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November 21, 1989

Mr. Carl Gertz, Project Manager
Yucca Mountain Project Office
Department of Energy
Nevada Operations Office
P.O. Box 95818
Las Vegas, NV 89193-8518

Dear Mr. Gertz:

Discussions in a recent Department of Energy (DOE) Technical Project Officer meeting for the Yucca Mountain Project indicate a near-term restructuring of the Yucca Mountain Program to a more surface-based characterization effort is being planned. The focus of the surface-based program will be to resolve site disqualifying issues and potentially adverse conditions prior to a large commitment of resources to an underground characterization program. The State of Nevada has commented in regard to the Site Characterization Plan for Yucca Mountain that an early resolution of site suitability issues is the only prudent course of action for the DOE.

The State, through its review of the SCP, has identified a number of programs of inquiry and study planned by the DOE which are not technically sound, rely on an out-dated database, or are not aligned with current scientific thought. The DOE's program to characterize the strain and tilt at Yucca Mountain is such a program. This letter and the attached discussion by one of the State's contractors, the Seismological Laboratory, Mackay School of Mines, University of Nevada-Reno, describes the limitations of the DOE program and proposes a state-of-the-art program for continuously-monitoring rock deformation at Yucca Mountain.

State-of-the-art measurement of rock strain and tilt is of paramount importance for understanding the short-term and long-term stability of the site, its probable future performance in waste isolation, and thus its effect on future generations. Strain and tilt information is particularly critical to understanding the hazard posed by the engineering requirements associated with both underground and surface construction. It is also vital for

establishing the base-line stability of the site and for providing warning signals should there be changing geologic conditions, such as changes in tectonic strain, changes in local strain associated with an earthquake, explosions or volcanic activity, changes in the water table, or changes in rock characteristics.

Strain and tilt monitoring provides the most fundamental type of observation that can be made of site stability, and relates directly to the tectonic stress at the site, to the relationship with the regional tectonic environment, to the rock-mass characteristics (such as in-situ bulk elastic properties and overall rock strength), to the effects of mining and radioactive heating, and to the response of the site to any perturbing geophysical effects. Continuous monitoring of the response of the rock-mass to various disturbances provides important data on the characteristics and stability of the site. The importance of strain monitoring is also recognized by some researchers within the U.S. Geological Survey (see August 17, 1988, memorandum from sixteen USGS hydrologists to V. Schneider; Subject: USGS role in Yucca Mountain Site Characterization Effort, P.4-5). The memorandum encourages USGS management to assure that plans are in place and funds allocated to initiate tectonic strain measurements at Yucca Mountain and investigate water table fluctuations which could be strain related. Site Characterization Plan revisions suggested by the USGS personnel include:

- "Concurrent measurement of volumetric strain in borehole at Yucca Mountain using strain meters similar to those used in studies of the San Andreas fault."

- "Installation of volumetric strain meters on the crest, flank and flat adjacent to Yucca Mountain."

- "Determination of temperature field in the vicinity of each strain meter prior to its emplacement."

- "Continuous monitoring of strain meters using intelligent data loggers."

Further, at the October 31, 1989, tectonics meeting in Las Vegas, the USGS (K. Fox) reported geodetic leveling data for the Southern Great Basin (1905-1985) which indicates a vertical component of rock deformation on the order of 400-500 mm. This magnitude of rock deformation suggests significant historical strain on the rocks in the region (including Yucca Mountain). These data also are indicators of an active tectonic environment, which should be monitored in the future for significant changes.

While the State does not agree with the approach proposed by the USGS in the SCP to obtain strain information in the critical frequency and resolution bands required, we do support the USGS position that the measurement of strain is critical to resolving questions of site stability and water table fluctuations. Continuous long-term deformation monitoring at the site could provide the necessary data on the magnitude of strain occurring on Yucca Mountain and would contribute to understanding the regional deformation suggested by the leveling data.

The Site Characterization Plan issued by the Department mentions the use of strainmeters and deformation meters for geotechnical analysis (see section 8.3.1.15, Thermal and Mechanical Properties), it does not indicate plans for measurement of strain and tilt to support resolution of tectonic issues. The plan for rock-mass characterization is based on measurements made with short base-line instruments and small samples, both in the laboratory and in-situ, and use of these measurements to extrapolate to larger scales by means of numerical simulation. Such short base-line instruments and small samples in concert with numerical simulations are inappropriate for understanding short-term and long-term tectonic strain. Recent literature (D. Agnew, "Strainmeters and Tiltmeters", Reviews of Geophysics, August, 1989) questions the reliability and adequacy of using borehole instruments to measure tectonic motions, as proposed by the Survey. Knowledge of changes in the strain field both close to the proposed repository site and in the surrounding region is important for interpreting tectonic processes.

The University of Nevada-Reno has developed a state-of-the-art program, modeled after a similar program successfully operated by the University of California-San Diego along the San Andreas fault. The program description (attached) presents a plan for installation of a crustal deformation monitoring system at Yucca Mountain. It describes the rationale for a continuous monitoring system, the design of the system, and estimates the cost and time required to install and initiate operation of the system.

As stated earlier the State believes the program presented in the attachment is more scientifically appropriate than that proposed by DOE to obtain necessary information to assist in determining the site condition. While the State believes it is important that DOE plan to implement such a program prior to any other planned subsurface disturbance, so effects from full-characterization activities can be measured, we are providing you with a copy of this proposed program in advance of our FY1991 grant application for your review, in that we anticipate its inclusion in our application. The Office and the University of Nevada-Reno personnel will be available at any time to meet with your technical staff and discuss this program.

Sincerely,

Robert R. Loux
Executive Director

RRL:CAJ/lmg

Attachment re enclosure on shelf

cc: James Brune, UNR
Larry Hayes, USGS
Robert Browning, NRC
Donald Deere, NWTRB
Dade Moeller, NRC-ACNW