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MEMORANDUM FOR: Leon L. Beratan, Chief
Earth Sciences Branch
Division of Radiation Programs, and
Earth Sciences, RES

FROM: Thomas J. Nicholson
Earth Sciences Branch
Division of Radiation Programs, and
Earth Sciences, RES

SUBJECT: TRIP REPORT - USGS/DOE NEVADA TEST SITE REVIEW, DENVER, COLORADO JULY 23-27, 1984

On July 23 through the 27, 1984, I met with USGS, DOE, and NRC technical staff, and State of Nevada and NRC Consultants to discuss the existing data base for DOE funded work at Yucca Mountain, Nevada Test Site, Nevada. A list of attendees is attached.

I was assigned to the unsaturated zone review group which reviewed the following items and related data:

A. List of Unsaturated Zone Data Reviewed - Parvis Montazer, USGS Principal Investigator.

1. Video (TV) log of UZ-1 from land surface to well depth of 1198 feet,
2. Well design instrument package and measurement techniques for UZ-1,
3. Moisture content data for drill hole cuttings from well UZ-1,
4. Neutron log of UZ-1,
5. Psychrometer data for UZ-1 and discussion of time-variant behavior prior to equilibrium conditions,
6. Heat dissipation probes for UZ-1 and relationship to psychrometer readings,
7. Backfilling of UZ-1 anulus to include moisture considerations for use of "bentonite" and "silica flour,"
8. Antecedent moisture conditions for implanting of "silica flour" backfill and a review of effective range of tension (suction) capabilities for heat probe (0 to -5 bars down to -10 bars) versus psychrometers (-5 bars and lower),

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9. H-1 data for pore size distribution and moisture content (statistical distributions of 1st and 2nd moments of porosities).

10. Calculated relative permeability data for H-1.

11. Gas permeabilities of G-1 and G-2 cores (Holmes & Nauver (H&N) laboratory derived values).

12. Plots of unsaturated hydraulic conductivity (K) versus the inverse of pressure.

13. Theoretical fracture modeling derived data (computer code results).

14. Vapor phase calculations and determination of upward flux to top of Topopah Spring Formation.

15. Pre-drilling site (drilling pods) preparation activities including wetting of disturbed materials during leveling of pads.

16. UZ-N holes for neutron probe monitoring to understand infiltration rates and movement. (minimal surface disturbance anticipated).

17. UZ-6 well may cost over $5 million for drilling and instrumentation (Discussion of possible contamination of UZ-6 hole due to prior pump test at H-4 in which 23 acre-feet were pumped and discharged to surface within 3,000 feet of UZ-6 borehole.)

B. List of Franklin Lake Playa - Information Reviewed - John Czanneckl, USGS Principal Investigator

1. Location of wells (previous large diameter wells, and USGS wells).

2. Water levels (artesian conditions exist in northern part of playa upto 7 feet above ground-surface, water level in the southern portion of the playa is 13 feet below land surface).

3. Vertical gradient description (upward).

4. Tensiometer cluster locations (4) each contained from 2 to 12 tensiometers.

5. Deuterium - oxygen data has been obtained.

6. "Eddy correlation" calculations for determination of evapotranspiration from the soil surface. (The calculations require sensible heat flux, soil heat flux, and net radiation which are obtained in the field and heat of vaporization which is a constant. The necessary data have been obtained).

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7. Another method that is being used for determination of ET is by calculating upward flow from the hydraulic conductivity - potential relationship data.

8. Maxey-Egan method is also used for determination of the percent of rainfall which will be recharged to the ground-water system.

C. Specifically Requested Data Reviewed by Nicholson and Ornstein, NRC, Tyler, DRI, and Bloomsburg, University of Idaho:

1. Psychrometer Data for UZ-1 (matric potential (mPa) vs. time (days)),

2. Weather data (rainfall, temperature, relative humidity, and barometric readings on a continuous basis),

3. Heat dissipation probe data (matric potential (mPa) vs time),

4. UZ-1 well blueprint of finished hole where the drilled diameter changed from 48" to 36" to 17½,"

5. Gas permeability values for UE25C-1 well, (Permeability (millidarcies) vs. inverse inlet pressure (1/PSIG),

6. Moisture retention curve for cores from wells UE 26A-6, G-1, and G2 (matric potential (bars) vs. volumetric water content),

7. Relative permeability (10^{-5} to 1 (dimensionless)) as a function of moisture tension (bars) for well USW G2,

8. Theoretical fracture computer code results and plots of permeability of liquid or gas vs. capillary pressure,

9. Holmes and Nauver (H&N) letter report of Oct. 4, 1984 letter to Parvis Montazer (laboratory tests and results).

D. FOLLOW-UP ITEMS--OBSERVATIONS AND QUESTIONS

1. More specific information is needed on (1) heat dissipation probes, (2) apparent inconsistency in moisture characteristic curves for G-2 at 324.8 feet, and (3) explanation of figure 1 in Oct. 4, 1983 letter from H&N to Parvis Montazer.

2. Regarding water content of H1 core, the following information is needed:

- What was the surfactant (foam) use?
- What is the hydrophobic/phillic nature of the surfactant?
- What is the effect of surfactant on surface tension?
- What is overall effect of surfactant on water content?

3. Helium porosity experiments (i.e., laboratory techniques and assumptions) need explanation.

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4. Review of intrinsic permeability values of all cores by H&N indicate a very wide range of values.

E. INFORMATION REQUESTED

1. Data which was reviewed and copies to be requested:

   a) U.S.G.S. unsaturated-saturated report (Holmes & Nauver letter to P. Montazer, USGS October 4, 1983 regarding NTS-TEC; MTL/83-99; Lab Report No. 83-406) containing statistical distribution of;

      (1) Porosity,
      (2) Moisture content (by weight and/or volume),
      (3) Saturation (%) etc., using laboratory tests on cores;

   b) Plots of;

      (1) moisture characteristic curves - water saturation as a function of moisture tension,

      (2) Relative permeability as a function of moisture tension used to derive relative permeabilities;

   c) SANDIA Report SAND-83-FY74 - "Laboratory Reports of Unsaturated Flow Characteristics of Core Samples from Nevada Test Site Well USW-G3";

   d) Copy of Video (TV) log of USGS hole UZ-1;

   e) Blue print of unsaturated zone monitoring instruments and locations for USGS hole UZ-1;

   f) From "Index of Plots done by Stephanie Yard" items; II.B Helium Gas Permeability Case Sample Data, III. B. & C. Relativity Permeability, Holmes and Narver Data and Laboratory Collected Data, IV. Type Curve-Fracture.

2. Data not reviewed but copies to be requested:

   a) Review of gas (vapor phase) sampling data for UZ-1;

   b) Overview of neutron probe holes (UZ-N holes) (location, frequency of measurements, and calibration procedures);

   c) Overview of deep well monitoring program for the unsaturated zone;

   d) Parvis Montazer's Ph.D thesis (final copy) at the Colorado School of Mines;

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e) U.S.G.S. Open File Report 8-XXX (Weeks & Wilson); and

f) Weeks, Ed., Field Determination of Vertical Permeability to Air in The Unsaturated Zone, USGS Professional Paper 1051, 1977

While in Denver, I also visited Rocky Mountain Arsenal to discuss with the facility staff and consultants, NRC Research FIN B2454, "Mitigative Techniques and Analysis of Generic Site Conditions for Ground-Water Contamination Associated with Severe Accidents." Douglas W. Thompson, Research Environmental Engineer, U.S. Army Engineer Waterways Experiment Station, and Edward W. Berry III, Chief, Compliance and Resources Branch, Rocky Mountain Arsenal discussed ground-water interdictive strategies with me. They stressed the importance of obtaining site specific hydrogeologic and soil mechanics properties and establishing a baseline monitoring network prior to the strategy analysis. If a site is anticipated to require mitigation, then a monitoring program prior to a contamination event is very important. I also met with Dr. Stanley G. Robson, Colorado District, WRD, USGS to discuss the ground-water flow analysis in support of the Rocky Mountain Arsenal interdictive program, and its relation to the NRC research project. Obviously, ground-water management models and contaminant transport codes are an important part of an interdictive strategy.

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Attachment: As stated

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G. Bloomsburg, U. of Idaho

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