ITEM REFERENCE: Section 18, page 18-1, paragraph 18.1 and Section 18.1, page 18-6, last paragraph

GAI COMMENT: "...However, GAI believes that insufficient detail has been presented by DOE regarding their QA Plan (i.e., quality and technical procedures), which is necessary in order to evaluate the quality of data produced and the reliability of repository design/construction/operation/performance."

STATUS: Disagreed

BWIP RESPONSE: The GAI conclusion is unsupported by their item-by-item evaluation in Section 18, pages 18-3 through 18-6, paragraph 18.3, of the SCR. Furthermore, there seems to be some confusion regarding the purpose, scope, and content of the SCR relating to repository design/construction/opera- tion/performance. The Quality Assurance Plan provides the systems environment necessary to produce detailed procedures controlling the quality of produced data and reliability. These detailed procedures will be available for evaluation as required by NRC Regulatory Guide 4.17 and referenced by GAI in Section 18 of the SCR. This level of detail is not appropriate to the SCP.

ITEM REFERENCE: Section 18.2, page 18-1, paragraph 4

GAI COMMENT: "This plan also provides for the use of computer code programs. Software is available for both developmental and production QA."

STATUS: Disagreed

BWIP RESPONSE: Golder Associates has made an incorrect summary of the BWIP quality assurance program regarding computers and software. The quality assurance program is applied in the development of computer code programs. This software, whether developmental or production, falls under appropriate quality assurance program control.

ITEM REFERENCE: Section 18.3, page 18-4, paragraph 2

GAI COMMENT: "...Thus, in order to adequately evaluate these (QA) procedures it is necessary for specifics such as testing methods, instrumentation, environmental controls, documentation, nonconformance/corrective action,

methods of analysis, and applicability and limitations of testing and instrumentation in acquiring the necessary information, be outlined for each activity to be performed."

STATUS: Agreed

BWIP RESPONSE: The specifics detailed are contained in implementing plans and procedures. These plans and procedures will be referenced in the SCP.