NUCLEAR SYSTEMS SAFETY PROGRAM

November 10, 1982
LR 82-11-03

Mr. L. Beratan
MS 1130-SS
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Leon:

SUBJECT: Suggested questions to be considered by NRC in reviewing the DOE Site Characterization Report for Basalt

In our discussions with you and the RES and NMMS staffs in our meeting at NRC on October 18, we agreed to provide a list of questions (Attachment A) which we feel need to be considered by NRC in reviewing the upcoming DOE site characterization report for the Hanford basalt site. The questions, which address only the site characterization phase, are a direct result of our work in evaluating high resolution geophysical techniques and in determining the status of instrument reliability.

In considering appropriate questions, we have referred to the following documents in addition to our own technical work:

1. National Plan for Siting High-Level Radioactive Waste Repositories and Environmental Assessment, prepared by the Department of Energy.

2. Standard Format and Content of Site Characterization Reports for High-Level Waste Geologic Repositories, NRC Regulatory Guide 4.17.

Virtually all questions of importance have been considered in NRC Regulatory Guide 4.17. However, we feel that there are several questions concerning the applicability of instruments which need to be further considered. Also, in the area of remote geophysical characterization, we feel that there are a number of questions which should be addressed.

Our questions fall into four areas. In the first area are those questions which deal with rock properties, hydrology, and instrument reliability. In the remaining areas, DOE has stated that their geophysical exploration program may use the following techniques: gravity, borehole, seismic reflection and refraction, down-hole radar, and electrical resistivity. Our list of questions in the geophysical measurements area concentrate on the borehole geophysics and seismic reflection techniques because these are considered to be the more useful of the techniques being considered. In addition, we

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address the usefulness of the electrical resistivity and down-hole radar techniques. We do not address the use of gravity or seismic refraction techniques because these are primarily considered to be useful for reconnaisance.

The questions in the geophysical areas are divided into three groups:

a) general questions which consider the effectiveness of different techniques,

b) questions pertaining to the use of seismic reflection and resistivity techniques (surface geophysics), and

c) questions pertaining to the use of downhole geophysical techniques.

If you have questions concerning the points which have been raised, please contact us directly. We will be happy to expand on any of the areas you feel will be important.

Sincerely,

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Attachments

Distribution:
Attachment B

ATTACHMENT A

I. Rock Properties, Hydrology, and Measurement Reliability

1. Has the impact of blasting and drilling been considered when measuring rock properties and internal stresses?

2. Has the heated repository experimental data been corrected for temperature effects on the instruments?

3. Do slow-flow hydrological measurement techniques properly account for distributed as well as localized flow?

4. Sections 6 and 9.4 of Regulatory Guide 4.17 consider geochemical effects on the waste form and container. Since similar chemical reactions have been found to adversely affect the accuracy and overall reliability of in-situ instrumentation over relatively short periods of time, what steps have been taken to mitigate these problems?

5. Fracture and fault mapping from exposed rock surfaces is very important during site characterization. Since poor construction techniques (e.g., overblasting and shot crete structural support) can mask this mapping, what type of construction control, in addition to the requirements of Section 8.5 of Regulatory Guide 4.17, is proposed to ensure that excessive rock damage will not occur.

6. Does sufficient laboratory analysis and field experience exist for the proposed measurements? Does the proposed underground test facility contain provisions for either DOE or NRC in-situ verification of instrument performance in a way which does not interfere with the site characterization measurements?

II. Effectiveness of Various Geophysical Exploration Techniques - General

1. Have the geophysical surveys been designed to accommodate site specific conditions such as:

   a) Size and configuration of targets of interest, and

   b) Unimportant geologic features which may create noisy data?

2. Have modelling studies been performed to test the capabilities of the geophysical techniques?

3. Has the smallest feature that needs to be detected been identified?

4. Will all important hydrological pathways will be known when site characterization is complete?

5. Since geophysical interpretations are not unique, have procedures been defined that will discriminate among the possible interpretations?

6. Models used to invert the geophysical data make idealized assumptions (e.g., isotropy, homogeneity, etc.). Do the assumptions used in the geophysical data reduction approach the reality of the known site characteristics?

7. Will core samples be taken and analyzed so as to calibrate the results of the geophysical mesurements?

8. How will geological data be incorporated into an updated geologic model of the site?

9. The effectiveness of down-hole geophysical techniques depends on the location of the sensors which depends on the location of the boreholes. How will the borehole locations be selected so as to properly sample the rock mass?

III. Surface Geophysics, Seismic Reflection, and Electrical Resistivity Techniques

1. Has modelling which takes into account known site characteristics been performed to determine:

   a) Minimum size of detectable features of interest, and

   b) Maximum probing range which permits recording reflected signals in the 100-500 Hz range?

2 What is the predominant frequency of the seismic survey? Is the frequency enough for a "high-resolution" seismic reflection survey?

3. Will the results of the seismic reflection surveys be corrected by using vertical seismic profiling data or continuous acoustic logging data?

4. If seismic reflection techniques are used to characterize the media of interest, how effectively can they detect hydrologic flow paths such as fractured zones, their extent, and their orientation at the depth of the containment layer?

5. What is the vertical and lateral resolution of the electrical resistivity surveys used to infer the thickness and extent of fractured zones? How will the issue of non-unique solutions be addressed for this method?

IV. Borehole Geophysics, Well Logging and Cross-Hole Technique

1. Is the volume of rock beyond the borehole walls which is being measured adequate for estimating the desired parameters without introducing excessive uncertainty?

2. Will borehole geophysical logging be used to infer rock mass characteristics such as porosity and permeability? What calibration procedures have been used?

3. Many of the petrophysical techniques used to invert well logging data were developed for sedimentary rocks. How applicable are the models used to invert the geophysical data from a basalt site?

4. Will the effects of eccentricity or increased borehole diameter be taken into account in the analysis of well-logging measurements? How will the measurements be corrected?

5. If employed, what are the azimuthal resolution and probing range of the down-hole radar techniques, given the conditions of the site in question?

6. How will the containment layer be probed to detect important hydrological pathways such as fractured zones which do not intersect boreholes? Will high resolution techniques be used to obtain detailed information on the rock forming the containment layer?

7. How well can the orientation, extent, and connection of fractured zones and flow paths in the containment layer be established using remote geophysical probing? Will tracer techniques be used to determine these parameters?

8. Given that the interpretation of all geophysical data is generally non-unique, will the predictive capabilities of the borehole geophysical techniques, such as well logging and cross-hole techniques, be tested at the site? Will this testing involve comparisons of the predictions with direct geological information obtained during confirmatory excavation or confirmatory drilling?

9. Will down-hole geophysics probing ahead of the face of the excavation be performed to minimize the possibility of constructing repository tunnels in zones of poor rock quality?

ATTACHMENT B

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