Lawrence Livermore National Laboratory

NUCLEAR SYSTEMS SAFETY PROGRAM
L-196

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Geology/Geophysics Section
Technical Review Branch
Division of High-Level Management
Office of Nuclear Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Transmittal of Reference LLNL's "PDPPs" Report
NRC FIN A-0297

Reference: LLNL Comments on DOE's Consultation Draft SCP for the NNWSI Site -- Preliminary Draft Point Papers (PDPPs), dated February 1988.

Dear Mr. Blackford:

The purpose of this letter is to transmit the reference document which summarizes our comments on the assigned sections of DOE's Consultation Draft Site Characterization Plan (C-Draft SCP) for the NNWSI site. The reference document has been prepared in a "preliminary draft point papers" (PDPPs) format as directed.

Our initial review and evaluation of DOE's C-Draft SCP for the NNWSI site has successfully been accomplished. This review was accomplished in accordance with two NRC review guides as follows: (1) Administrative Plan and Procedures (APP) for NRC Staff Review of DOE's Consultation Draft Site Characterization Plans and (2) Draft Technical Review Plan (TRP) for NRC Staff Review of DOE's Site Characterization Plans.

On 28 January 1988, NRC staff and other contractors had been alerted via a conference call to any major concerns and outstanding comments on the C-Draft SCP document. A report containing our preliminary draft point papers (42 pages) was then transmitted to NRC on 29 January 1988 via Fax Mail.

On 2-3 February 1988, meetings were held in Rockville, MD with NRC staff and other contractors to discuss these preliminary draft point papers. H. Larry McKague and C. Rus Purcell participated in these meetings with NRC staff.

Our review and evaluation of the C-Draft SCP document continued on the basis of new guidelines received from NRC staff. A second

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report (18 pages) containing additional comments and draft point papers was submitted to NRC on 8 February 1988 via Fax Mail. The first revision to our preliminary draft point papers (PDPP's) was made on 9 February 1988; these revised PDPP's (29 pages) were transmitted to NRC via Fax Mail on 9 February 1988.

Additional comments were put into a PDPP format, and these comments (23 pages), some with minor revisions, were transmitted to NRC on 18 February 1988 via Fax Mail.

The reference "PDPPs" report is a document summarizing LLNL comments on the basis of our review and evaluation of those assigned sections in DOE's Consultation Draft Site Characterization Plan for the NNWSI site.

If you have any questions, please let us know.

Sincerely yours,

Dae H. (Danny) Chung
Program Manager

cc: C. Abrams, NRC/WMGT
P. S. Justus, NRC/WMGT
J. S. Trapp, NRC/WMGT

LLNL COMMENTS ON

DOE'S CONSULTATION DRAFT SITE CHARACTERIZATION PLAN FOR THE NNWSI SITE

(Preliminary Draft Point Papers)*

The LLNL Task Team has reviewed the Consultation Draft Site Characterization Plan for the NNWSI Site in accordance with two NRC review guides:

(1) "Administrative Plan and Procedures (APP) for NRC Staff Review of DOE's Consultation Draft Site Characterization Plans," dated 18 December 1987.

(2) "Technical Review Plan (TRP) for NRC Staff Review of DOE's Site Characterization Plans," dated 18 December 1987. (Draft)

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*This Preliminary Draft Point Papers (PDPPs) document was read and approved by Dae H. (Danny) Chung.

Dae H. (Danny) Chung
LLNL Program Manager

February 1988

Comment 1

The consultation draft SCP has not considered the effects of seismic activity.

Basis

*Section 2.6.1 cites seismicity studies during the 1970s of two small earthquakes for evidence of stress orientation at the NTS.

*The relief of stress and readjustment through seismic activity may impact ground support requirements.

*Structural integrity is affected more by duration of a seismic event than by peak magnitude.

*HE studies performed on surface and buried events have shown that ground motions in the outrunning region can be greater at depth than at the surface.

Recommendation

*As a first step to determining the need for seismic considerations, the incidence of seismic events and their magnitude should be investigated.

*The seismic investigation should demonstrate why the phenomena should or should not be considered an "anticipated process and event."

*This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

References

Davis, B. C. (1987) Ground Shock Profiles for an Accidental Explosion at the Proposed Large Rocket Test Facility at Arnold Engineering Development Center, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee, AEDC-TR-87-38. (Also UCID-21244 dated July, 1987.)

Hobst, Dr. Ing. Leos, and Zajic, Ing. Josef (1977), Anchoring in Rock, Elsevier Scientific Publishing Company, NY

ASTM (1980), Effects of Radiation on Materials - Proceedings of the 10th International Symposium (ASTM Special Technical Publication 725).

Ailor, W. H. (Editor) (1971), Handbook on Corrosion Testing and Evaluation, Wiley & Sons, NY

Reviewer BD
Date 1/29/88
2/5/88 Rev 1

Chapter 2

Comment 2

The consultation draft SCP has not considered that the long term stability of a mined opening is based not only on how the rock will respond, but on the interaction of the ground support system with the rock under the anticipated thermal, mechanical, hydrologic, and geochemical effects.

Basis

*Section 2.4 discusses the thermal and thermomechanical properties of the intact rock relative to establishing tunnel size and spacing, emplacement hole geometry, and waste container thermal output but does not consider the thermal and thermomechanical impact on the ground support system.

*Section 2.8 discusses the excavation characteristics of the rock mass and draws inferences from similar rocks but the prior experience does not indicate that it includes a look at the interaction of the ground support system with the rock under the anticipated thermal, thermomechanical, and geochemical conditions.

*A Hilti bolt study performed in concrete indicated that an increased temperature (from the placement torque temperature) decreased the bolts effective load bearing capacity.

*Thermal and geochemical effects on chemical grouts can cause their degradation and/or the degradation of the rock grout interface.

Recommendation

*The geoengineering investigation should demonstrate why the interaction of the ground support system with the rock under the anticipated thermal, mechanical, hydrologic, and geochemical effects should or should not be considered an "anticipated process and event.

This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reference

Davis, B. C. (1984) Internal Study done for San Onofre Unit 1 Refueling Outage Modifications. Study transmitted to NRC as an Inspection Report Letter dated September, 1984.

Reviewer BD
Date 1/29/88
2/5/88 Rev 1

Chapter 2

Comment 3

The consultation draft SCP has implied various thermal and mechanical properties of the anticipated repository rock without significant data to warrant the conclusions.

Basis

°Several sections of Chapter 2 state conclusions drawn from limited data available and then reference section 8.3.1.15 as to the planned activities to collect data.

Recommendation

°Planned thermal and mechanical rock properties programs must be carried out before definitive conclusions on rock properties are drawn.

°The thermal and mechanical rock properties testing plan outlined should be regarded as a minimum acceptable standard.

This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer BD
Date 1/29/88
2/5/88 Rev 1

Chapter 2, p 2-4 to 2-5

Properties and Initial Conditions to be Evaluated

Comment

No mention is made regarding the importance of natural moisture content measurements both in the rock mass and the intact rock. Moreover, the importance of intact rock porosity measurements is not indicated (although included later in the chapter).

Basis

*Page 2-14 indicates that the natural moisture content is not important in the sampling and testing process, yet allowing the saturation state to change between sampling and testing could well alter the values of certain mechanical and thermal properties. Page 2-29 indicates a 30 percent reduction in unconfined compression between dry and saturated tuff which contradicts the earlier statement.

*On page 2-29 no mention is made on the effect of the porosity of a saturated specimen on the determination of Youngs modulus.

Recommendation

*Investigations of rock characteristics described in Chapter 8.3.1.4 and related study plans need to include descriptions of how in-situ rock moisture conditions will be preserved from sampling to testing and how laboratory test results will be correlated with in-situ conditions.

Reviewer RWG
Date 2/8/88

Chapter 2, p 2.2-2.4: Repository Conditions to be Evaluated

Comment

There is no recognition of the importance of the vadose zone as the primary means of waste isolation at the proposed Yucca Mtn site in this section which sets the overall framework within which geoengineering studies and analyses will be performed.

Basis

*Preliminary calculations of unsaturated zone ground water travel time and saturated zone travel time presented in the EA indicate that the saturated zone provides minimal waste containment (about 141 yr.) and that the ground water movement rate through the unsaturated zone provides the primary means of waste isolation at the Yucca Mtn site.

Recommendation

*The Repository Conditions to be Evaluated section should include explicit discussion of how the geoengineering studies, particularly evaluation of expected variations in rock and rock mass properties both by stratigraphic unit and depth will contribute to the evaluation of unsaturated zone hydrology. Many of the studies subsequently cited, e.g. evaluations of effective porosity and fracture characteristics, will contribute fundamental data relevant to post closure waste isolation.

*This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reference

DOE, (1986), Environmental Assessment, Yucca Mountain Site, Nevada Research and Development Area, Nevada, 3 vols, U.S. DOE, Office of Civilian Radioactive Waste Management, Washington, DC, pp 6-153-6-164.

Reviewer DWC
Date 1/27/88
2/5/88 Revision 1

Chapter 2, Section 2.1.2.3.1.1

Effect of Water Saturation on Compressive Strength

Comment

A statement is made (para. 2) that the saturation state of the repository will vary during its history, but no indications are given as to the expected ranges and time sequence of such variations.

Basis

*Thermal effects and long-term climatic variations are expected to affect both the disturbed and undisturbed portions of the travel path from the Yucca Mtn repository, and will affect degree of saturation, rock and rock mass properties in a time-varying manner.

*Changes in rock properties are likely to result from thermal drying. These may have adverse effects or rock strength and be irreversible resulting in reductions in available pore volumes during subsequent rehydration resulting in saturation at lower moisture contents than determined for rocks prior to the presence of the repository.

Recommendation

*Anticipated variations in saturation with time should be discussed and study plans to examine changes in rock, rock mass and hydrologic characteristics with time incorporated in Section 8.3.4 of the SCP along with an explicit discussion of how such data will actually be used to evaluate repository performance assessment (Section 8.3.1.4.3.3).

Reviewer DWC
Date 1/27/88
2/5/88 Revision 1

Chapter 2, Section 2.2.2.2 Natural Joints

Question

Does sufficient information exist about the characteristics of discontinuities in tuff beds beneath Yucca Mtn to determine the scope of planned laboratory and field tests of rock mass characteristics?

Basis

*The subject section of the CDSCP states that the condition of core from Yucca Mtn with unhealed joints has been inadequate for representative laboratory tests. Neal (1986) states that the properties of tuff samples tested in the laboratory differ substantially from rock mass properties estimated from geophysical data. Also, the CDSCP states that joints or faults containing gouge or other infillings may have a lower coefficient of friction than clean, unfilled joints. The characteristics of discontinuities are a major element in the evaluation of rock mass properties for engineering and hydrologic purposes.

*Tests in G-Tunnel upon which most geomechanical assessments to date have been based have been conducted in a different tuff sequence from that planned as repository host. Functional equivalence is assumed based on lithologic grounds, but has not as yet been demonstrated.

Recommendation

Chapter 8 of the SCP and related study plans should reflect the following:

*Coring and sampling methods exist to permit recovery of complete, essentially undisturbed samples of fractured rock. These should be employed to obtain samples of tuff from the Yucca Mtn area during initial phases of Site Characterization.

*These samples should be tested to demonstrate geomechanical equivalence with tuff tested in G-Tunnel before rock mechanics study plans for the Yucca Mtn test facility are made final and work schedules are developed. If this equivalence cannot be demonstrated, impacts on conceptual design and pre and post-closure performance should be assessed.

*Current schedules for the rock mechanics and dependent studies should be reviewed to determine impacts on them presented by any non-equivalencies identified.

Reference

Neal, J.T. (1986) Preliminary Validation of Geology at Site for Repository Surface Facilities, Yucca Mountain, Nevada, Sandia National Laboratories, Albuquerque, N.M., SAND 85-0815, 28pp.

Reviewer DWC
Date 1/27/88
2/5/88 Revision 1

Chapter 2, Section 2.3.2: Mechanical Properties of Rocks at the Site

Comment

It is not clear that the heated block experiment conducted in G-Tunnel evaluated a rock mass representative of that in the G-Tunnel area or functionally equivalent to that at Yucca Mtn.

Basis

*The rock mass tested during the heated block experiment in G-Tunnel showed essentially isotropic properties as expected based upon spacings and orientations of joints with the block.

*The CDSCP does not provide information as to the similarity of the tested block to joint characteristics generally prevailing within G-Tunnel and to joint characteristics anticipated at Yucca Mtn.

*The value of the heated block experiment in planning future thermal-mechanical studies may be reduced in proportion to the deviation of the block from average G-Tunnel and anticipated Yucca Mtn joint characteristics.

Recommendations

*Section 8.3.1.15.1.6.3 of the final SCP should include an explicit discussion of how a representative block will be selected for testing and study plans should be re-evaluated if necessary to assure that representative tuff masses are tested during Site Characterization.

*Joint mapping in the Yucca Mtn test facility described in Section 8.3.1.4.2.2.4 of the CDSCP should sufficiently preceed rock mechanics testing to assure that sufficient information is available for the planning and conduct of the rock mechanics tests.

Reviewer DWC
Date 1/27/88
2/5/88 Revision I

Chapter 2, Section 2.2.1.3 Effects of Water Saturation

Comment

The laboratory experiments on saturated joint strength described on page 2-50 do not appear appropriate for in-situ conditions.

Basis

*It has been shown many times that saturated rock masses have a lower friction angle than dry rock masses, probably owing to hydrostatic pressures which tend to develop along joints. One would normally anticipate a general loss of rock mass strength in saturated as opposed to unsaturated jointed rock masses.

Recommendation

*Section 8.3.1.15.1.4 of the final SCP should discuss how laboratory tests of fractured rock masses will be designed and constructed to permit evaluation of anticipated in-situ conditions.

*This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Chapter 2, Section 2.3.3

Relationship between intact rock, discontinuities and large-scale rock properties

Comment

The use of intact rock values for various strength properties in design analysis suggests that such design analysis should be approached with extreme caution because such values do not represent the condition of the rock mass.

Basis

*Laboratory measurements of strength and moduli do not represent upper bound values in jointed rock. In relatively massive rock such would be true. Such tests only measure the "grains and glue" of intact rock and do not recognize any of the larger defects of the rock mass.

Recommendation

*The final SCP should show how studies of rock masses such as those outlined in Section 8.3.1.15.1.3.3 will be used in determining appropriate geomechanical properties for repository design.

*This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Chapter 2, Table 2-18

Relationship of geoengineering data to issues, information needs and investigations

Comment

Porosity is a geoengineering parameter identified as important to a number of issues, information needs and investigations, but porosity as used in Table 2-18 covers several physical features including rock matrix porosity, fracture porosity and lithophysae.

Basis

*The rocks at the Yucca Mtn site contain voids of varying sizes, geometries and modes of origin. Fracture porosity and possibly lithophysae will exert the greater influences on geoengineering.

*Effective porosity (size and degree of interconnection of voids regardless of mode of origin) will have the principal influence upon water movement and waste transport.

Recommendation

*The specific type(s) of porosity to be evaluated for each item of concern should be shown in Table 2-18. Specific descriptions of studies to determine these properties need to be included in Chapter 8.3.4 of the SCP. Where similar studies are planned as portions of other phases of site characterization, cross references should be provided along with explicit discussions of how these tests will provide the desired information.

Reviewer DWC
Date 1/28/88
2/5/88 Revision 1

Comment

On page 2-66 the assumption that the joints above the water table are dry may be incorrect, even given the strong capillary attraction of the matrix.

Basis

*Although the climate is dry the vadose zone should still contain joint moisture. Thus cohesion values assigned may not be appropriate. Page 2-90/91 indicates that the vadose zone is partly saturated (65 percent saturation [pages 2-92/103]) which would provide considerable joint moisture.

Recommendation

Rock sampling procedures described in Chapter 8.3.1.4 and testing procedures included in Chapter 8.3.1.15 need to include descriptions of how joint moisture contents will be preserved so that planned tests described in Section 8.3.1.15.1.4.2 can properly reflect prevailing environmental conditions.

Reviewer RWG
Date 2/8/88

Chapter 2, Section 2.5.2.2 Thermal Expansion

Comment

The <3 percent fracture porosity utilized (page 2-82) may be inappropriate for the site.

Basis

*Studies indicate that the predominant jointing is vertical (page 2-19). Yet vertical borings have experienced substantial fluid loss (Chapter 1, page 1 215/238). There is no indication for borings drilled using air circulation. Vertical borings would normally be expected to exhibit minimum fluid loss in vertical jointing environments. Every indication is that the vertical joints are generally open and may have a relatively high effective porosity (in terms of the rock mass) and permeability (see also page 6-60).

Recommendation

*Section 8.3.1.4.2.2.3
The final SCP should present explicit plans for horizontal (from exploratory drifts) and angled (from surface) drill holes to better evaluate frequency, characteristics and hydraulic conductivity of vertical fractures at various depths surrounding the repository block.

Reviewer RWG
Date 2/8/88

Comment

There is no discussion of seismic velocity data in the tuffs of the repository area.

Basis

*Such a discussion should be a part of the geoengineering properties of the rock mass. Determination of dynamic properties including logitudinal, shear and vibrational velocities in various directions should be part of the program. This, in turn, would lead to better estimations of deformation moduli, the state of in-situ stress, and permits a more realistic relationship in relating certain laboratory tests to the in situ situation.

*Borehole seismic velocities within the welded tuff in USW G-4 (Figure 1-73) vary between 2500 m/s and 5000 m/s, indicating a significant difference in rock mass properties.

Recommendation

*Field geophysical studies described in Sections 8.3.1.4.2.1.2 and 8.3.1.4.2.1.3 need to include comprehensive engineering geophysical studies directed toward the determination of variations in rock mass properties and appropriate ratios between in-situ and laboratory properties.

*This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Chapter 2, Section 2.6 Existing Stress Regime

Comment

The final SCP should include plans for effective sequencing of contemplated stress measurement techniques at the Yucca Mtn test facility.

Basis

°Advantages and limitations exist with both principal methods of in-situ stress measurements, overcoring and hydraulic fracturing.

°Overcoring techniques permit determinations to be made of stress directions given suitable rock. Hydraulic fracturing can provide a larger scale test to determine magnitude of stress, but requires knowledge of the orientations of the components of the stress field to be most effective.

Recommendation:

°The SCP should outline a sequence of tests using overcoring to identify stress orientations followed by hydraulic fracturing in suitably oriented bore holes to determine stress magnitudes

°Because of the risk of rock mass damage resulting from a hydraulic fracturing experiment, such an experiment should be conducted within rock planned for excavation during subsequent phases of test facility or repository development.

°This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer DWC
Date 1/28/88
2/5/88 Revision 1

Chapter 2, Section 2.7.3.1 Thermally Induced Water Migration

Comment

The analogy between granite and tuff with respect to thermally induced water migration may not be appropriate because of differences in thermal expansion between the two rock types owing to mineral grain and porosity differences.

Basis

°Because of their differing conditions of origin these two rock types, while chemically similar, have greatly differing physical properties.

Recommendations

°Appropriate portions of Sections 8.3.1.4 and 8.3.1.15 need to reflect plans and schedules for early determination of in-situ and laboratory thermal properties of representative tuff specimens.

°Exploration and design schedules need to consider impacts of unfavorable findings as a result of these tests upon repository design criteria and performance assessment.

Reviewer RWG
Date 2/8/88

Chapter 2, Section 2.8.2.3

Estimated Support Requirements
Based on Rock Mass Classifications

Comment

On page 2-105 the support requirements determined from NGI and CSIR classification systems do not appear to consider construction method, i.e., drill and blast, controlled drill and blast, TBM.

Basis

°The requirement for tunnel support in jointed rock masses is often as much a function of the construction method as it is the state of stress and other rock characteristics. The release of gasses is a factor inherent in all drill and blast excavation methods, and tends to increase support requirements. For example the employment of a TBM and/or the New Austrian Tunneling Method may reduce or eliminate considerable amounts of support. Determination of support requirements should be part of the analysis of optimum tunneling methods.

Recommendation

Section 8.3.1.15 of the final SCP should outline plans to evaluate support requirements as a function of excavation method.

Reviewer RWG
Date 2/8/88

Chapter 2, Section 2.8.2.1 G-Tunnel Experience

Comment

Concerning construction methods and rock damage, (page 2-103) the extent of damage to the welded tuffs (in G Tunnel) as a result of controlled blasting methods is not clear.

Basis

°The details of the controlled blasting methods used and the amount of tunnel excavated by various methods are not presented so that it is difficult to assess the magnitude of the problem and its cause.

°Tunnels in tuff would be easily bored using tunnel borings machines (TBMs) currently available.

°On pages 2-108/109 the discussion of excavation methods appears inadequate. Many excavation methods could be used. The question is what is the preferable method given the economics and stability requirements of the repository. There is no discussion of the effect of construction methods on stress release and rock mass reaction. It is not established that increased fracturing in tuff up to 30 cm deep would be caused by a properly designed TBM. Suspect that the cited case (Nishida 1982) was unusual. The zone of "intense fracturing" (page 2-109) is not necessarily found around a tunnel bore if proper construction procedures are employed. The use of non-blasting methods may eliminate much of the problem for all practical purposes. Thus the change in mechanical and thermal properties of the rock mass immediately surrounding the bore may not be significant.

Recommendation

°Section 8.3.1.15.1.8 of the final SCP should include plans to evaluate rock damage caused by TBM excavation in comparison with controlled blasting and other methods.

Reference

Nishida, T., 1982, "Excavation of an Inclined Tunnel by Tunnel-Boring Machine," Tunnelling '82, M. J. Jones (ed.), pp. 145-152.

Reviewer RWG
Date 2/8/88

Chapter 2, Section 2.3.1.2 — Relationship of data to performance objectives

Comment

The applicability of short-term heater tests to longer term stability of waste emplacement holes is uncertain.

Basis

°Referenced heater tests were conducted for periods at least an order of magnitude less than the length of the period that cannister holes must remain open to permit waste retrieval.

°Long-term radiation and thermal stress may result in changes to rock properties not evident with short-term tests.

Recommendation

°The final SCP should outline studies designed to force rock samples at radiation and thermal loads more equivalent to the total amounts of energy to which they will be subject during the retrievability period to more accurately evaluate long-term rock stability.

°This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer DWC
Date 1/28/88
2/5/88 Revision 1

Chapter 2, Section 2.9.1.3

Preliminary evaluation of data uncertainty

Comment

The level of confidence to be expected for geoengineering data should be based upon the need for the data for repository design and performance assessment, not upon the ease with which the data can be collected.

Basis

°The CDSCP states "But if certain requirements are unattainable because of sampling uncertainty then the requirements can be relaxed as part of performance assessment."

°Methods exist to sample and test all geologic media upon or within which construction is proposed, although data collection may in some cases be costly and difficult.

Recommendation

°The final SCP should outline a program of studies that will provide a high degree of confidence with respect to all relevant geoengineering parameters relevant to repository design, operation and post closure ability to isolate waste.

°This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer DWC
Date 1/28/88
2/5/88 Revision 1

Chapter 2, Section 2.9.4

Relation to Regulatory Guide 4.17

Comment

Decisions on locations where geoengineering is obtained must wait for a finer definition of site stratigraphy and structure, which, at the present time, appears fairly general.

Basis

°The present state of knowledge concerning the proposed repository block in Yucca Mountain is very general.

°Intense exploration will be required to create the three-dimensional geoengineering model envisioned in the CDSCP.

Recommendation

°Site studies proposed in para. 1.8.3.2 and Section 8.3.1.4 of the SCP should include determination of the stratigraphy related to geoengineering aspects, in the vein of the thermal/mechanical units defined in Figure 2-5. An effort should be made to better correlate the lithologic/stratigraphic units with thermal/-mechanical units in terms of the various borehole geophysical logs and detailed surface exposure data.

°This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Chapter 6, Section 6.1.2 Reference Design Data Base

Comment

Page 6-40, para. 6.1.2.1.1 and figure 6-5. The Bare Mountain and Crater Flat areas are not shown on figure 6-5 as indicated in text.

Basis

°Missing data.

Recommendation

°An appropriate correction should be made in the final SCP.

Reviewer RWG
Date 2/12/88

Chapter 6, Section 6.1.2.1.5

Three-dimensional thermal/mechanical stratigraphy model

Comment

Page 6-44. The three dimensional model may be described by an equation, but it would be better visualized using contours and isopachs to illustrate the position and distribution of the various thermal/mechanical stratigraphic units.

Basis

°Such illustrations will permit reviewers to visualize and cross-check field and laboratory data to permit geologic validation of model inputs and to assure three-dimensional accuracy of the repository model.

Recommendations

°If such has already been done (Ortiz et al., 1985) appropriate summaries should be included in the final SCP.

°Design data outputs as a result of activities outlined in Sections 8.3.1.4 and 8.3.1.15 should include isopach, contour maps etc. as well as numerical data for computer analyses.

°This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reference

Ortiz, T. S., R. L. Williams, F. B. Nimick, B. C. Whittet, and D. L. South, 1985. A Three-Dimensional Model of Reference Thermal/Mechanical and Hydrological Stratigraphy at Yucca Mountain, Southern Nevada, SAND84-1076, Sandia National Laboratories, Albuquerque, N. Mex.

Reviewer RWG
Date 2/12/88

Chapter 6, Section 6.1.2.2.2 Stress

Comment

Page 6-46. Because of the complexities of crustal stress owing to the influence of Walker Lane at the site, the simple assumption that the maximum principal stress is vertical should be approached with caution.

Basis

°The only in-situ stress data at Yucca Mountain appears to be by hydrofracture methods which assumes that S_v is the maximum principal stress (page 2-84). It appears strange that strike-slip faulting is reflected by stress measurements in nearby areas, while Yucca Mountain exhibits normal faulting stress measurements (see Section 1.3.2.3). Until additional in-situ stress measurements are made at the site it would be well for conceptual design to consider the possibility of the principal maximum stress to be in a horizontal direction as it may have significance to repository orientation.

Recommendation

°Plans [illegible]dules outlined in the final SCP should include early [illegible] of state-of-stress studies outlined in Section 8.3.1.15.2.1 so that a preferred repository orientation can be established prior to major design decisions.

°This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Comment

Page 6-54. Negating the influence of fracture porosity on rock mass properties is highly questionable.

Basis

°The 3 percent estimate (page 2-82) appears to be based on an estimate for tuffs below the water table, for no direct data on the Tonopah Springs tuffs are available. The variability of seismic velocities in the welded tuff and the fluid losses experienced in borings suggest fracture porosity could be greater than matrix porosity. Because saturation states are based on matrix porosity only, considerable error could be introduced into the thermal/mechanical properties of the rock mass as shown on the accompanying tables (6-11, 6-12, 6-13).

Recommendation

°The final SCP should include studies under Section 8.3.1.4 or 8.3.1.15 to evaluate in-situ fracture and effective porosity particularly between the repository block and the water table.

°This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Chapter 6, Section 6.1.2.3.2 Deformability Properties

Comment

Page 6-56. The ratio between the deformation modulus of the rock mass and the elastic modulus of the intact rock should ultimately be tied to the frequency and orientation of fractures in the rock mass. It is better to determine the deformation value independently in large scale in-situ or seismic tests.

Basis

°Laboratory studies do not directly evaluate in-situ conditions.

°Large scale field studies can provide both areally averaged geotechnical properties and through careful experimental design can evaluate individual major anomalies (e.g. fault zones).

Recommendation

°The final SCP in Sections 8.3.1.4 and 8.3.1.15 should place major emphasis through appropriate scheduling and funding on in-situ studies so that rock mass characteristics will be adequately evaluated.

°This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Chapter 6, Section 6.2.4

Design of Surface Facilities

Comment

Page 6-124. Protection from flash flooding is listed as one of the criteria used for siting of surface facilities. The site selection seems contrary to data developed in Section 6.1.2.6.

Basis

°Apparent internal inconsistency in CPSCP.

Recommendation

°Flood hazard studies to be conducted as part of Section 8.3.1.2.1.2 and design studies should be explicitly coordinated in the final SCP so that potential inconsistencies can be detected and eliminated.

°This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Chapter 6, Sections 6.2.5 Shaft and Ramp Design
6.2.6 Subsurface Design

Comment

The conceptual design indicates two tunnel sizes for access ramps and Section 6.2.5.2.1.1 (page 6-141) indicates that ramps (access tunnels) are to be excavated by TBM. Similarly table 6-22 (page 6-145) and Figure 6-61 (page 6-147) show a variety of repository tunnel sizes and shapes, but it is not evident why such variations are necessary.

Basis

°Considerable savings could be realized by standardizing tunnel sizes (say 23 or 25 ft) so that one or two TBMs, as necessary to meet schedules, could handle all the underground excavation.

°The use of TBMs for all underground structures would tend to minimize rock damage and provide the most likely stable tunnel section under all in-situ stress conditions.

Recommendations

°The final SCP should include tests of the effects of various types of tunneling methods on rock damage and mining efficiency.

°Repository designs should be carefully reviewed to identify where greater levels of standardization can be achieved.

°This comment should be filed and reviewed when appropriate work plan submitted to NRC.

Reviewer RWG
Date 2/12/88

Comment

P 8.2-100, section refers to studies on controlled blasting to reduce fracturing resulting from blasting. Non-blasting methods of excavation should be discussed.

Basis

°Non-blasting excavation methods (e.g. TBM) should minimize rock damage and reduce the extent of the disturbed zone.

Recommendation

°Section 8.3.1.15 of the final SCP should include experiments to evaluate the extent of rock damage and effects upon the disturbed zone of alternative excavation methods.

Reviewer RWG
Date 2/12/88

Comment

P 8.2-161/163/164/170. Several tables refer to the maximum rock slab size as a performance measure. As loose rock slabs will be secured or removed, such a measure seems inappropriate.

Recommendation

°The subject performance measure needs to be reviewed and, if retained, an explicit discussion of its appropriateness should be included in the final SCP.

Reviewer RWG
Date 2/12/88

Chapter 8, Section 8.2.2.4.14

Summary of Thermal and Mechanical Rock Properties Program

Comment

P 8.2-215/216. Only topographic maps listed as available in Chapter 1 are 1:24000 U.S.G.S. quadrangle maps (page 1-25) which will be inadequate for the design of repository surface and access facilities.

Basis

°Detailed topographic maps are required for final designs of the subject facilities.

Recommendation

°Chapter 8 of the final SCP should reference the availability of suitable site topographic maps for finai design or describe plans for the acquisition of such topography as part of Site Characterization.

Reviewer RWG
Date 2/12/88

Chapter 8, Section 8.2.2.4.14

Summary of Thermal and Mechanical Rock Properties Program

Comment

Tensile strength determinations for both TSw2 and TSw1 units would appear important as the latter is also being considered for part of the repository, as well as being the potential overlying unit. As formulated only samples from TSw2 would be tested for tensile strength.

Recommendation

°Tests outlined in Section 8.3.1.15 of the final SCP in support of repository design should include samples or in-situ measurements from all relevant units.

Reviewer RWG
Date 2/12/88

Section 8.3.1.5

Question (Page 8.3.1.5-43, Paragraph 3)

The erosion and deposition responses at Yucca Mountain will have to include evaluation of local variables (i.e. uplift, subsidence, stream piracy, etc.) even if the climatic responses at Yucca Mountain are synchronous with those of the rest of the Great Basin.

Basis

•It is important for the climatic model developed for the Yucca Mountain area to correspond/correlate well with regional models of the Great Basin, however, the model still needs to evaluate local variables to completely understand the history of erosion and deposition at Yucca Mountain.

Recommendation

•Clarify and expand the paragraph so that it does not imply that if preliminary climatic responses at Yucca Mountain are synchronous with those of the rest of the Great Basin, the study will be complete and no further evaluation of local variables will be made.

Reviewer RP
Date 2/3/88

Section 8.3.1.5

Question (Page 8.3.1.5-44, Paragraph 1)

What data suggest the two sites selected, Pahute Mesa and Tonopah, have soils similar to the Yucca Mountain area during wetter periods

Recommendation

°Explain the significance of choosing the Pahute Mesa and Tonopah sites and why they were selected over other sites, or reference the section of the SCP that contains the explanation.

Reviewer RP
Date 2/3/88

Section 8.3.1.5

Question (Page 8.3.1.5-46, Paragraph 2)

The dust sampling program should be expanded.

Basis

°The chemical makup of contemporaneous dust is important in evaluating the potential sources of surface silica available for dissolution and redeposition in soil profiles and fracture fillings. More specifically, the results will be applicable in the evaluation of the carbonate-silica vein fillings as seen on the Bow Ridge Fault.

Recommendations

°Suggest more frequent sampling intervals and possible sampling during and/or immediately after major dust storms.

This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer RP
Date 2/3/88

Section 8.3.1.5

Question (Page 8.3.1.5-47, Table methods and Technical Procedures)

The Table states the "dust trap sampling" technical procedure is TBD. On page 8.3.1.5-46, paragraph 2, says a regional network of dust traps is already set up.

Recommendation

*Fix or clarify.

Reviewer RP
Date 2/3/88

Section 8.3.1.5

Question (Page 8.3.1.5-50 & 51, Objectives and Parameters)

It may be more advantageous to develop a soils chronology of geomorphic surfaces versus surficial deposits in the Yucca Mountain area.

Basis

°Based on recent studies in the Crater Flat area, the potential for a new updated mapping scheme of Quaternary surfaces will have to be evaluated when the data are available. Furthermore, these new data may have important age variations from the present mapping scheme of Hoover and Swadley.

Recommendation

°Recommend careful evaluation of the newest data on the mapping of surfaces in the Crater Flat area to determine if the previously completed surficial deposits mapping is the most applicable to aid in the evaluation of the Yucca Mountain site. Specific attention should be given to the new age-dating information which suggests the surfaces are younger than previously estimated.

This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

References

The 1987 yearly technical progress publication issued by the Nevada Bureau of Mines and Geology

Reviewer RP
Date 2/3/88

Section 8.3.1.5

Question (Page 8.3.1.5-53, top of page)

It is next to impossible to distinguish various surficial deposits of the nature found near Yucca Mountain in a boring.

Recommendation

*Recommend expanding the discussion in the section to adequately explain how the identification of the identification of surficial deposits is made in a boring. If this can not be explained, than it should be removed from the proposed program.

This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer RP
Date 2/3/88

Overview of the erosion program: Description of the future erosional rates required by the performance and design issue

Comment

The SCP does not specifically address the evaluation of 1) erosion/sedimentation and 2) flooding at the surface facility locations.

Basis

The overall erosion program will result in an understanding of the potential future erosion in the Yucca Mountain area and on specific watersheds in the area. These data will then have to be applied on an individual basis to evaluate erosion/sedimentation potential at the proposed specific surface facilities. Such site specific analyses will probably require special analyses beyond the scope of the area-wide study.

The overall flooding program will result in an understanding of the potential future flooding in the Yucca Mountain area and on specific watersheds in the area. These data will then have to be applied on an individual basis to evaluate flooding potential at the proposed specific surface facilities.

Recommendations

The SCP erosion and flooding sections should present the specific analyses that will be conducted at the location of each of the following surface facilities: exploratory shaft (ES), men and materials shaft (MMS), steel lined shaft (SLS), waste emplacement ventilation exhaust shaft (WEVES), muck handlir ramp and portal (MHR) and the waste handling ramp and portal (WHR).

The specific erosion programs will rely heavily on the overall site erosion program, but will emphasize different parameters at different facility locations, i.e. lateral erosion at the ES, SLS, and MMS: debris deposition and vertical erosion at the WEVES; vertical and lateral erosion and sedimentation along the MHR.

The specific flooding programs will be based on the overall site flooding program and will essentially compare the postulated elevations of the maximum probable flood to the elevations of the individual surface facility locations and draw conclusions regarding the potential for flooding at the facility. These studies should also include the location and design of all diversion structures and other man-made remediation structures.

References

1) Purcell, C. R., 1986, Potential Erosion at the Yucca Mountain Nuclear Waste Site. Transmitted to NRC in LLNL Monthly Management Letter Report No. 13, Sept. 8, 1987, Chung to Blackford.

2) Purcell, C. R., 1988, Geomorpnic Evaluation of Proposed Shaft and Ramp Locations Yucca Mountain High Level Waste Site. Transmitted to NRC in LLNL Monthly Management Letter Report No. 18, Feb. 5, 1988, Chung to Blackford.

3) Johnson, T. L., NRC, 1987, Report of Site Visit to NNWSI Project Memorandum to R. J. Starmer, NRC.

Reviewer R. Purcell
Date 1/29/88
2/5/88 Revision 1

Section 8.3.1.6

Recommendation

*Need to reference the sources of long-term average upland and hillslope erosion rates for the southern Great Basin.

Reviewer RP
Date 2/3/88

Section 8.3.1.6

Question (Page 8.3.1.6-7, forth paragraph)

Where do these hillslope erosion rates come from?

Recommendation

*Provide appropriate references to substantiate the discussion of average downwasting rates over the last 1-5 million years.

Reviewer RP
Date 2/3/88

Section 8.3 1.6

Question (8.3.1.6-12, First paragraph)

Recommendation

*Suggest including longitudinal profiling along Fortymile Wash and Drill Hole Wash.

Reviewer RP
Date 2/3/88

Section 8.3.1.6

Question (Page 8.3.1.6-30, Timeline Schedule)

The Timeline schedule looks inaccurate. Isn't the information from the climate program (#5) necessary to prepare reports at points #2 and #3? The Timeline shows it following the reports.

Recommendation

*Suggest reviewing and re-evaluating the Timeline schedule for the potential effects of erosion of hydrologic, geochemical, and rock characteristics.

Reviewer RP
Date 2/3/88

Question

Does sufficient knowledge exist concerning the subsurface structure and characteristics of geologic units beneath the reference conceptual site for repository surface facilities to make the assumptions about seismic-induced ground motion presented in paragraph 2, p 8.3.1.14-36?

Basis

° In Figure 8.3.1.14-6 a geologic unit identified as "Non welded Ashflow Tuff" is shown west of the Bow Ridge Fault as conformably overlying the Tiva Canyon Member of Paintbrush Tuff and dipping eastward. Beneath the Midway Valley area this same unit is shown as unconformably overlying the Tiva Canyon Member and subhorizontal. A study by Neal (1986) presents a similar illustration. Neal (1986) states that geophysical surveys provided poor subsurface data and that inconsistencies exist between subsurface models based on the geophysical data and those developed from surface and borehole geologic data.

° Drill hole RF#3 within Midway Valley encountered about 30 m of reworked tuffaceous sediment and airfall tuff between the Quaternary/Tertiary alluvium and the Nonwelded Ashflow Tuff unit. The general geotechnical properties (alluvium or bedrock, relative in-situ density) of this unit are not described in the CDSCP.

° Bedding attitudes within the reworked tuff and Nonwelded Ashflow Tuff units are not indicated on the log for RF #3 and these cannot be determined geometrically based upon one drill hole. The alluvium-reworked tuff contact was encountered in drill hole RF #3b at an elevation suggesting that an areal disconformity between these two units exists.

° No information is provided as to the method(s) used to advance the drill holes beneath Midway Valley. If fluids were used, minor perched water tables or zones of elevated moisture content, possibly suggestive of temporary perched zones, might not have been detected.

Recommendation

°Additional data concerning subsurface conditions beneath Midway Valley need to be developed and evaluated before specific Study Plans to determine seismic response and geotechnical properties of the conceptual site for repository surface facilities are ready for review. Assumptions presented in paragraph 2, p 8.3.1.14-36 should be regarded as premature based upon the quality of currently available data and the degree of uncertainty concerning the Midway Valley subsurface that presently exists.

Section 8.3.1.14.2.1.2 Activity: Preliminary Exploration

Comment

There is no explicit description of plans to explore the conceptual site for repository surface facilities for the presence of potentially active faults.

Basis

•Figure 8.3.1.14-6 shows a geologic cross section that includes the subject area. The section shows several faults beneath the area offsetting units within the Tiva Canyon Member of the Paintbrush Tuff. Effects of these faults on younger rocks and the Quaternary/Tertiary alluvium are unknown (Neal, 1986).

•Surface movement on an active fault could result in damage, tilting or collapse of structures and rupture utilities leading to safety hazards and disruption of repository operations.

•Section 8.3.1.14.2.1.2 contains several references to trenching and other studies of prospective building sites, but makes no reference to any systematic studies to evaluate possible Quaternary faulting within the conceptual site for repository surface facilities.

•General studies to determine ages of faults within the NNWSI area may not provide sufficient site-specific information for facility layout and safety assessments.

Recommendations

•Plans for systematic fault investigation(s) of the area(s) where repository surface facilities and utilities are proposed to be located should be developed and described in the SCP. Neal (1986) recommends that such studies be conducted.

•Schedules should be developed to assure that these studies proceed early enough during site characterization so that surface facilities can be located to avoid any such faults, utility layouts can minimize fault crossings and overall impacts on the NNWSI of the presence of any Quaternary faults within the area of repository surface facilities can be assessed.

Reference

Neal, J.T. (1986) Preliminary Validation of Geology at Site for Repository Surface Facilities, Yucca Mountain, Nevada, Sandia National Laboratories, Albuquerque, N.M., SAND 85-0815, 28pp.

Reviewer DWC
Date 1/25/88
2/5/88 Revision 1

Reference

Neal, J.T. (1986) Preliminary Validation of Geology at Site for Repository Surface Facilities, Yucca Mountain, Nevada, Sandia National Laboratories, Albuquerque, N.M., SAND 85-0815, 28pp.

Reviewer DWC
Date 1/25/88
2/5/88 Revision 1

Chapter 8, Section 8.3.1.15

Overview of Thermal and Mechanical Rock Properties Program

Comment

No discussion is evident on the sensitivity and repeatibility of the in-situ instrumentation, such as extensometers, load cells, etc., to be used.

Basis

°Some of the in-situ tests proposed may result in measurements on the threshold of such instrumentation to detect. Page 2-57 indicates that such an analysis will be made, but provides no details.

Recommendation

°The final SCP should include an explicit technical (as well as QA) discussion of instrument sensitivity and repeatibility.

Reviewer RWG
Date 2/12/88

Chapter 8, Section 8.3.1.15

Overview of Thermal and Mechanical Rock Properties Program

Comment

Page 8.3.1.15-2, Table 8.3.1.15-1. Testing of unit TSw1 for bulk density, grain density and porosity appears to have been overlooked.

Basis

°Conceptual repository drawings indicate that a portion of the repository will be located in unit TSw1.

°Bulk density, grain density and porosity are significant physical parameters.

Recommendation

°The final SCP should explicitly state that a full range of physical properties tests will be performed on unit TSw1 where its presence affects repository design and performance.

Reviewer RWG
Date 2/12/88

Chapter 8, Section 8.3.1.15

Thermal and Mechanical Rock Properties Program

Comment

No mention is made of any plans for rock mass permeability testing or determining seismic properties of the rock mass or moduli which may be derived from such testing.

Recommendation

*Such testing should be an important part of the rock mass testing program and the final SCP should outline plans for such tests.

Reviewer RWG
Date 2/12/88

Chapter 8, Section 8.3.1.15.1

Investigation: Studies to Provide the Required Information for Spatial Distribution of Thermal and Mechanical Properties

Comment

Page 8.3.1.15-18/26. Although there may be some theoretical basis for the term "zero porosity material", it does not occur in nature (at least on Earth).

Recommendation

°The term should be clarified in the final SCP.

Reviewer RWG
Date 2/12/88

Chapter 8, Sections 8.3.1.15.1
8.3.1.15.1.1

Overview of Thermal and Mecnanical Rock Properties Program

Comment

P 8.3.1.15-20. Greater consideration should be given to measuring joint properties in-situ rather than in the laboratory.

Basis

°No sampling method (for lab samples) is proposed (page 8.3.1.15-41) though sample sizes of 0.5 to 1 m are suggested (page 8.3.1.15-40).

°It is difficult to obtain good values on joint strength in the laboratory environment unless the joints are healed. However it is usually the unhealed joints that are the controlling factor in rock mass strength. Page 8.3.1.15-54 indicates that such in-situ testing may be done.

Recommendation

°Section 8.3.1.15.1.6 in the final SCP should include explicit discussion of plans for in-situ testing of joint characteristics.

Reviewer RWG
Date 2/12/88

Chapter 8, Sections 8.3.1.15 Overview and Demonstration
8.3.1.15.1.5.2 Breakout Rooms

Comment

Page 8.3.1.15-22. Only limited field measurements of rock deformation are indicated, yet later paragraphs cover extensive deformation testing in the demonstration breakout rooms. Further, page 8.3.1.15-45, the data obtained from the demonstration breakout rooms will be partly subject to the method of construction.

Recommendation

°It would be prudent to install extensometers from the surface prior to excavation in order to observe both instrumental noise and the amount of deformation that occurs during the excavation stage.

Reviewer RWG
Date 2/12/88

Chapter 8, Section 8.3.1.15.1.8 Study: In-situ Design Verification

Comment

Page 8.3.1.15-66. It appears (para. 8.3.1.15.1.8.1) that the only mining method being considered during site characterization is controlled drill and blast. Other methods should be considered and discussed, especially because of the necessity to preserve the peripheral rock in as undamaged state as possible.

Basis

°Experience demonstrates that other methods of excavation (e.g. TBM) may result in less rock damage and extent of the disturbed zone than drilling and blasting techniques.

Recommendation

°The final SCP should outline studies to evaluate alternative excavation methods and to determine their effects on the rock mass and extent of the disturbed zone.

Reviewer RWG
Date 2/12/88

Chapter 8, Section 8.3.1.15.1.8.3 Activity: Monitoring Drift Stability

Comment

Pages 8.3.1.15-69/70. Consideration apparently has not been given to employing microseismic techniques to pinpoint zones of stress relief both before, during and following construction of underground testing facilities.

Basis

°Such measurement techniques would be appropriate from the standpoint of both safety and better understanding stress relief and the state of stress in the rock mass which may affect the design and location of the repository.

Recommendation

°The final SCP should include a discussion of such techniques and outline plans for their evaluation or use.

Reviewer RWG
Date 2/12/88

Section 8.3.1.16

Question (Page 8.3.1.16-10, Study)

Recommend listing what specific washes will be studied for potential flooding.

This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer RP
Date 2/3/88

Section 8.3.1.16

Question (Page 8.3.1.16-12, Forth paragraph)

In the Yucca Mountain area, how does one distinguish a large boulder deposited in a channel by fluid flows versus one deposited by mass wasting?

This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer RP
Date 2/3/88

Section 8.3.1.17 Overview of Preclosure Tectonics
Page 8.3.1.17-34, P 6, line 10

Comment

The role of horizontal displacement is not considered in the development of fault displacement criteria (p 8.3.1.17-32, P 5, l 7; p 8.3.1.17-34, P 6, l 12; p 8.3.1.17-45 P 2, 6 and 8) .

Basis

°In discussions of fault displacement it is not clear if horizontal displacement is considered, except for the statement on page 8.3.2.27-46 (P5, l 11). In that statement the amount of undetected strike-slip motion is assumed to be as large as the measured dip-slip component. However, there is evidence (Frizzell and Zoback, 1987) that the horizontal component can predominate over the vertical component. One of Frizzell and Zobacks groups of faults had rakes of less than <20°. A fault with a rake of 20° and a vertical displacement of 5 cm would have a horizontal displacement of over 13 cm. Is that acceptable for either FITS or the underground repository? Basing acceptability on only vertical displacement could grossly under estimate the amount of total displacement.

°On page 1-207 in Chapter 1 there is a brief discussion of strike slip on faults and it is recognized that horizontal displacement could exceed vertical displacement and thus increase the displacement rate. It also states the strike-slip component of movement is being studied in order to determine more accurate estimates of both types of faulting and their probability of occurrence. It references section 8.3.1.8 (Overview of Post-closure Tectonics). It should be noted that total displacement is referred to, but specific horizontal displacement is not. Also, in that section there is no study to determine accurate estimates of both types of faulting and their probability as indicated on p 1-207.

Recommendation

°Criteria that includes an assessment of horizontal slip needs to be developed. This could be either a direct measure of the horizontal displacement, an indirect estimate using the measured rake of slickenslides on the fault, or a statistical estimate based on relative distribution of rake on faults with different strikes as developed in Frizzell and Zoback.

Reference

Frizzell, V. A., Jr. and Zoback, M. L., (1987) Stress Orientation Determined from Fault Slip Data in Hampel Wash Area, Nevada, and Its Relation to Contemporary Regional Stress Field, Tectonics, v 6, No. 2, p 89-98.

Reviewer HLMK
1/27/88
2/5/88 Revision 1

Section 8.3.1.17.1
Page 8.3.1.17-39, p 2

Investigation: Studies to provide required information on volcanic activity that could affect repository design or performance

Question

An ash fall from a silicic volcano will have its greatest effects on transportation and power supply.

Basis

*There are other factors related to a volcanic ash fall to consider besides the impact on surface and subsurface ventilation system. The most immediate effect of even a relatively light ash fall would be on transportation. Depending upon the duration of the ash fall and the amount accumulated, transportation to and around the repository area could be stopped for several hours to a week or more (Warrick et al., 1981). The electrical power supply system could also be interrupted.

Recommendations

*The impact of an ash fall on other parts of the total repository system needs to be considered.

*This comment should be filed and considered in revieweing appropriate study plan.

Reference

Warrick, Richard A. (1981) Four Communities under Ash after Mount Saint Helens Prog. Tech., Envir. and Man, Mono, 34, Inst Behaviorial Sci., Univ. of Colorado, 142 p.

Reviewer HLMK
1/27/88
2/5/88 Revision 1

Section 8.3.1.17.4.3.1
p 8.3.1.17-108, P 3

Activity: Conduct and evaluate deep geophysical surveys in an east-west transect crossing the Furnace Creek fault zone, Yucca Mountain, and the Walker Lane

Comment

A better seismic reflection data acquisition should be used.

Basis

°Seismic reflection surveys have been highly successful in Yucca Flat and Mid Valley because of the experimental design. One component of the seismic data acquisition was the use of shorter group intervals. Another difference was the use of stacked arrays concept.

°A successful seismic reflection survey program would be one of the major components of the subsurface exploration at Yucca Mountain. As such the program should be success oriented.

Recommendation

°Because successful seismic reflection surveys can provide valuable information to a number of different parts of the program, its design, execution and the data analysis should be supervised by a competent experienced reflection seismologist.

°The effort to obtain seismic reflection data will require more than a simple "off the shelf" survey. The group designing and executing the survey should be aware of the inherent problems associated with such surveys in both volcanic rocks and alluvial basins, especially those with a deep partially saturated zone above the water table. Such a group should be capable of identifying and correcting problems early in the survey.

Reference

Memo N. Burkhard to L. McKague (1988), Review of USGS Open File Report 83-912 and the final draft of the Weston Geophysical Report: Survey of Geophysical Techniques for Site Characterization in Basalt, Salt, and Tuff, p 65-66. Transmitted to NRC in LLNL Monthly Management Letter Report No. 6, Chung to Blackford, Feb. 5, 1987.

Reviewer HLMK
1/27/88
2/5/88 Revision 1

Section 8.3.1.17.4.5
p 8.3.1.17-132, P 2

Activity: Detachment faults at or proximal to Yucca Mountain

Question

How can contacts previously mapped as depositional and/or thrust faults be considered - "as in fact' - detachment faults on the basis of reinterpretation of the geologic maps?

Basis

°Reinterpretation of maps can only yield alternate interpretations of the contacts. To demonstrate these contacts are detachment faults requires additional field work.

Recommendation

°Detailed field mapping in areas which could be interpreted as detachment faults on geologic maps.

Reviewer HLMK
1/27/88
2/5/88 Revision 1

Section 8.3.1.17

Question (8.3.1.17-169, Activity)

This section intermixes the terms "surfaces" and "deposits" and as such, needs clarification.

Basis

*Geomorphic surfaces and surficial deposits are not the same and should not be used interchangably.

Recommendation

*Rewrite the section correcting the use of geomorphic surfaces versus geomorphic deposits.

Reviewer RP
Date 2/3/88

Section 8.3.1.17

Question (Page 8.3.1.17-169, Parameters)

Rock varnish dating should not be used as a stand-alone method to determine the age of a geomorphic surface.

Basis

*The use of rock varnish dating is a viable instrument to aid in determining the age of a geomorphic surface. However, it should be used in conjunction with various other parameters (i.e. degree of dissection, desert pavement development, soil profile development, etc.) and not stand on its own.

*Harrington and Whitney (1988) state in their discussion of rock varnish dating that sample selection is the major limiting factor for varnish age determination. Such inherent weaknesses in many dating techniques further emphasizes the contention that rock varnish dating of geomorphic surfaces should be supported by other techniques.

Recommendation

*Rewrite the section to include 1) how the desert varnish data will be combined with other data developed during the site characterization process and 2) refer to the appropriate sections of the SCP to show the plans to develop other data that should be combined with the rock varnish dates to provide a final interpretive picture of geomorphic surfaces.

References

Harrington, C. D. and Whitney, J. W. (1987), Scanning Electron Microscope Method for Rock-Varnish Dating, Geology, v 15, p 967-970.

Reviewer RP
Date 2/3/88
2/24/88 Rev. 1

Section 8.3.1.17

Question (Page 8.3.1.17-170, First paragraph)

Its questionable if geomorphic surfaces around Yucca Mountain will be mappable on satellite imagery, as anticipated. Many varnished areas are of such dimensions they may not be detected on satellite imagery.

This comment should be filed and reviewed when appropriate study plan is submitted to NRC.

Reviewer RP
Date 2/3/88