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**YUCCA
MOUNTAIN**

**YUCCA
MOUNTAIN
SITE
CHARACTERIZATION
PROJECT**

Monthly Status Report

November 1992

DISCLAIMER

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Monthly Status Report

November 1992

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WBS Elements Without Reportable Activity This Period

1.2.1.1	Systems Engineering Coordination and Planning
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1.2.5.5	Special Projects

Highlights

SNL staff presented the "Preclosure Radiological Safety Evaluation - Exploratory Studies Facility" draft document to the Project office.

See 1.2.1.5 Special Studies on page 2

SNL staff prepared "Recent Developments in Stochastic Modeling and Upscaling of Hydrologic Properties in Tuff" for presentation at the 1993 IHLRWMC.

See 1.2.3.2.2.2.2 Three-Dimensional Rock Characteristics Models on page 4

SNL staff are investigating time-dependent mechanical properties of fractures.

See 1.2.3.2.7.1.4 Laboratory Determination of the Mechanical Properties of Fractures on page 7

SNL staff prepared a data report on the experimental effects of nonstandard loading conditions on frictional properties.

See 1.2.4.2.1.2 Rock Mass Analyses on page 10

SNL staff provided ESF analyses to a Project Participant meeting in support of the design package for the North Portal.

See 1.2.5.4.7 Support Calculations for Postclosure Performance Analyses on page 20

SNL staff completed the inventory of YMP Record and Nonrecord Material.

See 1.2.12.2.2 Local Records Center Operation on page 25

SNL staff distributed the report on "The Use of Sequential Indicator Simulation to Characterize Geostatistical Uncertainty."

See 1.2.15.2 Administrative Support on page 28

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EXECUTIVE SUMMARY NOVEMBER 1992

WBS 1.2.1.5 Special Studies

- SAND92-2334, "Preclosure Radiological Safety Evaluation - Exploratory Studies Facility," has completed SNL review and has been submitted to the Yucca Mountain Project for policy review and approval. This report presents the results of a radiological safety evaluation conducted to assess the impacts of ESF design changes to preclosure radiological safety.

WBS 1.2.3.2.2 Three-Dimensional Rock Characteristics Models

- Work continues on constructing indicator simulations of lithology for the unsaturated zone at Yucca Mountain. Recent emphasis was placed on refining preliminary "picks" of the welded/nonwelded lithologic dichotomy in the various drill holes at Yucca Mountain and on developing a set of conditioning data that can be used for simulations for the Total System Performance Assessment (TSPA) activity. These simulations examine the effects of uncertainty in contact location as a first-order on groundwater flow.

WBS 1.2.3.2.7.1.4 Laboratory Determination of the Mechanical Properties of Fractures

- The time-dependent mechanical properties of fractures are being investigated to address long-term stability issues within the potential repository. A triaxial creep (constant shear stress) experiment has been conducted on a sample (right-circular cylinder, diameter of approximately 2.125 in., and length-to-diameter ratio of 3:1) with a fracture oriented approximately 35° to the sample axis. The confining pressure and the initial axial stress difference were both 10 MPa, which gave a ratio of shear-to-normal stress on the surface of ~0.36. The triaxial creep test continued at incrementally increasing stress levels. Little to no creep was observed, even though the shear-to-normal stress ratio reached as high as 0.73.



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EXECUTIVE SUMMARY, Continued NOVEMBER 1992

WBS 1.2.4.2.1.2 Rock Mass Analyses

- SAND92-1853, "Effect of Boundary Conditions on the Strength and Deformability of Replicas of Natural Fractures in Welded Tuff: Data Report," has completed technical review and is in management review. This report details the techniques employed in experiments that are designed to study the effect of a nonstandard loading condition on frictional properties using replicas of fractures tested for normal stiffness and shear deformation characteristics.

WBS 1.2.5.4.7 Support Calculations for Postclosure Performance Analyses

- A meeting was held on November 20, 1992 at SNL regarding the use of ESF Analyses #1 and #3 (SAND92-0790 and SAND 92-0792) to support the design package for the North Portal. SNL, USGS, DOE, and SAIC personnel were in attendance in Albuquerque, NM; other DOE and M&O personnel attended via conference call from Las Vegas, NV. Issues concerning the results of the analyses, their sensitivity to variations in hydrologic properties in the alluvium and Paintbrush Tuff, and the appropriateness of the documents for use in support of QA work were addressed and resolved to the satisfaction of all participants.

WBS 1.2.12.2.2 Local Records Center Operation

- The inventory of YMP Record and Nonrecord Material was completed and submitted to the YMP Project Office and the SNL "Recorded Information Management Department." The inventory research and interviews covered 1.043 linear feet of hard copy records.

1.2.1 SYSTEMS ENGINEERING

The objective of the Systems Engineering element is to apply the systems engineering discipline to transform the regulatory requirements into functional needs of the MGDS design, system configuration, and site characterization activities. The Systems Engineering element is comprised of four tasks: Systems Engineering Coordination and Planning (1.2.1.1), Program-Level Requirements Document Development (1.2.1.2.1), Project-Level Requirements Documents Development and Maintenance (1.2.1.2.2), and Special Studies (1.2.1.5), which includes development of items important to safety/waste isolation.

1.2.1.2.1 PROGRAM-LEVEL REQUIREMENTS DOCUMENT DEVELOPMENT

Significant Meetings Attended

F. J. Schelling participated in a comment resolution meeting for the draft Mined Geologic Disposal System-Requirements Document (MGDS-RD) in Las Vegas, NV on November 24, 1992.

Status Report on Ongoing Activities

Comment resolution on the MGDS-RD and five draft subsystem requirements documents continued.

1.2.1.2.2 PROJECT-LEVEL REQUIREMENTS DOCUMENTS DEVELOPMENT AND MAINTENANCE

Status Report on Ongoing Activities

Comment resolution on the five draft subsystem requirements documents continued.



1.2.1.5 SPECIAL STUDIES**Major Accomplishments**

The draft of SAND92-2334, "Preclosure Radiological Safety Evaluation - Exploratory Studies Facility," by F. J. Schelling and J. D. Smith, has completed SNL review and is awaiting Yucca Mountain Project (YMP) policy review and approval. Assessment Team comments on SLTR 92-0004, "Disturbance Criteria for Items Important to Waste Isolation: A Methodology and an Application to Unconsolidated Surficial Deposits," by F. J. Schelling, Y. K. Behl, and R. C. Kalinski, were responded to and have been accepted by the Assessment Team.

Status Report on Ongoing Activities

SNL staff is providing the Assessment Team with input that is pertinent to the selection of natural barriers that are considered important to complying with post-closure waste isolation performance objectives.



1.2.3 SITE INVESTIGATIONS

The objective of the Site Investigations element includes work scope related to site data collection and analysis to support site suitability evaluation, design, licensing, performance assessment requirements, and the natural barrier system component of the multiple barrier system described in the physical system. The Site Investigations element is comprised of eight tasks: Site Investigations Coordination and Planning (1.2.3.1), Systematic Acquisition of Site-Specific Subsurface Information (1.2.3.2.2.1), Three-Dimensional Rock Characteristics Models (1.2.3.2.2.2), Laboratory Thermal Properties (1.2.3.2.7.1.1), Laboratory Thermal Expansion Testing (1.2.3.2.7.1.2), Laboratory Determination of Mechanical Properties of Intact Rock (1.2.3.2.7.1.3), Laboratory Determination of the Mechanical Properties of Fractures (1.2.3.2.7.1.4), and Future Regional Climate and Environments (1.2.3.6.2.1.6).

1.2.3.1 SITE INVESTIGATIONS COORDINATION AND PLANNING

Significant Meetings Attended

SNL staff participated in the Sample Overview Committee (SOC) meeting on November 10, 1992 in Area 25 of the Nevada Test Site (NTS). Various core requests were considered and the second 500 feet of core from drill hole US-16 were made available for viewing.

1.2.3.2.2.1 SYSTEMATIC ACQUISITION OF SITE-SPECIFIC SUBSURFACE INFORMATION

Significant Meetings Attended

SNL staff participated in a one-day meeting in Denver, CO on November 13, 1992 to discuss development of a uniform, baseline geophysical logging program to support all "deep" drilling programs described in the Site Characterization Plan (SCP). Adopting a standardized suite of geophysical logs for drill holes at Yucca Mountain should result in significant cost savings.

Status Report on Ongoing Activities

The 1993 International High-Level Radioactive Waste Management Conference paper entitled "Influence of Deterministic Geologic Trends on Spatial Variability of Hydrologic Properties in Volcanic Tuff," by C. A. Rautman (SNL), J. D. Istok (Oregon State University), A. L. Flint (USGS), L. E. Flint (Raytheon Services Nevada), and M. P. Chornack (USGS), has been prepared. The document is currently completing both SNL and USGS technical review. The final draft should be sent to the Project Office early in December. (SCP Activity 8.3.1.4.3.1.1 and 8.3.1.2.2.3.1)

The Los Alamos National Laboratory (LANL) report entitled "Geologic Evaluation of Six Nonwelded Tuff Sites in the Vicinity of Yucca Mountain, Nevada for a Surface-Based Test Facility for the Yucca Mountain Project," by D. E. Broxton, S. J. Chipera, F. M. Byers, Jr., and C. A. Rautman (SNL) has completed both LANL and SNL review and is being sent to the Project Office by LANL. Investigators from SNL are contributing data and text sections on hydrologic properties to this collaborative publication. (SCP Activity 8.3.1.4.3.1.1)



Geostatistical analysis of hydrologic properties data from outcrop studies of the Bandelier Tuff, a natural analog for some of the nonwelded tuffs at Yucca Mountain, was deferred pending completion of manuscripts for the 1993 International High-Level Radioactive Waste Management Conference. (SCP Activity 8.3.1.4.3.1.1)

SNL and USGS investigators are continuing to discuss drilling plans and requirements following the Project Drilling Technical Requirements and Drilling Prioritization workshop held last month in Las Vegas, NV. These discussions identified several opportunities to combine drill holes from separate programs into one physical drill hole if the programmatic impediments can be resolved. SNL staff made several specific proposals related to interaction of the Systematic Drilling Program (SCP Activity 8.3.1.4.3.1.1) with other Project drilling programs at the Cost Reduction Working Group for Testing Programs meeting on November 25, 1992. Either one of the two principal hole-combination options or the use of simplified drilling methods on about half of the SD-drill holes could result in million-dollar-scale cost savings. Drilling schedules could be accelerated as well.

Major Activities Upcoming Next Three Months

Evaluation of data from the surface transects, including natural analogs, will continue. Preliminary plans include additional sampling in the shardy base of the Topopah Spring Member, which appears to be lithologically similar (and perhaps hydrologically similar) to the shardy base microstratigraphic unit of the stratigraphically higher Tiva Canyon Member. This latter unit forms the focus of the 1993 International High-Level Radioactive Waste Management Conference paper described above.

The air permeameter may be tested upon completion of repairs and used to collect permeability data from several promising locations as feasible. Emphasis will be placed on attempting to obtain field measurements from rock types that could not be cored for laboratory analysis because of their excessively friable nature. (SCP Activity 8.3.1.4.3.1.1)

1.2.3.2.2.2 THREE-DIMENSIONAL ROCK CHARACTERISTICS MODELS

Status Report on Ongoing Activities

Text and figures have been prepared for the paper entitled "Recent Developments in Stochastic Modeling and Upscaling of Hydrologic Properties in Tuff," by C. A. Rautman and T. H. Robey (Spectra Research Institute). The paper will enter SNL review by the end of November, and the final text should be sent to the Project Office by early December. The paper has been accepted for presentation at the 1993 International High-Level Radioactive Waste Management Conference. (SCP Activity 8.3.1.4.3.2.1 and WBS element 1.2.1.4)

Geostatistical evaluation of the two-dimensional, Tiva Canyon shardy base grid was completed to support preparation of the 1993 International High-Level Radioactive Waste Management Conference paper reported in Section 1.2.3.2.2.2.1 (above). (SCP Activity 8.3.1.4.3.2.1)

USGS personnel and SNL staff consulted on methods of conveying the "uncertainty" associated with standard geometric models of Yucca Mountain, such as those currently under development by USGS personnel using the Lynx Geotechnical Modeling System (first used at SNL). Geometric models, and the cross sections that typically represent those models, are usually presented as if there were no uncertainty in the location of contacts. Alternatively, the uncertainty may be acknowledged, but generally is addressed only qualitatively. Although the first priority of the current Lynx modeling efforts by the USGS is to produce a coherent three-dimensional geometric model, there is significant joint interest in representing the associated uncertainty in a rigorous and quantitative manner. Several alternative/complementary approaches to the issue, ranging from quantified "expert judgement" through mathematically formulated probabilistic techniques to summarized Monte Carlo methods, are under investigation. Uncertainty in both geometry (largely the responsibility of the USGS) and hydrologic properties (largely the responsibility of SNL) must ultimately be merged and addressed in performance assessments of the site. (SCP Activities 8.3.1.4.3.2.1 and 8.3.1.4.2.3.1)

Work is continuing on the recently initiated indicator simulations of lithology for the unsaturated zone at Yucca Mountain. During November, emphasis was placed on refining hasty, preliminary "picks" of the welded-nonwelded lithologic dichotomy in the various



drill holes and on developing a set of conditioning data that can be used for simulations for the Total System Performance Assessment (TSPA) exercise. Review of published USGS lithologic logs and geophysical logs (especially the density trace) confirmed that not all welded tuffs "are created equal." Whereas distinction of welded from nonwelded material is quite straightforward in the members of the Paintbrush Tuff, that distinction is much less obvious for the units belonging to the Crater Flat Tuff, which includes many partially welded subunits. It was tentatively decided to distinguish wholly nonwelded tuff from any material described as "poorly welded," "partially welded," or other similar quantified terms indicating post-depositional compaction. Even though the indicator simulations will present densely welded Paintbrush Tuffs in the same classification as the partially to moderately welded Crater Flat Tuffs, hydrologic properties will be assigned to each unit separately based upon sampling from a distribution *appropriate to that unit*. To recall the reasoning for the indicator simulations in the first place, this exercise was undertaken to explore the effects of uncertainty in contact location as a first-order control on groundwater flow. Material properties will not be simulated using geostatistics during this phase of the exercise. Spatial continuity will be an artifact of lithologic continuity. Existing material properties data are being compiled to support this decision and the eventual modeling of properties. (SCP Activity 8.3.1.4.3.2.1)

Major Activities Upcoming Next Three Months

Work on refining input data for the indicator simulations will continue.

Issues/Potential Problems Needing Resolution and Potential Impacts

Budget uncertainty is adversely affecting plans and execution of activities under this WBS element. (SCP Activity 8.3.1.4.3.2.1)

1.2.3.2.7.1.1 LABORATORY THERMAL PROPERTIES

Status Report on Ongoing Activities

Four successful calibration runs using the C-Matic low temperature (LT) system have been completed. These calibration runs were made using Pyrex 7740 reference samples placed in the moisture containment cell. Parafilm is being used as the interface medium. The fifth calibration measurement is in process. A calibration verification will then be performed using a high-purity fused-quartz reference sample. The C-Matic LT will be used for measuring thermal conductivity at temperatures from 20 to 100°C. (SCP Activity 8.3.1.15.1.1.3)

Major Activities Upcoming Next Three Months

The scoping study on the effects of saturation on thermal conductivity will begin after the C-Matic LT instrument is calibrated, the data acquisition software is verified and approved, and the relevant procedures are revised. (SCP Activity 8.3.1.15.1.1.3)



1.2.3.2.7.1.2 LABORATORY THERMAL EXPANSION TESTING

Status Report on Ongoing Activities

The tuff samples that will be used for scoping the effects of sample size on thermal expansion behavior are being machined.

A calibration verification was successfully completed using a small sample (1-inch long) of stainless steel.

A calibration run is being made using a four-inch long fused silica reference sample. The calibration is being conducted with a heating rate of 1/4°C and a cooling rate of 1°C, which is the initial cycle that will be used for detecting the silica polymorph transformations.

Major Activities Upcoming Next Three Months

Samples containing tridymite and cristobalite, which undergo polymorphic transformations at temperatures below 275°C, will be tested to determine when these transformations begin and end and their effects on the thermal-expansion behavior. The heating rates used on samples containing these silica polymorphs may need to be significantly less than rates used for testing other samples.

Technical Procedure (TP)-203, "Measurement of Thermal Expansion of Geologic Samples Using a Push Rod Dilatometer," will be submitted for approval pending successful verification with the apparatus described for small samples and slow heating rates.

A scoping study on the effects of sample size on thermal expansion will be initiated after the accuracy and reproducibility of the test data is established, instrument calibration is completed, data acquisition software is verified and approved, and relevant procedures are issued. (SCP Activity 8.3.1.15.1.2.1)

1.2.3.2.7.1.3 LABORATORY DETERMINATION OF MECHANICAL PROPERTIES OF INTACT ROCK

Status Report on Ongoing Activities

New England Research, Inc. (NER) is conducting a study of time-dependent deformation involving high-temperature experiments at creep and low strain rate conditions. The first constant stress (creep) experiment was performed in November. The sample failed within forty-eight hours of the differential loading at elevated temperature. At least six samples of TSw2 will be tested at a pore pressure of 4.5 MPa, a confining pressure of 5 MPa, and a maximum constant differential stress of 80 MPa. Initially, the experiments are performed at room temperature and then at 250°C. (SCP Activity 8.3.1.15.1.3.2)

NER staff members R. Martin and P. Boyd were in Albuquerque, NM on November 9 through 12, 1992 to present results from testing samples of Topopah Spring Member tuff in the investigation of time-dependent mechanical properties. In addition, reports in process were discussed.

A technical issue summary, "Characterization of Porosity in Support of Mechanical Property Analysis," has been accepted for presentation and publication at the 1993 International High-Level Radioactive Waste Management Conference in Las Vegas, NV. The paper is being prepared.

Major Activities Upcoming Next Three Months

SAND92-1810, "Unconfined Compression Experiments on Topopah Spring Member Tuff at 22°C and a Strain Rate of 10⁻³s⁻¹: Data Report," has been drafted, is being revised following a meeting of the authors, and will begin technical and editorial review in the next two months. (SCP Activity 8.3.1.15.1.3.2)



1.2.3.2.7.1.4 LABORATORY DETERMINATION OF THE MECHANICAL PROPERTIES OF FRACTURES

Status Report on Ongoing Activities

The time-dependent mechanical properties of fractures are being investigated to address long-term stability issues within the potential repository. A triaxial creep (constant shear stress) experiment has been conducted on a sample (right-circular cylinder, diameter of approximately 2.125 in. and length-to-diameter ratio of 3:1) with a fracture oriented approximately 35° to the sample axis. The confining pressure and the initial axial stress difference were both 10 MPa, which gave a ratio of shear-to-normal stress on the surface of about 0.36. The triaxial creep test continued at incrementally increasing stress levels. Little to no creep was observed, even though the shear-to-normal stress ratio reached as high as 0.73. (SCP Activity 8.3.1.15.1.4.2) Study Plan 8.3.1.15.1.4, "Laboratory Determination of the Mechanical Properties of Fractures," has been reviewed by other Project participants, Project Office staff, and Headquarters personnel. The review comments were received in May. The study plan is in the process of being revised. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

Work is continuing on the development of a computer program to model the dilation, normal stiffness, and shear stiffness of single fractures in rock. (SCP Activity 8.3.1.15.1.4.2)

Major Activities Upcoming Next Three Months

A revised version of Study Plan 8.3.1.15.1.4, "Laboratory Determination of the Mechanical Properties of Fractures," will be submitted to the Project Office in the next two months. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

SAND92-2216J, a journal article entitled "Simple Mathematical Model of a Rough Fracture," is being drafted and will be submitted for review in the next two months. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

SAND92-2333, "The Effect of Sliding Velocity on the Mechanical Response of Artificial Joints in Topopah Spring Member Tuff," has been drafted and will begin technical and editorial review in the next two months. (SCP Activity 8.3.1.15.1.3.2)

1.2.3.6.2.1.6 FUTURE REGIONAL CLIMATE AND ENVIRONMENTS

Status Report on Ongoing Activities

The present climate validation analyses (Phase II) were continued. Twenty years of observational data for twenty stations around Yucca Mountain are being compared with the nested regional climate model output.

Additional analysis of the present climate validation (Phase I) is also being performed to better understand the regional climate model behavior. The regional climate model is being revised based on the results of this analysis.

Major Activities Upcoming Next Three Months

The DOP 2-4 requirements for the Phase I Analysis will be addressed.

The test run of MM4BAT and its pre- and post-processing software will be documented.

The Phase I and II validation analyses will be continued.

Issues/Potential Problems Needing Resolution and Potential Impacts

The FY93 budget for WBS 1.2.3.6.2.1.6 has not been finalized. Therefore, the level of effort on this WBS element is being kept at the minimum.



1.2.4 REPOSITORY

The objective of the Repository element includes work scope related to the repository component of the physical system including the repository operations system, the underground facility component of the engineered barrier system, the access/borehole seals, and the monitoring system component of the performance evaluation system. The Repository element is comprised of nine tasks: Repository Coordination and Planning (1.2.4.1.1), Excavation Investigations (1.2.4.2.1.1.1), In Situ Thermomechanical Properties (1.2.4.2.1.1.2), In Situ Mechanical Properties (1.2.4.2.1.1.3), In Situ Design Verification (1.2.4.2.1.1.4), Rock Mass Analyses (1.2.4.2.1.2), Certification of Design Methods (1.2.4.2.3.1), Design Analysis (1.2.4.2.3.2), and Sealing and Design Requirements (1.2.4.6.1).

1.2.4.1.1 REPOSITORY COORDINATION AND PLANNING

Status Report on Ongoing Activities

Work continues with the thermal design working group that has been formed with key staff from SNL, Lawrence Livermore National Laboratory (LLNL), and the Management and Operations (M&O) contractor. The initial focus of this group is to revise the current Site Characterization Plan (SCP) thermal design goals for the repository. Once this is completed, issues such as the range of thermal loading to be studied during Advanced Conceptual Design (ACD) can be addressed. In the past month, SNL staff provided input to working groups. These groups developed a plan that identified the major issues related to thermal loading and proposed actions to move toward a decision on thermal loading for repository design.

Initial thermal-structural analyses to address a range of thermal loading for both in-drift and in-borehole emplacement schemes have been completed and a draft letter report sent to the M&O. Significant effort was expended this month in replanning work for FY93. Work scopes in some areas were revised based on expected budget reductions. The most severe impacts are in the areas of ESF test development, codes/models development, and QA certification.

Work was initiated to develop a limited-scope geotechnical test effort for the Exploratory Studies

Facility (ESF) starter tunnel. SNL is working closely with the M&O and LANL to define a set of tests that can be conducted in the starter tunnel to gather key design information. These tests are part of Study Plans 8.3.1.15.1.5 and 8.3.1.15.1.8.

Major Activities Upcoming Next Three Months

SNL will participate in the development of a plan for addressing the thermal loading of the repository. Specific actions for FY93 will be identified and thermal goal working groups will begin review of the thermal goals.

SNL will complete test plans for the ESF starter tunnel and begin implementing the program.

Issues/Potential Problems Needing Resolution and Potential Impacts

Reduction in the FY93 budget from the Mission 2001 baseline case will impact SNL's ability to support ESF design and the resolution of repository thermal loading issues. Delays are anticipated in completing model and code software QA requirements for documented QA analyses that support ESF design and the evaluations of items important to safety and waste isolation. Also impacted by reduced budgets and accelerated schedules are the SNL preparations for the ESF in situ tests.



1.2.4.2.1.1.1 EXCAVATION INVESTIGATIONS

Status Report on Ongoing Activities

Staff continued to revise Study Plan 8.3.1.15.1.5, "Excavation Investigations," to reflect the current ESF configuration and mining method.

1.2.4.2.1.1.2 IN SITU THERMOMECHANICAL PROPERTIES

Status Report on Ongoing Activities

Staff continued work on the rough draft of Study Plan 8.3.1.15.1.6, "In Situ Thermomechanical Properties."



1.2.4.2.1.3 IN SITU MECHANICAL PROPERTIES**Status Report on Ongoing Activities**

Staff continued work on the rough draft of Study Plan 8.3.1.15.1.7, "In Situ Mechanical Properties."

1.2.4.2.1.2 ROCK MASS ANALYSES**Status Report on Ongoing Activities**

Laboratory work continued on the experiments involving small polycarbonate models. This month, SNL continued its work to develop a reliable automatic method to extract two-dimensional strain/displacement information from the images of Moire fringes. An interpretation based on the theory of optics shows that the fringe patterns produced by the interference of the master grill with the sample grid are sinusoidal in form to a first approximation. The signal carries displacement information in the local frequency or phase, much like an FM radio signal. The problem is to remove noise, the background intensity and amplitude, and then invert the resulting sinusoid for the phase. This month SNL began work that uses a Hilbert Transform that directly extracts the local phase, frequency, and amplitude information. This method appears to work reliably on single profiles of fringes, but there are often unexplained displacement offsets between adjacent columns on two-dimensional images. Next month, SNL will explore and implement methods to eliminate these problems. The automated data-reduction method will be validated by applying it to well-understood test problems. Once the validation work is completed, SNL will continue the data-reduction process for the latest set of experiments.

A series of experiments designed to study the effect of a nonstandard loading condition on frictional properties has been conducted at the University of Colorado (CU). Replicas of fractures in rock samples have been tested for normal stiffness and shear deformation properties. SAND92-1853, "Effect of Boundary Conditions on the Strength and Deformability of Replicas of Natural Fractures in Welded Tuff: Data Report," details the experiment techniques. This SAND report has completed technical review and is now in management review. A graphical model has been used to predict the shear behavior and the results have been compared to the data. This analysis is being reported in SAND92-2247, "Effect of Boundary Conditions on the Strength and Deformability of Replicas of Natural Fractures in Welded Tuff: Comparison Between Predicted and Observed Behavior," which is close to completing editorial and technical review. Additional analyses of the data will be reported in a third SAND document that should begin SNL review in November.

A new study has been initiated to study the surface characteristics of natural fractures and relate these to the frictional data gathered on replicas of the surfaces.



This study will place special emphasis on determining whether the fitting parameters on the so-called "Barton Model" for frictional behavior have physical significance or not. The majority of the experimental work will be carried out by a CU graduate student at SNL.

R. Price (SNL) visited CU on December 1, 1992 to discuss the progress on the data and analysis reports and the plans for the new study.

1.2.4.2.3.1 CERTIFICATION OF DESIGN METHODS

Status Report on Ongoing Activities

All technical work required to obtain Quality Assurance (QA) certification for a special YMP version of JAC2D, SNL's primary thermomechanical finite-element code that contains one of SNL's jointed rock models, was completed in November. This work included running the test problems used to qualify the original JAC2D base version and a series that verified the implementation of the jointed rock model. This version of JAC2D (YMP 1.00 version) will be submitted for formal QA approval in early December.

SNL has begun porting the YMP V1.00 version of JAC2D to the SNL-YMP's local SUN computing network. Once the porting is complete, this code will allow SNL to save a significant amount of money by running problems locally rather than on the Cray.

Due to the new budget figures received this month, SNL has essentially stopped all code documentation efforts for the JAC2D code. In addition, the finite-element/boundary-element technology effort has also stopped for the same reason.

In November, the feasibility of using an augmented Lagrangian formulation to enforce connectivity and interpenetrability constraints was tested in SNL's one-dimension block code. The testing showed that this formulation worked very well. This approach allows these codes to take advantage of the simplicity of a penalty formulation while at the same time giving the user the ability to iteratively refine how well the constraints are satisfied. In the one-dimension test cases, the inter-block (element) constraints were satisfied in only one iteration. The next step will be to design a two-dimensional version of the code.

Also this month, SNL completed a draft of a report for a single joint set, three-dimensional jointed rock model. This report will begin the technical review process in December.



1.2.4.2.3.2 DESIGN ANALYSIS**Status Report on Ongoing Activities**

Internal SNL comments on SAND92-0589, "Yucca Mountain Site Characterization Project: New Three-Dimensional Far-Field Repository Field Thermomechanical Calculations," by Hardy et al., have been received and are being addressed. This report documents the work completed for Problem Definition Memo (PDM) 75-25. The analyses defined in the PDM were intended to provide information on the temperatures, stresses, and strains expected in the vicinity of ESF openings that may become part of the repository. The "new repository design" was used in the analysis, with thermal loadings of 57 and 80 kW/acre. (SCP Section 8.3.2.4.1.1)

Structural processing of the thermal results obtained as part of the SNL support to the M&O's systems study on repository thermal management was completed for an initial areal power density (APD) of 100 kW/acre. Results obtained using the compliant joint model option of the finite-element code JAC (Biffle, 1984) were transmitted to M&O personnel for inclusion in the Phase I study report.

Documentation of a study comparing the predictions of near-field thermal response using approximations of smeared two-dimensional heat sources and discrete three-dimensional representations continued. This study provided a preliminary evaluation of the adequacy of smeared source approximations in two-dimensional thermal modeling. Local APDs of 20, 25, 34, 57, 80, and 114 kW/acre were examined.

1.2.4.6.1 SEALING DESIGN AND DESIGN REQUIREMENTS**Status Report on Ongoing Activities**

Work associated with the development of a strategy to seal exploratory boreholes continued. Reevaluation of the borehole database continued and inconsistencies have been clarified and resolved with the M&O contractor. Database corrections are currently being implemented. In addition, the QA status of the SHAFT.SEAL user's manual was reviewed.



1.2.5 REGULATORY

The objective of the Regulatory element is to assure site-related compliance with Nuclear Regulatory Commission agreements, requirements, and policies; evaluate the performance of the natural barriers, engineered barriers, and total systems for meeting regulatory standards; and manage, maintain, and accumulate technical data and information produced by site characterization, design development, and performance assessment activities for the project. The Regulatory element is comprised of 11 tasks: Regulatory Coordination and Planning (1.2.5.1), Site Characterization Program (1.2.5.2.2), Technical Database Input (1.2.5.3.5), Total System Performance Assessment (1.2.5.4.1), Repository Performance Assessment (1.2.5.4.3), Site Performance Assessment (1.2.5.4.4), Interactive Graphics Information System (1.2.5.4.5), Development and Validation of Flow and Transport Models (1.2.5.4.6), Support Calculations for Postclosure Performance Analyses (1.2.5.4.7), Development and Verification of Flow and Transport Codes (1.2.5.4.9), and Special Projects (1.2.5.5).

1.2.5.1 REGULATORY COORDINATION AND PLANNING

Status Report on Ongoing Activities

Staff has continued to work on the organization of the natural-systems section of the 1993 international conference on the management of high-level waste. This work has included planning and implementation of a technical field trip and coordination of approximately 26 technical sessions and 1 plenary session.

Other work in this element has consisted of routine coordination of activities, budgets, and schedules in the Regulatory WBS element, 1.2.5. Several budgets, for example, have been prepared in support of the exercises requested by the Project Office. Coordination of the FY93 total-system performance assessment with other WBS elements has continued as well.

1.2.5.2.2 SITE CHARACTERIZATION PROGRAM

Status Report on Ongoing Activities

Staff participated in planning for a December technical exchange with the NRC staff and a briefing for the NRC Advisory Committee on Nuclear Waste. This effort produced agendas and speaking assignments for the two sets of presentations.



1.2.5.4.1 TOTAL SYSTEM PERFORMANCE ASSESSMENT

Major Accomplishments

Several papers accepted for submission to the 1993 International High-Level Radioactive Waste Management Conference are currently in various stages of review. Papers include "Scenario Development for Performance Assessment—Some Questions for the Near-Field Modelers," by R. W. Barnard and G. E. Barr; SAND92-2600C, "Sensitivity Analyses for Total System Performance Assessment," by M. L. Wilson; and SAND92-2386C, "The Most Likely Groundwater Flux Through the Unsaturated Tuff Matrix at USW-H#1," by J. H. Gauthier.

SAND92-2431, "Review of Radionuclide Source Terms Used for Performance-Assessment Analyses," by R. W. Barnard, was submitted for SNL internal technical review.

SAND91-1653, "Scenarios Constructed for Basaltic Igneous Activity at Yucca Mountain and Vicinity," by G. Barr, E. Dunn, H. Dockery, R. Barnard, B. Crowe, and G. Valentine, is currently in technical review.

Significant Meetings Attended

SNL staff attended the Expert Judgment workshop held in Albuquerque, NM on November 11 through 19, 1992. Support for the meeting included staff working on the steering committee and staff participating in the presentations. The presentations included "Experience From the 1991 Total System Performance Assessment" by P. Kaplan and "Expert Judgment as a Data Supplement" by M. Harr.

On November 18 through 19, 1992, SNL staff organized a meeting in Albuquerque, NM with staff

from LLNL to define the source terms that LLNL will be supplying for the next Total System Performance Assessment analyses. LLNL is working on thermal effects associated with alternative container placement configurations and higher heat loads. The members agreed to use a source term that had two waste-package emplacement configurations: the standard thin-wall package vertically placed in boreholes and the robust waste package in drift emplacement. An agreement was made to consider a limited number of thermal scenarios: the current heat load for the borehole emplacement case and a higher heat load for the drift emplacement problem. Also, the model for container failure should address the mechanisms that cause both waste-package degradation and fuel-rod failure. Staff members from SNL and LLNL also agreed to include a model for production of colloids in the source term. A modification of the ^{14}C source term to include releases due to cladding failure and fuel-assembly failure would be desirable.

Status Report on Ongoing Activities

SNL staff is continuing to add material to the draft scenario report for the nominal flow case. Approximately 20 sketches illustrating the events and processes of the scenarios were drafted and approved. Tree segments that will appear in the text are being drafted. Drafting constitutes the bulk of the work remaining to be done; about 100 sketches and 20 tree segments will be in the final report.

Source terms have been provided for the transmuted-waste aqueous analysis. A TSA TOSPAC run will allow a direct comparison with the TSPA-91 analyses using a spent-fuel source term.



1.2.5.4.3 REPOSITORY PERFORMANCE ASSESSMENT

Status Report on Ongoing Activities

Work continued on the documentation of a far-field thermal study that will be presented at the 1993 International High-Level Radioactive Waste Management Conference. The study focuses on an evaluation of a range of design-basis APDs given a consistent set of modeling assumptions. Captured in the three-dimensional model are an accounting for variations in yearly average waste characteristics and the use of a detailed repository geometry. (Design Activity 1.11.6)

1.2.5.4.4 SITE PERFORMANCE ASSESSMENT

Major Accomplishments

SAND92-0461, "Pre-Waste-Emplacement Ground-Water Travel Time Sensivity and Uncertainty Analyses for Yucca Mountain, Nevada," by P. Kaplan, has been approved for publication by the Project Office.

Several papers accepted for the 1993 International High-Level Radioactive Waste Management Conference are currently in preparation and review. These papers include "Recent Developments in Stochastic Modeling and Upscaling of Hydrologic Properties in Tuff," by C. Rautman and T. H. Robey; "Numerical Methods for Fluid Flow in Unsaturated Heterogeneous Fractured Tuff," by T. H. Robey; and "A Technical Basis for the Evaluation of the Geohydrology Disqualifying Condition in 10 CFR Part 960," by P. Kaplan, A. Van Luik, and J. Boak.

Significant Meetings Attended

SNL staff attended the INTRAVAL meeting in San Antonio, TX on November 9 through 12, 1992. At the meeting, P. Kaplan gave a presentation on "Geostatistics and Unsaturated Flow."

Status Report on Ongoing Activities

A tracking system for the data base group was designed and implemented. This system tracks source documents submitted to the Performance Assessment Data Base (PADB) by including citation number, Project Data Tracking Number, title, date of document, type of data available in submittal, date each type of data was entered in the PADB, QA level of each type of data, and job number under which the work was done. Each submittal is assigned a unique number called the Performance Assessment Number (PAN).

Review sheets for each type of data currently being entered into the database were generated. These sheets will be used by staff while reviewing data for possible submission into the PADB. This will improve the process of getting data into the database by identifying test conditions and any other required data.

Design of tables and input data was continued. New data appended to PADB included:

- Porosity data from 4 submittals (852 records),
- Bulk density data from 5 submittals (1745 records),



- Grain density data from 2 submittals (63 records),
- Saturated hydraulic conductivity from 4 submittals (466 records), and
- Permeability from 3 submittals (419 records).

The compilation for porosity and saturated hydraulic conductivity data for inclusion in the SNL PADB is essentially complete. Over ten documents have been reviewed to date. Data review sheets were reviewed and clarified for the PADB. Bulk transmissivities and permeabilities were identified as requested by modelers. Bulk permeability data sources were provided to SNL staff for review and evaluation. The SNL Total System Performance Assessment modelers requested bulk parameters for permeability and transmissivity to allow models and analyses to replicate the actual physical process if values from small laboratory-derived samples are used.

Retrieval of the saturated hydraulic conductivity from the old Site and Engineering Properties Data Base (SEPDB) and other documents (predominantly USGS Open File Reports) was completed. A data search and review for the next data of interest, bulk permeability parameters data, is underway. A review and evaluation of the Yucca Mountain drill hole descriptive and geophysical logs was also initiated.

Flow charts were developed to present an organized view of the relational geometry of the Data Working Group and the division of labor and responsibilities. The completed version of the Task Flow for the Performance Assessment Data Base Working Group has been distributed for internal review and comment.

Next month's efforts will concentrate on the continued evaluation of Yucca Mountain drill hole logs. Identification of additional bulk transmissivities and permeabilities as requested by modelers and the review and acquisition of moisture retention data will continue.

The stratigraphy review of 21 drill holes started at the end of October continues for comparison and extrapolation of the simulated geostatistical representations of Yucca Mountain. Five drill holes were reviewed: USW G-1, G-3, G-4, H-4, and H-5. SNL staff met and discussed the initial interpretation of holes USW G-4 and H-4. Comparison of drill hole information for correlation will continue. The reviews compare the drill hole logs to determine major stratigraphy breaks to compare with analyst-generated sections. A methodology was developed to evaluate

the stratigraphic (lithologic), core photograph, and geophysical logs for Yucca Mountain. The geophysical approach and methodology documentation were drafted.

The geostatistical unit adaptive method (GUAM) has been converted to provide identification of three-dimensional units rather than the two-dimensional cross sections. This program takes the output from the indicator simulations and constructs a simplified three-dimensional stratigraphy. GUAM will need revision to handle current interpretations of the data from the drill holes that will make it more difficult to pick up units.

The three-dimensional geostatistical indicator simulations for welded and nonwelded classes using SISIMPDF from GSLIB continues to be refined. SNL staff members attended several meetings to determine guidelines for picking out breakpoints between the classes in drill holes that are the sources of input data. The breakpoint between welded and nonwelded in Prow Pass was revised after reviewing the Scott and Bonk cross section and the drill hole data.

Two meetings were held to discuss the use of ARC/INFO and ARD/VIEW for performance assessment. An SNL staff member feels ARC/INFO will be limited in terms of expected capabilities. This member requested a breakdown of each type of data and drill holes to build a coverage that will bring up just certain drill holes depending on parameter and testing conditions. Research is being done to find the easiest way to build this table. One suggested way seems to be very time-intensive to maintain.

In an effort to reduce cost, SNL staff tested the INFORMIX database software as a possible replacement for INGRES, but found that it is unacceptable because of its limited forms and report capabilities.

Additional data on saturated conductivity and porosity from UZ-4 and UZ-5 have been added to the geostatistical adaptive grid (GAG) data files. The data files have been updated to match the breakpoints between classes determined by members of the SNL staff.

Chapter 4 of SAND92-0799, "Model Domains and Hydrologic Data Base to Support Early Site Suitability and Total Systems Performance Assessment Models," by Gainer et al., was completely rewritten. Chapter 5 will also require major changes.



1.2.5.4.5 INTERACTIVE GRAPHICS INFORMATION SYSTEM

Major Accomplishments

The operating system on the SUN SparcStation sass377, the main network server, has been upgraded to OS4.1.3. This upgrade allowed the upgrade of applications software such as PV-Wave.

Status Report on Ongoing Activities

Work continues to progress in the development of conversion techniques to translate the existing CALMA gridded-terrain models of the thermal/mechanical units into contour maps to be used in ARC/INFO. ARCVIEW techniques are being explored and view files developed for various subjects of interest. A data dictionary has been started to provide users with a guide to the data now available to them.

The following CALMA jobs have been completed:

- Job 396 for P. Gottlieb - Repository for Expansion Areas
- Job 400 for J. Houseworth - Profiles for INTERA/M&O

Major Activities Upcoming Next Three Months

Staff will relocate the computer systems to a new building and test and debug the local area network

(LAN) in the new location. A move plan that will minimize downtime and disrupted services will be developed and implemented.

Training in ARC/INFO and ARCVIEW for support personnel will continue. The additional license for ARC/INFO will be installed and a training program will be developed for users on the basics of building an ARCVIEW map at their workstation or PC.

Development of visualization techniques using Advanced Visualization Systems (AVS) will begin. Additional training in AVS will be obtained as needed.

Work will begin with GENISES to develop techniques to transfer data via the networks and begin replacing existing data with data qualified under a QA procedure when it becomes available.

The following CALMA jobs are in progress:

- Job 386 for H. A. Dockery - Drill Holes/Section
- Job 397 for D. L. Eley - Convert GTMs to ARC/INFO
- Job 398 for D. Guerin - Hydrogeologic Drillholes
- Job 399 for J. A. Fernandez - New Proposed/Exist Drillholes



1.2.5.4.8 DEVELOPMENT AND VALIDATION OF FLOW AND TRANSPORT MODELS

All activities addressed in this monthly status report support SCP Section 8.3.5.12.2.1.1. Activities supporting SCP Section 8.3.5.12.2.2.2. are not scheduled for FY92 and hence are not addressed.

Significant Meetings Attended

W. Lin (LLNL) visited R. J. Glass of SNL on November 18, 1992 to tour the SNL YMP Subsurface Flow and Transport Laboratory. It is hoped that some of the laboratory's capabilities may be used to assist in the large fractured block heater tests planned by LLNL.

R. Charbinau (Director of Water Resource Program) and D. Kline (Dean of Engineering Research) from the University of Texas, Austin visited R.J. Glass of SNL on November 24, 1992 to tour the SNL YMP Subsurface Flow and Transport Laboratory and discuss further development of student exchange programs.

R. J. Glass and V. C. Tidwell of SNL and P. Reimus (LANL) met with J. Wilson and students at NM Tech on November 25, 1992 to discuss collaborative efforts in fracture/matrix interaction.

Status Report on Ongoing Activities

Flow and transport through single fractures:

Four papers were accepted for presentation at the 1993 International High-Level Radioactive Waste Management Conference (IHLRWMC); work in November was primarily directed toward preparing these papers. The first paper presents experimental results focused on the behavior of individual gravity-driven fingers in an initially dry analog fracture, following up on full-field instability experiments reported at last year's meeting. The second paper also presents experimental results from the analog fracture system, extending previous work to include the effects of initial moisture content on both full-field instability and individual finger behavior. Preparation of experimental data records from these two studies for submission to the Data Records Management System (DRMS) continued and is expected to be completed in early December. The third paper presents development of a numerical technique to model the behavior of gravity-driven fingering in initially dry fractures. The fourth paper is the result of a collaborative effort with LANL staff. P. Reimus and B. Robinson and presents results of saturated flow and transport experiments in a natural fracture in welded

tuff. First drafts of all four articles were prepared in November and are currently under revision; final drafts are expected to be in internal review by mid-December and submitted to the conference in early January.

Plumbing modifications to the Rotating Test Stand (RTS) were completed; rerouted lines are expected to reduce down time caused by air entry into the system. The RTS was set up with a test cell allowing fully controlled boundary conditions on a test fracture 30.5 x 15.24 cm in size. This cell will be used in a new experimental sequence investigating the effects of air entrapment on fracture permeability and tracer migration. We are currently developing a computer-controlled solenoid valve system to allow application of controlled dye pulses into the system.

Fracture/matrix interaction:

Studies to understand the influence of matrix imbibition on fracture percolation in thin, two-dimensional systems cut normal to the plane of the fracture are still underway. In addition to the continued efforts to characterize the capabilities of the University of New Mexico Hospital's Polytron x-ray unit, studies have been reinitiated at SNL's nondestructive testing facility (NDT) using industrial x-ray equipment. The Polytron's phosphor detector offers near-real-time speed and direct digitization of image data. While the film recording medium used with NDT's industrial equipment represents slower detection, the greater dynamic range of the film results in greater range of measured properties. Fracture flow in tuff and sintered glass bead plates were examined at NDT, and data are being examined. Continued efforts are underway toward understanding the numerical model, LLUVIA-II, and measuring necessary input material properties. Results of the fracture flow tests are currently being assembled for presentation at the Fall meeting of the American Geophysical Union.

Analysis of data collected this summer on wetted structure in horizontal fractures in fractured rock continued. A paper covering this research was accepted for presentation at the IHLRWMC. A first draft of the article was prepared in November and is currently under revision.

Field, laboratory, and numerical experimentation to determine scaling laws for effective-media properties in heterogeneous media:

To support studies aimed at understanding processes governing rock property scaling and variability, an automated gas permeameter test system is being built. All needed components have been received and



All needed components have been received and construction is continuing on the unit. In addition, a paper for the IHLRWMC entitled "Scale Dependence of Effective Media Properties" is being written that outlines the approach that will be taken to investigate property scaling and describes the results of a scoping study that was performed early in FY92.

Development of experimental capabilities:

Efforts have continued to purchase a Phillips MG161 x-ray generator and tube head to be used in high-resolution imaging of moisture content and solute concentration fields in opaque materials (i.e., tuff samples). Receipt of the unit is scheduled for the first week in January.

Caisson test:

Batch acid-base surface titrations were carried out with acid-washed Wedron 510 sand and acid-washed Min-U-Sil silica. The latter solid has been used as a reference quartz standard for surface studies by other researchers. The coincidence of the titration curves of the Min-U-Sil indicates that the acid-washing procedure removes the non-quartz surface coatings from the Wedron sand. The titration curves of the acid-washed Wedron sand differs from that of raw Wedron; this indicates that the raw sand is coated with phases that are relatively insoluble at neutral and high pH.

Sorption studies were conducted to evaluate lithium as a reactive groundwater tracer for Wedron 510 and mixtures in 0.001M sodium chloride (NaCl) solution. Samples of the NaCl solution and unwashed Wedron 510 sand were prepared in ratios of approximately 1 to 1, 5 to 1, and 10 to 1 and allowed to stabilize under atmospheric conditions. Lithium as lithium bromide then was added to the samples in concentrations of 0.1 ppm, 1 ppm, and 10 ppm. After the samples stabilized, they were centrifuged, measured for pH, and filtered. The pH values ranged from 6.21 to 7.27. Lithium concentrations were measured using atomic absorption (AA) spectrophotometry with an air-acetylene flame. The data will be reduced during December to produce parameters for sorption isotherms.

Studies on sorption of nickel (Ni) by a 2.4-g ceramic cup used for withdrawing water samples from unsaturated caisson soil continued this month. The retention of Ni by the samplers will introduce uncertainty into the interpretation of the results of the caisson experiment. Analysis for Ni was done by graphite furnace atomic absorption. Breakthrough curves were established for solution pHs of 6.5 and 7.4. Half the breakthrough curve for a solution pH of

8.8 was established in October 1992. Flow through the ceramic cup was controlled at rates of 0.3 to 0.6 ml/min through the experiments. A comparison of the curves indicates that 90% breakthrough occurs after 600 ml and 720 ml of throughput for pHs of 6.5 and 7.4, respectively. For the run using a solution with a pH of 8.8, 90% breakthrough was not achieved because it was the first run and the time requirement was not yet anticipated. For 55% breakthrough, the required volumes were 190 ml, 410 ml, and 325 ml, respectively, for solution pHs of 6.5, 7.4, and 8.8. Further runs are required to confirm the effect of pH on the breakthrough curve to clarify if sorption actually decreases as the pH increases from 7.4 to 8.8. However, these curves give some indication as to the amount of Ni sorption that will occur in the caisson experiment.

Reactive transport experimentation:

A technique to measure Kds under unsaturated conditions being developed. The experiments are carried out with a Turbula™ mixer and involve batch sorption tests with ²³⁵U under unsaturated conditions followed by flushing the rock with solutions with high ²³⁸U concentrations. A simple mathematical model to calculate the Kd of uranium in unsaturated rocks from measurements of aqueous concentrations of ²³⁵U and ²³⁸U from the sorption tests has been developed.

Reactive transport model development:

Test problems from the CHEMVAL phase III and IV Validation/Verification program were run using the LEHGC code on a SPARC10 workstation. Limitations of the current version of the code were identified during the modeling activities and modifications to the code were made. The test problems simulated transport by advection and diffusion coupled with chemical reactions including aqueous complexation, precipitation, dissolution, and exchange. Surface complexation reactions have been modeled without transport. The results will be reported along with previous validation and verification calculations at the Fall AGU meeting in early December.

Major Activities Upcoming Next Three Months

The automated gas permeameter test system will be built and tested.

Staff will continue sorption experiments in support of the caisson experiment and start the nickel solubility study. Staff will continue validation/verification calculations with LEHGC and continue development of a method to measure Kds under saturated conditions. Surface titrations of Wedron 510 sand to obtain surface acidity constants will be carried out.



1.2.5.4.7 SUPPORT CALCULATIONS FOR POSTCLOSURE PERFORMANCE ANALYSES

Significant Meetings Attended

A meeting was held on November 20, 1992 at SNL regarding the use of ESF Analyses #1 and #3 (SAND91-0790 and SAND91-0792) to support the design package for the North Portal. SNL, USGS, DOE, and M&O personnel were in attendance in Albuquerque, NM; other DOE and M&O personnel attended via conference call from Las Vegas, NV. Issues concerning the results of the analyses, their sensitivity to variations in hydrologic properties in the alluvium and Paintbrush Tuff, and the appropriateness of the documents for use in support of QA work were addressed and resolved to the satisfaction of all participants. A letter was written to summarize the results of the meeting [L. E. Shephard to M. B. Blanchard, dated November 23, 1992, Subject: Resolution of Assessment Team (AT) Concerns Regarding SNL Input to ESF Design Package Classification Reports].

Status Report on Ongoing Activities

Calculations to estimate the effects on repository performance of surficial water used in the controlled zone outside the repository, which are presented in the ESF Performance Assessment (PA) Analysis No. 12 and PDM 72-32, were completed and have completed technical review. Two efforts are underway using these calculations. The first effort involves writing recommendations for controls on surficial water usage and locations of surficial ponds; these recommendations are intended for inclusion in

Appendix I of the ESF Design Requirements document (ESFDR) and the Surface-Based Testing Field Requirements Document (SBTFRD). The second activity is a SAND report (SAND92-2248) describing the analysis; this report is currently being drafted.

Preliminary efforts for a model validation exercise are continuing in collaboration with WBS 1.2.5.4.6 staff. Preliminary calculations are being performed in conjunction with a series of experiments investigating matrix/fracture interaction by modelling flow through a discrete fracture. These experiments are being performed by SNL Department 6115 staff. Results of initial calculations may be included in a paper to be presented at the American Geophysical Union conference in December 1992.

SNL staff participated in a working group to improve the surface-based testing job and test planing process. The group identified concerns that relate to test controls for which solutions could be derived.

Major Activities Upcoming Next Three Months

The documents describing the PA plan for the ESF Title II design support will be completed. The plan described in the document will be developed and implemented.

The two activities regarding ESF Analysis No 12—the recommendations for the ESFDR and SBTFRD and the report SAND92-2248—will be completed.

A new ESF PA analysis investigating the sensitivity of previous analyses to uncertainty in the hydrologic properties of the nonwelded Paintbrush Tuff will be initiated with the writing of a Work Agreement.



1.2.5.4.9 DEVELOPMENT AND VERIFICATION OF FLOW AND TRANSPORT CODES

Major Accomplishments

A paper entitled "Comparison of Numerical and Analytical Estimates for Effective Unsaturated Conductivities for Stratified, Heterogeneous Media" by R. R. Eaton and J. T. McCord, was accepted and will be presented at the winter AGU meeting December 9, 1992. The paper discusses how the LLUVIA-II code is being used to investigate the nonisotropic aspects of nonstratified heterogeneous media. These calculations will be used to supplement those for stratified media obtained earlier. This investigation will aid in the understanding of the applicability of one-dimensional flow for the Total System Performance Assessment study.

Report on Ongoing Activities

Code Development (Subactivity 1.6.2.1.2)

A report entitled "Review and Selection of Unsaturated Flow Models," by M. Reeves, J. Duguid, and N. Jasek, has been reviewed by R. R. Eaton. A review letter has

been drafted and contains SNL staff comments. The review was completed and sent to the M&O.

A summary entitled "Modeling Flow in Unsaturated Fractured Media" was presented to a newly formed WIPP working group on modeling effects of fracturing for performance assessment. The presentation summarized some of the work done to model flow in unsaturated fractured media for the YMP.

Software QA (No SCP Activity)

The report on the NCAR audit was completed by SNL staff. Review of documentation for climatology codes and the effort of process software QA records is continuing. Two SNL staff members constructed a matrix of the QARD Section 19 crosswalked with the current QAIP 3-2. Both identified issues in the QARD to be placed into the QAIP. An SNL staff member convened an internal meeting to discuss software issues. Work began on qualifying the ACCESS system libraries: SUPES, SUPLIB, PLT, and SVID. Test cases for the STAFF3D code were run and testing continued for the JAC2D code on the SUN hardware platform.



1.2.6 EXPLORATORY STUDIES FACILITY

The objective of the Exploratory Studies Facility element includes work scope related to the design, construction, and operation of the Exploratory Studies Facility. The Exploratory Studies Facility element includes the Exploratory Studies Facility Coordination, Planning, and Technical Assessment (1.2.6.1.1) task.

1.2.6.1.1 ESF COORDINATION, PLANNING, AND TECHNICAL ASSESSMENT

Status Report on Ongoing Activities

A monitoring plan that is consistent with ESF test plans was developed for the starter tunnel for the ESF.

SNL is working with the M&O and LANL to implement the plan. The construction monitoring will consist of seismic monitoring for blasting, rock quality determination and support system performance evaluations, and excavation closure monitoring for stability assessments.



1.2.9 PROJECT MANAGEMENT

The objective of the Project Management element includes work scope related to project-level planning and control, and management of contract activities. The Project Management element includes two tasks: Technical Project Office Management (1.2.9.1.2) and Project Control (1.2.9.2.2).

1.2.9.1.2 TECHNICAL PROJECT OFFICE MANAGEMENT

Significant Meetings Attended

On November 5, 1992, J. T. Holmes, Deputy TPO, attended the Nuclear Waste Technical Review Board (NWTRB) topical meeting on the ESF held in Las Vegas, NV.

On November 17, 1992, L. E. Shephard, TPO, participated in the Technical Advisory Group Meeting in Los Alamos, NM.

On November 18 through 20, 1992, the NWTRB topical meeting on expert judgment was held in Albuquerque, NM. L. E. Shephard and J. T. Holmes attended.

1.2.9.2.2 PROJECT CONTROL

Major Accomplishments

Planning and budget data were compiled and transmitted to the YMP Project on November 6, 1992 and again on November 19, 1992. Data for the YMP socioeconomic report were compiled and transmitted to YMP. The YMP SNL Project Manager reviewed the SNL WBS dictionary and provided comments.

Significant Meetings Attended

The SNL Project Management Team attended two half-day project management seminars. The SNL representative attended the PACS Steering committee meeting in Denver, CO.

Status Report on Ongoing Activities

Work on the AIMS INFORMIX person directory software continued during the month of November as a part of the configuration management system. The work is focusing on the input, query, update and reporting capabilities. A second phase of the work will focus on integrating the person database with other INFORMIX applications. The SNL cost data from October have been processed and are awaiting final approval of the SNL budget before reporting to YMP.

Major Activities Upcoming Next Three Months

FY93 budget, work scope, and schedule data will be reprogrammed to include the carryover and retransmitted to YMP when complete. The cost data for October and November will be transmitted when the budget has been finalized. The SNL WBS dictionary will be transmitted to YMP during December. Staff will start setting up a system to respond to the request for increased socioeconomic data reporting. This effort will require a major investment of time with no increase in resources.



1.2.11 QUALITY ASSURANCE

The objective of the Quality Assurance element includes work scope related to the development and maintenance of project participants' assurance programs consisting of all those planned and systematic actions necessary to provide adequate confidence that the information to obtain a license for siting, constructing, and operating a geologic repository and monitored retrievable storage facility will be met and complies with Federal regulations.

1.2.11 QUALITY ASSURANCE

Major Accomplishments

Four surveillances were completed this month. Technical work in WBS 1.2.1.4.1 was reviewed, as well as QA Program elements 1, 2, 5, 6, 12, 13, 16, 17, and 18.

The SNL YMP Quality Assurance Program Description (QAPD) Rev 01 was approved by the YMP Quality Assurance Department (QAD) and issued.

Status Report on Ongoing Activities

The procedure-streamlining process continues. The improvement and simplification of SNL Quality Assurance Implementing Procedures (QAIPs) will continue, as will activity on the development of a new computer-network-based QA matrix. QAIP 1-1, "Quality Assurance Program Description Control," was completed and issued.

The National Center for Atmosphere Research (NCAR) Audit resulted in ten findings. These findings were separately transmitted by memorandum dated November 25, 1992 to the responsible parties for prompt corrective action. In addition, one CAR was

elevated to "Significant Condition Adverse to Quality." The SNL Technical Project Officer was advised by memorandum dated November 24, 1992.

Major Activities Upcoming Next Three Months

A transition plan has been developed to bring SNL in compliance with the new revision to the Quality Assurance Requirements Document (QARD), once it is issued.

Three audits are scheduled for the next three months. International Technology Corp. (ITC), Disposal Safety Inc. (DSI), and Massachusetts Institute of Technology (MIT) will be audited.

Issues/Potential Problems Needing Resolution and Potential Impacts

Prior corrective action for a finding from a 1991 audit of the National Center for Atmospheric Research received ineffectual implementation. In the latest audit, follow-through verification found that the situation was again deficient. As stated above, one of the ten Corrective Action Reports resulting from the NCAR audit was identified as a significant condition adverse to quality. Resolution of the CAR will serve to determine if technical work at NCAR was impacted.



1.2.12 INFORMATION MANAGEMENT

The objective of the Information Management element includes work scope related to the project-level establishment of systems to facilitate organization, storage, and retrieval of information/documents. The Information Management element is comprised of four tasks: Information Management Coordination and Planning (1.2.12.1), Local Records Center Operation (1.2.12.2.2), Participant Records Management (1.2.12.2.3), and Document Control (1.2.12.2.5).

1.2.12.1 INFORMATION MANAGEMENT COORDINATION AND PLANNING

Major Accomplishments

Planning for the move to a new facility began.

1.2.12.2.2 LOCAL RECORDS CENTER OPERATION

Major Accomplishments

The inventory of Yucca Mountain Site Characterization Project (YMP) Record and Nonrecord Material was completed and submitted to YMP and the SNL "Recorded Information Management Department." The inventory research and interviews covered one thousand and forty-three (1,043) linear feet of hardcopy records. Approximately 95% of this quantity is dual storage duplicate copies that have not been verified against Project microfilm and approved for destruction as nonrecord materials.

Record packaging assistance was provided in major efforts related to Document Control and Training records.

Staff received 46 amended TDIFs from the YMP Manager, Automated Technical Data Tracking System (ATDT) for resubmittal to the Central Records Facility (CRF). Corrections were required as the TDIFs were changed due to upgrades of the ATDT caused by added/changed fields. Corrections were made to SNL systems and the TDIFs were prepared for submittal to the CRF as corrected records.

Status Report on Ongoing Activities

Records desk guidance training for new records management personnel continues.

Verification of pre-1990 hardcopy records against the Project microfilm was initiated with 6,374 pages from 16 SAND reports being reviewed.

One lost shipment of records to the CRF was researched, recorded, and resubmitted.

Records were processed for one SNL contractor group, RE/SPEC.



One data set was completed and submitted as a record package to the SNL/YMP Local Record Center.

Staff initiated the inventory of the Samples Library. Three hundred and seventy-five samples were reviewed, verified, corrected, and labeled as needed.

Major Activities Upcoming Next Three Months

All Desk Guidances will be completed.

All technical data that were previously submitted to the PDA will be reviewed to ensure that all records were appropriately identified and forwarded to the YMP Central Records Facility (CRF).

Staff will work through the Records Management Quality Action Team (QAT) to review the technical data record packaging process to determine if improved processing is possible to reduce redundancy and duplication of efforts and to improve protection of data.

Issues/Potential Problems Needing Resolution and Potential Impacts

When the ATDT system is changed, previously submitted TDIF forms should not be required to be corrected to include the new information. Any correction to a record requires resubmittal, which is extremely time consuming. A possible solution may be that on-line changes may be made to enhance information residing in the system, but record changes would not be required.

1.2.12.2.3 PARTICIPANT RECORDS MANAGEMENT

Major Accomplishments

Staff managed the Office of Civilian Radioactive Waste Management (OCRWM) Records and Nonrecord Inventory for the various SNL/YMP Record Centers and conducted 26 personnel interviews.

Significant Meetings Attended

Staff participated in one OCRWM Records Management Teleconference.

Major Activities Upcoming Next Three Months

Staff will initiate the Records Management Quality Action Team (QAT) to review the Record Series, and the Master List of File Codes and to revise records packaging processes to simplify work and enhance the organization of project or topic files.

The relocation and the space and facility needs for the SNL/YMP Local Records Center will be planned.

SNL and OCRWM approval/authorization will be obtained for the identification of YMP Project duplicate storage records as Federal nonrecords. When so designated approval/authorization for the verification and destruction of said records will be obtained.

Staff will support the DOE/YMP QA Audit November 30 through December 4 as well as being audited on Criteria 17.



1.2.12.2.5 DOCUMENT CONTROL

Major Accomplishments

The Controlled Document System software in the AIMS INFORMIX System was revised and data conversion completed.

Status Report on Ongoing Activities

The Controlled Document Staff recalled a large number of Controlled Documents and is in the process of assembling all data into Quality Records Packages (QRPs) for transmittal to the LRC. Work on the Controlled Document System is now limited to correcting serious errors and supporting a period of use without major changes to the software.

Major Activities Upcoming Next Three Months

SNL will continue to prepare and submit QRPs to the LRC for superseded and recalled Controlled Documents.

The Controlled Document Staff will support the 30 November through 4 December 1992 DOE/YMP QA audit, as well as being audited as part of Criteria 6.



1.2.15 SUPPORT SERVICES

The objective of the Support Services element includes work scope related to project-level general administrative and project support activities. The Support Services element is comprised of three tasks: Support Services Coordination and Planning (1.2.15.1), Administrative Support (1.2.15.2), and YMP Support for the Training Mission (1.2.15.3).

1.2.15.1 SUPPORT SERVICES COORDINATION AND PLANNING

Status Report on Ongoing Activities

Planning for the move to a new facility began.

1.2.15.2 ADMINISTRATIVE SUPPORT

Major Accomplishments

SAND91-0758, "The Use of Sequential Indicator Simulation to Characterize Geostatistical Uncertainty," by K. M. Hansen (SNL), was printed and distributed. This report discusses the structure or behavior of natural systems and a simulation experiment designed to study the quality of uncertainty bounds generated using sequential indicator simulation.

Status Report on Ongoing Activities

SNL continues its preparation of conference papers for the International High-Level Radioactive Waste Management Conference to be held in Las Vegas, NV in April 1993. A desk reference for preparing technical reports and references was updated.

Major Activities Upcoming Next Three Months

SNL will prepare and submit conference papers to the International High-Level Radioactive Waste Management Conference to be held in Las Vegas, NV in April 1993.

SNL will submit to the YMPO a list of property to be returned to the YMPO or disposed of in accordance with Nuclear Waste Fund (NWF) requirements.

SNL will continue to refine its property database and to work with SNL's Property Management organization in an effort to eliminate conflicting data in the SNL property database.



1.2.15.3 YMP SUPPORT FOR THE TRAINING MISSION

Major Accomplishments

Work on lesson plans for training on the most frequently used procedures was completed.

The orientation manual completed management review and is being issued to new hires.

Status Report on Ongoing Activities

Three "Geology for Non-Geologists" classes were conducted and videotaped.

Major Activities Upcoming Next Three Months

The "Geology for Non-Geologists" course will be completed and editing of the "Geology for Non-Geologists" course tapes will begin.

The "Hydrology" course will commence in January or February 1993.

A new training manager and training support staff will be hired to replace the resigning manager and support staff.

