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Please contact April V. Gil of my staff at 794-5578 if you have any questions or need more information.

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Enclosures:
1. Disclaimer
2. List Of Draft Documents
3. Draft Documents As Stated In Enclosure 2

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LIST OF DRAFT DOCUMENTS

1. Appendix G Discussion On Strategy For Mapping

APPENDIX G
DISCUSSION ON STRATEGY FOR MAPPING

DISCUSSION ON STRATEGY FOR MAPPING

Recommended Strategy and Rationale

The recommended strategy for mapping during repository construction is to: 1) map approximately 10% of emplacement drifts, based on the current drift spacing and layout; 2) map non-emplacement drift openings; and 3) observe rock mass conditions for anomalous conditions during construction. The rationale for mapping 10% of the emplacement drifts is that the frequency of mapped drifts is selected to assure intersection of features anticipated to affect repository performance. Present surface mapping shows several faults with approximately 200 - 300 m fault trace length within the repository block. Most of these faults are expected to penetrate the host repository horizon and extend downward to the water table. The importance of these faults to repository performance is currently uncertain. A frequency of mapping approximately 10% of the emplacement drifts, at the current spacing, would provide reasonable confidence of intersecting these surface mapped features at depth. The specific locations of the mapped emplacement drifts may also depend upon observations at during construction. Also, detailed mapping of an emplacement drift near the Performance Confirmation observation drifts provides needed rock mass characterization for the thermal monitoring and testing of emplacement drifts.

Sequencing Approach

A possible approach will be discussed regarding the sequencing of mapped drifts and contingencies in case an anomalous condition is found in a mapped drift. The recommended strategy includes mapping the non-emplacement perimeter and main drifts first. Then, the approach would sequence emplacement drift construction such that the first emplacement drift is excavated and mapped, then the eleventh emplacement drift is excavated and mapped. If no anomalous conditions are encountered, then the intermediate emplacement drifts can be constructed without the need to map any drifts between the mapped drifts. If an anomalous condition is found, then provisions are made to locate and bound the extent of the anomalous condition. This includes providing for and installation of an alternative ground support system that would allow mapping and characterization, if necessary, in adjacent drifts where the feature is expected to be located. This provision would be continued until the anomalous condition is no longer found and is bounded. When the drifting of the panel between the mapped drifts is complete, then the panel of drifts is released for emplacement of waste.

The next panel of drifts would proceed similarly, e.g., map the twenty-first drift: if OK, the emplacement drift between the eleventh and the twenty-first can be constructed without mapping, etc. Also, any observation drifts or cross-block ventilation drifts near the panel of drifts should be used as mapped drifts to bound the panel.

Current Concerns Regarding Observations During Construction

There are concerns about the ability to observe rock mass conditions during construction with the tunnel boring machine and precast concrete segment lining system that are envisioned for the emplacement drifts. With this strategy, a modified tunnel boring machine is needed which allows the observation of the rock mass during construction for anomalous conditions. The preferred tunnel boring machine for installation of a precast concrete lining would have a shield that covers about 270 degrees of the drift with only the invert area open. This tunnel boring machine design would provide support to the rock mass and allow installation of the precast segments for nearly all expected conditions. Observation of only the invert area is inadequate. There is too much smear and dust in the invert to be able to determine if anomalous rock mass conditions exist. But, it may not be necessary to see above the springline to get this information. The tunnel boring machine shield would need to provide some support below the springline and with an approximately 210-degree shield, most expected ground conditions would be accommodated and the precast segments could be installed. Approximately 150 degrees of viewing should be sufficient to determine if anomalous rock mass conditions exist. The type of anomalous conditions that would be of concern or would lead to mapping in the adjacent drifts includes: active flow of water, evidence of weathering or oxidation, thick fracture coating/minerals, evidence of hydrothermal alteration, and mineral resources.

With this approach, it appears that there is a capability to observe rock mass conditions during construction and have a tunnel boring machine that can efficiently emplace precast concrete linings in most expected ground conditions. In areas where anomalous conditions exist, the tunnel boring machine should also have the capability to change to an alternative ground support system to allow access/viewing/testing of this area. A steel ring support system, or rockbolts and mesh with installation of a heavy invert segment would allow the tunnel boring machine to push off the alternative ground support system in a fashion similar to the precast concrete segments. After viewing/testing is complete, a cast-in-place lining could be installed in the open area.

There are still a number of concerns and details that remain to be resolved to implement this strategy. One concern regards the ability to switch between precast segments and steel sets with cast-in-place concrete lining. In the current design, there is a potential mismatch of sizes. Recent drawings in design review show the minimum excavated diameter of an emplacement drift lined with precast segments to be 5550 mm, and for one containing steel sets and cast-in-place concrete lining to be 5650 mm. These dimensions are for the same inside diameter of 5100 mm. To use the same tunnel boring machine for both support systems requires using the same excavated diameter. Doing so, with the current configuration, results in different inside diameters, which may be acceptable. Maintaining the same inside diameters would require using thicker precast segments. Currently, there is no mismatch with rockbolts and cast-in-place concrete because the cast-in-place lining can be made thinner, but then there is a concern of what the tunnel boring machine pushes off. Having the tunnel boring machine push off of the alternative support system (mostly the precast invert section) can easily cause tunnel boring machine steering problems, and therefore use of this method would be limited to short distances or development of alternative features.

Purpose and Scope

The purpose of this discussion is to develop a recommended strategy for repository subsurface mapping during construction and provide the rationale for the recommendation. The scope of this discussion covers the translation of system level, regulatory requirements related to mapping and of derived requirements from reports or analyses into specific technical data needs. A technical evaluation of the data-needs is covered, and evaluations of criteria important to the mapping strategy are included.

Background

The extent of geologic mapping of emplacement drift wall surfaces required for performance confirmation activities or for other reasons could significantly impact the design and emplacement method of the emplacement drift ground support system. The preferred ground support system for emplacement drifts is a precast concrete lining. This lining is most economically emplaced immediately after the drift is excavated, allowing essentially no time for geological mapping of the drift walls. If a large portion of the drift wall must be mapped, then the advantage of this type of ground support system is reduced and the overall cost of the ground support system could be significantly increased.

A brief description of the terminology for mapping and observations which are used in this discussion is provided below. **Mapping** provides a record of encountered conditions and features for subsurface excavations; provides a database for design, for stability analysis, for confirmation of geotechnical predictions, and for maintenance and monitoring; and a permanent record of construction; per the American Society for Testing and Materials (ASTM) D 4879 - *Standard Guide for Geotechnical Mapping of Large Underground Openings in Rock* (ASTM 1991). Some examples of mapping are full periphery maps, detailed line surveys, and photogrammetry. **Observations** are conducted to provide documentation by qualified personnel to describe characteristics of the rock mass and record anomalous conditions as excavation progresses and to identify reportable geologic conditions. This is typically done by stationing a geologist at the TBM, and often photogrammetry is used to supplement records.

Reference Design and Assumptions

The reference ground support system design is a precast concrete lining in 90% of emplacement drifts, consistent with the mapping strategy. An initial, temporary, support plus cast-in-place concrete lining are used in the remaining 10% of emplacement drifts and in all non-emplacement drifts. There are currently two alternative designs for the ground support system. The first design alternative is a two-pass system with an initial support system consisting of appropriate combinations of steel sets, steel lagging, rock bolts, and welded wire fabric followed by a cast-in-place concrete lining system. This alternative could be used if 100% of the drifts were to be mapped. The second design alternative is a non-concrete alternative. It consists of steel sets, welded wire fabric, and steel lagging. It is assumed that rock samples can be obtained regardless of ground support system installed.

Requirements and Current Regulatory Position

The *Repository Design Requirements Document* (DOE 1994c) is the source of the following requirements related to mapping.

3.4.6 CONSTRUCTION RECORDS

B. Construction records for the GROA shall be prepared and maintained in accordance with 10 CFR 60.72(b) and Section 3.4.5 (of the *Repository Design Requirements Document*) to ensure useability for future generations. The required records include as a minimum, the following:

2. A description of the materials encountered.
3. Geologic maps and geologic cross-sections.
4. Locations and amount of seepage.
5. Details of equipment, methods, progress, and sequence of work.
6. Construction problems.
7. Anomalous conditions encountered.

[MGDS-RD 3.4.6][10 CFR 60.72(a) and (b)]

3.7.6 PERFORMANCE CONFIRMATION REQUIREMENTS

A. General Requirements.

4. The performance confirmation program shall provide data that indicates, where practical, whether:
   a) Actual underground conditions encountered and changes in those conditions during construction and waste emplacement operations are within limits assumed in the licensing review; and
   b) Natural and engineered systems and components required for repository operation, or that are designed or assumed to operate as barriers after permanent closure, are functioning as intended and anticipated.

   [MGDS-RD 3.7.2.7.A.3][10 CFR 60.140(a)]

The current regulatory position on mapping is that the regulations and existing regulatory guides provide limited guidance about level of detail necessary to satisfy requirements. The regulation calls for geologic maps and cross sections, but provides no guidance on the extent of the coverage and level of detail as to scale of the maps. Based on a review of Yucca Mountain Project communications, the project has made no commitments to NRC related to mapping of the repository. The Yucca Mountain Project should establish a position on the appropriate level of detail needed to satisfy performance confirmation requirements, construction records requirements, and design confirmation needs. Once this position is determined, the Yucca Mountain Project should initiate discussions with NRC on the level of detail needed to satisfy regulatory requirements (Younker, et al. 1997).

Technical Data-Needs

The above regulatory requirements lead to several technical data-needs. The identification of Performance Confirmation parameter data-needs, related to mapping, is documented in the *Performance Confirmation Concepts Study Report* (CRWMS M&O 1996f) and earlier in this *Performance Confirmation Plan*. Data-needs related to repository design confirmation are derived from the *Repository Design Data Needs* (CRWMS M&O 1995d) document and the assumption that this data stated as needed for the ESF will also be needed for the repository. The data-needs for construction records are used directly from the above requirement.

Performance Confirmation Parameter Data-Needs

Stratigraphy

Location and Characteristics of Faults and Fault Zones

Location and Characteristics of Fractures and Fracture Zones
Location of Fracture Infillings and Chemical, Mineralogical, and Biological Characteristics
Location and Characteristics of Seeps
Confirm Absence of Hydrocarbons and Mineral Resources

Repository Design Confirmation Data-Needs
Rock Mass Quality

Construction Records Data-Needs
Description of the Materials Encountered
Geologic Maps and Geologic Cross-Sections
Location and Characteristics of Seeps
Details of Equipment, Methods, Progress, and Sequence of Work
Construction Problems
Anomalous Conditions Encountered

Each of these data-needs is discussed in additional detail below. For the performance confirmation parameter data-needs, the current confidence in the data is qualitatively estimated. The use and importance of the data to repository design and performance assessment and process level model is discussed. Finally, the amount of additional data needed through mapping and/or observations is discussed. The repository design confirmation data-needs are covered by the performance confirmation parameter data-needs. All construction record data-needs are addressed as a whole category of information.

Stratigraphy

The current level of confidence in data related to stratigraphy is high, except in the southwest quadrant of the repository block. The importance of stratigraphy for design is that it bounds the vertical volume of rock available for the potential repository within the Topopah Spring thermal/mechanical unit with respect to the needed rock stability. Other stratigraphy related information that is used to limit the design are the minimum of 200 m overburden required by 10 CFR Part 960, and the assumed minimum of 100 m to the water table. The importance of the stratigraphy to the Performance Assessment and Process Modeling is that it defines geometric extent of applicable rock properties for thermal-hydrological and radionuclide transport analyses. The additional data needed for performance confirmation related to stratigraphy can be accommodated by mapping and sampling the non-emplacement drift openings in the reference repository layout. Observations during construction ensure there are no anomalous conditions related to the stratigraphy or indicate when additional mapping is necessary.

Faults and Fault Zones

There is moderate confidence in the faults and fault zones' locations and characteristics, but specific underground locations and the hydrologic importance of faults are uncertain. The importance of faults and fault zones for the design is that they bound the volume of rock available for the potential repository within Topopah Spring in horizontal direction, assuming a standoff of 120 m from the Ghost Dance fault and 60 m from other major faults; smaller faults with trace lengths of approximately 200 - 300 m are expected, but are not currently considered to impact design. The importance of faults and fault zones to Performance Assessment and Process Modeling, including fluid flow and radionuclide transport, is not yet known. Currently, only location and vertical offset of major faults and some pneumatic properties are considered, but not their thermal-hydrological and radionuclide transport properties. Their importance to postclosure performance will depend on the extent of the lateral diversion of flow within hydrogeologic units, which is being investigated now.

A summary of the unsaturated zone flow model relative to faults is provided below and is based on *The Site-Scale Unsaturated Zone Model of Yucca Mountain, Nevada, For the Viability Assessment* (LBNL 1997b). For flow above the repository, most of the fast path flow through the PTn unit is associated with structural features such as faults or fault-associated fractures that cross the various geologic formations comprising the PTn. Related to the percolation flux at the repository, analyses of borehole temperature data provide percolation rate estimates. Many of the high percolation flux estimates are obtained from boreholes that are located near faults. For flow below the repository, flow that encounters a generally eastward-dipping perched layer will be laterally diverted. The diversion continues until the water table is reached or until a fault or an extensive fracture system is encountered that can reinitiate mostly downward vertical flow. The above summary of the unsaturated zone flow model relative to faults is based on the available fault properties. The current fault properties are derived primarily from pneumatic data from the testing of the North Ghost Dance Fault Alcove. Gas permeabilities are on the order of hundreds of darcies and there are significant lateral variations in permeability within fault zones. Additional data on fault properties and processes are needed. Some additional data may be derived from the Enhanced Characterization of the Repository Block effort, which proposed testing in the Solitario Canyon fault. Also, long term fault zone hydrology monitoring and testing are included in this *Performance Confirmation Plan.*

Present surface mapping shows several faults with an approximately 200 - 300 m fault trace length within the repository block. These faults have a predominant north-south orientation. Most faults are expected to penetrate the host repository horizon and extend downward to the water table, and may be large enough to have an influence on repository performance or are candidates for detailed consideration. This evidence and the current uncertainty in the fault and fault zones importance to postclosure performance conservatively leads to a spacing of mapped drifts that would provide a reasonable confidence that these features would be located at the repository horizon and their fault characteristics (width, length, orientation, and displacement) would be established. Mapping all non-emplacement drift openings will provide additional information on some faults. In particular, mapping of the perimeter drifts, the West Main and Exhaust Main, provides an approximate 600 m spacing between mapped drifts. These drifts generally run in the north-south direction nearly parallel to the predominant fault orientation. Mapping of the three non-emplacement ventilation drifts and the five Performance Confirmation observation drifts, based on the current layout, leads to an approximate 600 m spacing in the direction of the emplacement drifts. The emplacement drifts run approximately in an east-west direction. In order to provide a reasonable likelihood that these approximate 200 - 300 m features are mapped, the frequency of mapped emplacement drifts should be on the order of about 300 m. A mapped emplacement drift frequency of approximately once every tenth drift will lead to this spacing given the current repository layout. The specific locations of which emplacement drifts are mapped may also depend upon the observations during construction. It is noted that a reduced frequency of mapped drifts may be possible depending upon the combined coverage of both the mapped non-emplacement drifts and the mapped emplacement drifts.

Fractures and Fracture Zones

Concerning the fractures and fracture zones, there is high confidence in the data near the ESF, but low confidence away from the ESF. Statistics on fractures characteristics are important. Also, the location and characteristics of fracture zones are important. As far as the fracture and fracture zone importance to design, for the ESF, their characteristics were considered in terms of rock stability through the Rock Mass Quality parameter. This parameter was used to evaluate ground support requirements. The information for the potential repository will be extrapolated from the ESF data and needs to be confirmed. For Performance Assessment and Process Modeling, detailed fracture characteristics are currently not used directly, but are considered in terms of equivalent rock matrix properties (e.g., porosity and hydraulic conductivity) which are derived from model calibrations against other data (e.g., measured moisture contents). Detailed fracture information near the instrumented emplacement drifts is needed in full-scale thermal monitoring. The mapping of the non-emplacement drift openings should provide adequate coverage for confirmation of the fracture statistics. Detailed mapping of an emplacement drift, including fracture parameters, provides the needed rock mass characterization for thermal monitoring and testing of emplacement drifts near Performance Confirmation observation drifts. At least one emplacement drift should be mapped near each Performance Confirmation observation drift.

Chemical/Mineralogical and Biological Characteristics of Fracture Infillings

There is high confidence in the ESF on chemical/mineralogical and biological characteristics of fracture infillings, but low confidence away from the ESF. These parameters are currently not considered in the design, because they have no direct impact on the excavation stability. For Performance Assessment and Process Modeling, chemical/mineralogical and biological characteristics of fracture infillings are considered in geochemical and waste package performance testing as a basis for waste package corrosion model development. The characteristics of fracture infillings may also influence fluid flow and radionuclide transport, but are not yet considered explicitly in performance assessments. This data will be collected through the observation of rock mass conditions during construction. If anomalous conditions are observed, then the location will be documented, samples will be taken, and investigation will be conducted.

Locations and Characteristics of Seeps

For the locations and characteristics of seeps, there is low confidence everywhere, including in the ESF. For design the location and characteristic of seeps are considered only as a contingency with respect to water removal from repository to the surface. For Performance Assessment and Process Modeling, seeps are considered in waste package material degradation (i.e., corrosion) and waste form dissolution modeling with respect to potential postclosure performance, without knowledge of actual locations and local variations in seepage rates. The determination of location and characteristics of seeps will be collected through the observation of rock mass conditions during construction. If anomalous conditions are observed, then the location will be documented, samples will be taken, and investigation will be conducted.

Hydrocarbons and Mineral Resources

With regard to hydrocarbons and mineral resources, there is high confidence everywhere of the absence of these resources. These parameters are not considered in current design or performance assessment, but the occurrence of hydrocarbons and mineral resources of economic value would be a site disqualifier per 10 CFR 960.4-8-2-1(d)(2) or a potentially adverse condition per 10 CFR 60.122(c)(17). Confirmation of the absence is needed and will be accommodated through the observation of rock mass conditions during construction. If anomalous conditions are observed, then the location will be documented, samples will be taken, and investigation will be conducted.

Construction Records

The data needs related to a description of the materials encountered; details of equipment, methods, progress, and sequence of work; construction problems; and anomalous conditions encountered will be accommodated through the observation of rock mass conditions during construction. The data-need related to location and characteristics of seeps was addressed as a performance confirmation data-need above. Geologic maps and geologic cross-sections will be supplemented with information developed from the mapped drifts.

Mapping Options

In developing the strategy for mapping the emplacement drifts, several options for mapping were considered and evaluated. The emplacement drift mapping options considered are:

1) Map non-emplacement drifts only; or
2) Map 10% of emplacement drifts (at present drift spacing)[1]; or
3) Map all emplacement drifts.

Each mapping option also includes mapping of non-emplacement drift openings and observation of rock mass conditions during construction. The rationale for option one is that it is the minimum possible amount of mapping of the emplacement drifts. This option should have the least impact on the preferred ground support design for emplacement drifts. The rationale for option two, mapping 10% of the emplacement drifts, is that the frequency of mapped drifts is selected to assure intersection of features that are anticipated to affect repository performance. Present surface mapping shows several faults with approximately 200 - 300 m fault trace length within the repository block. Most faults are expected to penetrate the host repository horizon and extend downward to the water table. And, the importance of these faults to repository performance is currently uncertain. A frequency of mapping approximately 10% of the emplacement drifts, at the current spacing, would

[1]The option "10% of emplacement drifts" includes any drift in the repository layout that would yield the appropriate frequency of mapped drifts and does not mean that only emplacement drifts should be included. The cross-block ventilation drifts and performance confirmation observations drifts should be included if they are located at the proper frequency.

provide a reasonable confidence of intersecting any of the surface mapped features at depth. Also, detailed mapping of an emplacement drift near the Performance Confirmation observation drifts provides for rock mass characterization for thermal monitoring and testing of emplacement drifts. The rationale for option three is that it is the maximum possible amount of mapping of the emplacement drifts. This option would have the least regulatory risk, regarding regulatory requirements on construction records and mapping for performance confirmation, since all drifts would be mapped.

Evaluation Criteria

The evaluation criteria that will be used to compare the mapping options described above include: the technical criterion of adequacy to meet data-needs; and the programmatic criteria of cost, schedule, regulatory risk, and impacts on design. These evaluations are later assessed to develop some conclusions and provide the overall recommendation for the mapping strategy.

Evaluation of Adequacy of Mapping Options to Meet Technical Data-Needs

This evaluation compares the above identified technical data-needs with the capabilities of each mapping option. For option one, Map Non-Emplacement Drifts Only, unless the size of important features is on the order of 600 m or greater and the need for rock mass characterization of emplacement drifts is later determined to be unnecessary, this option does not meet all the technical data-needs identified. For option two, Map 10% of Emplacement Drifts, this option meets all the technical data-needs identified unless the size of important features is less than 300 m. For option three, Map All Emplacement Drifts, all technical data-needs will be met.

Cost Evaluation of Mapping Options

This evaluation identifies option two as the reference cost and then provides an evaluation of the incremental cost differences to employ the other options. The cost for mapping and sampling is $35 M for the reference design (CRWMS 1997p) which is consistent with option two described above. This reference cost estimate is based on using the reference ground support design, but the lining cost is not included. These costs occur in the years 2004 - 2030. This evaluation has also developed a rough order of magnitude (ROM) estimate for the incremental cost of changing to option one or three.

For option one, Map Non-Emplacement Drifts Only, the estimate is a reduction of $20 M ROM in the years 2010-2030. Most of the cost is due to the change in ground support, from cast-in-place to precast in 10% of the emplacement drifts. The cost for option three, Map All Emplacement Drifts, is an increase of $180 M ROM in the years 2010-2030. Most of the cost is change in ground support from precast to cast-in-place in 90% of the emplacement drifts.

Schedule Evaluation of Mapping Options

This evaluation considers both impacts to the schedule for construction and emplacement of the waste and complexity of the construction logistics. None of the options is expected to influence the ability to meet the overall schedule, but only impact the complexity of the construction logistics. For option one, Map Non-Emplacement Drifts Only, the use of one ground support system for all emplacement drifts simplifies construction logistics. Option two, Map 10% of Emplacement Drifts, is the reference case and is conducted according to the schedule for construction and emplacement. This option has fairly complex construction logistics, due to having two different ground support emplacement capabilities. Single-pass ground support emplacement is used in 90% of the emplacement drifts, those drifts that are not mapped, and two-pass ground support emplacement is used in the 10% of the emplacement drifts that are mapped. Option three, Map All Emplacement Drifts, again is not likely to impact the ability to meet the overall construction schedule, but will have an impact on construction logistics due to having to emplace the ground support in a two-pass approach for all emplacement drifts.

Regulatory Risk Evaluation of Mapping Options

In this evaluation, the regulatory risk is qualitatively estimated by the sufficiency of information for regulatory compliance. For option one, Map Non-Emplacement Drifts Only, sufficiency is uncertain since limited guidance is provided, but this option does not satisfy all currently identified technical data-needs (see above evaluation). Based on this, the option is given a high risk. For option two, Map 10% of Emplacement Drifts, sufficiency is uncertain since limited guidance is provided, but the option is expected to satisfy all currently identified technical data-needs (see above evaluation). Based on this, the option is given a low risk. For both of the previous estimates there is considerable uncertainty, due to the lack of guidance. Discussions with the NRC on the mapping issue could reduce the uncertainty in these estimates of the regulatory risk. For option three, Map All Emplacement Drifts, this option would be sufficient for all needs, since all openings would be mapped, so the option is given no risk.

Design Impacts Evaluation of Mapping Options

In this evaluation, a qualitative description of the impacts on design, primarily ground support, is provided. For option one, Map Non-Emplacement Drifts Only, the preferred system of precast concrete lining can be used throughout the emplacement drifts, assuming use of cementitious materials is allowed. For option two, Map 10% of Emplacement Drifts, mapped drifts require a two-pass system, similar to the non-emplacement drifts. In this system following excavation, a first pass initially installs a temporary ground support. After the mapping is conducted, the second pass follows with a cast-in-place lining. The cast-in-place system provides less flexibility in control of concrete mix than the preferred system of precast concrete segments. But, the preferred system of precast concrete lining can be used in non-mapped drifts, 90% of the emplacement drifts. This option also maintains some flexibility in the design to respond to conditions and the ability to change the ground support system to respond to those changes. For option three, Map All Emplacement Drifts, the mapped drifts require a two-pass system, similar to non-emplacement drifts. This option precludes the use of precast concrete linings.

Conclusions and Recommendation

The evaluations will be assessed and weighed to develop a recommendation for the mapping option. The technical criterion on adequacy of the options to meet the technical data-needs is important. But, there is uncertainty in the importance of faults and faults zones, and the size of the features in the repository block which are important to performance. A conservative approach is to assure the ability to map these features in the design until the time that the uncertainty is resolved. For these reasons, option one is concluded to be less favorable and it is not recommended at this time considering this criterion and the current evaluation.

The cost difference, between options two and three, is significant and should be weighed in a decision between these options. The schedule criterion does not appear to be key discriminator between the options and the impacts on construction logistics are manageable. The regulatory risk evaluations for options two and three compare a low risk option vs. a no risk option. Finally, in considering the design impact between options two and three, precluding the preferred ground support option for design is a significant adverse impact for design and construction. In conclusion, option three is a significant cost increase and impact on design to reduce the regulatory risk from a low value to none. Thus, option two, Map 10% of Emplacement Drifts, is recommended, based on the above conclusions.

The recommended strategy for mapping during repository construction is to: 1) map approximately 10% of emplacement drifts, based on the current drift spacing and layout; 2) map non-emplacement drift openings; and 3) observe rock mass conditions during construction. The rationale for mapping 10% of the emplacement drifts is that the frequency of mapped drifts is selected to assure intersection of features anticipated to affect repository performance. Present surface mapping shows several faults with approximately 200 - 300 m fault trace length within the repository block. Most of these faults are expected to penetrate the host repository horizon and extend downward to the water table. The importance of these faults to repository performance is currently uncertain. A frequency of mapping approximately 10% of the emplacement drifts, at the current spacing, would provide reasonable confidence of intersecting these surface mapped features at depth. The specific locations of the mapped emplacement drifts may also depend upon observations during construction. Also, detailed mapping of an emplacement drift near the Performance Confirmation observation drifts provides needed rock mass characterization for the thermal monitoring and testing of emplacement drifts.

It is also recommended that discussions be conducted with the NRC on the mapping strategy and its rationale to reduce the uncertainty in the regulatory risk of the option selected. It is recommended that work be conducted to develop a position on the size and/or characteristics of features which will potentially impact repository performance. After the conduct of the Enhanced Characterization of the Repository Block effort, it is recommended that this discussion be reviewed and updated as necessary.

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Please contact April V. Gil of my staff at 794-5578 if you have any questions or need more information.

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STEPHAN J. BROCOUM

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Enclosures:
1. Disclaimer
2. List Of Draft Documents
3. Draft Documents As Stated In Enclosure 2

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Chad J. Glenn
High-Level Waste Management Office
U. S. Nuclear Regulatory Commission
1551 Hillshire Drive, Room 501
Las Vegas, NV 89134

TRANSMITTAL OF DOCUMENTS FOR INFORMATION USE ONLY

The U. S. Department of Energy's (DOE) Office of Civilian Radioactive Waste Management is dedicated to disseminating information about our program as quickly as possible to those interested in our products and progress. Therefore, we are making the enclosed documents available to you on request, with the understanding that these documents have not undergone formal DOE review and are provided for information only. The documents provide preliminary information that may change based on new information or analysis and are not intended for publication or wide distribution.

Although these documents have undergone technical reviews at the contractor organization, they have not undergone a DOE policy review, and therefore, the views and opinions of authors expressed in these documents do not necessarily state or reflect those of the DOE.

Please contact April V. Gil of my staff at 794-5578 if you have any questions or need more information.

ORIGINAL SIGNED BY:
STEPHAN J. BROCOUM

Stephan J. Brocoum
Assistant Manager for Licensing

AML:AVG-0092

Enclosures:
1. Disclaimer
2. List Of Draft Documents
3. Draft Documents As Stated In Enclosure 2

cc w/encls 1 and 2:
R. G. Hawe, DOE/YMSCO, Las Vegas, NV
Records Processing Center = " "
(ENCL 3 = PREVIOUSLY SUBMITTED)

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EWS
CONCURRENCE

RTG. SYMBOL YMSCO GIL INITIALS DATE 10-10-97
RTG. SYMBOL YMSCO NAME INITIALS DATE 10 Oct 97
RTG. SYMBOL YMSCO INITIALS DATE 10/14/97
RTG. SYMBOL YMSCO INITIALS DATE 10/14/97
RTG. SYMBOL YMSCO BROCOUM INITIALS DATE 10/14/97
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RTG. SYMBOL	INITIALS	DATE
YMSCO GIL		10-10-97
YMSCO HAWE		10 Oct 97
YMSCO WATERS		10/14/97
YMSCO BARTON		10/14/97
YMSCO BROCOUM		10/14/97
YMSCO		
YMSCO		
YMSCO		
YMSCO		
YMSCO		

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