

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

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TRIP REPORT

SUBJECT: DOE-NRC Technical Exchange on Unsaturated Zone Hydrologic Characterization (20-3702-001)

DATE/PLACE OF TRIP: Sept. 26-27, 1990, Stapleton Plaza Hotel, Denver, Colo.

AUTHOR: Ronald T. Green

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PERSON PRESENT:

CNWRA

NRC

Ronald T. Green

See Attached List

BACKGROUND AND PURPOSE:

The purpose of the technical interchange was to discuss the planned unsaturated zone (UZ) hydrologic and hydrochemical tests described in the SCP and, to a limited extent, NRC's Site Characterization Analysis (SCA) comments that relate to these planned tests. In addition, the UZ Hydrology Peer-Review Team results were discussed.

TECHNICAL INTERCHANGE TOPICS:

The Interchange commenced with opening remarks by Corey Macaluso/DOE, Ardyth Simmons/DOE and King Stablien/NRC. Representatives for the State of Nevada and the City of Las Vegas did not have opening remarks. Prior to the presentations, Claudia Newberg, technical lead for the DOE Unsaturated Zone Component of the Hydrology Program, described the organization of the UZ Program.

The first presentation was made by J. Mercer, who summarized the conclusions of the Peer-Review Team (PRT). The PRT is an august group of hydrology-related earth scientists appointed by the DOE to evaluate their UZ Program. A report of their conclusions and recommendations is in review and due to be published later this year. Included in the major points discussed during the presentation was the recommendation that research and construction activities be better coordinated. The PRT did not identify any new conceptual flow paths at Yucca Mt. They concluded that it is unlikely that fractures act as flow barriers, that perched water and vapor phase transport may be encountered but doubt that the steep groundwater gradients encountered to the north of Yucca Mt. due to tectonic activity is an important issue. M. Mifflin inquired why the G-Tunnel tests were discontinued. DOE responded that the G-Tunnel tests were canceled because of budgetary not programmatic constraints. The G-Tunnel report of tests performed to date is due out in the near future.

D. Hoxie made a presentation on Alternative Conceptual Models. His opinion is that there is a net moisture flux of zero at Yucca Mt. This statement was met with lively debate with particular reference to the effect of the zero net moisture flux upon the groundwater travel time.

A. Flint presented a summary of the Characterization of the Properties of the Unsaturated Zone at Yucca Mt. His presentation included descriptions of the DOE sampling and testing programs.

J. Russeau made a presentation of the DOE program of Deep Testing for Flow Processes. The purpose of this program is to define fluid flow direction in the UZ and to determine bulk properties of the unsaturated media. The boreholes are to be 12.5 inch diameter holes advanced to the water table (approx. 2500 ft) and each will have 16 dedicated instrument stations. There are to be about 18-20 boreholes. There will also be two boreholes dedicated for use in two separate vertical seismic profile (VSP) surveys.

G. LeCain made a presentation on the Air Permeability Testing. There are to be two aspects to these tests: 1) surface based testing employing boreholes and 2) subsurface based testing using the exploratory shafts. The prototype instruments have already been tested at the Apache Leap Site using air and nitrogen as the testing gases.

A. Yang discussed Geochemical and Isotopic Methods for Determining Flow Paths and Travel Times. A. Yang presented the results from several different geochemical and isotopic studies of water procured (squeezed or centrifuged) from rocks taken from boreholes in the UZ at Yucca Mt. The results of his studies provide valuable information needed to accurately interpret the hydrogeology of the UZ at Yucca Mt. Water sampled from a depth of 310 ft from UZ-4 had anomalously younger water as compared to water sampled from a depth of 330 ft from UZ-5. A full interpretation of the UZ will not be possible until water samples from rock core from greater depths from these boreholes and others are sampled. Sampling of water from these additional rock cores has not yet been permitted by the DOE custodians of the core samples.

L. Boughton presented results and plans for the UZ Fractured Rock Hydrology Project. Field-scale investigations at the ESF are planned and laboratory-scale experiments on assortment of different sized rock samples are at various levels of completion. The laboratory work is being conducted at the USGS lab in Denver.

The lab was visited by D. Chery/NRC and R. Green/CNWRA to become more familiar with the DOE efforts in this area. Several different instrumentation and measurement devices are employed at the lab for use in the fractured rock experiments. Included in their experimentation is the use of a Moire camera which uses reflected white light to map fracture surfaces with a resolution of 10 microns. The technology was developed by Cardenas-Garcia at Texas Tech and is currently available. Fracture surfaces and thicknesses are also to be measured by injecting liquid woods metal into fractures, allowing the woods metal to solidify then opening the fracture to remove the woods metal imprint of the fracture. The Moire camera is to be used to map the surface of the removed woods metal.

A relatively large block (approximately 30 cm. x 30 cm. x 70 cm.) of fractured welded tuff has been prepared for imbibition and tracer experiments. A series of 0.5 inch-diameter boreholes has been drilled into the matrix and fractures of the block to permit instrument emplacement. Instrumentation includes tensiometers, microwave psychrometers, electrodes and possibly gamma-gamma ray, heat-dissipation probes and

time domain reflectometry (TDR) to measure the moisture content. A small-scale (1/4 in diameter) borescope adapted from medical technology by Welch-Allyn Videoscope is used to inspect the boreholes. Olympus also produces similar borescopes.

Allen Flint summarized the DOE progress in studies concerning Meteorology and Infiltration at Yucca Mt. A large amount of regional- and local-scale meteorological data has been compiled from various local and federal agencies. An interpretation of the present climatic patterns has been made using these data. No prediction of infiltration has been made.

E. Kwicklis discussed the Process-Oriented Modeling of Flow in the UZ. These numerical studies address groundwater travel time and flux. The roles of fractures and air entrapment and air encapsulation within fractures have been studied. Channeling and the flux of water between fractures and the matrix are additional objectives of this study.

D. Hoxie and B. Bovardson discussed Site-Scale Hydrologic Modeling and Data Requirements. The ultimate model of this investigation is to be a model with dimensions 1 km. x 10 km. x 5 km. It is to be a site-specific, three-dimensional, non-isothermal, nonhomogeneous, two-phase transient model that includes sub-models used to represent greater detail or additional processes. Present efforts have been confined to two-dimensional models. The broader representation will include greater detail and will be more site-specific as data become available.

#### **CONCLUSIONS:**

The agenda of the meeting was initially proposed by the technical personnel at the NRC. The flavor of the interchange, therefore, was essentially technical in nature and, in my opinion, very informative. The presentations were well prepared and the participants were quite willing to share the results of their investigations with the other members at the meeting. The participants were also readily accessible at other times during the interchange for more detailed questions and discussions. The interchange afforded me the opportunity to become familiar with investigations conducted by DOE which are pertinent to the concerns of the Center with particular emphasis on the Thermohydrology Program and to meet the individuals performing these studies.

#### **PROBLEMS ENCOUNTERED:**

None

#### **PENDING ACTIONS:**

None

#### **RECOMMENDATIONS:**

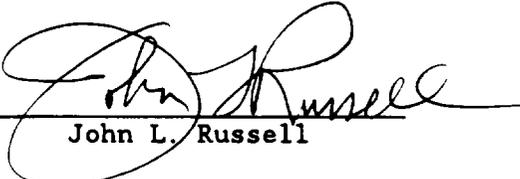
Participation at these technical exchanges, although time consuming and resource intensive, can (and should) be very informative. The Center staff, if possible, should participate. The DOE appeared to go to great lengths to assemble all the integral participants at the interchange, thus providing an excellent opportunity to review the DOE effort without expending excessive energies and resources.

**SIGNATURE:**

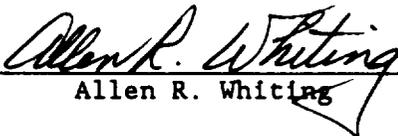
  
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Ronald T. Green

10/10/90  
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Date

**CONCURRENCE SIGNATURES:**

  
\_\_\_\_\_  
John L. Russell

10/10/90  
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Date

  
\_\_\_\_\_  
Allen R. Whiting

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\_\_\_\_\_  
Date

RTG/yl

Attachments

ATTENDANCE LIST  
DOE - NRC TECHNICAL EXCHANGE ON UNSATURATED  
ZONE HYDROLOGIC CHARACTERIZATION

September 26-27, 1990

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