Department of Energy
Washington, DC 20585

JUN 13 1994

Mr. Joseph J. Holonich, Chief
High-Level Waste and Uranium
Recovery Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Holonich:

Enclosed are the U.S. Department of Energy's (DOE) responses to one comment and seven questions from the U.S. Nuclear Regulatory Commission's (NRC) review of study plan 8.3.1.9.2.1, "Natural Resource Assessment of Yucca Mountain, Nye County, Nevada." The NRC comment relates to the proposed drilling program. DOE does not believe that a drill hole penetrating the Paleozoic section is required within the perimeter drift outline in order to evaluate the resource potential of the site. The NRC questions relate to various aspects of the natural resource assessment proposed by DOE. Specific responses to the comment and questions are in Enclosure 2.

The portion of Site Characterization Analysis Comment 53 that is still considered open by NRC in your letter of February 18, 1994 will be addressed in a separate letter.

If you have any questions, please contact Ms. Sheila Long at 202-586-1447.

Sincerely,

Dwight E. Shelor
Associate Director for
Systems and Compliance
Office of Civilian Radioactive
Waste Management

Enclosures:
1. Ltr, 2/18/94, Holonich to Shelor, w/encls
2. Responses to NRC Comment and Questions on Study Plan 8.3.1.9.2.1

1028
WM-11
NH03

cc:
R. Nelson, YMPO
R. Loux, State of Nevada
W. Offutt, Nye County, NV
T. J. Hickey, Nevada Legislative Committee
D. Bechtel, Las Vegas, NV
Eureka County, NV
Lander County, Battle Mountain, NV
P. Niedzielski-Eichner, Nye County, NV
L. Bradshaw, Nye County, NV
C. Schank, Churchill County, NV
F. Mariani, White Pine County, NV
V. Poe, Mineral County, NV
J. Pitts, Lincoln County, NV
J. Hayes, Esmeralda County, NV
B. Mettam, Inyo County, CA
M. Delligatti, NRC

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

FEB 18 1994

Mr. Dwight E. Shelor, Associate Director
for Systems and Compliance
Office of Civilian Radioactive Waste Management
U. S. Department of Energy
1000 Independence Avenue, SW
Washington, D. C. 20585

I-353809

Dear Mr. Shelor:

SUBJECT: REVIEW OF U.S. DEPARTMENT OF ENERGY (DOE) STUDY PLAN "NATURAL RESOURCE ASSESSMENT OF YUCCA MOUNTAIN, NYE COUNTY, NEVADA"

In a letter to the U.S. Department of Energy (DOE) dated March 16, 1993, the Nuclear Regulatory Commission informed DOE that the NRC staff's Phase I Review had identified no objections with any of the activities proposed in the Study Plan, "Natural Resources Assessment of Yucca Mountain, Nye County, Nevada" (Study Plan 8.3.1.9.2.1). At that same time, NRC also indicated that it had decided to proceed with a Detailed Technical Review (DTR) of that study plan. The purpose of this letter is to transmit the results of the NRC staff's DTR.

The NRC staff's review of the subject study plan has resulted in the identification of one comment and seven questions (Enclosure 1). The enclosed comment and questions will be tracked by the NRC staff as open items similar to SCA comments and questions.

In its letter of transmittal of the study plan (letter from Roberts to Holonich, December 17, 1992), DOE provided a discussion of how Site Characterization Analysis (SCA) open items (Comment 53 and Questions 14 and 15) were addressed in the study plan. In a follow-up letter of February 5, 1993, DOE provided additional information related to Comment 53 and Questions 14 and 15 and requested that those SCA open items be considered resolved. The NRC staff has evaluated that information and considers Comment 53 open and Questions 14 and 15 resolved. The staff's evaluation of DOE's responses to the SCA open items is in Enclosure 2.

In addition, the staff observes that the study plan, in providing a basis for certain statements, cites references as "in press," "in preparation," or "personal communication." References in preparation or personal communications are not acceptable as stated in the "1993 DOE/NRC Level of Detail Agreement and Review Process for Study Plans." References that are in press are acceptable citations, but should be made available to NRC, upon request, at the time of the staff's review.

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ENCLOSURE 1

If you have any questions concerning this letter or its enclosures, please contact Charlotte Abrams of my staff at (301) 504-3403.

Sincerely,

Kenneth R. Hooks

for Joseph J. Holonich, Director
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management
Office of Nuclear Material Safety and
Safeguards

Enclosures: As stated

cc: R. Loux, State of Nevada
T. J. Hickey, Nevada Legislative Committee
J. Meder, Nevada Legislative Counsel Bureau
R. Nelson, YMPO
M. Murphy, Nye County, NV
M. Baughman, Lincoln County, NV
D. Bechtel, Clark County, NV
D. Weigel, GAO
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B. Mettam, Inyo County, CA
V. Poe, Mineral County, NV
F. Mariani, White Pine County, NV
R. Williams, Lander County, NV
L. Fiorenzi, Eureka County, NV
J. Hoffman, Esmeralda County, NV
C. Schank, Churchill County, NV
L. Bradshaw, Nye County, NV

ENCLOSURE 1

Study Plan 8.3.1.9.2.1 Natural Resource Assessment of Yucca Mountain, Nye County, Nevada

COMMENT 1

There are no existing drill holes within the perimeter drift outline that penetrate Paleozoic rocks and none are proposed.

BASIS

- Figure 2-1 of the study plan shows no existing or proposed drill holes at a depth that would penetrate Paleozoic rocks underlying Yucca Mountain.
- Existing drill hole UE25p#1, located approximately 2.0 miles southeast of the perimeter drift outline (Figs. 2-1 and 2-2), penetrates approximately 1,800 ft of the Paleozoic rock.
- Three deep drill holes (G-5, G-6, and G-7) extending into the Paleozoic section are proposed as part of the mineral and energy resource assessment of the site (Section 2.1.2.1, p. 2-3).
- The three proposed deep geologic exploratory drill holes (G-5, G-6, and G-7) are located outside of the controlled area and are approximately 2.5 to 6.0 miles outside the perimeter drift outline (Fig. 2-1).
- The purpose of the three G-series deep drill holes is to acquire regional stratigraphic information (DOE, 1993, Table 2.1, p. 12).
- "These holes (G-series) are located too far from the repository block to provide much geostatistical data" (DOE, 1993, Table 2.1, p. 12).
- Although the justification given in the Natural Resource Study Plan (Section 2.5.1, p. 2-12) for not drilling deep holes within the perimeter drift is that the holes would be "too costly and too damaging to the repository block itself", DOE is nevertheless proposing, in the Systematic Drilling Program (DOE, 1993, Section 1.2, p. 4) that twelve drill holes, ranging in depth from 1,700 ft to 3,000 ft be drilled inside the perimeter drift outline.
- DOE (1993, Section 2.4.1, pp. 21 and 22) indicates that the SCP (DOE, 1988, p. 8.4.3-43) presents analyses demonstrating that drilling activities (including a drill hole into the water table within the perimeter drift outline) do not impact the site adversely.

RECOMMENDATION

For the assessment of mineral and energy resources, rather than relying solely upon information derived from either existing or planned drill holes that are remote (2.0 to 6.0 miles) from the perimeter drift outline, consider extending (to below the Tertiary/Paleozoic contact) one or more of the proposed deep drill holes that are to be located within the conceptual design repository (DOE, 1993, Fig. 1.3, p. 5).

REFERENCES

DOE (U.S. Department of Energy), 1988. "Site Characterization Plan: Yucca Mountain Site, Nevada Research and Development Area, Nevada". Office of Civilian Radioactive Waste Management, DOE RW-0199. 9 Volumes.

DOE (U.S. Department of Energy), 1993. Study Plan 8.3.1.4.3.1, Systematic Acquisition of Site Specific Subsurface Information, Rev. 1, dated June 4, 1993.

Study Plan 8.3.1.9.2.1 Natural Resource Assessment of Yucca Mountain, Nye County, Nevada

QUESTION 1

How will "surrounding areas" be selected and sampled?

BASIS

- In Section 2.1.1.1 (p. 2-2), it is mentioned that the chemical composition of rocks from the site will be "...compared and contrasted with samples from surrounding areas that are known to be mineralized."

- According to Section 3.1.1.1 (p. 3-2), samples will be collected from areas with "...potential or suspected mineralization, such as Calico Hills, Wahmonie-Salyer district, and from prospects and currently or previously active mines."

- In Section 3.2.8 (p. 3-11), it is stated that "The synthesis of data will take into account altered and mineralized rocks known to occur in nearby areas outside the site area...."

- In Section 3.4.1.1 (p. 3-20 and Fig. 2-1), with respect to determining the presence or absence of hydrocarbon source rocks, the organic content of potential source rocks will be addressed by "...sampling Paleozoic stratigraphy cored in boreholes adjacent to the site and exposed in outcrops in nearby areas ...."

- The idea of investigating areas with established resource potential and looking for correlations with the findings at Yucca Mountain is a sound one. It is not clear as to how these sampled areas are to be compared with the Yucca Mountain site area. Discussion of how these areas are to be (or have been) selected, mapped, drilled, sampled, and interpreted is critical in ensuring that any comparison with Yucca Mountain is important. Identifying what features are to be compared and contrasted is also important.

RECOMMENDATION

Revisions to the study plan should include some discussion of the types of mineral deposits that will be considered. References to recent reports by Bergquist and McKee (1991) and Tingley (1992) would also be useful for identifying a number of possible comparison sites. The study plan should explain how the "surrounding areas" are to be mapped, sampled, and interpreted to validate any comparisons.

REFERENCES

Bergquist, J.R., and McKee, E.H., 1991. Mines, Prospects, and Mineral Occurrences in Esmeralda and Nye Counties, Nevada, Near Yucca Mountain, Administrative Report. U.S. Geological Survey.

Tingley, J.V., 1992. Mining Districts of Nevada. Report 47. Nevada Bureau of Mines and Geology. Reno, NV.

Study Plan 8.3.1.9.2.1 Natural Resource Assessment of Yucca Mountain, Nye County, Nevada

QUESTION 2

What plans exist for utilizing geochemical information from existing drill holes that are located within the conceptual design repository ?

BASIS

- In Section 2.1.2.1 (p. 2-3), it is stated that the "...subsurface sampling program will include a sufficient number of drill cores selected so as to adequately cover the study area."
- It appears that the subsurface sampling program (Section 2.1.2.1, p. 2-3; Section 3.1.1.1, p. 3-1 and Fig. 2-1) includes no subsurface sampling within the controlled area.
- There are a number of existing deep drill holes (USW G-4, USW H-4, USW H-5, and USW WT-2) within the conceptual design repository ranging in depth from 2,060 to 4,000 ft from which mineralogical samples have been obtained (DOE, 1992).
- The subsurface sampling program (Section 3.1.1.1, p. 3-1), although indicating that a sufficient number of drill holes will be selected to adequately cover the site area, neither describes nor depicts (Section 3.1.1.1, p. 3-1 and Fig. 2-1) drill holes either existing or planned that are closer than two miles to the conceptual design repository.

RECOMMENDATION

Consider using both existing subsurface information and subsurface information that can be obtained from drill holes currently proposed within the controlled area.

REFERENCES

DOE (U.S. Department of Energy), 1992. Yucca Mountain Site Characterization Project, Existing and Proposed Drillholes Within 10 Km of the Site, Map YMP-92-081.0, EG&G/EM Remote Sensing Laboratory.

DOE (U.S. Department of Energy), 1993. Study Plan 8.3.1.4.3.1, Systematic Acquisition of Site Specific Subsurface Information, Rev. 1, dated June 4, 1993.

Study Plan 8.3.1.9.2.1 Natural Resource Assessment of Yucca Mountain, Nye County, Nevada

QUESTION 3

Remote sensing is not mentioned as a possible test. Given the usefulness of such methods in determining surface alteration and regional structural trends, what plans are there to include the analysis of remote sensing imagery?

BASIS

- Section 2.2 considers a number of geological and geophysical analyses but does not mention the use of remote sensing technology.
- Remote sensing imagery has been used to identify zones of clay and iron oxide hydrothermal alteration in semi-arid and arid regions of the western U.S. (e.g., Mouat et al., 1986; Magee et al., 1986; Taranik, 1987).
- Landsat Thematic Mapper and SPOT imagery was also used by Castor et al. (1990) to identify and compare fault patterns and zones of alteration in the mineral evaluation of the Yucca Mountain Addition.
- The resolution of satellite images approaches 10 to 20 m and would be useful in identifying zones of hydrothermal alteration of the Yucca Mountain region.
- Appropriate filters may also be useful for directional edge enhancement in order to identify possible lineaments and fault patterns associated with mineralization, hydrocarbon and geothermal resources.

RECOMMENDATION

Consider a plan to use remote sensing (satellite imagery, aerial photography) imagery to delineate areas of alteration and regional structural trends and lineaments in the Yucca Mountain region.

REFERENCES

Castor, S.B., Feldman, S.C., and Tingley, J.V., 1990. Mineral Evaluation of the Yucca Mountain Addition, Nye County, Nevada. Nevada Bureau of Mines and Geology, Open File Report 90-4, 80 pp.

Magee, R.W., Moore, J.M., and Brunner, 1986. Thematic Mapper Data Applied to Mapping Hydrothermal Alteration in Southwest New Mexico: Proceedings of the 5th Thematic Conference on Remote Sensing for Exploration Geology, Reno NV.

Mouat, D.A., Myers, J.S., and Miller, N. L., 1986. An Integrated Approach to the Use of LANDSAT TM Data for Gold Exploration in West Central Nevada: Proceedings of the 5th Thematic Conference on Remote Sensing for Exploration Geology, Reno NV.

Taranik, J.V., 1987. Application of Aerospace Remote Sensing Technology to Exploration for Precious Metals in the Western United States: Proceedings of the Bulk Minable Precious Metals Symposium, Geologic Society of Nevada. p. 551-576.

Study Plan 8.3.1.9.2.1 Natural Resource Assessment of Yucca Mountain, Nye County, Nevada

QUESTION 4

What plans are there to consider the effects of extrusive/intrusive ratios outside of the range of about 1 to 10 and to identify the source of additional parameters necessary for input into the Finite Element Heat and Mass Transfer Code?

BASIS

- In Section 3.3.1.3 (p. 3-14), it is stated that extrusive/intrusive ratios of "...about 1 to 6 for the basaltic type and 10 or greater for the silicic type..." of volcanoes will be used to approximate the size of inferred intrusions. This inferred size will be used as input into the FEHMN (Finite Element Heat and Mass Transfer Code) (Zyvoloski et al., 1991) heat and mass transfer model.

- The extrusive/intrusive ratios that are used in the study plan (Section 3.3.1.3, p. 3-14) are empirical values. Values as low as 1:200 for basalt and 1:100 for rhyolites have been reported at the Coso Volcanic field (Bacon, 1982) to the southwest of Yucca Mountain. Since intrusion size is one type of input into the FEHMN program (Zyvoloski et al., 1991), varying this ratio could have significant effects on any modeling study results.

RECOMMENDATION

Consider conducting geothermal modeling for sensitivity analysis and propagation of uncertainty related to extrusive/intrusive ratios.

REFERENCES

Bacon, C.R., 1982. Time-predictable bimodal volcanism in the Coso Range, California. Geology: pp. 65-69.

Zyvoloski, G., Dash, Z., and Keldar, S., 1991. FEHMN 1.0: Finite Element Heat and Mass Transfer Code: LA-12062-MS, Los Alamos National Laboratory, Los Alamos, NM.

Study Plan 8.3.1.9.2.1 Natural Resource Assessment of Yucca Mountain, Nye County, Nevada

QUESTION 5

What plans are are there for consideration of comparison areas in the context of the language of 10 CFR 60.21(c)(13) and 10 CFR 60.122(c)(17)?

BASIS

- Although the consideration of comparison areas is mentioned in the study plan (Sections 2.1.1.1, 3.1.1.1, 3.2.8, and 3.5), what is actually described in the different activities is the comparison of the Yucca Mountain area to areas of known mineralization (or proven geothermal/hydrocarbon potential). Although this is extremely useful in terms of determining the types of models that are appropriate to the Yucca Mountain setting, it is not apparent that the proposed comparison satisfies the provisions of 10 CFR Part 60.

- The three separate components of the requirement [10 CFR 60.21(c)(13)] for the comparison areas to be investigated include: (1) similar size, (2) representative of the geologic setting and (3) within the geologic setting.

RECOMMENDATION

Address the differences between the comparison described in this study plan with comparison areas as defined in 10 CFR 60.21(c)(13) and 10 CFR 60.122(c)(17). Include a statement describing how the proposed comparison area approach described in the study plan satisfies these NRC rule provisions.

Study Plan 8.3.1.9.2.1 Natural Resource Assessment of Yucca Mountain, Nye County, Nevada

QUESTION 6

What techniques will be used to estimate the size and number of undiscovered deposits?

BASIS

- The 10 CFR Part 60 evaluation of the probability of inadvertent human intrusion associated with the exploration for natural resources requires a quantitative evaluation of mineral and energy (hydrocarbon and geothermal) resources at the site. In Study Plan Section 3.5.1 (DOE, 1992, page 3-31), a general, three-step methodology is described for obtaining a "...probabilistic, quantitative estimate of mineral endowment of a given area...." Although the methodology is reasonable, it is not clear how the transition will be made between Steps Two (Delineation of favorable areas) and Step Three (Estimate the size and number of undiscovered deposits of each type), and no references are provided for clarification.

- It appears that a significant amount of subjective interpretation will be necessary, but there is no clear indication of how the resultant interpretation will be used to obtain a probabilistic and quantitative estimate.

- Techniques are available for quantitatively delineating potential targets and estimating reserves of some types of mineral deposits (e.g., Harris and Pan, 1991; Pan and Harris, 1990; Chung et al., 1988; 1992).

RECOMMENDATION

Provide detail on techniques that may be used to quantify the size and number of undiscovered deposits. Provide information on uncertainties, sensitivity analysis, and error propagation. For subjective interpretation, discussion of the expert elicitation process is appropriate.

REFERENCES

Chung, C.F., Fabbri, A. G., and Sinding-Larsen, R. (eds.), 1988. Quantitative Analysis of Mineral and Energy Resources. Dordrecht, Netherlands: Reidel.

Chung, C.F., Singer, D. A., and Menzie, W. D., 1992. Predicting Sizes of Undiscovered Mineral Deposits: An Example Using Mercury Deposits in California. Economic Geology, Vol. 87: pp. 1174-1179.

Harris, D.P., and Pan, G., 1991. Consistent Geologic Areas for Epithermal Gold-silver Deposits in the Walker Lake Quadrangle of Nevada and California: Delineated by Quantitative Methods. Economic Geology, Vol. 86, pp. 142-165.

Pan, G., and Harris, D. P., 1990. Quantitative Analysis of Anomalous Sources and Geochemical Signatures in the Walker Lake Quadrangle of Nevada and California. Journal of Geochemical Exploration, Vol. 38, pp. 299-321.

Study Plan 8.3.1.9.2.1 Natural Resource Assessment of Yucca Mountain, Nye County, Nevada

QUESTION 7

What form will the results from this study (p. 4-1) take for input into Investigation 8.3.1.9.3 (DOE, 1988 - Studies to Provide the Information Required on Potential Effects of Exploiting Natural Resources on Hydrologic, Geologic, and Rock Characteristics)?

BASIS

- Data from this study plan (p. 4-1) will be used in Investigation 8.3.1.9.3 "by providing the basis for probabilistic calculations for determining inadvertent human interference and (or) intrusion ... at Yucca Mountain in the postclosure period ..." (DOE, 1988, p. 8.3.1.9-45).

- The specific ways in which the results from this study plan will be used to provide a basis for probabilistic calculations are not discussed. It is not clear how this study will provide other than qualitative results.

RECOMMENDATION

Expand the discussion in Study Plan Section 4.0 to provide information on the form which the results may be expected to take and how this information will be used to provide quantitative input into probabilistic calculations. A discussion of possible expert elicitation methods may be appropriate.

REFERENCES

DOE (U.S. Department of Energy), 1988. "Site Characterization Plan: Yucca Mountain site, Nevada Research and Development Area, Nevada". Office of Civilian Radioactive Waste Management, DOE RW-0199. 9 Volumes, p. 8.3.1.9-45.

U.S. Department of Energy Responses to U.S. Nuclear Regulatory Commission Comment/Questions on Study Plan 8.3.1.9.2.1 (Natural Resources Assessment of Yucca Mountain, Nye County, Nevada)

Comment 1:

There are no existing drill holes within the perimeter drift outline that penetrate Paleozoic rocks and none are proposed.

Response:

At the present stage of planning for the integrated drilling program, the G-holes are designed primarily for geologic study, whereas the SD-holes (Study 8.3.1.4.3.1) are to be used and instrumented mainly for other purposes. However, information from cores and geophysical logs from the SD boreholes, to the extent of their penetrations, will also be utilized in assessing natural resource potential. DOE does not believe that a drill hole penetrating the Paleozoic section is required within the perimeter drift outline in order to evaluate the resource potential of the site. If NRC believes that a resource assessment will be inadequate as a result of not drilling into the Paleozoic section within the perimeter drift, DOE wishes to be apprised of this important information as soon as possible. DOE currently has no plans to deepen an SD-hole or move a G-hole within the perimeter drift boundary.

Question 1:

How will "surrounding areas" be selected and sampled?

Response:

Descriptions given in Study Plan 8.3.1.9.2.1, Revision 0, identify the methods and procedures that will be used in the comprehensive sampling and analytical programs that are being planned, not only within the immediate area of Yucca Mountain, but in other areas of interest as well. Some of these other areas are specifically named, but additional ones may also be sampled and studied as the investigation progresses. Bergquist and McKee (1991) "Mines, Prospects, and Mineral Occurrences in Esmeralda and Nye Counties, Nevada, Near Yucca Mountain" contains maps and deposit descriptions that will be useful in selecting other localities for examination. This report was prepared after the preparation and approval of Study Plan 8.3.1.9.2.1, and therefore was not available for reference in the study plan.

Other areas used for comparison will not be drilled or mapped in detail as part of Study 8.3.1.9.2.1. Several of these localities, however, have been studied and data have been published which will be fully utilized in the study, as indicated in the study plan.

Question 2:

What plans exist for utilizing geochemical information from existing drill holes that are located within the conceptual design repository?

Response:

Present wording in the study plan does not preclude the study and sampling of cores from both existing and proposed boreholes located within the controlled area. To the contrary, such data will be utilized to the extent necessary to obtain adequate coverage. Personnel are examining the core from boreholes drilled since the resumption of new work in July 1991, i.e., UZ-14, UZ-16, SD-12, from the perspective of the natural resource assessment. As the question points out, although existing deep drill holes are available, the core from these holes is not qualified. A decision has not been made whether or not these holes will provide data for potential licensing that would be used in any way beyond simple corroboration of qualified holes.

Question 3:

Remote sensing is not mentioned as a possible test. Given the usefulness of such methods in determining surface alteration and regional structural trends, what plans are there to include the analysis of remote sensing imagery?

Response:

Many studies in the site characterization plan (geologic mapping, tectonic studies, etc.) use various kinds of aerial photography and some also use satellite imagery in achieving study objectives. For example, Study 8.3.1.17.4.3 (Quaternary Faulting within 100 Km of Yucca Mountain) plans to use a variety of remote sensing techniques (including Thematic Mapper data and side-looking radar) to map, among other features, the distribution of hydrothermal alteration. To the extent that such data will be added to the geologic/geophysical data base applicable to resource assessment, it will be fully utilized in Study 8.3.1.9.2.1. It should be pointed out that most areas of alteration and regional structural trends and lineaments are already known or are likely to be identified in ongoing or future studies in the Yucca Mountain area.

Question 4:

What plans are there to consider the effects of extrusive/intrusive ratios outside of the range of about 1 to 10 and to identify the source of additional parameters necessary for input into the Finite Element Heat and Mass Transfer Code?

Response:

The NRC appears to be concerned that an appropriate range of ratios estimating intrusion size are taken into account for the FEHMN program so that simulations include realistic and documented ratios established in the Basin and Range province. The ratios quoted in the cited passage in Section 3.3.1.3, p. 3-14 of the study plan are not meant to imply that these are the only ranges that will be considered in FEHMN simulations.

Question 5:

What plans are there for consideration of comparison areas in the context of the language of 10 CFR 60.21(c)(13) and 10 CFR 60.122(c)(17)?

Response:

The term "geologic setting" is not specifically defined for Yucca Mountain in 10 CFR Part 60. For purposes of this and other studies in the site characterization plan, a good definition would be as follows:

> All of the geologic elements (structural, stratigraphic, volcanic, geomorphic) that characterize, affect, or contribute to the makeup and evolution of Yucca Mountain. Such a setting, therefore, includes all of the neighboring ranges and bounding basins, the proximal fault zones that distinguish the structural pattern of Yucca Mountain and the surrounding areas (typical of the Southern Basin and Range), and all adjacent volcanic fields.

The intent of this study is not to conduct a mineral resource assessment of any and all areas within the "geologic setting" that are similar geologically to Yucca Mountain. For these reasons, comparisons (within the context of the present study) are limited to those localities containing known mineralization. It should be noted that 10 CFR 60.21(c)(13) requires an identification of natural resources and estimates as to undiscovered deposits, the exploitation of which could affect repository performance. Except for the potential for inadvertent human intrusion of Yucca Mountain itself (the focus of the

present study), it would appear unlikely that exploitation of natural resources elsewhere within the "geologic setting" would compromise the ability of the repository to contain radioactive wastes. In any case, consideration of this probability is outside the scope of Study 8.3.1.9.2.1. The distinction between the "geologic setting" that would be applicable to 10 CFR 60.21(c)(13) and the 10 CFR 60.122(c)(17) potentially adverse condition is that the latter applies to the controlled area as interpreted by the language "within the site," whereas the former refers to the explanation of the geologic setting provided above.

Question 6:

What techniques will be used to estimate the size and number of undiscovered deposits?

Response:

No work has yet been done, nor has any specific scheduling or staffing been defined, for this activity. The study is in a data-gathering phase. Under these circumstances, it is premature to describe in greater detail all the steps that will be taken to estimate the size and number of undiscovered resources in the Yucca Mountain area. Consequently, it is appropriate to state in the study plan that "standard methodology" will be employed, and delay further discussion until such a time that much of the data has been collected and evaluated, and a determination made as to the extent and form of the modeling that can best be applied for purposes of assessing mineral potential.

Question 7:

What form will the results from this study (p. 4-1) take for input into Investigation 8.3.1.9.3 (DOE, 1988 - Studies to Provide the Information Required on Potential Effects of Exploiting Natural Resources on Hydrologic, Geologic, and Rock Characteristics)?

Response to Question 7:

A primary objective of Investigation 8.3.1.9.3 is to determine the extent to which the actual or inferred presence of resources at the site might influence the exploration activities of future generations. All of the geological, geophysical, and geochemical data that will be collected, evaluated, and modeled as part of Study 8.3.1.9.2.1 relate to this objective. The qualitative and/or quantitative nature of these data can only be determined

after the work is completed. Similarly, it is premature to discuss the specific form in which the results will be presented, but the purpose is to provide a comprehensive resource assessment that is directly applicable to the needs of Investigation 8.3.1.9.3; this purpose is clearly indicated in the study plan.