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MINUTES OF THE 86TH ACNW MEETING
SEPTEMBER 24, 26, AND 27, 1996

- TABLE OF CONTENTS -

- APPENDICES -

CERTIFIED 12/18/96 BY
PAUL W. POMEROY

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MINUTES OF THE EIGHTY-SIXTH MEETING OF THE
ADVISORY COMMITTEE ON NUCLEAR WASTE
SEPTEMBER 24, 26, AND 27, 1996
LAS VEGAS, NEVADA

YUCCA MOUNTAIN SITE TOUR
SEPTEMBER 25, 1996

The 86th meeting of the Advisory Committee on Nuclear Waste (ACNW) was held at Hotel San Remo, Chateau 1 and 2, 115 East Tropicana Avenue, Las Vegas, Nevada, on September 24, 26, and 27, 1996. The purpose of this meeting was to discuss and take appropriate actions on the items listed in the attached agenda. The entire meeting was open to the public. On September 25, 1996, the Committee toured the Yucca Mountain site and its environs.

A transcript of selected portions of the meeting was kept and is available in the NRC Public Document Room at the Gelman Building, 2120 L Street, N.W., Washington, D.C. [Copies of the transcript are available for purchase from Neal R. Gross and Co., Inc., Court Reporters and Transcribers, 1323 Rhode Island Avenue, N.W., Washington, D.C. 20005. Transcripts are also available on FedWorld from the "NRC MAIN MENU." The Direct Dial Access number for FedWorld is (800) 303-9672; the local Direct Dial Access number is (703) 321-3339.]

Dr. Paul W. Pomeroy, Committee Chairman, convened the first day of formal presentation at 8:30 a.m. on September 26th and briefly reviewed the schedule for the meeting. He stated that the meeting was being conducted in conformance with the Federal Advisory Committee Act. He stated that the Committee had received a request from Nye County to make an oral statement during the meeting. He also invited other members of the public who were present and had something to contribute, to let the ACNW staff know so that time could be allocated for them to make oral statements.

ACNW Members Drs. B. John Garrick, William J. Hinze, and George M. Hornberger were present. [For a list of other attendees, see Appendix III.]

I. CHAIRMAN'S REPORT (Open)

[Note: Mr. Richard K. Major was the Designated Federal Official for this part of the meeting.]

Dr. Pomeroy identified a number of items that he believed to be of interest to the Committee, including:

- The Commission appointed Dr. George M. Hornberger, Professor, Department of Environmental Sciences, University of Virginia, as a member of the Advisory Committee on Nuclear Waste.

- For the first time in several years, there are now five NRC Commissioners.

- William Russell, Director, Office of Nuclear Reactor Regulation (NRR), announced his retirement effective September 30, 1996, and Frank J. Miraglia, Deputy Director, NRR, will become Acting Director until Mr. Russell's position is filled.

- Dr. Virginia Colten-Bradley's rotational assignment with ACNW had been extended through the end of September, at which time Ms. Lynn Deering will return to the ACNW staff from a rotational assignment with Commissioner Rogers.

II. ACNW PLANNING SESSION (Open)

[Note: Mr. Richard K. Major was the Designated Federal Official for this part of the meeting.]

On September 24, 1996, the Committee spent the entire day planning future meetings and focusing on an operating strategy and priority issues. No technical reviews occurred. Present at the meeting were ACNW Members: Paul Pomeroy, John Garrick, William Hinze, George Hornberger, and ACNW staff members Richard Savio and Richard Major.

The following meeting days and topics were selected for the rest of calendar year 1996:

a) **87th ACNW Meeting, October 22-23, 1996**

- Review selected Direction-Setting Issue Papers and the Commission's strategic reassessment process.
- Review Shallow Land Burial Sites licensed under the former 10 CFR Part 20.302, 20.304, and current 20.2002.
- Receive Annual Ethics Training.
- Prepare ACNW reports on Radionuclide Transport from the Yucca Mountain repository, Critical Group and Reference Biosphere for Waste Disposal Regulations, Coupled (Thermal-Mechanical-Hydrologic-Chemical) Processes, High and Low-Level Waste Time of Compliance, selected Direction Setting Issue Papers, Shallow land Burial sites, and ACNW Priority Issues.

b) **88th ACNW Meeting, November 12-13, 1996:**

- Review internal planning issues and priorities for the next 12 to 18 months.
- Prepare ACNW reports.

c) **89th ACNW Meeting, December 10-13, 1996:** (Note: Subsequently cancelled.)

- Review internal planning issues and priorities for the next 12 to 18 months.

- Review Igneous Activities (note this topic may slip until January 1997).
- Prepare ACNW reports.
- Meet with NRC Commissioners in groups of two.

The Committee discussed strategic issues for its operation. The ACNW should focus its advice on the national role the NRC plays in nuclear waste disposal. More attention should be paid to efforts to harmonize the risks from various toxic (hazardous and radioactive) substances. The question was raised as to whether the current philosophy of waste disposal (a permanent solution that future generations can ignore) should not shift to waste management and recognize that future generations will be involved. The Committee believes it should strive to apply more of a risk perspective to the topics it reviews.

The Committee discussed the nature of its activities. The ACNW provides the Commission technical advice on the issues it reviews. To what extent should the Committee provide analysis of policy issues? In all cases, the focus of the ACNW is on public health and safety. Given the fact that safety is the driver of ACNW activities, the Committee's knowledge should bear directly on safety.

The Committee discussed value of attending outside meetings to stay abreast of recent developments in the field of waste management. To the extent practical, Committee Members and staff will attend outside meetings.

Dr. Garrick was asked to prepare a preamble to the next set of ACNW priority issues. Mr. Major was asked to draft the next list of ACNW priority issues based on the day's discussions.

Some key elements of an ACNW operating strategy are:

- There should be a balance between proactive and reactive review topics.
- ACNW should set criteria for reviewing proactive issues.
- The Committee should consider all issues brought to it by the staff but should review only a subset of these issues.
- Timeliness should be a consideration for ACNW advice.
- Having the expertise to perform a valuable review should be a consideration for producing ACNW advice.
- ACNW should review issues that appear on the Commission agenda (and issues that do not appear, but should).
- ACNW should review issues that all four Committee Members agree are important.

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The Committee discussed issues that should be placed on its priority list for the next 12 to 18 months. These issues now include the following:

1) Regulatory Framework

2) Site Characterization Activities Related to Waste Isolation Strategy

3) Repository Design

4) Viability Assessment (VA)

5) Role of NRC/ACNW in LLW Disposal

6) Risk-Informed, Performance-Based Regulation

7) Role of ACNW in Decommissioning

8) Performance Assessment (PA)

9) Role of Expert Judgment

10) Uranium Mill Tailings

11) Spent Fuel Surface Storage Facilities

The Committee discussed its letter-writing process. The audience for ACNW letters is the Commission, the NRC staff, and the public. Each report should be sponsored by a lead Committee Member. In the report drafting process, other Committee Members should provide the lead Member with key points they wish to see included and fundamental differences they have with an initial draft. Members need not make editorial comments on initial drafts. If Members have no comments or are unable to comment on a draft report, the lead member should be informed. In addition to a lead member responsible for the production of a report, a second member will be assigned to each letter. The second member will serve as a collaborator in the writing of initial drafts of Committee reports.

Members will receive copies of all transcripts of ACNW meetings. Floppy disks and hard copies are both available.

Ms. Carol Harris discussed resources available to the Committee in FY97. The funds for travel have been reduced 20% in relation to last year. Only two full-time employee person-years can be charged to the Nuclear Waste Fund from the ACNW Office. The FY97 budget will support eight full Committee meetings and four working groups. The budget will allow the use of consultants on 22 working days through personal services contracts. The use of contractual agreements will

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permit the use of more consultants, but contracts requires a 60-day notice period prior to using a consultant.

The Committee discussed its response to NRC's strategic assessment process and selected Direction-Setting Issue (DSI) papers. Conversations will be held with Commission offices to aid in a decision on how the Committee should react to the November 15, 1996, deadline for comments. Committee Members will read the Direction-Setting Issue papers over the next two weeks. Tentative assignments were made for responding to the DSIs. A long and short list of assignments was compiled. The long list includes the following:

2. Oversight of the Department of Energy - Paul Pomeroy

4. NRC's Relationship with Agreement States - George Hornberger

5. Low-Level Waste - George Hornberger

6. High-Level Waste and Spent Fuel - William Hinze

7. Materials/Medical Oversight - William Hinze

9. Decommissioning, Non-Reactor Facilities - Paul Pomeroy

12. Risk-Informed, Performance-Based Regulation - John Garrick

24. Power Reactor Decommissioning - John Garrick.

The short list of DSIs for ACNW consideration would include issues 5, 6, 9, and 12.

III. YUCCA MOUNTAIN FIELD TRIP

During the morning of September 25, the Committee visited the Exploratory Studies Facility (ESF) tunnel, and participated in a familiarization tour (and hands-on examination) of the tunnel boring machine (TBM). Underground tour stops included several of the test alcoves. In the afternoon, the Committee visited the Amargosa Valley, as well as the Ash Meadows National Wildlife Refuge. The purpose of the afternoon visit was to directly observe agricultural activities and environmental areas down-gradient from the proposed repository at Yucca Mountain (Amargosa Valley is ~25-30 km away from Yucca Mountain; its second quarter 1996 population estimate was 1136).

Exploratory Studies Facility Tour

On the morning of September 25, 1996, the ACNW was escorted by DOE representatives on a tour of the ESF at the proposed Yucca Mountain site. The first stop was at the DOE Operations Center in Las Vegas, Nevada, to watch a video of tunnel safety training, and

to look at a model of the ESF. Ms. Carol Hanlon, DOE Yucca Moutain Project Office (YMPO), organizer of the tour, along with Dr. Russ Dyer, DOE YMPO, escorted the party. Other attendees included ACNW staff; Mr. William Belke, NRC On-site Representative; Ms. Linda Durcell, DOE Yucca Mountain liaison; and other DOE representatives.

After being fitted with respirators, safety lights, and other standard equipment, Dr. McNeally, Morrison Knutson, provided an overview of the TBM. He noted that the objectives of the tunneling include examining geomechanical responses in the repository horizon, permeability testing in several alcoves, thermal effects, and zeolite experiments.

Dr. McNeally described the various parts of the TBM, including the cutter head, the grippers, thrust cylinders that push the machine forward, mapping gantry, and trailing gear, containing systems that feed the gripper. The length of the TBM is 140 meters long with trailing gear. Presently, the TBM is operating at a rate of about 30-40 feet a day. As of September 9, 1996, the TBM had traveled approximately 6350 meters, having turned the last corner of the "U" shape. Alcoves 1 through 7 are in various stages of completion.

The party was transported through the 4-mile tunnel via rail cars. Contacts between formations were well marked and easily observed. The tuffaceous rocks contained large voids formed from gas pockets.

Mr. Ned Elkins, Management & Operations (M&O), led the rest of the tour. The first strata observed from the rail car included the Tiva Canyon unit of the Paint Brush Tuff, followed by the Pah Canyon unit of the same formation. Below that was the crystal-rich, nonlithophysal Topapah Spring unit, followed by the upper and middle (repository unit) and lower lithophysal units of the Topapah Spring formation. Approximately 200 meters into the tunnel, across from Alcove 2, the Bow Ridge fault was observed, where this unit is offset as much as 100 meters, the largest offset observed in the tunnel. Cross-hole permeability tests are being conducted in Alcove 2.

The Drill Hole Wash fault was the next visible structure, at about 2000 meters. The party stopped at Alcove 5, at 2800 meters, near the lowest point in the tunnel. Alcove 5 contains a thermal-mechanical heater test. Apparently, rain collects at the lowest point and is pumped periodically. Alcove 5 is excavated at a 7 percent grade in order to maintain the middle lithophysal unit of the Topapah Spring formation at a constant 10 meters overhead. The thermal-mechanical test began in August, and the rock has been heated to about 90°C. An important objective of the testing was to establish initial conditions of the rock with respect to moisture content, using electrical resistivity measurements and a technology called sea mist to measure water chemistry. The purpose of the single heater test is to gain insights into how to design the large scale drift heater test planned for December 1997. It was noted that permeability from one side of the heater test block to the other side changes as much as two orders of magnitude. Further into the alcove the excavation for the drift scale heater test was being done using drill and blast technology. Seismic energies were measured using drill and blast, and it was found

that the energies were very low (100 mm/sec), thus DOE believes it is unlikely that the technology will change the characteristics of the existing fractures.

The next stop was Alcove 6, the Northern Ghost Dance Fault Alcove, at 3737 meters. Here an Alpine Miner is being used to excavate. In order to avoid intercepting or crossing the Ghost Dance fault, the miners have drilled a dry horizontal hole with the hopes of stopping about 15 meters before the fault. At the time of the visit, the fault had not yet been located, but is expected to be about 125-130 meters in from where the Alpine Miner was stopped. Testing along the fault will be conducted to assess air-vapor movement along the fault.

The last stop was Alcove 7, the Southern Ghost Dance Fault Alcove, at 5073 meters, where 70-90 meters of offset from the Ghost Dance Fault is observable. The party was able to climb upon the TBM, and in small groups, enter the operator control cab and the mapping gantry. Finally, the group was transported back to the tunnel entrance. Along the way Mr. Elkins pointed out the trace of the Sundance Fault, which resembled a fracture with no offset.

Amargosa Valley Tour

Mr. Ralph McCracken, a farmer in Amargosa Valley, led the tour. After providing some general information on current and potential valley development, water table data, and local services --school, church, senior center, stores, etc.-- the tour stopped at the following locations, discussing activities with the landowners:

1. Saddleback Orchards- a 5001 pistachio tree farm
2. John Dear catfish farm
3. R and B Garden - elephant garlic farmer
4. Ostrich breeding farm

In addition, the tour observed two dairy cattle farms (~3000 head each), a pig farm, a sod farm, several alfalfa farms, and the ABC mining operation (borate/paint pigment) and the IMV bentonite operation.

After concluding its visit to Amargosa Valley, the Committee proceeded to the Ash Meadows Wildlife Refuge where the U.S. Fish and Wildlife Service agent indicated that this refuge had more endemic species of plant and animal life than any other in the United States. Several unique pupfish were seen in the Crystal Springs and Ash Meadows waters.

IV. FLOW AND RADIONUCLIDE TRANSPORT AT YUCCA MOUNTAIN (Open)
[Note: Dr. Andrew C. Campbell was the Designated Federal Official for this part of the meeting.]

On September 26th this session of the meeting began with welcoming remarks from Wes Barnes, Yucca Mountain Project Manager, DOE Site Characterization Office. Mr. Barnes noted that the program had changed from an academic-oriented project to one more concerned with a project management approach. He described some of these changes and the current focus of the project.

Dr. George Hornberger chaired this session and provided some opening remarks. He noted that the purpose of this working group session was to investigate the status and results of studies of both the saturated and unsaturated zones at Yucca Mountain. The presentations, he added, would encompass the following three issues: (1) flow and transport through an interconnected network of fractures such as may occur at Yucca Mountain; (2) the role of geochemical effects on transport, including studies of site geochemistry, sorption, solubility, and colloids; and (3) approaches to integrate geochemical data and modeling with hydrologic models and the role of integrated models in iterative performance assessment (PA).

Dr. Hornberger discussed some of the dramatic budgetary and programmatic changes in the HLW activities for both DOE and NRC that have recently occurred. He noted that this working group session would aid ACNW in reviewing and evaluating NRC's key technical issues (KTIs) and their importance to performance. He also stated that the standard for compliance of the proposed HLW repository is undergoing significant changes after the National Research Council reviewed the technical bases for the Yucca Mountain standard and recommended that a risk-based, site-specific standard be developed. He discussed ACNW's role in reviewing a number of areas within the scope of the changing DOE and NRC programs. He added that one of the key areas of concern in a risk-based approach is the transport of radionuclides via groundwater. This is one of the key components of the DOE Waste Containment and Isolation Strategy (WCIS) and was one of NRC's KTIs. Therefore, he stated, it is important to establish the significant processes and mechanisms for retaining and retarding the release and transport of radionuclides from the repository.

Dr. June Fabryka-Martin, Los Alamos National Laboratory (LANL), described the program for sampling the isotope, ^{36}Cl, within the ESF, which started in January 1996 and had collected more than 100 samples at the time of the ACNW meeting. Dr. Fabryka-Martin described the different tuff units at Yucca Mountain and the associated water flow characteristics. Two specific issues are whether the Paintbrush Tuff non-welded (PTn) unit will act like a barrier to water flow and how much water gets into the Topopah Springs welded (TSw) unit, in which the repository will be built. Dr. Fabryka-Martin also discussed variations in the $^{36}Cl/^{35}Cl$ isotopic ratio, different sources of ^{36}Cl, and how they affect the ratio to stable ^{35}Cl. These sources of ^{36}Cl include the following: anthropogenic production from oceanic nuclear testing in the 1950s and 1960s ("bomb pulse"); natural production in the atmosphere from cosmic ray interactions with ^{40}Ar, ^{36}Ar, ^{35}Cl; in situ

natural production in the surface and near surface environment from cosmic ray reactions with isotopes such as ^{39}K, ^{40}Ca, and ^{35}Cl; and deeper natural production from neutron capture by ^{35}Cl.

Dr. Fabryka-Martin described the three main objectives of the study: (1) to evaluate the frequency and distribution of preferential flow paths; (2) to provide bounding estimates of the water travel time in the TSw tuff unit at the repository horizon; and (3) to evaluate the extent to which the PTn tuff unit reduces vertical water flux or increases groundwater travel time (GWTT). The sampling approach involves two sampling methods, one to systematically collect samples every 200 meters in the ESF and the other to sample specific features, including the PTn subunit contacts in the ESF.

Dr. Fabryka-Martin showed the results to date. The $^{36}Cl/^{35}Cl$ isotopic ratio displays a bimodal distribution showing significant increases only in the feature-based samples. Although a significant number of feature-based samples do not show elevated ^{36}Cl, all those that do are associated with faults that cut to the surface (i.e., they are mapped on the surface). In addition, she noted that all the regions with multiple samples showing elevated ^{36}Cl are associated with major fault zones. Other bomb pulse isotopes that have been found associated with high ^{36}Cl samples include ^{129}I and ^{99}Tc. Dr. Fabryka-Martin described the work being performed to reduce uncertainties in the data sets, which come from various sources. They also plan to acquire corroborating evidence for fast water flow paths. This includes more measurements of other bomb pulse isotopes (^{3}H, ^{129}I, and ^{99}Tc) in the ESF. Another goal is to provide interpretations of pre-bomb $^{36}Cl/^{35}Cl$ isotopic ratios as indicators of GWTT, which includes establishing upper limits, best estimates, and lower limits. She noted that the current thinking is that pre-bomb $^{36}Cl/^{35}Cl$ isotopic ratios reflect changes in geomagnetic intensity, as well as changes in the deposition rate for Cl. She described some of the assumptions and tests conducted. She also compared some modeling results for 6-40 thousand years before present with data obtained from pack-rat middens. These data and modeling results both show an abrupt change 10,000 years ago.

Two members asked questions about sampling approaches, sample variability, and the main criteria used for selecting what is sampled. Dr. Fabryka-Martin noted that they plan more systematic sampling. She also said that the lower $^{36}Cl/^{35}Cl$ ratios for the borehole samples, compared to those from the ESF, may reflect an artifact caused by the surface drilling equipment that finely grinds up the rock samples that can be obtained.

Dr. Bruce Robinson, LANL, discussed $36Cl/^{35}Cl$ isotope ratios and described the flow characteristics of the different tuff units at and above the ESF and how these affect the relation between the percolation flux and the age of pore water in the rock matrix. He showed the results of model simulations of $^{36}Cl/^{35}Cl$ in the various units of Yucca Mountain. He also discussed the reconstructed ^{14}C and ^{36}Cl activities in the atmosphere for the past 50,000 years. Dr. Robinson compared the measured and model-predicted correlation between ^{14}C and ^{36}Cl activities in perched water bodies at Yucca Mountain. He presented a preliminary model of matrix flow and discussed the average percolation flux through Yucca Mountain. The breakthrough of bomb pulse ^{36}Cl to the ESF suggests a

percolation flux of 1-5 mm/yr whereas the model prediction of 0.1 mm/yr does not correspond to the data (unless the $^{36}Cl/^{35}Cl$ interpretations are incorrect). He said that a small percentage of infiltrating water (0.1-0.01%) gets through in short periods of time (1-50 years). He concluded by reiterating some of the main points.

There were questions dealing with the infiltration into the mountain. One of the key issues was how to obtain quantitative measures of the water flux. Dr. Robinson acknowledged that it was difficult to get direct evidence of the flow distribution, but that the ^{36}Cl data will help to understand how moisture moves through the different permeable layers and fractures.

Dr. Bo Bodvarsson, Lawrence Berkeley Laboratory, provided an outline of his presentation on flow modeling and percolation at Yucca Mountain, which included discussions of the unsaturated zone data and model, the calibration of the model, percolation flux studies, and the testing program to reduce uncertainties. He discussed the importance of understanding the percolation flux in DOE's WCIS. He noted that this affects all parameters down to the saturated zone. Dr. Bodvarsson discussed the models previously used by DOE and some of their implications for moisture movement in Yucca Mountain. He also presented the current modeling approach being used by DOE. He further discussed the indicators of the percolation flux through the mountain. He noted that no one data set dominates the results and that it is necessary to look at all the data sets to come to conclusions about the percolation flux. Dr. Bodvarsson discussed the different flux indicators and the range of flux values that can be obtained from the data. The flux of water is estimated from a number of ongoing studies. These studies include the following: fracture properties and fracture/matrix interaction, infiltration, in-situ conditions, pneumatic data, ESF moisture balance, geology and geophysics, and matrix properties. These studies support the development of the unsaturated zone site-scale model, including: conceptual models, 3D-numerical models, the moisture model, the thermal model, and the gas-flow model. In turn, these model outputs provide input to the transport model, the Total System Performance Assessment (TSPA) model, thermal modeling, and gas transport. The unsaturated zone flow model must provide for material (gas and water) and energy balances.

Dr. Bodvarsson discussed the percolation flux indicators and the range of flux values associated with each. The infiltration model suggests a percolation flux of 5-10 mm/yr. The saturation and moisture data suggest a percolation flux of about 1 mm/yr. The pneumatic data cannot indicate a moisture flux; however, there is a very high fault permeability for gasses that suggests an interconnected fracture network through which moisture can move to the repository horizon. The environmental isotopes (e.g., $^{36}Cl/^{35}Cl$) suggest a percolation flux of 1-5 mm/yr. The perched water data suggest a percolation flux of about 2 mm/yr. The temperature/heat flow data for Yucca Mountain suggest a deficit in the estimated heat flux through the mountain. This can be explained either due to heating of water that is percolating down through the mountain or heat changes due to evaporation and condensation of moisture in the gas phase moving through the permeable fractures in the mountain. Borehole temperature data suggest an infiltration rate of

about 5-10 mm/yr. Thus, all these sources of information and data indicate a percolation flux in the range of 1-10 mm/yr.

In response to questions, Dr. Bodvarsson noted that the percolation flux is the total bulk mass flow, and he described why the data support a higher percolation flux. He described the implications of different flux values for the potential for lateral moisture movement through the different tuff units at Yucca Mountain, which have a wide range in permeability. Dr. Bodvarsson added that the flux through the fractures is much faster than the flux through the matrix; however, he maintained that the total mass flux was the same. He also described the infiltration model and the methodology used to calculate the infiltration flux. He discussed the older and new alternative models for moisture flow through the mountain and the implications of the newer model for the DOE WCIS. One of the modeling studies showed that at a percolation rate of 28 mm/yr, no moisture would drip into the ESF drifts, but if it increased to 280 mm/yr, dripping would occur. A second modeling study showed that at percolation rates of 1-10 mm/yr, there would not be any "dry out" of the repository. Dr. Bodvarsson described some of the tests that are planned or could be done to test the hypothesis. One test is to evaluate percolation flux in horizontal boreholes drilled deep enough into the ESF walls to be well away from the continual drying effect of the ventilating air. He added that a moisture balance for air and water entering and leaving the ESF needs to be done. In addition, tests for rock matrix properties and lateral flow tests are needed.

A question was raised about the coupling of flow and transport models and any problems with this approach. Dr. Bodvarsson said that there were not many problems with performing these analyses separately because different grid spacings are required for flow and transport modeling. He also noted that the saturated and unsaturated zone models are poorly coupled. There was also some discussion of the effect of transient conditions on the models. Dr. Bodvarsson also discussed the differences between the equivalent continuum model (ECM) and the dual continuum model.

Dr. Randy Bassett discussed studies at the Apache Leap Research Site (ALRS), near Globe, Arizona, which are being done by his research group at the University of Arizona. He said that ALRS is a wetter site than Yucca Mountain, and that significant amounts of fracture flow are observed there, allowing them to measure and study these phenomena. The site provides an analog to a wetter future climate at Yucca Mountain. Dr. Bassett described the ALRS study areas, including an older mine tunnel that intercepts water flowing through fractures. He also described the studies conducted at a "deep-slant borehole" that they drilled at ALRS and mentioned some air permeability tests. He described some initial observations at the ALRS of seeps in the tunnel, and he discussed the historical data for the site. He noted that only certain fractures are observed to have water flowing through them. He described three kinds of flow observed in the tunnel: continuous constant flow; episodic flow, which correlates with surface rainfall events and flow in Queen Creek, a stream above the tunnel; and horizontal flow, which they have deduced from the homogeneous nature of the water chemistry over large horizontal distances.

Dr. Bassett described the isotopic data collected at the ALRS and its importance for understanding the flow system. They collected data for a number of isotopes and chemical species, including. the bicarbonate anion, oxygen isotopes, boron isotopes, and sulfur isotopes. The goal was to try to elucidate the relative importance of fracture flow and matrix flow. They did not collect ^{36}Cl data because they feared possible contamination. Dr. Bassett showed a graph of the stream flow above the tunnel and subsequent fracture flow observed in the tunnel. He noted that water may begin flowing in the fractures shortly after a rain event, but that it often takes a long time for water to cease flowing. This lag time is due to the time required to fill up the fracture system, for water to subsequently flow along certain fast pathways, and then for the remaining water to drain from the fractures. They originally thought that no fracture flow would occur unless the matrix became saturated, but subsequent observations showed that this was not the case.

Dr. Bassett also discussed the tracer tests conducted at ALRS. They determined that the discharge from the fractures was a mixture of creek water and perched water. The latter remains for some time in the fractures and rock matrix. He noted that there is a need for geochemical data to identify and confirm which fractures are flowing. He described a variety of conditions necessary for the formation of perched water bodies. Dr. Bassett also discussed the purpose of the "deep-slant borehole" test. He discussed the ^{14}C signature of small amounts of moisture in the rock matrix, and its implications for fracture flow. These data were obtained by using a vacuum extraction process. He also discussed the use of uranium isotopes ($^{234/238}U$) to understand fracture matrix interactions. In regions with little leaching, such as perched water zones, there is a high $^{234/238}U$ ratio whereas in regions with a large amount of leaching, the ratio is significantly lower. He concluded by reiterating the evidence for rapid flow and transport through fracture networks, the presence and implications of perched water bodies and the effect on flow and transport, and the improved understanding of flow and transport through fracture systems that was obtained from the studies of isotopes such as ^{14}C and $^{234/238}U$.

During a question and answer session, Dr. Hornberger asked if ALRS is analogous to Yucca Mountain during a wetter, cooler climate. Dr. Bassett replied that this was their current thinking about the study area. He went on to describe some of the implications for the Yucca Mountain site from the ALRS. He was asked whether, under pluvial conditions, Solitaro Canyon Wash or 40 Mile Wash at Yucca Mountain could behave in the same way as Queen Creek does at the ALRS and transmit water to the repository horizon via fractures. Dr. Bassett said that DOE would have to do studies and model calculations to establish if this could occur. Dr. Hinze asked about the vacuum extraction technique for low-moisture rocks and its possible application to understanding fracture matrix interactions at Yucca Mountain. Dr. Bassett replied that it would be possible to apply the methodology and that the technique would be published in the journal Radiocarbon in a couple of months.

Mr. William Glassley, Lawrence Livermore National Laboratory (LLNL), next discussed the geochemistry of the near-field environment. He provided a physical description of different regions around a repository and described the chemical characteristics of these

regions. He delineated four different regions created by the heating effect of the emplaced waste, as follows: (1) the above boiling region, (2) the boiling region, (3) the condensation region, and (4) the engineered barrier system.

In the above boiling region, moisture exists in a vapor state and in the boiling and condensation regions, water can exist in both a vapor and a liquid state. He noted in the regions where the temperature is at or above the boiling point, there will be a rapid evolution of non-equilibrium chemical effects, which he discussed. He described how they had determined that in the near vicinity of the emplaced waste, chemical equilibrium will not be achieved for either fracture or matrix flow and that kinetic effects will dominate the chemistry and mineralogy of the system. In this region, a number of effects will be evident: the chemical state of the system will be primarily oxidizing in nature; the evolution of pH will depend upon the amount of carbon dioxide and oxygen present (i.e., whether the system is open to or closed to the atmosphere); and chloride will be concentrated to fairly high values as the water evaporates. These effects could have a dramatic impact on the corrosion potential of the waste packages.

In the boiling region, two phases of water will exist--liquid and vapor. These two phases will interact with the large volume of rock present and the resulting geochemical reactions will be rock dominated, except at high water-volume flow paths. Dr. Glassley described the reactive transport modeling that was performed. He depicted two geochemical regions: (1) a recycling zone above the waste package heat sources, where water evaporates and condenses with continual drainage back into the boiling zone; and (2) the region below or to the sides of the packages where evaporation and condensation take place so as to drain water away from the waste. He described some modeling that they have done for this region and the predicted mineralogy and porosity changes in the rock. The main effect in the zone above the waste packages, where distilled water is reacting with the rock for long periods of time, is that the naturally occurring form of silica, "ristobalite" dissolves and quartz precipitates as a secondary mineral phase. The net effect is to significantly increase the porosity of the rock in this region. As time progresses the quartz will dissolve and further increase the rock's porosity. However, in the region 5 meters away, where the water drains away, the interactions and changes in porosity are not so extreme -- the water chemistry will primarily be controlled by reactions with the minerals and the changes in porosity will not be very large. Overall, the changes in water chemistry will not be larger than the natural variations currently seen at the site.

In the Engineered Barrier System (EBS) region, he noted that the major effect of high temperatures will be on the performance of cement liners and the container metals. This is an area of significant uncertainty because not much is known about how this system will behave over time. In their reactive transport modeling, Dr. Glassley said that LLNL assumed that the water chemistry would be similar to low temperature cement/water interactions. That is, it is assumed that the pH would be very high initially (pH = 12-13), but modeling has shown that, as the fluid reacts with the iron in the containers, its pH will decrease dramatically (pH = 6) and then increase again (pH= 10) as secondary iron mineral phases precipitate. In response to a question, Dr. Glassley noted that this progression occurs because the iron phases that precipitate from the reaction are less

reactive than the original metal of the container. Dr. Glassley then described the complex evolution of chemical conditions below the repository and the effect these would have on the transport of radionuclides out of the EBS. He concluded by describing areas that will require further analysis and experiments to better understand the complex interactions that may take place. He noted that the materials introduced into the repository will have the largest effect on the potential changes in the near field chemistry and that this aspect of the problem will have the greatest impact on waste package performance. He added in closing that, in the areas away from the EBS, the chemistry will be rock dominated, except where high fluid flow may occur.

During the question and answer session that followed, Dr. Garrick asked how this work is being integrated with design considerations. Dr. Glassley replied that changes in pH and the oxidation/reduction potential of the system are the major controls on the container performance. He added that one of the most important areas for reducing uncertainty is to identify the materials to be used in constructing the repository and to determine which materials have the least uncertainty in terms of affecting the waste package performance. Dr. Hinze asked about the effect of porosity changes and also about the possible use of backfill in the repository. Dr. Glassley noted that they are looking at whether flow barriers and high permeability regions may develop. He added that they are looking at the chemical consequences of backfill. In order to gain some benefit, he said that the backfill would have to produce a high pH and a reducing environment. He added that none of the materials being contemplated could control the chemistry well enough to achieve these desired effects. Dr. Virginia Colten-Bradley, ACNW staff, asked about the temperatures used in the calculations. Dr. Glassley described the analyses, which were done at 25°C and 62°C. He stated that no significant differences in reactions were observed in the results at these temperatures.

Dr. Bruce Robinson, LANL, next presented the role of fracture coatings in controlling matrix - fracture interactions and radionuclide transport. Dr. Robinson described the main issues of concern about the potential transport of radionuclides at Yucca Mountain. These issues include: (1) whether there are natural barriers to radionuclide migration, (2) the possible effects of fast pathways, (3) the possible effects of fracture coatings, and (4) the possible effects of diffusion. He also described the experimental studies conducted by Dr. Inez Triay, LANL, and coworkers using columns of crushed tuff rock and diffusion studies using slices of fractured rock from Yucca Mountain. He described the results for three radioisotopes -- tritium (^{3}H), technetium (^{99}Tc) and neptunium (^{237}Np). The results showed that ^{237}Np was significantly retarded relative to both ^{3}H and ^{99}Tc. He went on to describe the experimental details and the implications for fracture transport at Yucca Mountain. He compared the results of different sorption experiments conducted on the fractured rocks. Some fractures showed little uptake of ^{237}Np, while others showed significant uptake. The latter had manganese oxide coatings and it is believed that sorption on to the Mn mineral phases present were responsible for the uptake of ^{237}Np. Dr. Steindler asked how they controlled the oxidation/reduction environment in the experiment. Dr. Robinson described how this was done experimentally. Dr. Hinze asked about the effects due to different aperture sizes. Dr. Robinson replied that the larger fractures would be able to transmit contaminants more easily.

Dr. Robinson discussed the diffusion cell experiments that were being conducted at LANL. He described the apparatus and how the experiments were conducted, and presented some of the results. One of the main goals was to determine if fracture coatings inhibited diffusion into the matrix. There were three main conclusions to the experiments: (1) diffusion into the matrix can be relatively fast; (2) ^{237}Np can be significantly retarded by sorption onto Mn minerals and diffusion into the matrix; and (3) fracture coatings do not inhibit diffusion. Since the experiments were conducted under saturated conditions, Dr. Bassett asked about the effect of an unsaturated matrix on diffusion. Dr. Robinson noted that a "skin" of saturated tuff may develop in the rock matrix near the fracture which would tend to dominate the diffusion process. Dr. Hornberger asked how the information would be used in PA. Dr. Robinson replied that the main issue is the role fractures play in transporting radionuclides from the repository to the water table. He pointed out that if matrix flow dominates transport, then the issue is not important, but if fracture flow controls the transport of radionuclides, the degree of retardation becomes very important in determining performance. They envision using the information developed in these experiments in the modeling program.

Dr. John Kessler, Electric Power Research institute, spoke about the role of colloids in fracture transport and its application to Yucca Mountain transport modeling. Dr. Kessler discussed the goal of establishing "reasonable assurance" in licensing a repository at Yucca Mountain and noted the distinction between this goal, which requires a conservative approach, and having full knowledge or understanding. He described the known properties of colloids as follows: They are extremely small particles, and generally range from a few microns (millionths of a meter) down to a few nanometers (billionths of a meter) in size. The chemical properties of these small particles is driven by the surface properties of the colloids. One specific feature is the surface charge on the particle, which is often negative. Since many mineral surfaces have a net negative charge, many colloids are repelled by the mineral surfaces and therefore remain in suspension. Dr. Kessler distinguished "true colloids" from "pseudo-colloids." Actinide colloids are an example of true colloids, he noted, whereas "natural colloids," such as small clay particles, are an example of pseudo-colloids. Natural colloids may provide surfaces for radionuclides to adsorb onto. He noted that the chemical properties of colloids are different than for dissolved chemical species and are modeled differently. The chemical properties, of both the colloids and the system of fractures through which they may migrate, control whether colloids can enhance or retard the migration of radionuclides at Yucca Mountain. A fully conservative treatment would probably not be able to demonstrate compliance; therefore, there is a need for a sufficient degree of realism in the treatment of colloids to determine if they are important to the performance of the repository.

Dr. Kessler discussed the need to determine the degree of colloid mobility or immobility. One important property of colloids is the tendency to adhere to the air/water interface, such as the surfaces of bubbles. This may be the major mechanism for moving colloids through the unsaturated zone at Yucca Mountain. For the purposes of licensing, it might be assumed that this property allows colloids to move through the unsaturated zone relatively unimpeded. Dr. Kessler noted that the properties of colloids are much better

known in the saturated zone. He described a number of scenarios for colloids in the saturated zone. He said that coagulation of colloids is known to occur under saturated conditions and they may become bound up once they get to the water table. These colloids may then reside at the top of the water table, allowing radionuclides to dissolve into solution. Another scenario is that pseudo-colloids may carry radionuclides to the air/water interface at the water table and, subsequently, radionuclides could de-sorb from the colloids. In either case, the concentration of colloids and the sorption characteristics need to be known. He described a third scenario involving the possible migration of colloids through fractures in the saturated zone. He discussed the laboratory and field studies and modeling of colloid behavior in this type of scenario. Dr. Kessler said that sufficient information is available to model this type of scenario. A fourth scenario he discussed is the possible deposition and erosion of colloids in the saturated zone, but this would require faster flow rates than generally occur at Yucca Mountain. He then described the information needed for dealing with colloids in the saturated zone at Yucca Mountain. This includes: the generation rate for true colloids, the concentrations of "pseudo-colloids" and their sorption characteristics, the stability of the colloids, and the size distributions of colloids. He said that, as an option, one might want to consider certain information requirements for the unsaturated zone in a more realistic fashion. He went on to describe a variety of scenarios that could be incorporated into transport models for Yucca Mountain and the information needed for these different scenarios.

In response to questions from Drs. Hornberger and Bassett, Dr. Kessler addressed the stability of colloids and discussed some of the information needed and possible field and laboratory studies that he felt would satisfy these information needs. Dr. Garrick asked about Dr. Kessler's experience in the area of colloids. Dr. Kessler described his interest in the unsaturated zone. Dr. Colten-Bradley asked how colloids would be stopped at the air/water interface in the saturated zone. Dr. Kessler replied that the saturated zone is generally a depositional environment for colloids and, although that may also be true for the unsaturated zone, it would be more difficult to demonstrate. Dr. Hornberger asked about possible movement along the air/water interface. Dr. Steindler asked what happens if the basic assumptions they make about colloids are not shown to be valid? Dr. Kessler replied that one approach is to focus on the saturated zone, where more is known about colloids, and treat the unsaturated zone conservatively. In addition, specific experimental and modeling studies may be necessary to obtain sufficient information to model the saturated zone. Dr. Campbell asked if the partitioning between the dissolved phase and the colloidal phase would need to be known in order to differentiate diffusion into the matrix from transport as colloids. Dr. Kessler replied that it would be necessary to have that partitioning information.

Dr. Bruce Robinson, LANL, spoke about coupled flow and transport modeling for Yucca Mountain. He provided an overview of the issues to be covered, including: near-field release rates, base-case simulations for key radionuclides, hydrologic properties of the system, fracture and matrix interactions and their effect on transport, the impact of thermal effects from the waste, and reactive transport modeling for ^{237}Np. Dr. Robinson discussed some of the specific areas of importance in these general categories. He addressed transport after near-field releases occur. Based upon the modeling, the

release rate becomes constant about 1,000 years after canister failure, so a release rate is taken as a starting point of the analysis. He also discussed differences between the dual permeability and equivalent continuum models and said that the dual permeability model is superior for transport modeling. Dr. Robinson also described the stratigraphy and presence of zeolites in Yucca Mountain.

Dr. Robinson discussed the batch sorption experiments conducted at LANL to measure the sorption properties of the zeolitic tuff rock at Yucca Mountain. For ^{237}Np, the average measured K_d value was 2.5±2-3 (ml/g). Those results showed a log-normal distribution. He discussed the effects of increasing pH or increasing carbonate, which decrease the K_d values to zero. Dr. Hornberger asked if these experiments were done on crushed rock. Dr. Robinson replied that they were, hence the resulting K_d values only apply to the matrix, not to the fractures. Many studies, he said, show that this is a defensible approach. He went on to discuss the modeling, including the descritization that was used in the analyses. Although the dual permeability model was earlier said to be superior, LANL used the equivalent continuum model in these calculations. He noted that for the purpose of screening calculations the ECM was suitable. The arrival at the water table took about half a million years in this analysis. He said that the effects of a range of realistic solubilities did not greatly change the result. He discussed the resulting relative doses for different radionuclides. If ^{237}Np is assigned a relative dose value of 1.0, then ^{99}Tc is 0.04, ^{238}U is 0.003; and ^{79}Se is 0.006. These numbers are varied in this way primarily because of the dose conversion factors (DCF). For example, ^{237}Np consistently gives the highest dose, even though it is retarded significantly relative to ^{99}Tc, because of its high DCF. For other calculations, Dr. Robinson said that he would focus on ^{237}Np to represent performance. He showed that changing the permeability of the zeolitic layers within the range of values thought to occur at the site had a significant effect on the transport behavior and performance. These results indicate areas that need further study, such as obtaining better permeability data for the zeolitic units at Yucca Mountain.

Dr. Robinson then discussed the modeling results for fracture and matrix transport using a dual permeability model. He described the details of the model and discussed the particle tracking procedure used to determine the relative amount of fracture and matrix flow. He noted that the shapes and heights of the peaks are significantly affected by the different model assumptions. He talked about the effects of varying infiltration rates and varying fracture/matrix transport in the models. In general, higher infiltration rates produce higher peak doses. Also, he noted that the transport time in the saturated zone is much faster (by about a factor of 10) than in the unsaturated zone. The only impact of the saturated zone on the result is the dilution and dispersion as the contaminants migrate to the accessible environment. Dr. Campbell asked how they defined the accessible environment and the time it takes radionuclides to get there. Dr. Robinson replied this was the time it took to get 25 km from the site and that essentially all of the retardation occurs in the unsaturated zone. Dr. Campbell then asked what was the cause of the double peaks in the dose versus time plots. Dr. Robinson replied that this was due to different transport times for fracture and lateral migration versus vertical flow down through the matrix. Dr. Pomeroy asked what information they had for the saturated zone.

Dr. Robinson replied that LANL had hydrologic data from over 100 wells and geologic data from a smaller number of wells. They plan to evaluate chemical evidence and isotopic data (^{14}C) to determine the ages of the saturated zone waters. This information will allow them to calibrate the model.

Dr. Robinson then reviewed the thermal-hydrologic impact of the waste heat on the transport properties of the system. He said that after a few thousand years the repository waste is cool enough for the matrix to re-wet and return to ambient flow conditions. Since ^{237}Np transport takes place over much longer time scales, the thermal pulse does not appear to affect it. However, he indicated, this does not include the possible effects of dissolution or precipitation of different mineral phases and the impact on permeability. Finally, he discussed the importance of ^{237}Np speciation on its transport properties. In particular, he discussed the significant effect of carbonate complexation on ^{237}Np mobility. Rather than simply assuming a conservative K_d, their reactive transport model takes into account the aqueous speciation of ^{237}Np to better assess its transport behavior. He also discussed the different chemical compositions of J-13 well water and UE-25 P-1 well water and the effects that different chemical properties can have on ^{237}Np transport.

During the question and answer session, Dr. Campbell asked what effect water chemistry changes in the near-field environment, such as higher ionic strength, would have on the transport properties of ^{237}Np. Dr. Robinson replied that the zeolite zone extends more than 100 meters below the repository and they expect that the water chemistry at that depth would be determined by the unaltered rock in this deeper zone rather than by the heat pulse and chemical changes in the near-field environment. Dr. Pomeroy asked what they plan to do to obtain more information on the zone under the repository horizon and how it might be incorporated in time for TSPA-VA. Dr. Robinson discussed some of the ongoing projects and noted that most of the information would have to be obtained from a limited number of boreholes, but that they were looking at sources of information that could be obtained in time for the VA.

Dr. Abe Van Luik, DOE, spoke about integration of flow and transport model information into TSPA. He described the ongoing TSPA work since TSPA-95 was completed, including abstraction, analyses, and results. These further analyses will be provided in the form of published reports and will be available after the review process is finished. In the area of model abstraction, he discussed the sensitivity studies being conducted for the unsaturated zone flow model, the thermal-hydrologic model, the waste package degradation model, waste form dissolution, radionuclide mobilization, unsaturated zone and saturated zone transport, and possible volcanic and seismic disruptive events. He noted, in particular, that the effects of the higher projected percolation rates were being evaluated in these sensitivity studies. In the area of current performance assessment work, he said that the PA group was working closely with the process level modelers, and that they were evaluating a wide range of alternative conceptual models in these analyses.

He described DOE's latest TSPA work. He said that sensitivity analyses are being conducted to evaluate the impacts of percolation flux versus seepage flux, advective flux and contact with the waste form, waste package degradation, cladding degradation, and the form of radionuclide release. He described detailed assumptions that were made in the analyses. One important change is that DOE is also looking at dose calculations at significant distances from the repository and much longer time frames than are required under the existing regulations. In their analyses DOE is still looking at release rates and the other requirements of the existing standards and regulations. Dr. Van Luik described the different results for TSPA-95 and the current analyses that take into account the higher percolation flux and other more recent data and results. He described the effect that the higher flux and higher matrix permeabilities have on the results, such as the potential for water dripping on the waste packages, the reduced time of repository dry out, and the decreased transport times. He also described the future anticipated activities and the plan for completing the TSPA-VA. He also discussed the approach for assuring that the TSPA-VA captures the process level modeling.

In response to a question from Dr. Pomeroy, Dr. Van Luik stated that the VA would be transmitted to the President in September 1998. Dr. Garrick asked why there was such emphasis on the VA. Dr. Van Luik said it was because the VA was essentially the ultimate "dry run" for the license application (LA) that will be submitted to the NRC. He also said that they would ask the NRC for comments on the VA. Dr. Hinze wanted to know the effect that the new infiltration data would have on the WCIS. Dr. Van Luik said that this is being reviewed and that the new view of the mountain is being incorporated into their analyses. DOE is trying to determine what else needs to be done. Dr. Hinze also wanted to know what studies are planned for the saturated zone. Dr. Russ Patterson, U.S. Geological Survey, responded that the saturated zone model is a deliverable product and that it will be available after review. The next deliverable after that will be the results of the reactive and nonreactive tracer studies being conducted at the C-well complex. There was also some discussion of the critical group. Dr. Hornberger wanted to know what was being done in the area of colloids. Dr. Van Luik said that LANL is responsible for this and that they are evaluating the effects on K_ds, but more work is needed. Dr. Hinze stated a concern that the model indicates that 90 percent of the flow is in the matrix. Dr. Bodvarsson described the various sources of information on rock properties, especially in the unsaturated zone. He also described some of the alternative models they are considering. There was a discussion of the effects of different permeabilities. There was also a question about the thermal effects on the zeolites. Dr. Robinson described some of the LANL results and the published reports. Dr. Colten-Bradley said that much of the work was done by Dr. David Bish at LANL. Dr. Robinson also said that it was difficult to incorporate the data into the models. The permeability changes can go either way due to dissolution and precipitation effects. Dr. Glassley described some of the modeling activities for the near-field that will feed into TSPA-VA. Dr. Garrick noted that he liked the approach of the working group presentations, with specific discussions leading to integration. Dr. Bassett provided a series of comments. He noted that there is much data, but many parameters are assumed. It is difficult for the model to predict parameters that can generally only be found by collecting field data, such as the presence of a perched water zone that his research group

discovered at the ALRS. He emphasized the need for collecting data and conducting field tests. Coupled hydrologic-geochemical models have far too many degrees of freedom to be useful in a predictive sense. Dr. Hornberger added that solving the inverse problem requires calibration from many sources of information and data.

V. **SITE CHARACTERIZATION INTEGRATION THROUGH THE USE OF PERFORMANCE ASSESSMENT (PA)** (Open)

[Note: Ms. Lynn Deering was the Designated Federal Official for this part of the meeting].

The Committee conducted a question-and answer panel discussion on the subjects of integration of site characterization and PA and use of expert judgment in assessing uncertainty in process-level models. Dr. Garrick led the discussion by noting that the purpose of this session was to discuss DOE's proposed plan for characterizing uncertainties in process-level models through the use of expert judgment, the model abstraction process, collaboration between scientists and PA analysts, weighting of scenarios, and the treatment and propagation of uncertainty. The panel of experts included Abe Van Luke, DOE, Bo Bodvarsson, Lawrence Berkeley Laboratories; June Fabryka-Martin, LANL; Bruce Robinson, LANL; and Robert Andrews, M&O.

Questions asked by Committee members included the following: Will the three dimensional (3-D) flow model be abstracted or used in its entirety in TSPA-VA? How will the 3-D flow model be abstracted without losing essential details of the model? What are the critical parameters driving the 3D model? How does the 3-D model treat spatial variability and assign uncertainty values for interpolated data points? Could the repository be engineered to avoid having to consider complex coupled processes? What information will be obtained from the various heater tests and when will it be available? Would the experimental program be greatly modified if it were known that fracture flow dominates the unsaturated zone flow system? How will TSPA-VA and other activities be used to focus on what data needs still exist before licensing and for performance confirmation? How will DOE address NRC's concerns about the way DOE modeled the unsaturated zone in TSPA-95? Will the hydrochemistry program be able to reduce uncertainty in the magnitude of flow in fractures, in addition to the rate of flow? Will DOE peer review panels on a continuing basis, during the elicitation itself and afterwards as an independent evaluator of the process? Will the same criteria apply to selecting inside experts as outside experts?

In response to these and other questions from the Committee, the panelists conveyed that the 3-D flow model will be abstracted because its complexity, particularly for transient simulations, cannot be realized in a risk-type PA. Thus, the most significant output of the 3-D model will be simplified in a useable form for the TSPA model, including magnitude and distribution of fluxes, uncertainties in fluxes, and distribution of flux between fractures and matrix. The 3-D model is set up with 30,000 grid blocks, each block having more than 15 parameters, not all of which are critical to performance. Sensitivity analyses should be limited to processes most important to performance. Abstraction allows

screening the process models to bound ranges of parameter values ahead of time. A single steady-state realization of the model takes about 12 hours.

Critical parameters driving the model include matrix permeability and alpha values for fractures, and coupling between gas flow, heat, and moisture contents. Regarding whether the repository can be engineered to avoid having to consider complex questions about coupled processes, the design and site programs are integrated to develop solutions.

Regarding heater test information, there will be laboratory test results on heat pipe effects, enhanced vapor diffusion, and preferential flow down fractures due to thermal effects, for the large block test, which is starting soon, and the single thermal-mechanical heater test, which began last month. The large block test will include pneumatic tests to examine permeabilities of the fracture system. As to whether there will be any information from the single heater test on thermal-chemical coupling, it was noted that there will always be a considerable amount of uncertainty about this.

In response to a question as to whether the experimental program would be changed if fracture flow was known to dominate the flow system, the panelists responded that the program is now being revised to try to get a more statistically valid description of the role of fracture flow versus matrix flow, by continuing the systematic sampling, plus sampling nearby fractures with specific characteristics to better understand matrix/fracture interaction. The measurements in the ESF so far have given the investigators greater confidence in infiltration rates. However, for radionuclide transport, information in the non-welded units below the ESF is needed to determine the relative fracture and matrix flow below the repository. It was suggested that work is needed to further characterize the zeolitic portion of the Calico Hills unit because this portion of the unsaturated zone is critical to PA.

Regarding changes being made to TSPA-VA from TSPA-95, the TSPA-VA will incorporate new flow information, as well as transport information on matrix diffusion, dispersion, retardation, and effective porosity.

As to whether the hydrochemistry program will answer questions about magnitude of flux in fractures in time for TSPA-VA, panelists indicated they thought the program would be able to provide this information in time. They highlighted plans to compare the infiltration maps with chloride pore water concentrations with depth for consistency, and to use a transport model to follow the chloride concentrations downward. This will allow them to test their ability to model the observed ^{36}Cl concentrations in the ESF, and the Cl pore water concentrations in the boreholes that penetrate the Calico Hills unit. They believe this will provide useful information about the question of relative flux in fractures and matrix with depth. Also noted was the possibility of using the University of Arizona's device to measure ^{14}C as another way of dating the pore water in the matrix of the ESF.

With respect to uncertainty associated with thermal-hydrologic coupling, in its expert judgment workshops, DOE plans to describe all of the uncertainties associated with the current understanding in thermal-hydrologic response as it drives performance, both for drift and larger-scale, and update the thermal-hydrologic models with information as it becomes available from the single heater test, and examine the possible conceptual models. It was noted that each of 10,000 waste packages may have their own thermal-hydrologic response; thus, reduce uncertainty about this variability, engineers are proposing a line-loading to achieve a more-uniform thermal load.

Regarding the question of how TSPA-VA and other activities will be used to focus on what data needs still exist before licensing, Dr. Van Luik responded that a systems engineering study was started last year to assess what the confirmation program should include. Also, investigators are continuously identifying areas where they need more information.

Regarding the question of whether DOE will use peer review panels during the elicitation itself and afterwards as an independent evaluator of the process, DOE indicated that this was correct. DOE wants to ensure the panel has an opportunity to provide input along the way, rather than after the work is completed. In this way, the panel can evaluate how well the work was done, rather than just whether an activity was completed. In response to the question about criteria to select internal and external experts, the same criteria apply, but there are limitations as to who is available and knowledgeable on the inside. Outside experts are needed in infiltration and rock properties and fracture data. DOE plans to record what they did and why, but the whole exercise is to improve the models and DOE's understanding. It is not clear whether the experts' opinions will be incorporated into TSPA-LA.

At the close of the session, the Committee expressed satisfaction with the panel format, particularly for discussing PA integration issues, and noted it hopes to continue with this format in the future.

VI. REPOSITORY DESIGN FOR VIABILITY ASSESSMENT (VA) (OPEN)

[Note: Mr. Howard J. Larson was the Designated Federal Official for this part of the meeting].

Mr. D. Stucker, DOE, after an initial background statement, introduced Mr. J. Bailey, Deputy Operations Manager, Engineering and Integration, M&O contractor, who provided the Committee with an overview of the goals of the design program, its current schedule, and some preliminary concepts.

Mr. Bailey noted that the reference design for the VA, which may not be the final design of the repository, would, nevertheless, identify tentative and likely resolutions to engineering drivers, in addition to being tied directly to the TSPA for the VA. He noted that

the design of the repository was a first-of-a-kind effort, and as such, there was a continuing need to develop potential solutions to resolve unprecedented regulatory designs. He gave as an example, the repository ventilation system, which he perceived as a system with safety significance, but one that the NRC had yet to review.

Upon approval of the VA, the next step in the design evolution would be the development of the license application design. It was likely that the LA design would, also, not be the final design). The Advanced Conceptual Design (ACD) that was published in March 1996, represented years of design effort and provided a common reference for the start of the design for VA. However, the ACD will not be updated. The overall design program is called a one-pass program, which, over a five-year period, would permit the ongoing development of a single design to support the VA, the Environmental Impact Statement, and the LA.

Mr. Bailey proceeded to discuss the various prioritization elements (performance assessment, use of existing technology, costs, licensability) used in this single-pass process and discussed the several design phases currently envisaged in the design schedule. He also noted the use of consultant panels to guide the process, with the focus on solutions.

Among the VA design issues currently being evaluated were: thermal loading strategies, possible EBS performance enhancements, criticality control concepts, emplacement drift ground supports, various performance confirmation concepts, retrievability concepts, how to dispose of site-generated wastes (resulting from the use of single- or dual-purpose casks vs. use of a multi-purpose canister), and the viability of remote underground handling concepts.

He concluded with a discussion of some of the concepts currently under consideration concerning the total site activities--from the unloading of the received casks through the eventual placement of the waste containers via an emplacement gantry onto support pedestals in the repository design drifts.

In response to Dr. Hinze's question as to an example of the learning process thus far, Mr. Bailey noted that the fracture orientation of the rocks is different than originally thought. This will result in a new direction for the drifts. He also noted that the current criteria for arriving at an appropriate setback distance was arbitrary: 60 meters from any fault, ease of construction, and consideration as to whether the robustness of waste packages would permit a change in setback distance.

Mr. Bailey discussed the impact on the repository cross-section of changing thermal loading from the current 83 kw. For example, if the current thermal loading was only 20 kw/Ac, a much larger repository would be needed (3500 acres vs. 850 acres). DOE is currently looking at areas east and west of the current repository footprint.

Dr. Pomeroy asked about DOE's intention to add an east-west drift and was told a decision would be made this year, and if the answer was affirmative, the design would be finalized in 1998 and construction would commence in 1999.

Dr. Garrick asked about the composition of the design team and was told the principal responsibilities were: Morrison-Knudsen -- underground work, Fluor-Daniel -- surface facilities, and Framatome -- waste package and handling efforts. In addition, SAIC, Intera, Duke Engineering, LLNL and several other laboratories contributed to this truly integrated team effort.

Mr. Bailey, in response to a query, noted that DOE has not "traded off" a repository located in a favorable geologic setting for a "beefing-up" of the EBS.

Dr. Hinze concluded the session by noting that the Members recognize that what had been unstated in this presentation was the extremely high level of effort associated with the repository design.

VII. COMMENTS FROM INTERESTED PARTIES (Open)

[Note: Mr. Howard J. Larson was the Designated Federal Official for this part of the meeting].

Representatives from Nye County, Nevada, had requested in advance (per the Federal Register Notice) an opportunity to make a presentation to the Committee during this portion of the meeting.

Mr. N. Stellavato, Nye County On-site Representative, provided a brief introduction to the Nye County drilling program. He was followed by M. Murphy, Nye County Regulatory Advisor, who discussed the goals of the program in addition to discussing its past accomplishments and the County's proposed future activities. He noted that, in addition to monitoring and evaluating DOE's general scientific and site characterization program, the County intends to identify areas that, from their perspective, are not being adequately addressed by DOE.

He stated that Nye County had one borehole (ONC-1) and had instrumented DOE hole NRG-4. In addition, the County is also monitoring pressure, temperature, and relative humidity in the ESF. The County has proposed eight new boreholes, to be drilled in three phases, but recognizes the difficulty in obtaining the necessary DOE funding. (Current funding is limited to that which can be considered as supporting on-site representation - Nuclear Waste Policy Act, Section 117(d).)

Mr. P. Montazer, METI (Nye County contractor), described various tests, some of the results of the monitoring and conceptual simulations, and provided some potential applicability of the results obtained thus far. He stated that their key issues of concern were related to the pneumatic and hydraulic systems in the repository block, the identification of potential alternative designs that can improve the performance of the repository, and the adequacy of DOE's hydrologic and geologic models of Yucca Mountain. After discussing several of their tests, he provided the following conclusions and recommendations:

1. Monitoring the activities in the ESF tunnel should be given a higher priority.

2. The existing facilities can be used to estimate large-scale rock properties (thereby minimizing costs).

3. More comprehensive simulations are justified to predict moisture and heat removal from the repository.

4. The DOF scientific program should be more flexible.

5. Backfill may not be necessary if long-term engineering problems can be resolved.

Among his responses to multiple questions from the Committee, Mr. Montazer noted the following:

1. His perception that pressure changes can be transmitted for long distances.

2. Dripping will not occur in the large tunnels if proper ventilation is maintained.

3. Close liaison is maintained with DOE, which, although appearing receptive to the Nye County data, has yet to change direction in response to the reported results of the Nye County program.

4. Nye County proposes to run a four-hole tracer test downstream of the repository block, believing that such a test may be particularly significant since ONC-1 responds within 2 hours of the C-well tests (although the C-well program is ~2600 feet distant).

5. Some groups (including the Nuclear Waste Technical Review Board) project that there is another fault below the Bow Ridge fault.

6. Nye County concurs that angle holes appear to have several unique benefits; the County therefore proposes to drill one (G-2) in the steep gradient.

In response to a request from Dr. Pomeroy as to whether there were any further comments from attendees at the meeting, Mr. D. Shuttle, Boulder City, Colorado, representing himself as a private citizen, stated that he believed that there were no interrupted pathways between the matrix and the fractures, and therefore, the physical relationships in this area must be further understood.

VIII. **EXECUTIVE SESSION (OPEN)**

[Note: Mr. Richard K. Major was the Designated Federal Official for this part of the meeting.]

A. **Future Meeting Agenda** (Open)

Appendix IV summarizes the proposed items endorsed by the Committee for the 87th ACNW Meeting, Rockville, Maryland, October 22-23, 1996, and future Working Group meetings.

B. **Future Committee Activities**

The Committee discussed agendas for their October, November, and December meetings.

The meeting adjourned at 4:45 p.m. on Friday, September 27, 1996.

under consideration. The contention must be one which, if proven, would entitle the petitioner to relief. A petitioner who fails to file such a supplement which satisfied these requirements with respect to at least one contention will not be permitted to participate as a party.

Those permitted to intervene become parties to the proceeding, subject to any limitations in the order granting leave to intervene, and have the opportunity to participate fully in the conduct of the hearing.

A request for a hearing or a petition for leave to intervene must be filed with the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Docketing and Services Branch, or may be delivered to the Commission's Public Document Room, Gelman Building, 2120 L Street, NW, Washington, DC, by the above date. Where petitions are filed during the last ten (10) days of the notice period, it is requested that the petitioner promptly so inform the NRC by a toll-free telephone call to Western Union at 1–(800) 248–5100 (in Missouri 1–(800) 342–6700). The Western Union operator should be given Datagram Identification Number N1023 and the following message addressed to Dr. William D. Travers, Director, Spent Fuel Project Office, Office of Nuclear Material Safety and Safeguards; petitioner's name and telephone number; date petition was mailed; plant name; and publication date and page number of this **Federal Register** notice. A copy of the petition should also be sent to the Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and to Mr. Gary Johnson, Esq., Vice President, General Counsel, and Corporate Secretary, Northern States Power Company, 414 Nicollet Mall, Minneapolis, MN 55401.

Non-timely filings of petitions for leave to intervene, amended petitions, supplemental petitions, and/or requests for hearing will not be entertained absent a determination by the Commission, the presiding Officer, or the presiding Atomic Safety and Licensing Board that the petition and/or request should be granted based upon a balancing of the factors specified in 10 CFR 2.714(a)(1)(i)–(v) and 2.714(d).

For further details with respect to this action, see the application dated August 7, 1996, which is available for public inspection at the Commission's Public Document Room, 2120 L Street, NW, Washington, DC 20555, and at the local public document room at the Minneapolis Public Library, Technology and Science Department, 300 Nicollet Mall, Minneapolis, MN 55401. The Commission's license and safety evaluation report, when issued, may be inspected at the above locations.

Dated at Rockville, Maryland, this 9th day of September 1996.

For the U.S. Nuclear Regulatory Commission.

William D. Travers,

Director, Spent Fuel Project Office, Office of Nuclear Material Safety and Safeguards.

[FR Doc. 96–23757 Filed 9–16–96; 8:45 am]

BILLING CODE 7590–01–P

Advisory Committee on Nuclear Waste; Revised Notice

The 86th meeting of the Advisory Committee on Nuclear Waste (ACNW) scheduled for September 26 and 27, 1996, at the Hotel San Remo, 115 East Tropicana Avenue, Las Vegas, Nevada, in Chateau 1 and Chateau 2 is being extended to include a session on Tuesday, September 24, 1996, in the Conference Center. All other items pertaining to September 26 and 27, 1996, remain the same as published in the **Federal Register** on Thursday, September 5, 1996 (61 FR 46832).

The agenda for this session shall be as follows:

Tuesday, September 24, 1996—8:30 a.m. until 6:00 p.m.

The ACNW will conduct a planning session and will not formulate advice for the Commission during this session. The conduct of Committee activities, procedures and operations, as well as future priorities, will be discussed.

For further information contact: Mr. Richard K. Major, Chief, Nuclear Waste Branch (telephone 301/415–7366), between 8:00 A.M. and 5:00 P.M. EDT.

ACNW meeting notices, meeting transcripts, and letter reports are now available on FedWorld from the "NRC MAIN MENU." Direct Dial Access number to FedWorld is (800) 303–9672; the local direct dial number is 703–321–3339.

Dated: September 11, 1996.

Andrew L. Bates,

Advisory Committee Management Officer.

[FR Doc. 96–23761 Filed 9–16–96; 8:45 am]

BILLING CODE 7590–01–P

Advisory Committee on Reactor Safeguards; Joint Meeting of the ACRS Subcommittees on Instrumentation and Control Systems and Computers and on Electrical Power Systems; Notice of Meeting

The ACRS Subcommittees on Instrumentation and Control Systems and Computers and on Electrical Power Systems is scheduled to hold a joint meeting on October 8, 1996, Room T-2B3, 11545 Rockville Pike, Rockville, Maryland.

The meeting will be open to public attendance.

The agenda for the subject meeting shall be as follows: Tuesday, October 8, 1996—8:30 a.m. until the conclusion of business.

The Subcommittees will continue their review of the proposed Standard Review Plan Sections, Regulatory Guides, and Branch Technical Positions related to digital instrumentation and control systems. The Subcommittees will also review the status of NRC programs to address equipment vulnerabilities to lightning and other transients. The purpose of this meeting is to gather information, analyze relevant issues and facts, and to formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Oral statements may be presented by members of the public with the concurrence of the Subcommittee Chairman; written statements will be accepted and made available to the Committee. Electronic recordings will be permitted only during those portions of the meeting that are open to the public, and questions may be asked only by members of the Subcommittees, their consultants, and staff. Persons desiring to make oral statements should notify the cognizant ACRS staff engineer named below five days prior to the meeting, if possible, so that appropriate arrangements can be made.

During the initial portion of the meeting, the Subcommittees, along with any of their consultants who may be present, may exchange preliminary views regarding matters to be considered during the balance of the meeting.

The Subcommittees will then hear presentations by and hold discussions with representatives of the NRC staff, its consultants, and other interested persons regarding this review.

Further information regarding topics to be discussed, whether the meeting has been cancelled or rescheduled, the Chairman's ruling on requests for the opportunity to present oral statements and the time allotted therefor can be obtained by contacting the cognizant ACRS staff engineer, Mr. Michael T. Markley (telephone 301/415-6885) between 7:30 a.m. and 4:15 p.m. (EDT). Persons planning to attend this meeting are urged to contact the above named individual one or two working days prior to the meeting to be advised of any

Dated: August 29, 1996.

M. Rebecca Winkler,

Committee Management Officer.

[FR Doc. 96–22562 Filed 9–4–96; 8:45 am]

BILLING CODE 7555–01–M

Special Emphasis Panel in Networking and Communications Research and Infrastructure; Notice of Meeting

In accordance with the Federal Advisory Committee Act (Pub. L. 92–463, as amended), the National Science Foundation announces the following meeting.

Name: Special Emphasis for NSFNET Connections Panel (#1207)

Date and Time: September 25, 1996; 8:30 a.m. to 5:00 p.m.

Place: Room 1175

Type of Meeting: Closed

Contact Person(s): Mark Luker, Program Director, CISE/NCRI, Room 1175, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230, (703) 306–1950.

Purpose of Meeting: To provide advice and recommendations concerning proposals submitted to NSF for financial support.

Agenda: To review and evaluate proposals submitted for the NSFNET Connections Program.

Reason for Closing: The proposals being reviewed include information of a proprietary or confidential nature, including technical information; financial data, such as salaries, and personal information concerning individuals associated with the proposals. These matters are exempt under 5 U.S.C. 552b.(c) (4) and (6) of the Government in the Sunshine Act.

Dated: August 29, 1996.

M. Rebecca Winkler,

Committee Management Officer.

[FR Doc. 96–22561 Filed 9–4–96; 8:45 am]

BILLING CODE 7555–01–M

NUCLEAR REGULATORY COMMISSION

Advisory Committee on Nuclear Waste; Notice of Meeting

The Advisory Committee on Nuclear Waste (ACNW) will hold its 86th meeting on September 26 and 27, 1996, at the Hotel San Remo, 115 East Tropicana Avenue, Las Vegas, Nevada, in Chateau 1 and Chateau 2. The date of this meeting was previously published in the **Federal Register** on Wednesday, December 6, 1995 (60 FR 62485).

The entire meeting will be open to public attendance. The agenda for this meeting shall be as follows: *Thursday, September 26, 1996—8:30 A.M. until 6:00 P.M. Friday, September 27, 1996—8:30 A.M. until the conclusion of business*

During this meeting, the Committee plans to consider the following:

A. *Radionuclide Transport at Yucca Mountain*—The Committee will investigate the status and results of studies and modeling of radionuclide transport in the saturated and unsaturated zone at Yucca Mountain. This topic will constitute the entire meeting on Thursday. Specific focus will be on the transport of radionuclides in fracture systems at Yucca Mountain. This will include the ingress of water to the repository horizon and geochemical processes that affect transport of radionuclides out of the repository via fracture systems.

B. *Site Characterization*—The Committee will discuss site characterization integration through the use of performance assessment. A continuation of discussions with the Department of Energy on Total System Performance Assessment will be held with emphasis on the use of expert elicitation panels.

C. *Repository Design for Viability Assessment*—The Committee will discuss the advanced conceptual design for the proposed repository at Yucca Mountain, Nevada, with representatives of the Department of Energy and other interested parties.

D. *Public Comments*—The Committee will hear comments from members of the public on concerns related to nuclear waste disposal.

E. *Preparation of ACNW Reports*—The Committee will discuss proposed reports, including: radionuclide transport at Yucca Mountain, specifying a critical group and reference biosphere to be used in a performance assessment of a nuclear waste disposal facility, the consideration of coupled processes (thermal-mechanical-hydrological-chemical) in the design of a high-level waste repository, time of compliance in high- and low-level waste disposal, and the DOE program plan and waste isolation strategy.

F. *Committee Activities/Future Agenda*—The Committee will consider topics proposed for future consideration by the full Committee and Working Groups. The Committee will discuss ACNW-related activities of individual members.

G. *Miscellaneous*—The Committee will discuss miscellaneous matters related to the conduct of Committee activities and organizational activities and complete discussion of matters and specific issues that were not completed during previous meetings, as time and availability of information permit.

Procedures for the conduct of and participation in ACNW meetings were published in the **Federal Register** on September 27, 1995 (60 FR 49924). In accordance with these procedures, oral or written statements may be presented by members of the public, electronic recordings will be permitted only during those portions of the meeting that are open to the public, and questions may be asked only by members of the Committee, its consultants, and staff. Persons desiring to make oral statements should notify the Chief, Nuclear Waste Branch, Mr. Richard K. Major, as far in advance as practicable so that appropriate arrangements can be made to schedule the necessary time during the meeting for such statements. Use of still, motion picture, and television cameras during this meeting will be limited to selected portions of the meeting as determined by the ACNW Chairman. Information regarding the time to be set aside for this purpose may be obtained by contacting the Chief, Nuclear Waste Branch prior to the meeting. In view of the possibility that the schedule for ACNW meetings may be adjusted by the Chairman as necessary to facilitate the conduct of the meeting, persons planning to attend should notify Mr. Major as to their particular needs.

Further information regarding topics to be discussed, whether the meeting has been canceled or rescheduled, the Chairman's ruling on requests for the opportunity to present oral statements and the time allotted therefore can be obtained by contacting Mr. Richard K. Major, Chief, Nuclear Waste Branch (telephone 301/415–7366), between 8:00 A.M. and 5:00 P.M. EDT.

ACNW meeting notices, meeting transcripts, and letter reports are now available on FedWorld from the "NRC MAIN MENU." Direct Dial Access number to FedWorld is (800) 303–9672; the local direct dial number is 703–321–3339.

Dated: August 29, 1996

Andrew L. Bates,

Advisory Committee Management Office.

[FR Doc. 96–22612 Filed 9–04–96; 8:45 am]

BILLING CODE 7590–01–P

Issuance of a Memorandum of Understanding between the Nuclear Regulatory Commission and the Pennsylvania Department of Environmental Protection

AGENCY: Nuclear Regulatory Commission.

ACTION: Notice of issuance of a Memorandum of Understanding.

SUMMARY: This notice is to advise the public of the issuance of a Memorandum of Understanding (MOU)

APPENDIX II

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555

Rev. 2 September 20, 1996

SCHEDULE AND OUTLINE FOR DISCUSSION
86TH ACNW MEETING
SEPTEMBER 26-27, 1996

Thursday, September 26, 1996, Hotel San Remo, Chateau 1 and 2, 115 East Tropicana Avenue, Las Vegas, NV.

1) 8:30 - ~~8:45 A.M.~~ Opening Remarks by the ACNW Chairman (Open)
1.1) Opening Statement (PWP/RKM)
1.2) Items of Current Interest (PWP/RKM)
~~8:45~~ - ~~9:00~~ A.M. 1.3) Welcome from Wes Barnes, Yucca Mountain Project Manager, Site Characterization Office, DOE

2) ~~9:00~~ - **6:00 P.M.** Flow and Radionuclide Transport at Yucca Mountain (Open) (GMH/ACC)
8: 8:42
~~9:00~~ - 9:10 A.M. 2.1) Introductory Remarks by G.M. Hornberger
8:4 9:45
~~9:10~~ - ~~9:55~~ A.M. 2.2) Fracture Flow
2.2.1) Isotopic (Cl-36) Evidence for Fracture Flow at Yucca Mountain (Dr. June Fabryka-Martin, LANL)
50 -
~~9:55~~ - 10:45 A.M. 2.2.2) Deep Percolation and Flow Modeling at Yucca Mountain (Dr. G. Bodvarsson, LBL)

10:45 - 11:~~00~~ A.M. * * * **BREAK** * * *
11:05
~~11:00~~ - 11:45 A.M. 2.2.3) Insights for Yucca Mountain from Fracture Flow Studies at Apache Leap Research Site (Dr. Randy Bassett, Univ. of Arizona)

11:57 12:55
11:45 - ~~12:45~~ P.M. * * * **LUNCH** * * *

1:05 50
~~12:45~~ - 1:~~30~~ P.M. 2.3) Geochemical Effects on Transport
2.3.1) Near-Field Chemical Effects and Impacts on Release and Transport (Dr. Bill Glassley, LLNL)

1:50
1:~~30~~ - 2:15 P.M. 2.3.2) Role of Fracture Coatings in Controlling Matrix - Fracture Interactions and Radionuclide Transport (Dr. ~~Ines Triay~~, LANL) Bruce Robinson

2:55
2:15 - ~~3:00~~ P.M. 2.3.3) The Role of Colloids in Fracture Transport and Application to Yucca Mountain Transport Modeling (Dr. John Kessler, EPRI)

2:55
~~3:00~~ - 3:15 P.M. * * * BREAK * * *

2.4) Integrated Transport Modeling

3:15 - 4:~~00~~ P.M. 2.4.1) Coupled Flow and Transport Modeling for Yucca Mountain (Dr. Bruce Robinson, LANL)

4:~~00~~ - 4:45 P.M. 2.4.2) Integration into TSPA of Process Level Models for Flow and Transport (Dr. Abe Van Luik)

deferred to discussion time ← ~~4:45 - 5:00~~ P.M. 2.4.3) Hydrogeochemical Transport Models (Dr. Randy Bassett, Univ. of AZ)

4:45 5:15
~~5:00~~ - 6:00 P.M. 2.5) Discussion and Meeting Summary

5:15
~~6:00~~ P.M. * * * RECESS * * *

Friday, September 27, 1996, Hotel San Remo, Chateau 1 and 2, 115 East Tropicana Avenue, Las Vegas, Nevada.

8:35 - 8:38
3) ~~8:30~~ - 8:35 A.M. Opening Statement by the ACNW Chairman (Open)

8:38 8:58
4) ~~8:35~~ - ~~8:45~~ A.M. Welcoming Remarks - (Open) Assemblyman Robert Price, Chairman, Nevada Legislature's Committee on High-Level Radioactive Waste

8:58 10:35
5) ~~8:45~~ - ~~10:30~~ A.M. Site Characterization Integration through the use of Performance Assessment, (Open) (BJG/LGD)

- Q & A on TSPA '95, Abstraction, Percolation, Flux, Dilution, Dispersion, Use of Expert Elicitation - Abe Van Luik, DOE

10:35 - 12:65
~~10:30~~ - ~~10:45~~ A.M. * * * BREAK * * *

6) ~~10:45~~ 10:55 - ~~12:15~~ 12:20 P.M. Repository Design for Viability Assessment (Open) (WJH/HJL) - Dean Stucker, DOE

- Will Repository Employ Backfill?
- Horizontal or Vertical Waste Emplacement
- Final Emplacement Set Back Distance from Faults
- E-W Exploration of Upper Block
- Thermal Design Basis
- The Delta between Viability Assurance and Site Suitability

~~12:15~~ 12:20 - ~~1:15~~ 1:25 P.M. * * * LUNCH * * *

7) ~~1:15~~ 1:35 - ~~3:15~~ 2:30 P.M. Comments from Interested Parties (Open) (PWP/HJL)

7.1) Nye County presentation
7.2) Others

2:30 - 2:50 Break

8) ~~3:15~~ 2:50 - 4:30 P.M. 4:15 Preparation of ACNW Reports (Open) Discuss Possible Reports on the Following Topics:

8.1) Coupled (TMHC) Processes (VCB)
8.2) Time of Compliance in Low-Level Waste Disposal (ACC)
8.3) Radionuclide Transport at Yucca Mountain (ACC)
8.4) Critical Group and Reference Biosphere (HJL)
8.5) High-Level Waste Time of Compliance Road Map (ACC)

4:15 - ~~4:30~~ 4:45 9) Committee Activities/Future Agenda (Open) (PWP/RKM)

9.1) Set Agenda for 87th ACNW Meeting October 22-23, 1996
9.2) Review Items for Out Months
9.3) Future Working Group Topics/Dates
9.4) Future Outline of Meetings Members May Attend
9.5) Reconcile EDO Responses to Committee Reports

4:45 ~~6:00~~ P.M. ADJOURN

APPENDIX III: MEETING ATTENDEES

86TH ACNW MEETING
SEPTEMBER 24-27, 1996

ACNW MEMBERS	9/24	9/25	9/26	9/27
Dr. Paul W. Pomeroy	X	X	X	X
Dr. William J. Hinze	X	X	X	X
Dr. B. John Garrick	X	X	X	X
Dr. George M. Hornberger	X	X	X	X

ACNW Consultants:

Dr. Martin J. Steindler and Dr. Andrew Bassett.

ACNW STAFF	9/24	9/25	9/26	9/27
Dr. Andrew Campbell		X	X	X
Ms. Virginia Colten-Bradley		X	X	X
Ms. Lynn Deering		X	X	X
Mr. Howard J. Larson		X	X	X
Ms. Carol A. Harris		X		
Mr. Richard K. Major	X	X	X	X
Dr. Richard P. Savio	X	X	X	X
Ms. Michele S. Kelton			X	X

ATTENDEES FROM THE NUCLEAR REGULATORY COMMISSION

September 26, 1996

J. Bradbury	NRC
B. Belke	NRC
C. Glenn	NRC

September 27, 1996

J. Bradbury	NRC
C. Glenn	NRC

ATTENDEES FROM OTHER AGENCIES AND GENERAL PUBLIC

September 26, 1996

S. Brocoum	DOE/YMP/AMSL
L. Hayes	M&O/TRW/SPO
L. Rickertson	M&O/TRW
R. Bassett	Univ. Arizona
E. Tiesenhausen	Clark County
D. Hoxie	USGS
C. Lee Bendixsen	Lockheed-Martin Idaho
C. Hanlon	DOE
J. Yoxen	M&O/SAIC
A. Gill	DOE/AMSL
J. Canepa	LANL
R. Murray	M&O WCFS
J. York	Weston
E. Morris	ANL
R. Linden	PMO/SAIC
R. Patterson	DOE/AMSP
A. Haghi	M&O/Duke
G. Bussod	LANL
F. Rodgers	DOE
A. Van Luik	DOE
M. Bennett	Nevada Legislature
D. Bryan	DOE/YMSCO
N. Stellavato	Nye Co.
P. Montazer	MET/Nye Co.
E. Fujita	Argonne Natl. Lab.
M. Murphy	Nye County
J. Youken	M&O
S. Stothoff	CNWRA
D. Sevougian	M&O/INTERA
B. Glassley	Lawrence Livermore Natl. Lab
S. Frishman	NV NWPO
J. Treichel	NV NWTF

ATTENDEES FROM OTHER AGENCIES AND GENERAL PUBLIC (CONT'D)

September 26, 1996 (Cont'd)

M. Muffhi	MAI
J. Fabryka-Martin	LANL
P. Hammond	M&O
T. Taylor	M&O
J. Blink	M&O
G. Asupho	DOE/YMP
B. Verne	DOE/YMSCO
R. Rogers	PMO/WCFS
D. Shettil	GMII/State NV
J. Kessler	EPRI
V. Palciauskas	NWTRB
B. Bodvarrson	LANL
C. Henkel	NEI
S. Nelson	M&O/WCFS
B. Robinson	LANL
V. Dulock	M&O
B. Andrews	M&O
J. Rosentmac	PMO/TRW

September 27, 1996

A. Van Luik	DOE/YMSCO
C. Bendixsen	Lockheed-Morton Idaho
V. Dulock, Jr.	M&O
E. Morris	ANL
A. Haghi	M&O/Duke
B. Andrews	M&O
J. York	Weston
S. Stothoff	CNWRA
M. Bennett	NV Legislature
M. Murphy	Nye Co.
N. Stellavato	Nye Co.
J. Meder	NV Counsel Bureau
R. Patterson	DOE
S. Frishman	NV NWPO
R. Murray	M&O/WCFS
T. Bjerstedt	DOE/YMSCO
J. Kessler	EPRI
D. Sevougian	M&O/INTERA
F. Rodgers	DOE
E. Taylor	M&O/TRW
B. Price	Assemblyman NV
V. Palciauskas	NWTRB
J. Regan	NV State Senate
D. Stache	DOE

ATTENDEES FROM OTHER AGENCIES AND GENERAL PUBLIC (CONT'D)

September 27, 1996 (Cont'd)

B. Bodvarsson	LANL
C. Henkel	NEI
E. Tiesenhausen	Clark County
D. Shettel	GMI, Inc.
G. Asupho	DOE
J. Bailey	M&O/TRW
A. Gil	DOE/YMP
J. Veal	NV Legislature
R. Linden	PMO/SAIC
R. Craun	DOE
D. McKenzie	M&O
D. Montazer	MET/Nye
S. Meyers	M&O
H. Benton	M&O
B. Mettam	Inyo County
C. Johnson	WCFS
M. Gil	not listed
J. Harris	not listed

APPENDIX IV: FUTURE AGENDA

The Committee agreed to consider the following during the 87th ACNW Meeting, October 22-23, 1996:

- Decommissioning for Disposals of Radioactive Waste by Land Burial Authorized Under the Former 10 CFR 20.304, and 10 CFR 20.302, and the Current 10 CFR 20.2002 - The Committee will review a draft branch technical position that will provide criteria for screening onsite burials disposed of in accordance with former 10 CFR 20.304 and 10 CFR 20.302 requirements to determine whether further remediation is required.

- Direction-Setting Issue Papers - The Committee will be briefed by the NRC staff on the direction-setting issue papers (produced as part of the agency's strategic assessment of regulatory activities) and will provide comments on those issues for which it believes its review will enhance the strategic assessment process.

- Ethics Training - The Committee will receive its annual ethics training from a representative of the agency's Office of the General Counsel.

- Preparation of ACNW Reports - The Committee will discuss proposed reports, including radionuclide transport at Yucca Mountain, specification of a critical group and reference biosphere to be used in the PA for a nuclear waste disposal facility, consideration of coupled processes (thermal-hydrological-mechanical-chemical) in the design of a high-level waste repository, time of compliance in high- and low-level waste disposal, comments on selected agency direction-setting issue papers, and shallow land burials licensed under the former 10 CFR 20.304 and 10 CFR 20.302 requirements.

- Committee Activities/Future Agenda - The Committee will consider topics proposed for future consideration by the full Committee and the Working Groups. The Committee will discuss ACNW-related activities of individual members.

- Miscellaneous - The Committee will discuss miscellaneous matters related to the conduct of Committee activities and organizational activities and complete discussion of matters and specific issues that were not completed during previous meetings, as time and availability of information permit.

APPENDIX V

LIST OF DOCUMENTS PROVIDED TO THE COMMITTEE

[Note: Some documents listed below may have been provided or prepared for Committee use only. These documents must be reviewed prior to release to the public.]

MEETING HANDOUTS

AGENDA ITEM NO.	DOCUMENTS
2	Flow and Radionuclide Transport at Yucca Mountain (Open)

1. Recent Isotopic (^{36}Cl) Evidence for Fracture Flow at Yucca Mountain, presented by June Fabryka-Martin and Bruce Robinson, Los Alamos National Laboratory, dated September 26, 1996 [Viewgraphs]
2. Deep Percolation and Flow Modeling at Yucca Mountain, presented by G. S. Bodvarsson, Lawrence Berkeley National Laboratory, dated September 26, 1996, [Viewgraphs]
3. Insights for Yucca Mountain from Fracture Flow Studies at the Apache Leap Research Site, Superior Arizona, presented by Randy Bassett, University of Arizona, dated September 26, 1996
4. Near-Field Chemical Effects: Impacts on Release and Transport, presented by William Glassley, Lawrence Livermore National Laboratory, dated September 26, 1996 [Viewgraphs]
5. Radionuclide Transport through Fractures, presented by B. Robinson, Los Alamos National Laboratory, undated [Viewgraphs]
6. Colloid-Aided Transport in Fractures, presented by John Kessler, Electric Power Research Institute, dated September 26, 1996 [Viewgraphs]
7. Coupled Flow and Transport Modeling for Yucca Mountain, presented by Bruce A. Robinson, Los Alamos National Laboratory, undated [Viewgraphs]
8. TSPA Insights on Significance of Alternative Conceptual Models, presented by Dr. Abe Van Luik, Department of Energy, dated September 26, 1996 [Viewgraphs]

6	**Repository Design for Viability Assessment (Open)**

9. Repository Design for Viability Assessment, presented by Jack N. Bailey, DOE, dated September 27, 1996 [Viewgraphs]

MEETING HANDOUTS

AGENDA ITEM NO.	DOCUMENTS
7	**Comments from Interested Parties (Open)**
	10. Nye County Technical Program, presented by Nick Stellavato, Mal Murphy, and Parvis Montazer, Nye County, undated [Viewgraphs]
	11. Nye County Nuclear Waste Repository Program Past and Future, A. Thumbnail Sketch, dated September 27, 1996
	12. "An Evaluation of the Hydrology at Yucca Mountain: The Lower Carbonate Aquifer and Amargosa River," prepared by Oversight Consultants, Esmeralda & Inyo Counties, prepared for Inyo County, California & Esmeralda County, Nevada, dated February 1, 1996
8	**Preparation of ACNW Reports**
	13. "Time of Compliance for LLW Disposal"

MEETING NOTEBOOK CONTENTS

TAB NUMBER | DOCUMENTS

1 **Opening Remarks by ACNW Chairman**

1. Introductory Statement by the ACNW Chairman, dated September 24, 1996
2. Items of Current Interest, undated
3. Introductory Statement by the ACNW Chairman - Second Day, September 26, 1996
4. Introductory Statement by the ACNW Chairman - Third Day, September 27, 1996

2 **Flow and Radionuclide Transport at Yucca Mountain**

5. Contents
6. Status Report
7. Agenda
8. Memo from L. Deering, ACNW, to ACNW Members, Subject: "Trip Report for June 26-27, 1995 NWTRB Meeting of the Panel of Hydrology and Geochemistry: Fracture Flow and Transport in Arid Regions," dated July 6, 1995
9. Draft Paper: "Systematic Sampling for Chlorine-36 in the Exploratory Studies Facility," prepared by J.T. Fabryka-Martin, et.al., dated March 23, 1996.
10. Draft Document: "An Unsaturated Zone Flow and Transport Model of Yucca Mountain," prepared by B.A. Robinson et.al., dated October 1995.
11. White Paper: "The Critical Role of Geochemistry in the Program Approach," prepared by A.M. Simmons et a., dated February 1995.
12. Excerpt from "Geochemical Investigations Related to the Yucca Mountain Environment and Potential Nuclear Waste Repository," NUREG/CR-6288, by W.M. Murphy and R.T. Pabalan, dated November 1994.
13. "Radionuclide Sorption in Yucca Mountain Tuff with J-13 Well Water: Np, U, and Pu," I.R. Triay et.al., dated August 1996.
14. "Comparison of Np Sorption Results Using Batch and Column Techniques,"I.R. Triay et al., dated August 1996.
15. Preprint from a symposium "Studies of Neptunium (V0 Sportion on Quartz, Clinoptilolite, Montmorillonite, and a-Alimina," F.P. Bertetti et al., dated March 1996.
16. Report: "Potential Implications of Colloids on the long-term Performance of an HLW Repository," H. Manaktala, et al., dated September 1995.

MEETING NOTEBOOK CONTENTS

TAB NUMBER	DOCUMENTS
3	**Repository Design for Viability Assessment**
	17. Table of Contents
	18. Status Report
	19. Memo from H.J. Larson, ACNW, to ACNW Members, Subject: "Mined Geologic Disposal System (MGDS), Advanced Conceptual Design Report (ACD)," dated March 1996.
	20. MGDS-ACD Report, Volume II, Chapter 4, Design Basis Assumptions and Development and Chapter 5, Concept of Operations.
	21. "Operating a Geologic Repository," DOE/OCRWM, undated
4	**Comments from Interested Parties**
	22. Table of Contents
	23. Status Report
5	**Preparation of ACNW Reports**
	24. Facsimile from B.Hinze, ACNW, to A. Campbell, ACNW, Subject: "Revision of the TOC LLW Letter," dated September 9, 1996.
	25. Facsimile from B. Hinze, ACNW to A. Campbell, ACNW, Subject: "High-Level Waste Time of Compliance Road Map," dated September 8, 1996.
	26. Draft presentation overheads for ACNW Meeting on August 22, 1996, "Public Comments on the Branch Technical Position on the Use of Expert Elicitation in the High-Level Radioactive Waste Program"
6	**Committee Activities/Future Agenda**
	27. Table of Contents
	28. Set Agenda for 87th ACNW Meeting October 22-23, 1996
	29. Review Items for the Out Months
	30. Future Working Group Topics/Dates
	31. Future Outside Meetings for Members/Staff
	32. Blaha List
	33. M&O List of Future Meetings
	34. Reconcile EDO Response to Committee Reports