



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**

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MEMORANDUM FOR: Ronald L. Ballard, Chief
Geology and Engineering Branch, HLWM

FROM: Keith I. McConnell, Section Leader
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Geology and Engineering Branch

SUBJECT: TRIP REPORT ON ATTENDANCE AT THE GEOLOGICAL SOCIETY OF
AMERICA COMBINED CORDILLERAN/ROCKY MOUNTAIN SECTION MEETING

On May 19-21, 1993, I attended the combined Cordilleran/Rocky Mountain Section Meeting of the Geological Society of America in Reno, Nevada. The purpose of my attending this meeting was to report on presentations given that had relevance to the proposed high-level waste repository site at Yucca Mountain, Nevada. Tectonic hazards such as faulting and volcanic activity are of potential concern to the proposed repository site at Yucca Mountain and the presentations at this meeting reported on a substantial amount of tectonics-related work performed in, or in close proximity to, the geologic setting of Yucca Mountain. As a result, a large number of the abstracts presented had relevance to Yucca Mountain. Fourteen of these abstracts were included in a theme session on "Recent Geoscience Advances at Yucca Mountain and Surrounding Region."

The focus of many of the tectonics-related abstracts was on the nature and rates of faulting in Nevada, specifically, the potential for temporal and spatial clustering of earthquakes and associated fault displacement. Temporal and spatial clustering of fault events and long recurrence intervals between fault events are important to the repository program because these factors could complicate the assessment of the hazard due to faulting at Yucca Mountain. For example, linear rate calculations of faulting over the Quaternary Period may underestimate the hazard if faults at Yucca Mountain are entering into another clustering episode. Likewise, the hazard due to faulting may be underestimated if Quaternary faults with long recurrence intervals are not recognized and characterized. Guidance developed by the staff (NUREG-1451) on the investigation of fault displacement hazard has identified these factors among those that need to be characterized and evaluated during DOE's site characterization program.

A summary observation derived from the presentations is that geologists working in the Basin and Range Province of Nevada consider that there is a substantial body of evidence supporting the occurrence of temporal and spatial clustering during the Quaternary Period and that, because of a poor understanding of tectonic processes, it is difficult to predict where or when activity will occur in the future. Moreover, geologists working in Nevada believe that long recurrence intervals (i.e., > 100,000 years) between fault events are not uncommon, in fact, one scientist (dePolo) projected that 25 to 30% of Quaternary faults in Nevada have recurrence intervals greater than 125,000 years.

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In one of the tectonics-related sessions, Carl Johnson of the State of Nevada made a presentation that raised a concern with what he termed "extremely speculative" effects on the repository block resulting from near field seismic events. Johnson noted that there are 32 known Quaternary faults in the vicinity of the proposed repository site and there is a paucity of historical strong motion data recorded for near field earthquakes. Due to these factors, he concluded that estimating the potential ground motion and fault displacement effects on the repository would be very speculative.

Below are listed other relevant observations in the order that they were presented.

Pearthree and others: Historical faulting in Central Nevada represents a temporal clustering of activity because the historical rate of large-earthquakes is approximately 10 times the longer-term average. Temporal and spatial clusters have occurred over intervals of several thousand years in portions of central Nevada.

Machette and others: The Sonoma Range fault is characterized by a recurrence interval of 30-70 thousand years with the last event occurring 7-20,000 years ago and a prior event 100-150,000 years ago.

Bell: Noted that Bob Wallace had made the observation that faults with historical displacement in northern Nevada have recurrence intervals that range between thousands of years to > 100,000 years.

McMackin: Proposed a scenario where rising levels of hydrostatic stress concurrent with a climatically-driven rise in the water table could trigger faulting by decreasing the effective normal stress retarding fault slip. He further speculated that water could be expelled from collapsing caverns in the underlying carbonate aquifer and migrate upward with sufficient pressure to open existing fractures or create new fractures by hydrofracturing, eventually reaching the repository.

Swan and others: Indicated that the Paintbrush Canyon fault east of Yucca Mountain has had at least five displacement events in the Quaternary with a recurrence interval of between several thousand years and tens of thousands of years for the Late Pleistocene. They noted temporal clustering along the Paintbrush Canyon fault. Average displacement per event was 40-80 cm.

Menges and others: Indicated that the Bow Ridge fault at Yucca Mountain has had 4 events in the mid-Pleistocene with 5 to 16 cm of displacement per event.

dePolo and others: Noted that a definition for an active fault as one that had moved in the past 10,000 years would not have included approximately 1/2 of the historical ruptures in the Basin and Range. He also noted that 25-30% of Quaternary faults have had their last displacement > 125,000 years ago.

Anderson and others: The prior record of seismicity does not provide any hint that an area is susceptible to triggering by a distant seismic event.

In summary, meetings such as the Geological Society of America, particularly when they are held in the State of Nevada, serve as a forum for the presentation of a substantial amount of data that have relevance to Yucca

Mountain. A significant portion of these data are being collected by investigators outside of the DOE program (e.g., academia, Bureau of Land Management, state geological surveys), and outside the staff's normal lines of communication. Moreover, alternative interpretations to those provided to the staff by DOE are commonly described. Our reviews of the DOE program can be substantially enhanced by attendance at this type of meeting and I recommend continued support for NRC and CNWRA staff attendance.

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