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ROCK MECHANICS SUBGROUP

of the

DOE/USGS EARTH SCIENCE TECHNICAL PLAN WORKING GROUP

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October 9, 1979

Mr. James O. Duguid
Batte1le Memorial Institute
505 King Avenue
Columbus, OH 43201

Dear Jim,

As per your Sept. 28, 1979 request, I have reviewed the draft of the final version of the Earth Sciences Technical Plan. All comments are of a general nature:

1. The added material (basically all that from p. 37 onward) represents a signficant overall improvement of the document from the January 1979 version. However, that added material is somewhat uneven. It seems to be too terse in some places and far too elaborate and detailed in other places. The descriptions of the site selection process are examples of the latter.

2. I have taken the liberty of writing a new section 3.2 Rock Mechanics (p. 68-69). This new section (attached) is not significantly longer than the original, nor necessarily better, but it is different. If you would like to use it, or any part of it, please feel free to do so.

3. P. 13 and Fig. 1 - I'm appalled (but not really surprised) that it is now estimated to take 12 years to develop a repository in salt. In 1970, we proposed a repository at Lyons and the estimate at that time was 6 years. Is the extent of our accomplishments in the last 10 years measured by a doubling of the lead time? Furthermore, and this is the real comment here, if salt requires 12 years then I would judge that more than 17 years would be required for other rock types, since I believe it will take more than 5 years to bring the state of knowledge for them to the same level that salt is today.

4. P. 41 - Table 2 - I don't agree in every case with the Working Groups evaluation of the "status". However, I can understand how that status represents the consensus of the ESTP/Working Group members.

5. P. 71, middle paragraph - These are very fine sounding words, "Major emphasis on ... experimental design ... peer review ... insure that all worthwhile data measured ... ". What are the facts of the situation? A peer group recently reviewed the Climax-Spent

Fuel Test and concluded that the technical aspects of the experimental design were grossly deficient, that much worthwhile data could be obtained by nominal upgrading of the experimental instrumentation and that a significant body of granite response data would be irrevocably lost without the upgrade. The results of this recommendation was that the Climax-Spent Fuel Test is proceeding according to original design. A number of "peer reviews" of the Basalt-Near Surface Test Facility have recently recommended that the use of real spent fuel in this test represents a needless complication and an investment of funds far exceeding the technical benefit to be gained, and that those funds could be much more wisely used to improve the basic understanding of the behavior of basalt. The result of these recommendations is that the "demonstration" of spent fuel disposal, using real spent fuel is still a major element of the test.

In the case of the single paragraph on page 71, I would therefore have to conclude that the ESTP document is a collection of very fine sounding words which have little or no relation to the real world. Should this conclusion be applied to the entire document? I am not just suggesting that this paragraph should be rewritten but that the entire document should be carefully reviewed by the Working Group to make sure that it accurately reflects the real world. If it is ever shown that any part of the document is a PR sham bearing no relationship to reality (as I did above?), the entire report will be discredited or perhaps totally disregarded and all of your efforts will have been in vain.

With regard to your invitation to attend the meeting of the Working Group on Oct. 16, 1979 to discuss these comments, it appears that because of the ESTP/Rock Mechanics Subgroup program review meeting on the same day and other prior commitments that neither Paul Gnirk or I will be able to come to Columbus. If, after reviewing these comments, you feel that it is essential for the Rock Mechanics Subgroup to be represented at the Working Group meeting, please call me and we can explore some alternative.

Sincerely,

William C. McClain

William C. McClain

WCM/jch
Attachment

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3.2. Rock Mechanics

In general, the objective of the rock mechanics programs is to develop a sufficiently detailed understanding of the rock behavior that accurate predictions of the response of a specific rock type at a specific location to the several "stresses" imposed by a waste repository (especially the excavation and the heat load) can be made and reasonably extrapolated to the desired long time frames. At the generic level, these studies do not start from total ignorance - man has been exploiting mineral resources from underground excavations for many centuries and geoscientists have developed an extensive literature on the laboratory properties of rocks. This extensive background means that usually the principal problems in rock mechanics can be defined very early in the evaluation of a generic rock type. Usually those problems are related to the development of sophisticated modeling techniques and effects of heat and elevated temperatures.

Once a rock type has been identified as being of interest for its potential as a host media for a waste repository, the usual procedure is to initiate a series of "scouting" experiments to identify any special problems related to the effect of heat sources in the perturbed stress and deformation fields surrounding an underground opening. These experiments are a mix of laboratory testing, bench-scale experiment and preliminary in situ tests. In all cases however, the purpose is to develop the necessary understanding of the physics of the rock response. That understanding takes the form of mathematical models of the behavior of the rock at the several scales of interest, (eg. canister scale, disposal room scale, repository scale and far-field).

At some point during this process, rock cores and other samples become available from the site exploration programs and from other sources. These cores and samples are subjected to extensive properties testing (eg. elastic and inelastic deformation properties and strength, thermal properties and fracture characteristics; all as a function of temperature and pressure). These tests provide input parameter values for the mathematical models, statistical evaluation of the ranges of those values and specific data on potential candidate rocks.

As the development of the models proceeds, their predictive capabilities are tested against an increasingly elaborate series of in-situ heater

tests and demonstrations. The model development is therefore seen as an iterative process with each cycle resulting in refinements and increased sophistication until the desired level of predictive capability is achieved. This process has reached different levels for the several rock types currently under consideration. For salt, reasonably accurate predictive models are available for the canister and room scales (based upon the large number of in situ tests which have been completed) while repository and far-field models are at a more rudimentary stage. Work on all of these salt models is continuing and the field testing of the large scale models will, of course, be major undertaking. For granite, the models are considered to be inadequate at this time due to insufficient understanding of the behavior of fractures. For the other rock types, present status can be best described as still at the "scouting" stage with the principal problems related to the effects of the chemical and mineralogic changes produced by elevated temperatures.