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Thomas R. Kuesel
Chairman of the Board

December 7, 1984

Mr. Hubert J. Miller
Chief, Repository Projects Branch
Division of Waste Management
U.S. Nuclear Regulatory Commission
Mail Stop 623-SS
Washington, D.C. 20555

Subject: Site Characterization for
Nuclear Waste Repositories

Dear Mr. Miller:

Through the U.S. National Committee on Tunneling Technology, I have obtained a copy of the September 1984 draft of the NRC Draft Generic Technical Position on "In-Situ Testing during Site Characterization for High-Level Nuclear Waste Repositories". I understand that this document is open to comment through December 10th.

I have been involved in engineering studies of nuclear waste repositories since 1971, when we were engaged by the DuPont Company to appraise the proposed Bedrock Waste Storage Project for the Savannah River Plant. Since then, we have been more or less continuously engaged in the programs of the AEC and NRC, and are currently involved in engineering studies for the proposed repositories in Tuff, basalt and salt.

The perspective resulting from this experience, plus long professional association with underground projects for transportation, defense, and water resources uses, has provided the basis for the attached comments. I hope you will find them useful.

Sincerely,

Thomas R. Kuesel

TRK:kp
Encl.
CC: Susan V. Heisler

U. S. Nuclear Regulatory Comission

Draft Generic Technical Position

"In-Situ Testing During Site Characterization
for High-Level Nuclear Waste Repositories"

Comments by Thomas R. Kuesel
Member, National Academy of Engineering
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In 1973, at the conclusion of two years of intensive theoretical studies and analysis of a sophisticated boring program for the proposed Bedrock Waste Storage Project at the Savannah River Plant, I recommended to the AEC that no definitive determination of the suitability of the site could be made without digging a shaft to secure access to the proposed repository horizon, and constructing exploratory drifts or galleries for in-situ inspection and testing.

Although the NWTS program has enjoyed the attention of a vast army of researchers over the past 10 years, and has produced a mountain of research reports, this basic recommendation still holds. I am pleased to see that the NRC is now requiring that site characterization studies, including construction of deep shafts, exploratory tunnels in the repository horizon, and in-situ testing, be undertaken prior to site selection and approval.

However, I am concerned that the emphasis appears to be more on testing than on inspection. While a certain amount of in-situ rock testing is useful, the emphasis on testing and analysis of test data is misplaced. The most valid assessment of the suitability of a proposed repository site can be made by a trained engineering geologist or tunnel engineer in a hard hat and boots, walking through the exploratory galleries and looking at the rock walls, and not by a theoretical analyst sitting at a computer terminal analyzing the results of instrumentation monitoring.

It is not much of an exaggeration to state that the only really significant questions about a geologic repository are:

- Does the rock mass have open joints?
- Do the joints bear water?

If the answer to these questions is yes, the site is almost certainly not suitable, and all other site data and analysis are irrelevant. If the answer is no, subsidiary questions to which the analysis of physical site measurements is relevant may be worth pursuing, but the main problem has already been solved.

It is a mistake to assume that the behavior of a rock mass (from both structural and hydrological viewpoints) depends primarily on the characteristics of the rock material. The behavior depends much more heavily on the pattern and characteristics of the joints and other geologic defects in the rock. Tests on rock samples removed and brought to a testing laboratory, and even measurements of instruments drilled into the host rock in in-situ exploratory galleries, tell little or nothing about rock joints and defects. To assess the behavior of a rock mass, we are less interested in the rock, and more interested in the spaces between the rocks. The effects of rock joints, shears, and other geologic defects can best be appraised through geologic mapping of the exploratory galleries, followed by in-situ inspection by a skilled tunnel engineer. Construction records of excavation procedures and rock behavior during excavation, and particularly records of ground water flow, are also valuable sources of information for appraisal of repository site acceptability.

I have been involved in the design and construction of two classified hardened defense facilities for DOD. Site A was constructed in granite, and Site B in greenstone. The granite is much harder and stronger than the greenstone, and comparison of laboratory and in-situ test data would lead one to rank the granite as superior to the greenstone. However, a five minute walk through the access tunnels of these facilities is sufficient to convince one of the clear superiority of the greenstone. The granite, an igneous rock, was subjected to shrinkage upon cooling, and is shot through with relatively open joints. Its hardness makes it brittle, which leads to stress concentrations in the joints and to jagged overbreak to recessed joint planes. In contrast, the greenstone, a metamorphic rock, has been geologically molded into a dense mass. Its joints are tight and well-knit. Being more malleable than the granite, it is much tougher. There was very little overbreak, and the smooth walls of the excavation indicate a smooth distribution of stresses around the opening, with resulting great stability.

These observations are based not on in-situ testing, but rather on in-situ inspection.

The performance requirements for nuclear waste repositories are greatly different from those for hardened defense facilities. Nonetheless, the experience is instructive. I hope that both NRC and DOE will give due weight to the importance of in-situ inspection, as well as in-situ testing, in developing the site characterizations for proposed repositories.

Thomas R. Kuesel