John Bell, Nev. Bureau of Mines and Geology

Task _

Review of Quaternary Geology
and
Evaluation of Potential for Undetected Fault Scarps
At and Near Yucca Mountain

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RATIONALE

In reviewing the 1984 "U.S. Department of Energy Draft Environmental Assessment for the Proposed High-level Nuclear Waste Site at Yucca Mountain", numerous major deficiencies were noted in the tectonics studies (see my detailed comments in the 1985 State of Nevada Comments, v. II). These included:

--Structure-tectonics of the Walker Lane
--Potential for strike-slip movement
--Potential for undetected fault scarps
--Lineament analysis
--Geomorphic analyses of faults
--Integration of structural and Quaternary geology relationships
--Probabilistic estimates of potential for large earthquakes and surface faulting
--Explosion-induced faulting

These deficiencies are critical to the evaluation of the post-closure favorable condition which requires that tectonic processes have less than one chance in 10,000 of leading to a loss of waste isolation over the next 10,000 years. Although DOE is now preparing a NNWSI Project Seismic/Tectonic Position Paper which will assign probabilistic estimates to various tectonic scenarios, such an evaluation is fruitless without an adequate and accurate data base.

Previous work suggests that the potential for tectonic activity is substantially greater than acknowledged by DOE in the Draft EA. Seismic data suggest that north-northeast-trending faults are susceptible to slip in the current stress field, and that such faults at Yucca Mountain may also be tectonically stressed to near the rupture point (Rogers and others, 1983; Healy and others, 1984). Field review of exploratory trenches by the Principal Investigator with U.S.G.S. staff suggests that some faults at Yucca Mountain (in particular, the Bow Ridge and Solitario Canyon faults) have had recurrent late Quaternary (including Holocene) movement. Taken together, the geologic and seismic data suggest

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that the potential for significant seismicity and renewed movement on faults exists and should be considered (U.S. Geological Survey, 1984).

OBJECTIVE

In order for the State of Nevada to adequately and objectively assess the probability that tectonic processes may lead to a loss of waste isolation during the next 10,000 years, the Nevada Bureau of Mines and Geology proposes the following two-year investigative and review program. In brief, we propose to: first, review and evaluate all Quaternary geologic data, including surficial geologic, soils, age-dating, structural, and exploratory trenching information; and second, evaluate the potential for undetected active faults through the use of low-sun-angle aerial photography. This is a slightly modified version of the draft proposal submitted by the Principal Investigator to the Nevada Nuclear Waste Project Office in the fall of 1984. Some of the previously proposed tasks will now be performed separately by D.B. Slemmons, namely, conducting a regional structural-tectonic analysis and estimating maximum earthquake values.

PROPOSED PROGRAM

First Year

I. Tectonics-- Detailed Analysis of Individual Fault Zones

1. Review and annotate all literature pertaining to the structural-tectonic activity within the geologic setting of Yucca Mountain.
2. Acquire aerial photography for a 56km (35mi) radius of the proposed waste repository (Figure 1). The 56km radius is commonly referred to as the "site vicinity" and is analyzed as standard procedure in the siting of nuclear facilities. Tectonic activity within this area influences maximum anticipated ground acceleration at the site. This coverage may be modified based on airspace restrictions; alternative photographic coverage may be substituted, such as limiting the photography to specific fault zones.
   a. Fly low-sun-angle aerial photography; black-and-white, 1:12,000- or 1:18,000-scale.
   b. Obtain existing 1:24,000-scale standard aerial mapping photography.
   c. Obtain low-altitude (miscellaneous scales) U.S.G.S. in-house aerial photography.
3. Analyze aerial photography.
   a. Map faults, suspected faults, and related tectonic features.
   b. Categorize the quality, or confidence level, of each identification.
4. Transfer all mapped features to topographic bases.
5. Field check major fault zones.

II. Quaternary Geology-- Preliminary Assessment

1. Review and annotate all literature pertaining to the Quaternary Geology of the Yucca Mountain area, including surficial geology, pedology, archeology, paleoclimatology, and absolute age-dating techniques.
2. Conduct reconnaissance-level field verification of stratigraphic controls and relationships. This will include the utilization of Quaternary geology and soils consultants such as Roy Shlemon and Fred Peterson.
3. Evaluate the present adequacy of the Quaternary stratigraphic controls being used for structural-tectonic assessment.

III. Synthesis

1. Compare faults mapped during this study to those delineated by previous studies (Scott and Bonk, 1984; Swadley and Hoover, 1984; U.S. Geological Survey, 1984).
2. Compare all mapped faults to Quaternary stratigraphy and develop a preliminary assessment of the adequacy of age control.
3. Develop a preliminary assessment of the recency and frequency of several critical fault zones at and near Yucca Mountain: the Paintbrush Canyon, Bow Ridge, Windy Wash, and Solitario Canyon faults.
4. Recommend scope of second year study.

Second Year

I. Tectonics-- Detailed Analysis of Active Fault Zones

Based on the results of the first year study, examine active and suspected active faults in detail. This possibly would include examining existing exploratory trenches or excavating new ones.

II. Quaternary Geology-- Detailed Analysis of Stratigraphic Controls

Based on the results of the first year study, field checking and verification studies would be extended to either confirm previous work or develop a new stratigraphic scheme. This would include the application of several geomorphic techniques, such as scarp morphology, and an evaluation of the paleoclimatic interpretations. It is anticipated that this task would again involve the consulting expertise of a Quaternary geologist, such as Roy Shlemon, and a paleoclimatic geologist, such as Robert Thompson, a specialist in Great Basin paleoclimates.

III. Synthesis

Based on an integration of the tectonic and Quaternary data, determine the recency and frequency of movement on faults at and near Yucca Mountain. Products of this synthesis will include estimates of slip rates and recurrence intervals for major faults.