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NUCLEAR REGULATORY COMMISSION  
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March 22, 1995

MEMORANDUM TO: Mysore Nataraja, Acting Section Leader  
Geosciences/Geotechnical Engineering Section  
ENGB/DWM/NMSS

FROM: *Abi*  
Abou-Bakr Ibrahim, Project Manager  
Geosciences/Geotechnical Engineering Section  
ENGB/DWM/NMSS

SUBJECT: TRIP REPORT, DENVER, COLORADO, FEBRUARY 27 TO MARCH 2, 1995

PURPOSE OF THE TRIP:

The purpose of this trip to the Denver, Colorado, area was threefold.

1. To visit the USGS Office in Golden, Colorado, and meet with Dr. Art Frankel to discuss his new seismic hazard program.
2. To attend the Workshop on "Selection of Earthquake Scenarios for Modeling Ground Motion at Yucca Mountain."
3. To visit the USGS Office in Lakewood, Colorado, to examine seismic reflection lines collected around the Atlas mill tailings site, Moab, Utah.

INTRODUCTION:

DOE is responsible for identifying the seismic design values for the facilities important to safety. Therefore, DOE has to collect the data needed and elicit information from the experts in the field of earth sciences. As a result, DOE tasked the USGS/ M&O to conduct several workshops to elicit the needed information for identifying the seismic hazard at Yucca Mountain. The first workshop was held in the Denver, Colorado, area from February 28 to March 1, 1995. Nevada Bureau of Mines; US Bureau of Reclamation; Geomatrix Consultants; University of Nevada at Reno, NV; and USGS were invited as participants, while U.S. Nuclear Waste Technical Review Board (NWTRB) staff and NRC were invited as observers. Several future workshops sponsored by DOE will be attended by NRC staff. The next workshop is scheduled for April 17, 1995.

Within the last decade, LLNL and EPRI developed codes for estimating the seismic hazards for eastern U.S. sites. The inputs for these codes are based on identifying source zones and expert elicitation process. Recently, Dr. Art Frankel of the USGS has developed a methodology and a new computer code which estimates seismic hazards without the use of inputs from expert elicitation.

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**SUMMARY OF MEETINGS AND WORKSHOP:**

1. On February 27, 1995, I visited Dr. Art Frankel at the USGS Office in Golden, Colorado, to discuss his new seismic hazard method and the associated computer code. The new computer code eliminates the need for using expert elicitation for identifying seismic source zones, such as those used in LLNL and EPRI studies. In previous seismic hazard studies, expert elicitation was one of the major inputs in the analysis. One of the major reasons for developing this new program is to get away from the subjective judgments involved in drawing seismic source zones where the causative structures of seismicity are largely unknown. The new program uses spatially-smoothed representations of historic seismicity to calculate the probabilistic seismic hazard for different periods of exposure.

The advantages of this program are: 1) it is simple; 2) there is no need to elicit expert opinion; and 3) it is fast to run.

I discussed the possibility of acquiring a copy of the program when it is available for distribution. Because of the simplicity of this program, it can be included as a module in the Iterative Performance Assessment Program developed by the staff and CNWRA.

2. On February 28 and March 1, 1995, I participated as an observer in the workshop sponsored by USGS. Renner Hofmann, CNWRA, and Leon Reiter, NWTRB, also attended the workshop as observers. There were about 30 attendees at this workshop. A List of Attendees is attached as Enclosure 1, and the Agenda for the workshop is attached as Enclosure 2.

The objectives of this workshop were: 1) to select five scenario earthquakes for input to ground motion modeling at Yucca Mountain; 2) to identify geologic constraints and uncertainties associated with the input. That is to say, to identify the characteristics of the five most dominant fault models at Yucca Mountain, such as fault length, geometry, and displacement, that would contribute to the hazard at the site. After identifying the objectives of the workshop, the group was split into four subgroups and were requested to identify these scenarios. After a period of solicitations and consultations, the participants identified six scenarios as the dominant ones. These are: 1) Furnace Creek/Death Valley fault system; 2) Bare Mountain fault; 3) Rock Valley fault; 4) Solitario Canyon fault; 5) Paint Brush Fault; and 6) "Coalesced" faults (Windy Wash, Solitario, and Fatigue Wash). One of the four teams proposed a Cedar Mountain earthquake type model at Yucca Mountain as an additional scenario. This type of model was discussed thoroughly by the participants, but no conclusion was reached whether to consider it in the modeling exercise or not. One of the observers raised the question about the possibility of considering the Ghost Dance fault/Solitario Canyon fault as a scenario for modeling, but it was indicated that the Solitario Canyon fault scenario can be modeled as close as possible to the site.

The meeting was productive and enabled the various participants who worked at Yucca Mountain to exchange different points of view and aggregate the information into five scenarios.

I suggested to Dr. Tom Hanks, one of the organizers of the workshop, that before starting the modeling exercise, the seismic reflection data collected last year by USGS should be examined to verify the fault parameters to be used.

- On March 2, 1995, I visited the USGS office in Lakewood, Colorado, to discuss the seismic reflection data collected around Moab, Utah.

It was suggested that the Atlas mill tailings site may be underlain by the Moab fault. It is not clear whether the Moab fault near Moab, Utah, is a tectonic structure or a salt dissolution collapse. Therefore, the objective of this visit was to examine seismic reflection lines for the existence of the fault and explore the possibility of other existing seismic reflection lines in the area of interest. Several seismic reflection lines were examined with Curt Huffman of USGS. The recently collected data showed good basement reflections on the section, and the salt structure is well defined. These lines were not quite in the vicinity of the area of interest. Mr. Huffman identified two other contractors who may have collected seismic reflection data closer to Moab, Utah, and may have crossed the Lisbon fault. I contacted those contractors and acquired the maps which identified the locations of the seismic reflection lines in the vicinity of Moab. This information will be transmitted to the Atlas mill tailings manager for their consideration in resolving the issue at question. Dr. Philip Justus will be in Denver, Colorado, and will have a chance to examine these new lines at the contractor offices.

My meeting with Mr. Huffman was very productive. We explored the tectonics of the area and discussed the several scenarios under which the surficial faults may be connected to the basement faults, and the consequence of such a scenario on the design of the Atlas site.

In conclusion, my trip to Denver, Colorado, provided an opportunity to interchange and discuss relevant issues with the USGS staff and to collect information needed to address several issues which I am responsible for in both the High-Level Waste and Uranium Recovery programs.

If you have any questions regarding this report, please contact me at 415-6651 or in Room T-7C24.

Enclosures: As stated

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### List of Participants

|                    |                      |                  |
|--------------------|----------------------|------------------|
| Anderson, Ernie    | USGS/Golden          | 303-273-8578     |
| Anderson, Larry    | USBurRecl/Denver     | 303-236-4195x282 |
| Bell, John         | NevBurMinesGeol/Reno | 702-784-1939     |
| Bucknam, Bob       | USGS/Golden          | 303-273-8566     |
| Coppersmith, Kevin | Geomatrix Conslt     | 415-434-9400     |
| Crone, Tony        | USGS/Golden          | 303-273-8591     |
| dePolo, Craig      | NevBurMinesGeol/Reno | 702-784-4161     |
| Fridrich, Chris    | USGS/YMPB/Denver     | 303-236-0516x278 |
| Hanks, Tom         | USGS/Menlo Park      | 415-329-5634     |
| Hamilton, Warren   | USGS/Denver          | 303-236-1329     |
| Machette, Mike     | USGS/Golden          | 303-273-8612     |
| Menges, Chris      | USGS/YMPB/Las Vegas  | 702-794-7201     |
| O'Leary, Dennis    | USGS/YMPB/Denver     | 303-236-0516x276 |
| Pezzopane, Silvio  | USGS/YMPB/Denver     | 303-236-0516x279 |
| Ramelli, Alan      | NevBurMinesGeol/Reno | 702-784-4151     |
| Schneider, John    | WCFS/USGS/Menlo Park | 415-329-5591     |
| Schwartz, David    | USGS/Menlo Park      | 415-329-5651     |
| Whitney, John      | USGS/YMPB/Denver     | 303-236-0516x275 |
| Wong, Ivan         | WCFS/Oakland         | 510-874-3014     |
| Yount, Jim         | USGS/UN-Reno         | 702-784-5565     |

### List of Observers

|                       |                          |                    |
|-----------------------|--------------------------|--------------------|
| Abrahamson, Norm      | Consultant               | 510-582-9017       |
| Allen, Clarence       | CalTech/NWTRB            | 818-395-6904       |
| Coates, Mary-Margaret | SAIC/Denver              | 303-236-0516x291   |
| Hofmann, Renner       | SWResrchInst/San Antonio | 210-522-5308       |
| Ibrahim, Buck         | NRC                      | 301-415-6651       |
| Quittmeyer, Rich      | WCFS/Las Vegas           | 702-794-1864       |
| Reiter, Leon          | NWTRB                    | 703-235-4473       |
| Savy, Jean            | LLNL                     | 510-423-0196       |
| Stepp, Carl           | WCFS/Consultant          | 512-338-0620       |
| Sullivan, Tim         | DOE/Las Vegas            | 702-794-7915       |
| Tillson, David        | NNWPO/Consultant         | (801) 363-4093     |
| Ziamba, Jim           | USGS/YMPB/Denver         | (303) 236-0516x304 |

**Breakout Session: Selection of Scenario Earthquakes**

|                               |                               |                          |
|-------------------------------|-------------------------------|--------------------------|
| Group 1                       | Anderson, Ernie               | USGS/Golden              |
|                               | Anderson, Larry               | USBurRecl/Denver         |
|                               | Bell, John                    | NevBurMinesGeol/Reno     |
|                               | Schwartz, David               | USGS/Menlo Park          |
|                               | Abrahamson, Norm <sup>1</sup> | Consultant               |
|                               | Hofmann, Renner <sup>1</sup>  | SWResrchInst/San Antonio |
| Group 2                       | Bucknam, Bob                  | USGS/Golden              |
|                               | Coppersmith, Kevin            | Geomatrix Conslt         |
|                               | dePolo, Craig                 | NevBurMinesGeol/Reno     |
|                               | Fridrich, Chris               | USGS/YMPB/Denver         |
|                               | Menges, Chris                 | USGS/YMPB/Las Vegas      |
|                               | Ibrahim, Buck <sup>1</sup>    | NRC                      |
| Quittmeyer, Rich <sup>1</sup> | WCFS/Las Vegas                |                          |
| Group 3                       | Machette, Mike                | USGS/Golden              |
|                               | O'Leary, Dennis               | USGS/YMPB/Denver         |
|                               | Pezzopane, Silvio             | USGS/YMPB/Denver         |
|                               | Ramelli, Alan                 | NevBurMinesGeol/Reno     |
|                               | Reiter, Leon <sup>1</sup>     | NWTRB                    |
|                               | Savy, Jean <sup>1</sup>       | LLNL                     |
| Group 4                       | Whitney, John                 | USGS/YMPB/Denver         |
|                               | Wong, Ivan                    | WCFS/Oakland             |
|                               | Yount, Jim                    | USGS/UN-Reno             |
|                               | Crone, Tony                   | USGS/Golden              |
|                               | Hamilton, Warren              | USGS/Denver              |
|                               | Stepp, Carl <sup>1</sup>      | WCFS/Consultant          |
| Sullivan, Tim <sup>1</sup>    | DOE/Las Vegas                 |                          |

<sup>1</sup>Observers: initial assignments, free to "float"

## Agenda for Workshop to Characterize Scenario Earthquakes in the Yucca Mountain Region

**WORKSHOP OBJECTIVES:** To select approximately five scenario earthquakes and to specify geologic constraints and associated uncertainties for input to a set of ground motion modeling exercises pertinent to the potential nuclear waste repository at Yucca Mountain, Nevada. Specifically, observable fault characteristics such as fault length, displacement and geometry will be used to constrain earthquake parameters such as magnitude, distance and focal mechanism.

### February 28th (11AM to 6PM)

1. Introduction and Overview (30 min)
  - Introduction to ground motion scenario project (10 min, *Hanks*)
  - Meeting Approach, Format, and Logistics (10 min, *Pezzopane*)
  - Required geologic input data and uncertainties (10 min, *Schneider*)
2. Geologic and Tectonic Framework of the Yucca Mountain Region (2 hrs. discussion led by *O'Leary, Fridrich*)
  - Tectonic models of Basin and Range faults - (1 hr)
  - Lunch (a working lunch will be provided)
  - Tectonic models of Yucca Mountain faults (1 hr)
3. Select scenario earthquakes (faults) (4 hrs. discussion led by *Schwartz and Pezzopane*)
  - Overview of Candidate faults (30 min)
  - Selection of 5 or 6 scenario earthquakes
    - Breakout session (1 hr)
    - Plenary session (1 hr)

### March 1st (9:00AM to 5PM)

4. Assess source properties of scenario earthquakes (5 hrs. discussion led by *Schneider*)
  - Overview of required source properties (~2 hrs with discussion)  
Issues: fault dimensions, depth, displacements, analogies to other tectonic regimes, ...
  - Define earthquake properties for local, regional, and background events
    - Breakout session (1.5 hrs)
    - Plenary session (1.5 hrs)
5. Wrap-Up Discussion/Observers Commentary (~1 hr. discussion led by *Hanks*)