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MONTHLY HIGHLIGHTS AND STATUS REPORT

# Yucca Mountain Site Characterization Project

U.S. DEPARTMENT OF ENERGY

YUCCA MOUNTAIN PROJECT

Sandia National Laboratories

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Sandia National Laboratories
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
Monthly Status Report

August 1993

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## August Highlights

SNL staff completed pre-test analyses for a bench-scale experiment to develop an empirical relationship for the thermal conductivity of backfill.

See *1.2.2.4.3 Container/Waste Package Interface Analysis* on page 2.

SNL staff is constructing a new two-dimensional model of RQD values along the profile of the ESF north ramp.

See *1.2.3.2.2.2.2 Three-Dimensional Rock Characteristics Models* on page 4.

SNL staff identified locations for additional shallow north ramp boreholes to investigate the depth of alluvium.

See *1.2.3.2.6.2.1 Surface Facilities Exploration Program* on page 6.

SNL staff completed numerous material properties tests for core from drill holes NRG-2, -3, and -6.

See *1.2.3.2.6.2.2 Surface Facilities Laboratory Tests and Material Property Measurements* on page 6.

## August Highlights, Continued

SNL staff prepared logs for the NRG-2a borehole and performed standard penetration tests in borehole NRG-2b.

See *1.2.3.2.6.2.3 Surface Facilities Field Tests and Characterization Measurements* on page 7.

SNL staff submitted a report, "The Effect of Sliding Velocity on the Mechanical Response of Artificial Joints in Topopah Spring Member Tuff," to complete Milestone 0S49.

See *1.2.3.2.7.1.4 Laboratory Determination of the Mechanical Properties of Fractures* on page 11.

NCAR completed the nine corrective actions that resulted from an October 1992 audit.

See *1.2.3.6.2.1.6 Future Regional Climate and Environments* on page 12.

Construction monitoring activities this month included recording seismic data from construction blasting and developing rock mass quality estimates for 200 ft. of tunnel.

See *1.2.4.1.1 Repository Coordination and Planning* on page 13.

The "Strategy for Sealing Exploratory Boreholes for the Yucca Mountain Project" report completed SNL management and technical reviews.

See *1.2.4.6.1 Sealing and Design Requirements* on page 19.

SNL staff met with the Technical Data Parameter Dictionary working group to establish terminology for data entry and the technical database structure.

See *1.2.5.3.5 Technical Database Input* on page 21.

## *August Highlights, Continued*

SNL staff completed calculations of waste-package lifetimes for the four emplacement configurations analyzed in TSPA-2.

See *1.2.5.4.1 Total System Performance Assessment* on page 22.

SNL staff completed three-dimensional analyses of the in-drift and vertical emplacement cases and the four far-field thermal models for TSPA-2.

See *1.2.5.4.3 Repository Performance Assessment* on page 23.

SNL staff used two slabs of Topopah Spring tuff to conduct a large-format investigation of the impact of matrix imbibition on saturated fracture flow.

See *1.2.5.4.6 Development and Validation of Flow and Transport Models* on page 26.

The "Evaluation of the Effects of Underground Water Usage and Spillage in the Exploratory Studies Facility" report was submitted for SNL review.

See *1.2.5.4.7 Supporting Calculations for Postclosure Performance Analyses* on page 28.

SNL staff transmitted the PACS FY94 budget to the Project office. Staff is also refining SNL milestone processes.

See *1.2.9.2.2 Project Control* on page 32.

SNL QA staff prepared the technical staff for the Project Office audit.

See *1.2.11 Quality Assurance* on page 34.

SNL LRC staff implemented a streamlined process for verification of records against microfilm.

See *1.2.12.2.2 Local Records Center Operation* on page 35.

SNL Records Management supervisory staff is developing the 1994 Program Plan for the Records Management staff.

See *1.2.12.2.3 Participant Records Management* on page 37.

**DISCLAIMER**

Quality assurance checks on data contained in this report have been performed only to determine that the data have been obtained and documented properly. The SNL Project Department cautions that any information is preliminary and subject to change as further analyses are performed or as an enlarged and perhaps more representative data base is accumulated. These data and interpretations should be used accordingly. Milestones have not been baselined and are included only to show status.

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**WBS 1.2.2.4.3 Container/Waste Package Interface Analysis**

- The formulation of a bench-scale experiment aimed at developing an empirical relationship for the thermal conductivity of backfill began. Pre-test analyses have been completed and are being used to establish instrumentation requirements, instrumentation locations, and approximate test durations.

**WBS 1.2.3.2.2.2.2 Three-Dimensional Rock Characteristics Models**

- Construction of a new two-dimensional model of rock quality designation (RQD) values along the profile of the Exploratory Studies Facility (ESF) north ramp has been initiated using RQD values measured on core from drill holes NRG-1, -2, -2a, -3, -6, and RF-8 by the ESF Soil and Rock Properties Study. Satisfactory models of vertical spatial continuity were obtained from the data; measurements are spaced at 10-ft intervals. However, the poor spatial arrangement of the available drill holes renders variograms in the dip direction somewhat inconclusive.

**WBS 1.2.3.2.6.2.1 Surface Facilities Exploration Program**

- The locations for additional north ramp boreholes designated NRG-8a, NRG-8b, and NRG-8c were identified. These shallow boreholes will investigate the depth of alluvium to the west of Exile Hill above the north ramp. NRG-2b was drilled to a depth of 130 ft with good core recovery. Drilling was stopped at 130 ft to allow standard penetration testing to be performed in the hole. An updated cross section was prepared for the north ramp.

**WBS 1.2.3.2.6.2.2 Surface Facilities Laboratory Tests and Material Property Measurements**

- Mechanical properties tests for core from NRG-2 have been completed. Bulk properties and splitting tension tests have been completed on core from NRG-3. Mechanical properties tests have been completed for core from NRG-6.

**WBS 1.2.3.2.6.2.3 Surface Facilities Field Tests and Characterization Measurements**

- Structural and lithologic logs were prepared for the NRG-2a borehole. Standard penetration tests were performed in borehole NRG-2b to determine the bearing capacity of the unconsolidated tuff adjacent to the Rainier Mesa unit.

**WBS 1.2.3.2.7.1.4 Laboratory Determination of the Mechanical Properties of Fractures**

- SAND92-2333, "The Effect of Sliding Velocity on the Mechanical Response of Artificial Joints in Topopah Spring Member Tuff," was submitted to the Project Office on August 31, 1993. This submittal completes the requirements for Milestone 0S49.

**WBS 1.2.3.6.2.1.6 Future Regional Climate and Environments**

- The National Center for Atmospheric Research (NCAR) successfully executed the nine corrective actions that resulted from findings in an audit conducted in October 1992, and the Corrective Action Reports have been closed.

**WBS 1.2.4.1.1 Repository Coordination and Planning**

- SNL staff continued construction monitoring activities at the ESF starter tunnel under Study Plan 8.3.1.15.1.8. In the past month, seismic records from construction blasting were recorded, and rock mass quality estimates for the first 200 ft of tunnel were developed. Rock bolt load cells were installed at two stations and readings were recorded at regular intervals. Data packages for these two activities are being prepared for submittal to the records system.

**WBS 1.2.4.6.1 Sealing and Design Requirements**

- SAND93-1183, "Strategy for Sealing Exploratory Boreholes for the Yucca Mountain Project," has completed SNL technical and management reviews and is being prepared for submittal to the Project Office. This report develops a strategy for sealing boreholes based on evaluations of the current and planned borehole system, the potential impacts on performance that the borehole system could have, and the available technologies to seal boreholes.

**WBS 1.2.5.3.5 Technical Database Input**

- SNL staff organized meetings between individual SNL technical staff and the Technical Data Parameter Dictionary Working Group. The intent of the meetings was to establish consistent terminology for data entry and the technical database structure.

**WBS 1.2.5.4.1 Total System Performance Assessment**

- SAND 93-0852, "The Appropriateness of One-Dimensional Yucca Mountain Hydrologic Calculations," by Roger Eaton was submitted to YMP for review.

  The calculations of waste-package lifetimes for the four emplacement configurations analyzed in TSPA-2, 57 kW/AC (SCP), 114 kW/AC (SCP), 57 kW/Ac (in-drift), and 114 kW/Ac (in-drift), are completed. The range of lifetimes is from about 900 years to over 10,000 years. The baseline analyses for the human-intrusion scenario for each of the four cases is also completed.

**WBS 1.2.5.4.3 Repository Performance Assessment**

- Three-dimensional analyses of the in-drift and vertical emplacement cases being examined in the next iteration of the Total System Performance Assessment (TSPA) were completed. The three-dimensional results showed significant variations from those obtained using two-dimensional models. Based on a composite of these three-dimensional results and analytical solutions, updated boundary conditions were developed and provided to Lawrence Livermore National Laboratory staff and to the Management and Operations waste package design team for use in simulating characteristic waste-form temperatures.

  The four far-field thermal models required for the next iteration of the TSPA were completed. The thermal profiles from these cases have been reduced into estimates of the number of packages protected by a boiling front as a function of time and estimates of volumetric dry out. The SNL performance assessment staff is now incorporating the estimates into their calculations.

**WBS 1.2.5.4.6 Development and Validation of Flow and Transport Models**

- Exploration of the impact of fracture-matrix interaction on rapid transport mechanisms continues. A large format (60 cm by 30 cm by 2.54 cm) investigation of the impact of matrix imbibition on saturated fracture flow was conducted using two slabs of Topopah Spring tuff. X-ray absorption (using the YMP industrial x-ray) was used to image the transient saturation fields as fluid imbibed into the tuff slabs from a 100 m slot fracture. Tuff slab hereogeneity was noted to have significant influence on the imbibition and diffusion fields.

**WBS 1.2.5.4.7 Supporting Calculations for Postclosure Performance Analyses**

- The report for ESF Analysis #13, "Evaluation of the Effects of Underground Water Usage and Spillage in the Exploratory Studies Facility" (SAND93-1182), has been submitted for internal SNL review (Level 3 Milestone OS14).

**WBS 1.2.9.2.2 Project Control**

- The PACS FY94 budget was transmitted on August 16, 1993. Impact statements were developed for ongoing work in underfunded or nonfunded areas, and the formalization of Level 3 Milestones commenced.

  Internal processes for the identification and statusing of milestones are being refined. In addition to accurate monthly statusing of milestones, the refinements will allow accurate forecasting of milestone completion dates well in advance of the due date.

**WBS 1.2.11 Quality Assurance**

- The QA staff focuses on prepared the technical staff for the Project Office audit to be held in September. Instructions for interfacing with auditors, a checklist of requirements to have in order, and recommendations were distributed.

**WBS 1.2.12.2.2 Local Records Center Operation**

- The LRC staff implemented a streamlined process for verification of records against microfilm. A desktop guidance for the process was also written.

**WBS 1.2.12.2.3 Participant Records Management**

- The 1994 Program Plan for the Records Management staff is being developed by the Records Coordinator and the Supervisor. The plan will establish the goals and objectives for the staff.

# 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 to 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.

## *1.2.1.1 SYSTEMS ENGINEERING COORDINATION AND PLANNING*

## *1.2.1.2.1 PROGRAM-LEVEL REQUIREMENTS DOCUMENT DEVELOPMENT*

## *1.2.1.2.2 PROJECT-LEVEL REQUIREMENTS DOCUMENTS DEVELOPMENT AND MAINTENANCE*

## *1.2.1.5 SPECIAL STUDIES*

All commitments scheduled within the System Engineering element have been fulfilled.

# 1.2.2 WASTE PACKAGE

The objective of the Waste Package element includes support to the Container/Waste Package Interfa Analysis element (1.2.2.4.3) in the conduct of thermal and structural analysis of the near-field environment th will support evaluations of emplacement orientation, the effects of backfill properties and timing, as well other thermal loading issues related to waste package design.

## *1.2.2.4.3 CONTAINER/WASTE PACKAGE INTERFACE ANALYSIS*

Major Accomplishments

The formulation of a bench-scale experiment aimed at developing an empirical relationship for the thermal conductivity of backfill began. Pre-test analyses have been completed and are being used to establish instrumentation requirements, instrumentation locations, and approximate test durations.

# 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 twelve tasks: Site Investigations Coordination and Planning (1.2.3.1), Systematic Acquisition of Site-Specific Subsurface Information (1.2.3.2.2.2.1), Three-Dimensional Rock Characteristics Models (1.2.3.2.2.2.2), Surface Facilities Exploration Program (1.2.3.2.6.2.1), Surface Facilities Laboratory Tests and Material Property Measurements (1.2.3.2.6.2.2), Surface Facilities Field Tests and Characterization Measurements (1.2.3.2.6.2.3), 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), Ground Motion From Regional Earthquakes and Underground Nuclear Explosions (1.2.3.2.8.3.3), and the Future Regional Climate and Environments (1.2.3.6.2.1.6).

## *1.2.3.1 SITE INVESTIGATIONS COORDINATION AND PLANNING*

Significant Meetings Attended

Sandia National Laboratories (SNL) staff attended the August 4 Sample Overview Committee (SOC) meeting in Area 25 at the Nevada Test Site (NTS). Numerous sample requests by various Project participants were acted upon. In addition to the usual discussion of sample requests from drill core, there was a brief discussion of sampling within the Exploratory Studies Facility (ESF). At this time, it appears that the SOC will not be involved in allocating these samples. Instead, consolidation of sampling in the underground workings will be through the Los Alamos National Laboratory (LANL) ESF Test Coordinators office. The next SOC meeting is scheduled for September 1.

Status Report on Ongoing Activities

Staff conducted routine oversight activities in the Site Investigations element. In addition, staff coordinated the SNL input to the first iteration of the FY94 budget Planning and Cost System (PACs) exercise.

## *1.2.3.2.2.2.1 SYSTEMATIC ACQUISITION OF SITE-SPECIFIC SUBSURFACE INFORMATION*

Status Report on Ongoing Activities

Preparation of FY94 budgets and scopes of work and schedules occupied a significant portion of the month. Increased Project emphasis on site drilling related to the main test level of the ESF drifts has led to a high priority being assigned to the Systematic Drilling Program. Additional staff resources are being assigned to this activity. (SCP Activity 8.3.1.4.3.1.1)

The paper entitled "Spatial Variability of Hydrologic Properties in Volcanic Tuff," intended for publication in the journal *Groundwater*, continues in SNL review because of other staff commitments. Resolution of SNL comments is anticipated during September. The paper, an expansion of work originally presented at the International High-Level Radioactive Waste Management Conference in April, includes a test of the hypotheses developed by the original work. (SCP Activity 8.3.1.4.3.1.1 and 8.3.1.2.2.3.1)

SNL staff normally assigned to this activity continued to be heavily involved in providing geologic support for WBS element 1.2.3.2.6.2, "Soil and Rock Properties of Potential Locations of Surface Facilities" (SCP Activity 8.3.1.14.2.1). Geologic logging of core, virtually identical to that scheduled for the Systematic Drilling Program, is

the principal focus of this support. (SCP Activity 8.3.1.4.3.1.1)

The draft data reports, tentatively entitled "Physical and Hydrologic Properties of Outcrop Samples from a Nonwelded to Welded Tuff Transition, Yucca Mountain, Nevada," and "Physical and Hydrologic Properties of Surface Outcrop Samples at Yucca Mountain, Nevada," remained in deferred status because of other staff commitments. (SCP Activity 8.3.1.4.3.1.1 and 8.3.1.2.2.3.1)

Major Activities Upcoming Next Three Months

Budgets should be finalized in the near future.

Staff will continue to support the ESF Soil and Rock Properties Study (SCP Activity 8.3.1.14.2.1) as requested. Hole NRG-2B is the only remaining scheduled north ramp drill hole during FY93, and it is currently on hold pending resolution of core-recovery problems. (SCP Activity 8.3.1.4.3.1.1)

Drafts of reports in preparation will be finalized and reviewed as appropriate. Beyond this wind-down of existing scoping activities, principal emphasis will be placed on completing all prerequisites for initiating the Systematic Drilling Program, probably in early FY94. Drill hole SD-12 is anticipated to be the first hole; initiation is dependent upon completion of drill hole UZ-14 and release of the LM300 drill rig. (SCP Activity 8.3.1.4.3.1.1)

### *1.2.3.2.2.2.2 THREE-DIMENSIONAL ROCK CHARACTERISTICS MODELS*

Major Accomplishments

An updated version of the Lynx GMS software package (ver. 2.8), received in late August from the vendor, Lynx Geosystems, Inc., of Vancouve B.C., will be installed as soon as practical. This release continues the beta-test site arrangement SNL entered with Lynx several years ago. Although the specific improvements in the new release are uncertain at this time, the major focu: over the past year or so has been to port the GMS system to the industry's now-standard X-Windows graphical user interface. (SCP Activity 8.3.1.4.3.2.1)

Significant Meetings Attended

SNL staff participated in an informal meeting on August 10 with Project Office, U.S. Nuclear Regulatory Commission (NRC), and U.S. Geological Survey (USGS) staff to review three-dimensional modeling activities in general and to discuss the relative merits of two specific software packages currently in use by different participants. SNL staff presented recent results involving geostatistical methods and current plan for integrating these modeling techniques with th three-dimensional geometric model being developed by the USGS using the Lynx GMS software package. (SCP Activity 8.3.1.4.3.2.1)

Status Report on Ongoing Activities

Budget preparation for FY94 occupied a significant portion of the month. A great deal of effort focused on internal integration of activities at SN intending to use three-dimensional rock character istics models produced by this activity, because the Project and this activity in particular are only now reaching the point where "complete" model: to support various analyses are appropriate.

Construction of a new two-dimensional model of rock quality designation (RQD) values along the profile of the ESF north ramp has been initiated using RQD values measured on core from drill holes NRG-1, -2, -2A, -3, -6, and RF-8 by the ES Soil and Rock Properties Study (SCP Activity 8.3.1.14.2.1). Satisfactory models of vertical

spatial continuity were obtained from the data; measurements are spaced at 10-ft intervals. However, the poor spatial arrangement of the available drill holes (all holes but NRG-6 are tightly clustered at the east end of the ramp profile) renders variograms in the dip direction somewhat inconclusive. This is extremely unfortunate, as the anisotropy ratio (stratigraphic-vertical to horizontal) is perhaps the primary controlling factor in generating values away from cored holes. Nevertheless, a set of preliminary simulations has been produced and post-processed into expected value sections and displays showing the probability of exceeding specified threshold values of RQD. Even though there are serious reservations about the data arrangement (information from holes NRG-4 and -5 is not yet available), the results of the modeling exercise are probably not too erroneous. The probability maps show nearly ubiquitous poor (less than 50) RQD values, and the simulations properly capture the region of extremely poor (less than 10) RQD values related to the nonwelded post-Tiva Canyon tuffs present immediately west of Exile Hill. Given the poor spatial arrangement of data and the limitations of the inferred (sub)horizontal variogram, it appears that rock quality may improve at deeper levels within the Tiva Canyon Member. Incorporation of results from NRG-4 and -5 should improve the model markedly. In the meantime, sensitivity studies will be conducted to investigate the consequences of various assumed anisotropy ratios. (SCP Activity 8.3.1.4.3.2.1)

Preparation of the study plan for the Three-Dimensional Rock Characteristics Models study continues very slowly using the revised U.S. Department of Energy (DOE)/NRC level-of-detail agreement for study plans. Other priorities severely limit the amount of time available for this work. Additional staff resources are anticipated during September that should allow completion of this study plan by the currently scheduled milestone date of December 31. (SCP Activity 8.3.1.4.3.2.1)

Draft text sections for the 1993 Total System Performance Assessment (TSPA) summary document describing the construction of the repository-scale three-dimensional indicator simulations of lithology are being revised, although other commitments are limiting staff availability for this work. Several figures illustrating the spatial structure models were prepared for publication as part of the TSPA document. (SCP Activity 8.3.1.4.3.2.1)

Major Activities Upcoming Next Three Months

Work will commence on attempting to modify the simulation codes to accommodate the soft information provided by the microstratigraphic units known at Yucca Mountain. SNL staff will discuss with USGS personnel the required interfaces to the geometric model being developed by the USGS. The initial Lynx model of the Topopah Spring Member of the Paintbrush Tuff, including its internal microstratigraphic zonation, has been completed by the USGS, and efforts are underway to load this model into SNL's Lynx system for further use. Additional contact with Lynx Geosystems, Inc. in Vancouver, B.C., clarified the mechanics of extracting the required soft information from the geometric model. In early August, the Project Office authorized direct transfer of the existing USGS Lynx model on tape to SNL, but the tape has not yet been received in Albuquerque. (SCP Activity 8.3.1.4.3.2.1)

### 1.2.3.2.6.2.1 SURFACE FACILITIES EXPLORATION PROGRAM

Major Accomplishments

The locations for additional north ramp boreholes designated NRG-8a, NRG-8b, and NRG-8c were identified. These shallow boreholes will investigate the depth of alluvium to the west of Exile Hill above the north ramp. NRG-2b was drilled to a depth of 130 ft with good core recovery. Drilling was stopped at 130 ft to allow standard penetration testing to be performed in the hole. An updated section was prepared for the north ramp. An 11"-by-17" color version was produced.

Status Report on Ongoing Activities

Drilling has been completed on NRG-4.

Major Activities Upcoming Next Three Months

The need for an additional north ramp borehole near NRG-2 is being investigated. Drilling of NRG-7 and SD-12 is scheduled to start in October.

### 1.2.3.2.6.2.2 SURFACE FACILITIES LABORATORY TESTS AND MATERIAL PROPERTY MEASUREMENTS

Major Accomplishments

Mechanical properties tests for core from NRG-2 has been completed. Bulk properties and splitting tension tests have been completed on core from NRG-3. Mechanical properties tests have been completed for core from NRG-6.

Status Report on Ongoing Activities

Mechanical properties testing is underway on core samples from NRG-3, NRG-5, and NRG-2a. Thermal properties testing is underway on core samples from NRG-6.

Samples from NRG-6 to 416.0 ft are being tested. A request for samples for thermal properties testing below this depth has been submitted to the SOC.

*Thermal Conductivity Testing*

Thermal conductivity testing on air-dry samples and saturated samples have been completed at 30°C, 50°C, and 70°C. The thermal conductivity of the samples that were initially saturated were also measured at 110°C, 155°C, 200°C, 245°C, and 290°C. The scientific notebooks for these tests are being reviewed. These thermal conductivity data will be submitted to the project database after review of the scientific notebooks is completed and data summary sheets are prepared.

Thermal conductivity of oven-dry samples will be measured at 30°C, 50°C, 70°C, 110°C, 155°C, 200°C, 245°C, and 290°C.

*Thermal Expansion Testing*

Thermal expansion testing on air-dry samples have been completed for temperatures to 110°C, and the data have been submitted to the YMP Central Records Facility (CRF) under Technical Document Information Form (TDIF) No. 301783.

Thermal expansion testing on saturated samples was delayed so that parts for the saturation test

apparatus can be cloned. The system is currently undergoing calibration; testing will resume after the dilatometer calibration is completed. For these measurements, the atmosphere surrounding the sample during testing will be controlled (i.e., high humidity) in a saturation test apparatus to minimize sample dehydration at temperatures below the nominal boiling point of 100°C. When this temperature is reached, the temperature will be held constant for 30 hours and the sample allowed to dehydrate until the length stabilizes. Heating will be restarted and will continue until 300°C is reached, then the sample will be cooled to ambient temperature.

*Mineralogy*

Polished thin sections from 17 samples (depths of 22.2 ft to 416.0 ft) were completed. Mineralogic and petrologic analysis of the samples has begun. These analyses, including whole rock chemistry, will be used to interpret data from thermal and mechanical tests and to determine if correlations exist between these values and the physical properties of the rock.

Major Activities Upcoming Next Three Months

Core samples from NRG-2B, NRG-4, and NRG-5 will be submitted for mechanical properties testing.

Provided that samples from NRG-6 below 416 ft are obtained from the Sample Management Facility (SMF) in a timely manner, thermal properties testing will be completed and reported to the Project Office.

Other Items to Report

Priority has been given to thermal properties testing on samples from NRG-6. Additional test equipment was brought on line so that studies to establish baseline test conditions for site characterization can be performed. See WBS 1.2.3.2.7.1.1, "Laboratory Thermal Properties" and WBS 1.2.3.2.7.1.2, "Laboratory Thermal Expansion Testing" for discussion of these activities.

### *1.2.3.2.6.2.3 SURFACE FACILITIES FIELD TESTS AND CHARACTERIZATION MEASUREMENTS*

Major Accomplishments

Structural and lithologic logs were prepared for the NRG-2a borehole. Standard penetration tests were performed in borehole NRG-2b to determine the bearing capacity of the unconsolidated tuff. Results are being analyzed.

Status Report on Ongoing Activities

Structural and lithologic logs are being prepared for NRG-4 and NRG-2b.

Major Activities Upcoming Next Three Months

Standard penetration tests will be performed to determine soil bearing capacity for a booster pump station, water storage tanks, and the ESF muck conveyer system. Additional field tests to support design of these facilities are under consideration.

### *1.2.3.2.7.1.1 LABORATORY THERMAL PROPERTIES*

Status Report on Ongoing Activities

Priority has been given to thermal conductivity testing on samples from NRG-6 (see WBS 1.2.3.2.6.2.2, "Surface Facilities Exploration Program"). Until additional test equipment is brought on line, the studies to establish baseline test conditions for thermal conductivity measurements have been delayed.

A system calibration for the new low temperature (LT) instrument has been completed, and the study on the effects of sample saturation on thermal conductivity has begun. These experiments are necessary to determine whether thermal conductivity has a predictable dependence on the saturation state of the sample and, if so, to describe the nature of the relationship. Results from these experiments will be used to determine the optimal baseline test conditions for thermal conductivity characterization. (SCP Activity 8.3.1.15.1.1.3)

The comparative instrument has been calibrated and is ready for the study of fracture effects on thermal conductivity of Unit TSw2. Machining of samples for this study was delayed due to modifications of the sample dimension. The sample machining is anticipated to be complete in the first part of September. If fractures are observed to have a significant effect, samples containing natural fracture will be obtained and tested. (SCP Activity 8.3.1.15.1.1.3)

A petrographic photo album of Yucca Mountain rocks has been compiled for use in training and as a visual reference for evaluating welding, devitrification, and alterations observed in thin sections.

Major Activities Upcoming Next Three Months

Testing activities for the scoping study of the effects of saturation on thermal conductivity will be completed. Three samples of welded devitrified tuff and three samples of nonwelded zeolitic tuff will be used for this study. The thermal conductivity of each sample will be measured at nominal temperatures of 30°C, 50°C, and 70°C, at five different saturation states (fully saturated, oven-dry, air-dry, and two other intermediate states). A moisture containment cell will be used for controlling the test environment. (SCP Activity 8.3.1.15.1.1.3)

After test samples are machined and inspected, the study of the effects of fractures on thermal conductivity will be initiated. The thermal conductivity of two air-dry samples from Unit TSw2 will be measured using the comparative method. A nominal temperature of 30°C and stress levels of 0 MPa, 2.5 MPa, 5 MPa, 7.5 MPa, and 10 MPa will be used. After the samples are tested, they will be cut in half and the fracture surface roughened. The halves will be rejoined and the thermal conductivity measurements will be repeated. (SCP Activity 8.3.1.15.1.1.3)

Technical and safety procedures for using the rock crushing and grinding equipment at the University of New Mexico (UNM) will be developed.

### *1.2.3.2.7.1.2 LABORATORY THERMAL EXPANSION TESTING*

Status Report on Ongoing Activities

Priority has been given to thermal expansion testing on samples from NRG-6 (see WBS 1.2.3.2.6.2.2, "Surface Facilities Exploration Program"). Until additional test equipment is brought on line, the studies to establish baseline test conditions for thermal expansion measurements have been delayed.

Assembly of the additional dilatometer is in process. Calibration of the system is anticipated to be completed during the first half of September.

The study of the effects of sample size on thermal expansion will begin after a successful calibration. Results from these experiments will be used to determine the optimal baseline test conditions for thermal expansion characterization. (SCP Activity 8.3.1.15.1.2.1)

Major Activities Upcoming Next Three Months

Testing activities for the study of the effects of sample size on thermal expansion will be completed. Five samples of each of four different lithologies (welded devitrified, welded vitric, nonwelded vitric, and nonwelded zeolitic) will be tested for each sample size. The samples will be right cylinders of two sizes—0.25-in. (0.6-cm) diameter x 1 in. (2.54 cm) and 1-in. (2.54-cm) diameter x 4 in. (10.2 cm) nominally. The samples will be fully saturated before experiments are started. The samples will be heated and the atmosphere surrounding the sample during testing will be controlled (i.e., high humidity) in a saturation test apparatus to minimize sample dehydration at temperatures below the nominal boiling temperature of 100°C. When this temperature is reached, temperature will be held constant and the sample allowed to dehydrate until the length stabilizes. Heating will be restarted and continue until the temperature reaches 300°C; then the sample will be cooled to ambient temperature (25°C). (SCP Activity 8.3.1.15.1.2.1)

After the study of the effects of sample size on thermal expansion is completed, the study of the effects on sample saturation will be initiated. Five samples of each of four different lithologies (welded devitrified, welded vitric, nonwelded vitric, and nonwelded zeolitic) will be tested. Three initial saturation states will be examined—fully saturated, air-dry, and oven-dry. The atmosphere surrounding the sample during testing will be controlled (i.e., high humidity) in a saturation test apparatus to minimize sample dehydration at temperatures below the nominal boiling point of 100°C. When this temperature is reached, the temperature will be held constant and the sample allowed to dehydrate until the length stabilizes. Heating will be restarted and will continue until 125°C is reached; then the sample will be cooled to ambient temperature. (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 most recent series of experiments consists of samples of TSw2 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, followed by an interval at 250°C. At the conclusion of the most recent experiment, the internal furnace was damaged. The furnace has been repaired, and the system is being calibrated. A fourth experiment will begin in September. (SCP Activity 8.3.1.15.1.3.2)

NER is also performing a study of the mechanical properties of tuff samples from a series of drill holes denoted as NRG (north ramp geology). These holes are located along the length of the planned position of the north ramp of the ESF. The samples are machined, dried, and saturated prior to testing at uniaxial conditions. Other samples are tested in indirect tensile (Brazil) experiments and for average grain densities. Sample porosities are being calculated, and compressional and shear wave velocities are measured. This month, 17 unconfined experiments, 31 Brazil tests, and 61 measurements of average grain density have been completed from samples of USW NRG-6 and UE25 NRG-2. The data have been plotted and the results compared with previous existing data from smaller samples. (SCP Activities 8.3.1.15.1.3.1 and 8.3.1.15.1.3.2)

SAND93-2051A, "Strength-Size-Porosity Empirical Model for Yucca Mountain Tuff," has been drafted and entered into the SNL review process. The abstract will be submitted for publication and presentation at the Fall 1993 American Geophysical Union (AGU) meeting in San Francisco, CA, on December 6 through 10, 1993.

Two members of the NER staff were in Albuquerque, NM, on August 11 through 13, 1993, to visit with the staff at SNL. The discussions centered on the plans for and results from testing of time-dependent mechanical properties and the examination of rock and test results from core recovered from the NRG drill holes. (SCP Activities 8.3.1.15.1.3.1 and 8.3.1.15.1.3.2)

Major Activities Upcoming Next Three Months

In the study of the mechanical properties of NRG drill hole samples at NER, experiments on samples from UE25 NRG-3 will be completed early in September. Testing of samples from UE25 NRG-2A and UE25 NRG-5 will follow. Data analysis will be continuous as the data are collected. (SCP Activities 8.3.1.15.1.3.1 and 8.3.1.15.1.3.2)

SAND92-0119, "Experimental Comparison of Laboratory Techniques in Determining Bulk Properties of Tuffaceous Rocks," and SAND92-0847, "The Effect of Frequency on Young's Modulus and Seismic Wave Attenuation in Tuff," are in management review and should be submitted to the Project Office in September. (SCP Activities 8.3.1.15.1.3.1 and 8.3.1.15.1.3.2)

R. Price will be in White River Junction, VT, on September 14 through 17, 1993, to visit with the staff at NER. Discussions will include plans for an upcoming meeting with the ESF designers, examination of core and test results from NRG drill holes, and the results from time-dependent mechanical properties experiments. (SCP Activities 8.3.1.15.1.3.1 and 8.3.1.15.1.3.2)

### *1.2.3.2.7.1.4 LABORATORY DETERMINATION OF THE MECHANICAL PROPERTIES OF FRACTURES*

Major Accomplishments

SAND92-2333, "The Effect of Sliding Velocity on the Mechanical Response of Artificial Joints in Topopah Spring Member Tuff," was submitted to the Project Office on August 31, 1993. This submittal completes the requirements for Milestone OS49. (SCP Activity 8.3.1.15.1.3.2)

Status Report on Ongoing Activities

Analysis and data reduction of the long-term creep test on a sawcut in Topopah Spring Member tuff is nearing completion. The data indicate that for dry, room-temperature conditions, steady-state creep is never attained; only transient creep is observed. A peculiar phenomenon was recorded in two of the several incremental creep tests. Usually, a step increase in the shear stress was associated with a step increase in slip followed by the transient. In two cases, there was a delay of as much as 15 hours before the sudden increase in slip occurred. This phenomenon merits some investigation.

Work is continuing on the development of a computer program to model the dilation, normal stiffness, and shear stiffness of single fractures in rock. An early version of the code was used to study the changes in the aperture of a fracture under normal stress. During this process, a bug in the software was discovered. Major modifications to the program are being made and then analysis will continue. (SCP Activity 8.3.1.15.1.4.2)

SAND93-2041A, "Effect of Roughness and Material Strength on the Mechanical Properties of Fracture Replicas," and SAND93-2049A, "Joint Creep in Yucca Mountain Tuff," have been drafted and entered into the SNL review process. The abstracts will be submitted for publication and presentation at the Fall 1993 AGU meeting in San Francisco, CA, on December 6 through 10, 1993.

A comment resolution meeting for Study Plan 8.3.1.15.1.4, "Laboratory Determination of the Mechanical Properties of Fractures," was held in Las Vegas, NV, on August 19, 1993. All three of the authors were at the meeting to respond to comments from the Project Office review. The comments were resolved, and a plan revision will be submitted to the Project Office in early September. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

Major Activities Upcoming Next Three Months

The draft of a new standard test method, "Standard Test Method for Normal and Shear Stiffness of Rock Fractures Using a Compression/Rotary Shear Apparatus," completed the first review and vote by ASTM Subcommittee D18.12 on Rock Mechanics. The results of this review were discussed at the committee meetings in Atlanta, GA, on June 22 and 23, 1993. The draft was well received, with relatively few technical comments. The draft will be revised in the next two months. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

### *1.2.3.2.8.3.3 GROUND MOTION FROM REGIONAL EARTHQUAKES AND UNDERGROUND NUCLEAR EXPLOSIONS*

Status Report on Ongoing Activities

Revisions to the study plan entitled "Ground Motion From Regional Earthquakes and Underground Nuclear Explosions" are ongoing.

Major Activities Upcoming Next Three Months

The development of a preliminary groundwater model for Yucca Mountain will be initiated.

### *1.2.3.6.2.1.6 FUTURE REGIONAL CLIMATE AND ENVIRONMENTS*

Major Accomplishments

Nine Corrective Action Reports (CARs) from SNL's October 1992 audit of National Center for Atmospheric Research (NCAR) were successfully closed. A replacement contract with NCAR was placed.

Status Report on Ongoing Activities

Preparation of a draft study plan continues. Training and other actions performed in preparation for a readiness review continues. Issue of the Transition Plan for transferring Pacific Northwest Laboratory (PNL) work to SNL is expected soon.

# 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*

Major Accomplishments

SNL continued construction monitoring activities at the ESF starter tunnel under Study Plan 8.3.1.15.1.8. In the past month, seismic records from construction blasting were recorded, and rock mass quality estimates for the first 200 ft of tunnel were developed. Data packages for these two activities are being prepared for submittal to the records system.

Status Report on Ongoing Activities

Staff conducted routine oversight activities in the Repository element. In addition, staff coordinated the SNL input to the first iteration of the FY94 budget PACs exercise. Detailed work scopes and budgets were developed based on the integrated testing and site characterization plans.

Work on the initial drafts of Study Plans 8.3.1.15.1.6, "In Situ Thermomechanical Properties" and 8.3.1.15.1.7, "In Situ Mechanical Properties," continued.

Rock bolt load cells were installed at two stations in the starter tunnel and readings were recorded on regular intervals. Locations for the two multiple point borehole extensometers (MPBXs) were identified, but the drilling of the holes was delayed until blasting of the tunnel bench is completed. Once the blasting in the tunnel is completed, the MPBX gages will be installed along with wiring to connect the load cells and MPBX gages to an automatic data recording system. The information collected during this investigation is being provided to the Management and Operations (M&O) design and construction management team so that real-time evaluations of the performance of the excavations, construction techniques, and ground support can be made.

A draft report describing the proposed strategy for sealing boreholes, SAND93-1184, has completed SNL internal review and is being revised for submittal to the Project Office. The report develops a strategy for sealing boreholes based on evaluations of the current and planned borehole system, the potential impacts on performance that the borehole system could have, and the available technologies to seal boreholes.

Major Activities Upcoming Next Three Months

Staff will complete and submit the borehole sealing strategy report, SAND93-1184 (Milestone OS24).

Staff will complete test interference analyses in support of study plan development and ESF design requirements (Milestone OS17).

Staff will complete installation of instrumentation for the north ramp starter tunnel under Study Plan 8.3.1.15.1.8, "In Situ Design Verification."

Other Items to Report

SNL is continuing temporary monitoring of rock mass movement as the ESF starter tunnel is excavated. Several sets of tape extensometer pins have been installed to monitor closure of the pilot heading. This work is not part of Study Plan

pilot heading. This work is not part of Study Plan 8.3.1.15.1.8, "In Situ Design Verification," but is similar in nature to the more permanent monitoring that will be installed under the study plan. This temporary monitoring is being conducted under WBS 1.2.6.1.1.

### *1.2.4.2.1.1.1 EXCAVATION INVESTIGATIONS*

Status Report on Ongoing Activities

Staff continued to incorporate changes to Study Plan 8.3.1.15.1.5, "Excavation Investigations," in response to comments received from Project Office reviewers.

Major Activities Upcoming Next Three Months

Staff will work with Project Office reviewers to finalize the Study Plan 8.3.1.15.1.5, "Excavation Investigations."

### *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."

The SAND report "Test Instrumentation for the ESF In Situ Thermomechanical Experiments" was returned from SNL management with management review comments, and the report was modified to incorporate the comments.

Major Activities Upcoming Next Three Months

Staff will continue drafting Study Plan 8.3.1.15.1.6, "In Situ Thermomechanical Properties."

Staff will produce a final draft of the SAND report "Test Instrumentation for the ESF In Situ Thermomechanical Experiments" that incorporates comments from management review.

Under LANL coordination staff will work with Lawrence Livermore National Laboratory (LLNL) staff to consolidate SNL's ESF thermomechanical testing with LLNL's hydrothermal testing, if possible.

### *1.2.4.2.1.1.3 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."

Major Activities Upcoming Next Three Months

Staff will continue drafting Study Plan 8.3.1.15.1.7, "In Situ Mechanical Properties."

### *1.2.4.2.1.1.4 IN SITU DESIGN VERIFICATION*

Status Report on Ongoing Activities

Staff continued construction monitoring of the ESF north ramp starter tunnel. The monitoring plans include seismic monitoring for blasting, rock quality determination, ground support system performance evaluations, and excavation closure monitoring for stability assessments. In this reporting period, seismic blast monitoring was conducted, and installation of load cells to be used to monitor rock bolts used as ground support continued.

As an activity separate from construction monitoring, staff fielded additional monitoring activities in the north ramp starter tunnel to address safety concerns. Convergence monitoring of the tunnel and support girders was conducted, and rock bolt load cells for evaluating ground support were monitored.

Major Activities Upcoming Next Three Months

Staff will continue to field construction monitoring activities and to procure and design instrumentation and a data acquisition system needed for future monitoring activities.

Staff will continue to field the additional monitoring activities in the north ramp starter tunnel to address safety concerns as an activity separate from construction monitoring.

### *1.2.4.2.1.2 ROCK MASS ANALYSES*

Status Report on Ongoing Activities

Work related to laboratory testing of small, layered polycarbonate models continued in July. This month the data from four tests were analyzed. The tests consisted of a far-field view of loading normal to the plates, a close-up view of loading normal to the plate, a far-field view of loading at 10° to the plate, and, a close-up view of loading at 10° to the plate. The results are quite interesting. For the first two experiments, the displacements around the hole are nearly symmetrical, as expected. The experiments did detect joints that exhibited 2$\mu$m to 3$\mu$m of uniform slip. Although these experiments will be very helpful for the code-validation efforts, data reduction for these tests is extremely time-consuming. SNL staff will be exploring ways of either speeding up the data reduction or modifying the tests to obtain the information necessary for code validation. The report covering the experiments is being drafted and will be ready for review near the end of September.

A study of the surface characteristics of natural fractures and how to relate these to the frictional data gathered on replicas on the surfaces is continuing. This study will place special emphasis on determining whether the fitting parameters in the Barton Model for frictional behavior have physical significance. This is being accomplished by investigating the effect on fracture shear strength and dilation with variation in three parameters: normal stress, roughness, and the strength of the rock material. A draft SAND report is being prepared. The report was sent to SNL from the University of Colorado (CU) and has been returned to CU with comments.

A series of experiments designed to study the effects of a nonstandard loading condition on frictional properties was conducted at CU in 1992. SAND92-1853, "Effect of Boundary Conditions on the Strength and Deformability of Replicas of Natural Fractures in Welded Tuff: Data Report," detailing the experiment techniques and the resulting data, has completed management review and has been submitted to the Project Office. The first of two analysis SAND reports, 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," was approved by the Project Office in July and will be printed in September.

R. Price and S. Brown (SNL) visited the staff at CU on August 17, 1993. The progress on the data and analysis reports and the results from the ongoing study were discussed.

An abstract summarizing the results of the rotary friction experiments (entitled "Effect of Roughness and Material Strength on the Mechanical Properties of Fracture Replicas") has been drafted and entered into the SNL review process. The abstract will be submitted for publication and presentation at the Fall 1993 AGU meeting in San Francisco, CA, on December 6 through 10, 1993.

Major Activities Upcoming Next Three Months

A report covering the layered plate experiments will be prepared.

Design support analyses will be performed for the second section of the north ramp.

### *1.2.4.2.3.1 CERTIFICATION OF DESIGN METHODS*

Major Accomplishments

Work at CU in developing joint constitutive models is being completed. This work began with CU conducting a literature search to identify the "best" available joint constitutive model in the literature. Experimental data developed in 1.2.4.2.1.2 has been fitted to Plesha's joint constitutive model. This month, a report covering the work was drafted. SNL and CU are disappointed that, although the Plesha joint constitutive model appeared to have the features that were needed, working with the model showed that there were a number of deficiencies of which the original developers were apparently not aware. Further work with this model will not be pursued.

Status Report on Ongoing Activities

In other work at CU, modifications to the discrete element code, DDA, are being performed to implement an augmented lagrangian approach for enforcing the contact constraints and a subblock concept. This month, CU staff drafted a paper covering this work. At SNL, J. Jung has implemented a classical lagrangian approach to explore the subblocking concept in a two-dimensional research code. The classical lagrangian approach was explored to provide a basis to compare the augmented approach. Next month, some comparisons between augmented and classical lagrangian approaches will be performed.

In a separate activity, the coupled finite element/boundary element research is continuing. In August, another successful test in which non-linear finite elements were coupled to linear boundary elements was conducted. The test case involved pressurizing a cavity in an infinite media. This result is a significant accomplishment for this activity. The near-term plans are to test the coupling using at least two more nonlinear models and then draft a report covering the work.

SNL staff has been working to improve SNL's continuum joint model. This month, a single joint set, three-dimensional version of the successful two-dimensional model was implemented. Testing of the model will be conducted next month.

The JAC2D manual went out for technical review. SNL anticipates this report going to the Project Office next month.

Major Activities Upcoming Next Three Months

Testing of a discrete element code subblocking concept will continue.

Implementation of the subblocking concept into the DDA code will continue.

Development of a coupled finite element/boundary element technology will continue to assess how to couple nonlinear finite elements to linear boundary elements.

*1.2.4.2.3.2 DESIGN ANALYSIS*

No significant activities this reporting period

### *1.2.4.6.1 SEALING AND DESIGN REQUIREMENTS*

Major Accomplishments

SAND93-1183, "Strategy for Sealing Exploratory Boreholes for the Yucca Mountain Project," has completed SNL technical and management reviews and is being prepared for submission to DOE. This report develops a strategy for sealing boreholes based on evaluations of the current and planned borehole system, the potential impacts on performance that the borehole system could have, and the available technologies to seal boreholes.

Status Report on Ongoing Activities

SAND93-1183 is being prepared for transmittal to the DOE.

Major Activities Upcoming Next Three Months

SAND93-1183 will be transmitted to the DOE and DOE comments will be reviewed. The report will be revised based on these comments.

Other Items to Report

SNL staff continue to review the UZ-16 grout materials.

# 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), Supporting Calculations for Postclosure Performance Analyses (1.2.5.4.7), Development and Verification of Flow and Transport Codes (1.2.5.4.9), and Energy Policy Act Support (1.2.5.5.2).

## *1.2.5.1 REGULATORY COORDINATION AND PLANNING*

Status Report on Ongoing Activities

Staff conducted routine oversight activities in the Regulatory element. In addition, staff coordinated the SNL input to the first iteration of the FY94 budget PACs exercise.

## *1.2.5.2.2 SITE CHARACTERIZATION PROGRAM*

Status Report on Ongoing Activities

Staff contributed to a number of two-day meetings for the Integrated Test Evaluation (ITE) effort, which is prioritizing Site Characterization Plan (SCP) studies with respect to design information needs.

Rev. 3, Chapter 3 of the License Application Annotated Outline was reviewed and comments submitted to the M&O.

### *1.2.5.3.5 TECHNICAL DATABASE INPUT*

Major Accomplishments

D. Eley organized meetings between SNL YMP technical personnel and the Technical Data Parameter Dictionary Working Group on August 4. The intent of the meetings was to establish consistent terminology for data entry and the technical database structure (among other functions).

In FY94, there will be considerable improvement in funding for this activity over FY93 levels, indicating a greater interest in technical database concerns by the Project Office.

Significant Meetings Attended

On August 2, D. Eley attended a demonstration of ARC/INFO models, which are part of the Performance Assessment Database. The presentation was offered by Debbie Beiso.

On August 4, M. Shain, E. James, and D. Eley attended the opening session of the Technical Data Parameter Dictionary Working Group with A. Simmons and T. Asakura.

On August 6, D. Eley participated in a demonstration of SNL YMP data modeling capabilities for A. Simmons.

On August 20, P. Warner, M. Shain, D. Eley, and L. Shephard discussed the specific roles associated with SNL YMP database management.

On August 26, D. Eley and M. Shain had a follow-up meeting to discuss their impressions of database roles.

Major Activities Upcoming Next Three Months

M. Shain and D. Eley will meet with L. Shephard to determine the extent of SNL YMP database responsibilities.

B. Lewis plans to conduct a workshop on using the ATDT system.

Issues/Potential Problems Needing Resolution and Potential Impacts

The problem of processing the technical data backlog was not addressed in the FY94 budget (i.e., no funding was allocated for this task).

### 1.2.5.4.1 *TOTAL SYSTEM PERFORMANCE ASSESSMENT*

Major Accomplishments

SAND93-0852, "The Appropriateness of One-Dimensional Yucca Mountain Hydrologic Calculations," by Roger Eaton, was submitted to the Project Office for policy review.

Significant Meetings Attended

SNL staff met at LLNL on August 2, 1993, to work with the YMIM code, which is being used to generate the source term for TSPA-2. There were a number of coding problems with YMIM, and SNL staff had several questions on the interpretation of parameters and parameter values. Most of the problems were resolved at the meeting and during follow-up discussions However, a few questions relating to parameter values still remain.

Status Report on Ongoing Activities

*TSPA-2*

The calculations of waste-package lifetimes for the four emplacement configurations analyzed in TSPA-2, 57 kW/Ac (SCP), 114 kW/Ac (SCP), 57 kW/Ac (in-drift), and 114 kW/Ac (in-drift), are completed. The range of lifetimes is from about 900 years to over 10,000 years. The baseline analyses for the human-intrusion scenario for these four cases are also completed.

A memo on the details of the modeling that will form the basis for flow and transport in the saturated zone for TSPA-2 was completed and is currently in review by SNL and USGS staff. Information on the SNL saturated zone model was also made available to the M&O at their request.

Staff completed generating the first input files for the aqueous-release calculations for TSPA-2. The revised fracture data has now been entered. However, before the input files can be finalized, the fuel-rod temperatures must be received from LLNL and the M&O.

The weeps model was modified to use the most recent version of the source model (YMIM). Unfortunately, the most recent version of YMIM contained a logical fault that took SNL staff a week to identify and correct. Presently, the weeps model is operational, and a suite of test cases were run. The run times for realizations of the size expected for TSPA-2 were found to be excessive, with approximately 80% of the run time spent in YMIM. Staff are investigating methods for reducing the number of calls to YMIM.

Staff sent acknowledgments to the USGS personnel who responded to a request for comment on a SNL draft memorandum concerning groundwater-flux distributions for use in TSPA-2. A memorandum describing the hydrothermal-effects model that is to be used in TSPA-2 was also circulated for review, but no comments have been received, yet.

A set of sensitivity studies to determine the effect of fracture modeling on the amount of perched-water and dry-out in the vicinity of buried nuclear waste has been completed. The results show that as the fracture conductivity is reduced parametrically (10, $10^2$, $10^4$, and $10^6$), the effect of the fractures becomes negligible and repository dry-out becomes insignificant. These results indicate the importance of accurately modeling fractures when calculating the presence of multiphase flow in the vicinity of buried nuclear waste.

A method-of-lines (MOL) code for two-phase flow in porous media and for modeling barometric pumping of water vapor in a discrete fracture/matrix system has been undergoing testing and application to estimate respired moisture from Yucca Mountain. The code was successfully tested by comparison with a solution to the heat pipe problem discussed by Udell and Fitch (1985). The coupling between fracture and matrix models was tested by simulation of an analytical solution to periodically driven diffusion in a fracture/matrix system. This comparison was also excellent. The code is being applied to estimate the amount of water vapor extracted from Yucca Mountain through barometric pumping. Two barometric cycles have been considered, the diurnal cycle and a five-day cycle typical of weather-induced barometric fluctuations. The latter cycle appears to be more effective in extracting water vapor. It has also been determined that the respired moisture is maximized for a particular value of effective binary diffusion coefficient, with all

other parameters remaining unchanged. This is of considerable interest in light of the well-known observation that apparent diffusion coefficients for two-phase systems in porous media are typically larger than the theory would suggest. Documentation of these results in underway and will be included as ancillary calculations in the SNL report on TSPA-2.

*Scenario Development*

SAND92-2186, "Scenarios Constructed for Nominal Flow in the Presence of a Repository at Yucca Mountain and Vicinity," has had coauthor comments incorporated and is currently in technical review.

SAND91-1653, "Scenarios Constructed for Basaltic Igneous Activity at Yucca Mountain and Vicinity," has completed all review comment resolution and has been submitted to the printer for publication.

### *1.2.5.4.3 REPOSITORY PERFORMANCE ASSESSMENT*

Major Accomplishments

Three-dimensional analyses of the in-drift and vertical emplacement cases being examined in the next iteration of TSPA have been completed. The three-dimensional results showed significant variations from those obtained using two-dimensional models. Based on a composite of these three-dimensional results and analytical solutions, updated boundary conditions were developed and have been provided to LLNL and to the M&O's waste package design team for use in simulating characteristic waste-form temperatures.

The four far-field thermal models required for the next iteration of TSPA have been completed. The thermal profiles from these cases have been reduced into estimates of the number of packages protected by a boiling front as a function of time and estimates of volumetric dry out. Performance assessment (PA) staff is now incorporating these estimates into their calculations.

Status Report on Ongoing Activities

Work continued on defining analyses required to support Phase II of the M&O's thermal loading systems study. Specific analyses have been defined and should be complete by the end of the next reporting period.

Experimental and numerical modeling results for a series of nonisothermal flow visualization experiments are currently being documented. A final progress report should be available within the next three weeks.

### *1.2.5.4.4 SITE PERFORMANCE ASSESSMENT*

Significant Meetings Attended

On August 6, 1993, SNL staff briefed DOE and Edgerton, Germeshausen and Grier (EG&G) staff on the SNL approach to data/ information management. The presentation highlighted the process SNL is using to support the generation of the current TSPA in the areas of data gathering, interactive data bases, data base management, graphical representation through GIS, and the analytical use of results from the data.

Staff met with the Yucca Mountain INTRAVAL working group in Seattle, WA, on August 3 and 4, 1993. Results of the SNL effort to model saturation data for UZ-16 were presented.

M. Harr from Purdue University visited SNL on August 9 through 11, 1993. While at SNL, he reviewed the methods for generating random, auto-correlated fields that were developed at Purdue in support of YMP.

SNL staff member briefed the PA staff from DOE and the M&O in Las Vegas, NV, on August 23, 1993, on advanced geostatistical simulation and economic decision modeling that has been done in support of EM-551. Possible applications to the Yucca Mountain Project were discussed. The Purdue software, discussed above, was also demonstrated, and a copy of the package was left with DOE for review.

Status Report on Ongoing Activities

A report on the SNL modeling effort for INTRAVAL was completed and submitted for review by the INTRAVAL participants. A presentation of SNL results was prepared for the INTRAVAL wrap-up meeting in Stockholm, Sweden, in late August. The presentation was given by a representative of DOE attending the meeting.

Work began on a documentation of the development of two-dimensional ground water travel time (GWTT) calculations based on insights from the INTRAVAL work. The SNL participation in the INTRAVAL project centered on verification of numerical approaches for two-dimensional GWTT calculations that were already being developed. The calculations have been revised to incorporate zeolitic materials that are not included in the shallow calibration cross section A problem with the upper boundary condition was also identified and corrected.

A rough draft documenting the stratigraphy development for TSPA-2 has been completed. The input parameter distribution parameters generated for TSPA-2 were also completed. This analysis finalized the fracture parameters: fracture frequency, fracture spacing, fracture porosity, fracture hydraulic conductivity, fracture air-entry parameter, fracture orientation, and fracture aperture. The original distributions had to be modified by assigning a maximum value 30 times the expected value and a minimum value of 0.0 to capture data in the tails of the distribution. This modification was necessary due to the limited data set and the original treatment of fracture frequency parameters as approximated exponential distributions.

Documentation is progressing on the parameter generation for TSPA-2 and for the stand-alone document, which will contain more detail. Subjects to be covered are stratigraphy development, data sources, and probability distribution function (PDF) development for matrix, bulk, and fracture parameters.

The Performance Assessment Data Base staff has initiated a review of the data base design and the requirements for the integration of the test results from construction monitoring, thermomechanical testing, and properties testing at Yucca Mountain.

### 1.2.5.4.5 *INTERACTIVE GRAPHICS INFORMATION SYSTEM*

Major Accomplishments

The computer network at the new facility is installed and operational. Network servers and systems are being configured for the upcoming move.

Status Report on Ongoing Activities

Project participants are still requesting Calma products and are expected to continue needing the Calma thermal/mechanical model for the immediate future. Plans to shut down the Calma system at the end of FY93 are now on hold. The system will not be moved to the new facility, but will continue to be operational for a short time in the existing location.

Development is continuing on a series of coverages showing the starter tunnel, alcoves, and instrument locations.

One Calma job was completed during this period.

Major Activities Upcoming Next Three Months

Staff will relocate the existing computer systems and local area network (LAN) to the new facility in a manner that will minimize down time and disrupted services.

Staff will find alternate sources for three-dimensional model products and eliminate the Calma software.

Staff will plan and begin the implementation of a user environment that provides access to data obtained from instruments placed in the tunnels at Yucca Mountain. This will enable users to utilize several tools to manipulate, visualize, and output the data as needed.

The following jobs are in progress:

- Job 397 for D. L. Eley - Convert GTMs to ARC/INFO
- Job 398 for D. Guerin - Hydrogeologic Drill Holes
- Job 401 for L. H. Skinner - Contours of Yucca Mountain
- Job 405 for C. A. Rautman - Rebuild TSw1 Model per New Input
- Job 406 for L. S. Costin - Starter Tunnel Database Cover
- Job 407 for M. L. Jones - Add New Data Coverages
- Job 410 for L. S. Costin - Neutron Holes and NRG 1-6 Holes

### 1.2.5.4.6 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 FY93 and hence are not addressed.***

Major Accomplishments

All accomplishments have been included in the Status Report on Ongoing Activities for the sake of brevity and completeness.

Status Report on Ongoing Activities

A significant portion of this month's activity was directed toward QA-related tasks. Principal Investigators (PIs) responded to findings of the July SNL internal QA audit. This involved documentation of review of log books and revision of Quality Assurance Grading Reports.

*Caisson Test*

Potentiometric titrations on acid-washed Wedron 510 sand were obtained for ionic strengths of approximately 0.001, 0.01, and 0.1 M. Plots of pH vs. surface charge show that some analytical difficulty remains to be overcome at low pH due to diffusion of acid out the burette tip during the early stages of an alkalimetric titration. The titration protocol has been modified so that the acid burette tip is removed from contact with the solution during alkalimetric titration. A draft Technical Procedure, "Batch Sorption Experiments Under Atmospheric and $CO_2$-free Conditions," was prepared that describes the procedures used to carry out batch sorption experiments at Sandia National Laboratories in support of the caisson experiment.

A kinetic batch sorption study was run to determine the time dependency of Ni sorption by Wedron 510 sand using a $NaHCO_3$ buffer to produce a pH of ~7.7. After 1/2 hour, 94% of the Ni had been sorbed; after 8 hours, 99% had been sorbed. It is apparent that Ni sorption is very rapid, and that equilibrium was reached during previous batch experiments, which were mixed for 2-3 days.

The results of column studies of Li transport under atmospheric conditions with the Wedron 510 sand were analyzed using the CXTFIT code. The results indicate that a kinetic sorption model fits that sharp leading edge and tail of the Li elution curve better than an equilibrium sorption model. The first-order sorption rate constant obtained from the column data was similar to the rate constant obtained from kinetic batch sorption experiments. In a separate study, an isotherm was obtained from batch experiments over a Li concentration range of 1 to 1000 ppm. A Freundlich isotherm fit the data well; however, calculated $K_d$'s at 10 ppm were approximately 10 times those obtained from the kinetic batch studies.

In order to resolve uncertainties in the effect of $CO_2$ on Li sorption and to evaluate potential analytical errors in the flame atomic adsorption technique used to analyze the Li, studies of Li sorption under atmospheric conditions were carried out. Measured sorption was close to 0 at pH = 7, and dropped to -5% at pH > 8. (In contrast, experiments run under $CO_2$-free conditions show sorption of 20-25% at pH = 7, dropping to about 5% at pH = 10.) The sand blanks show that no significant Li desorbs from the sand at any pH, therefore, the negative sorption values at high pH for the atmospheric data must be an artifact of the Li analysis technique. It is probable that matrix effects are the cause of the error. The Na added at pH > 7 as NaOH almost certainly acts as an ionization suppressant during AA analysis, increasing the signal for Li in the electrolyte and causing a spurious drop in the Li $K_d$'s for the samples above pH = 8. The offset between the atmospheric and $CO_2$-free data sets may be due to a similar effect. The presence of carbonate species in solution may be somehow affecting the ability of other elements being released from the sand to suppress Li ionization during flame analysis. Studies will be carried out to resolve these uncertainties in September.

*Reactive Transport Model Development*

Formal technical review of "User's Manual for LEHGC: A Langrangian-Eulerian Model of HydroGeological Transport in Saturated-Unsaturated Media-Version 1.0" continued. Development of post-processing software to produce contours for two-dimensional simulations continued. Preliminary work on adapting the

LEHGC code for simulations of colloidal transport in fractured media began.

*Reactive Transport Experimentation*

Efforts directed toward obtaining surface complexation constants for Li and Ni sorption by pure quartz and goethite continued during August. A series of alkalimetric titration curves were obtained for an aliquot of Min-U-Sil that had been cleaned by boiling in 6 *N* HCl at ionic strengths of 0.0006, 0.0032, 0.011, and 0.094 *M*. Double-extrapolation plots were prepared for Min-U-Sil data obtained from the British Geologic Survey for the CHEMVAL2 modeling exercise. The data support an intrinsic acidity constant in the range of $10^{-6.9}$ to $10^{-8.1}$ and an association constant for $Na^+$ of $10^{-7.4}$ to $10^{-7.7}$ and will be used to verify the technique.

Synthetic goethite was prepared for sorption experiments and analyzed by XRD for purity and crystallinity. The only phase detected was goethite, with rather broad peak profiles indicative of small crystallite size and/or an amorphous component.

An abstract entitled "Unraveling Multi-Solute Sorption by Mineral Mixtures Through Surface-Complexation Studies of Simple Systems: Sorption of Ni and Li by a Natural Sand" has been accepted for oral presentation at the fall Geological Society of America meeting in Boston, MA, on October 25.

*Flow and Transport Through Single Fractures*

The purpose of this task is to challenge existing conceptual models of fracture flow and explore possible rapid transport mechanisms that may be relevant to performance assessment at Yucca Mountain.

Work exploring the effects of fracture wetted structure on relative permeability continued. Methodology for documentation of experimentation and analysis of data was refined. The primary tool for image acquisition and analysis is the IP-Lab software package from Signal Analytics. An updated version of this package (2.4) was evaluated and determined to contain sufficient bugs as to preclude this use; at this time, SNL staff will continue to use version 2.3. During exploratory testing, the solenoid valves controlling flow through the test fracture were observed to act as air traps. This problem was resolved by remounting the valves at an inclination. While the system was disassembled, system plumbing and solenoid wiring were rerouted to facilitate removal of the test cell without disturbing the experimental setup.

Interactions normal to the fracture plane: Exploration of the impact of fracture-matrix interaction on rapid transport mechanisms continue. A large format (60 cm by 30 cm by 2.54 cm) investigation of the impact of matrix imbibition on saturated fracture flow was conducted using two slabs of Topopah Spring tuff. X-ray absorption (using the YMP industrial x-ray) was used to image the transient saturation fields as fluid imbibed into the tuff slabs from a 100$\mu$m slot fracture. Following full saturation of the matrix by a KI solution, deionized water was introduced into the fracture and the transient diffusion of the deionized water into the KI-saturated matrix was imaged by x-ray absorption. Tuff slab heterogeneity was noted to have significant influence on the imbibition and diffusion fields.

Interactions in the fracture plane: Refinement of experimental apparatus allowing observation of fracture wetted structure as a function of matrix pressure continued. A relay to shut off the camera if the flow of cooling fluid is interrupted was installed and tested. Fixtures that position the scale used for pressure measurement were reconfigured to ease alignment.

Systematic experimentation was begun. In order to minimize the time necessary for the system to equilibrate at each time step, a high-porosity sintered glass plate was used as the porous matrix. Scoping experiments designed to locate potential problems in the proposed experimental sequence indicated good potential for success. However, during set up for the actual experiment, the matrix plate underwent catastrophic failure. After disassembly and examination of the test cell, no explicit cause for the failure was identified. A second plate was substituted and the cell reassembled without mishap. This second plate subsequently failed during initial filling of the test cell.

The aforementioned failures necessitated a complete reevaluation of pressure distribution within the test cell. To minimize future risk, the assembly procedure has been revised and the

transient application of external pressures between assembly and experimentation will be reduced. It is believed that these steps will allow completion of the experimental sequence.

*Field, Lab, and Numerical Experimentation to Determine Scaling Laws for Effective-Media Properties in Heterogeneous Media*

Measurement of gas permeability at multiple scales has continued on tuff slabs to be used in the fracture-matrix interaction studies described above. Additional permeameter tip seals were designed and constructed. At present a suite of tip seals exist that represent measurement scales spanning five orders of magnitude on a per volume basis. Arrangements have been made for collecting, cutting, and transporting from NTS to SNL blocks of tuff on which to perform multi-scale permeability tests. However, the sintered glass plates used in this experiment are custom-manufactured and not replaceable in the short term.

Major Activities Upcoming Next Three Months

Staff will carry out the tracer study in the caisson with LANL staff, complete studies of surface complexation Li and Ni by sand used in caisson and supporting laboratory studies, and carry out Li-Ni ion exchange studies with sand. The isotherm experiments to determine the linear range of sorption of tracers and the surface potentiometric titration of sand will be completed. Work will continue to implement LEHGC code on massively parallel architecture and to develop a method of unsaturated $K_d$ measurements with the Turbula mixer. The method for laser fluorescence measurements of U in sand and fractured media will be optimized.

### *1.2.5.4.7 SUPPORTING CALCULATIONS FOR POSTCLOSURE PERFORMANCE ANALYSES*

Major Accomplishments

The report for ESF Analysis #13, "Evaluation of the Effects of Underground Water Usage and Spillage in the Exploratory Studies Facility" (SAND93-1182), has been submitted for internal SNL review (Level 3 Milestone OS14).

Significant Meetings Attended

S. Sobolik attended a meeting in Las Vegas, NV, on August 17, 1993, concerning FY94 waste isolation impacts evaluations. Other organizations represented at the meeting were LLNL, DOE, and the M&O. A structured approach for identifying and performing general-purpose waste isolation impact evaluations was formulated. This meeting was followed by two conference calls on August 30, 1993, to discuss details of specific analyses. This framework is being used to identify FY94 activities and plan the budget for WBS 1.2.5.4.7.

Status Report on Ongoing Activities

The ESF PA Analysis #14 investigating the sensitivity of previous analyses to uncertainty in the hydrologic properties of the nonwelded Paintbrush Tuff is continuing. Summer student Walter Cruz (Universidad del Turabo, Puerto Rico) performed preliminary calculations and documented them in a report to the Science and Technology Alliance at SNL. This PA analysis has been identified as a potential activity with Level III Milestones for FY94.

In response to a request from LANL, additional calculations similar to those performed for ESF Analysis #2 (SAND91-0791) have been performed to evaluate their sensitivity to differing conditions in the Tiva Canyon welded unit in the north ramp starter tunnel. Sensitivity to the amount of water used for construction activities and to fracture conditions in the tunnel walls is being evaluated. A memo describing the results is due September 1, 1993.

Programmatic review comments for the report SAND92-2248 were received this month. These are being resolved.

Major Activities Upcoming Next Three Months

S. Sobolik will participate in a DOE-NRC Technical Exchange on the ESF Title II Design that has been tentatively scheduled for mid-September. The presentation will be concerned with the underground water analysis (ESF Analysis #13) specifically relating to fire suppression.

FY94 budget and milestone planning for WBS 1.2.5.4.7 will be completed.

Documentation of ESF Analysis #13 will be continuing, with SAND93-1182 to complete technical and management review by the end of FY93 (Level III Milestone OS14).

### *1.2.5.4.9 DEVELOPMENT AND VERIFICATION OF FLOW AND TRANSPORT CODES*

Status Report on Ongoing Activities

Staff spent much of the month preparing for the Quality Assurance audit in September. Verification of software files in the records center was performed in cooperation with the technical staff. Pre-audit conversations with DOE auditors were also held as part of the preparation activities.

Processing of software QA records also continued, and staff assisted with network database information required for the move to the new facility.

### *1.2.5.5.2 ENERGY POLICY ACT SUPPORT*

Significant Meetings Attended

A meeting of the National Academy of Sciences (NAS) committee on Technical Bases for Yucca Mountain Standards was held in Las Vegas, NV. At the request of the NAS committee, a presentation entitled "Radionuclide Releases From Geologic Repositories" was made by R. W. Barnard.

# 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 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

Staff provided input to the LANL Test Coordination Office for revisions to the Test Planning Package, the Job Package, and the work plan for construction monitoring in the Exploratory Studies Facility. These revisions are associated with the extension of the starter tunnel and the construction of the first alcove.

Major Activities Upcoming Next Three Months

Under LANL coordination, staff will work with LLNL staff to consolidate SNL's ESF thermomechanical testing with LLNL's hydrothermal testing, if possible.

Staff will support development of tracer requirements for testing in the ESF facility.

Staff will supply a preliminary estimate of support needed from the Integrated Data-acquisition System (IDS) by the SNL in situ field experiments in order to aid the designers of the IDS system develop the IDS system.

# 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

Staff participated in a number of Project meetings in Las Vegas, NV. Topics included budget, planning, design, technical data, and license application development.

## *1.2.9.2.2 PROJECT CONTROL*

Major Accomplishments

Staff transmitted the monthly cost and budget data on August 12, and the PACS FY94 budget submittal on August 16. Impacts statements from work not funded in FY94 have been transmitted to the Project.

During the week of August 9, SNL staff participated in the DOE Inspector General's Office audit of the project.

Capital equipment costs for FY93 were reconciled and reported to the Project.

During the month of August, five milestones were completed and reported to the Project.

Status Report on Ongoing Activities

Internal processes for the identification and statusing of milestones are being refined. In addition to accurate monthly statusing of milestones, the refinements will allow accurate forecasting of milestone completion dates well in advance of the due date.

SNL staff are working on the development of Level 3 milestones for FY94 and preparing basis of estimates calculations and supporting documentation. Work is also progressing on planning for changes in the SNL financial systems that will affect the ability and mechanisms of collecting cost data to report to the Project.

Errors in the financial information system (FIS) report for costs reported under 1.2.1, 1.2.2, and 1.2.5 were corrected by assigning accurate B&R codes to inactive case numbers.

Major Activities Upcoming Next Three Months

Major upcoming activities include the end of the fiscal year reconciliation exercises, as well as the YMP audit during September. The move of SNL YMP offices offsite to a location near the airport will occur during the last two weeks of September.

# 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

Activities this month were focused on preparing the staff for the upcoming Project Office audit. Instructions for interfacing with auditors and a checklist of requirements to have in order were distributed.

### Significant Meetings Attended

Two staff members attended a Lead Auditor Training class for Registrar Accreditation Board ISO 9000 accreditation.

### Status Report on Ongoing Activities

Staff continues to implement procedure improvement and transition to the new Quality Assurance Requirements and Description (QARD). One procedure remains to be revised. The following list summarizes the status of particular procedures.

- QAIP 2-5, Training (Revised): Ready to issue.
- QAIP 3-2, Software QA Procedure draft: Working with technical staff.

Proposed corrective actions are being finalized for CARs issued as a result of the SNL internal audit.

Final resolution and response to the four open CARs from the June 1993 QA Audit of International Technology Corporation (ITC) were received during this reporting period.

A QA Annual Evaluation of J.F.T. Agapito & Associates was completed during this report period. There were no findings or follow-up items.

### Major Activities Upcoming Next Three Months

A surveillance is scheduled to be performed, in conjunction with YMQAD, at Battelle's Pacific Northwest Lab to examine turnover status of the Global Climate Modeling activity.

### Other Items to Report

A Process Quality Management and Improvement (PQMI) evaluation was initiated on the SNL QA Audit Report process. A flow chart, time-line study, and historical data of audit report issuance time were developed for the last 5 years of the SNL QA Audit Program. Some stall points, process delays, and inefficiencies have been identified. Further meetings will report results of this study and any planned improvements.

# 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*

Status Report on Ongoing Activities

Routine oversight of information management activities were conducted.

## *1.2.12.2.2 LOCAL RECORDS CENTER OPERATION*

Major Accomplishments

Ten boxes of proprietary Procurement records were entered into the Records Management System (RMS) system. The total number of records entered in RMS for the month was 99 for a total of 28,973 pages.

Staff implemented a streamlined process for verification of records against microfilm. A desktop guidance for the process was written.

Twenty-six cited references (1,430 pages), for publications were submitted to the Central Records Facility (CRF).

Four TDIFs were prepared and submitted to the RMS.

Three TDIFs were entered into the YMP Automated Technical Data Tracking System (ATDT).

Significant Meetings Attended

On August 4 and 11, staff participated in a Disaster Preparedness and Recovery Plan committee meeting.

On August 11, two members of the staff attended Environmental Safety and Health (ES&H) training.

On August 13, the Records Coordinator and Supervisor attended the QA Audit Meeting.

A meeting was held with technical staff for a package submittal and with the TPO concerning the new Technical Data Coordinator responsibilities.

Status Report on Ongoing Activities

The meetings and planning for the LRC move to the new facility continue. The move is scheduled for the end of September.

Staff are preparing for the DOE Quality Assurance Audit scheduled for the week of September 13. An audit meeting on September 2 will be attended by involved staff.

One calibrations package was submitted to the CRF (1,677 pages). Two other calibrations packages are being held for Document Deficiency and Justification Form approval (649 pages). Four Technical Procedures packages are in process. A search of RIS for duplicates was completed for approximately 20 technical data sets (47 binders).

Two new data sets were opened.

Major Activities Upcoming Next Three Months

LRC and Training Guidance are being rewritten. The projected completion date is November 1, 1993.

Eighteen three-ring binders (36 inches of paper; 9,000 pages), which contain Site and Engineering Properties Data Base (SEPDB) records, were reviewed against microfilm for duplicates to be destroyed.

Staff will research and propose a phased approach to development of a Disaster Preparedness and Recovery Plan for the YMP Records Management Program. A checklist has been revised to focus on vital records and a preliminary design for the flyer has been completed.

Staff will rework the manner in which milestones for SANDs, TDIFs, SLTRs, and conference papers are tracked and scheduled to be discussed and finalized with Project Control staff.

Issues/Potential Problems Needing Resolution and Potential Impacts

AIMS and RIS were disconnected four times again this month. This continues to be a problem.

### 1.2.12.2.3 PARTICIPANT RECORDS MANAGEMENT

Major Accomplishments

Discussions were held with the QA Manager concerning future Records Management review of all QA procedures as they are revised to ensure identification of responsibilities for records preparation and submittal and to ensure identification of QA records.

The Program Plan for the Records Management staff for 1994 is being worked on by the Records Coordinator and the Supervisor. The plan will establish the goals and objectives for the group.

Major Activities Upcoming Next Three Months

Staff will conduct weekly meetings of the Nuclear Waste Management Center Quality Action Team (QAT) for planning the relocation and designing the space and facility needs for all Information Centers (to include the SNL/YMP Local Record Center). The expected shipping date for the shelving is August 27. Meetings are continuing to make sure that all needs are met. Phones will be functional on Monday morning September 13, 1993.

Staff will obtain SNL and DOE Office of Civilian Radioactive Waste Management (OCRWM) approval/authorization for the identification of YMP Project duplicate storage records as Federal nonrecords. When so designated, staff will obtain approval/authorization for the verification and destruction of said records. A memo from the Records Coordinator to the SNL "Recorded Information Management Department" was sent on August 24 requesting approval of process.

A nondocumented verbal request from the YMP Record Manager to revise the proposed FY94 budget was prepared for review.

The Records Manager will attend the NIRMA Symposium in Atlanta, GA, August 29 through September 3, 1993.

### 1.2.12.2.5 DOCUMENT CONTROL

Status Report on Ongoing Activities

Work continued on integrating the Document Control database with the Training database to eliminate duplicate data.

Major Activities Upcoming Next Three Months

Obsolete records will be eliminated from the Document Control system to significantly reduce the number of records that will have to be recoded before integration with the Training database. Hard copies of these records will be made and stored for future reference.

Document Control staff will work on a comprehensive update of the Person Table to verify and update data in the Document Control system prior to integration with the Training database.

Integration of the Document Control and Training database will be completed.

# 1.2.15 SUPPORT SERVICES

The objective of the Support Services element includes work 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*

Significant Meetings Attended

SNL and contractor staff responsible for tasks under the Support Services element attended a monthly meeting to provide updates on activity status, accomplishments, and future plans for work in this element.

Status Report on Ongoing Activities

Support Services element activities were maintained as needed.

## *1.2.15.2 ADMINISTRATIVE SUPPORT*

Major Accomplishments

SNL staff sent one SAND report to the printers.

Procurement and subcontractor overcommitments totalling $1.4 million were identified, and obligations were reduced.

An itemized list of all procurement and subcontractor commitments was forwarded to the Project Office. For each commitment, the following information was provided: item/service description, WBS number, purchase requisition number/contract number, total value, and estimated payment/delivery date.

Status Report on Ongoing Activities

Missing property totalling $17,000 has been found and inventoried, while $66,000 of missing properties have been located at offsite contractors, but are yet to be inventoried. Most of the missing small-value property will be located during the move to the new SNL YMP offices.

Major Activities Upcoming Next Three Months

SNL is planning to decontrol all items with a dollar value of less than $1,000.

The SNL YMP property schedule is due to the Project Office on September 30.

The submittal of property management information is due to the Project Office on October 29.

### *1.2.15.3 YMP SUPPORT FOR THE TRAINING MISSION*

Major Accomplishments

The design of the Training Center has been completed, and materials and equipment have been ordered.

SNL QAIP 2-5 has been approved and will be distributed.

Status Report on Ongoing Activities

Staff continues to use parallel entry into FoxPro and Informix while the effort continues to develop a relational database integrating the Training and Controlled Document databases.

Major Activities Upcoming Next Three Months

Work will begin on eliminating inactive training records from the database prior to integrating the Training database with the Controlled Document database. Hard copies of the inactive records will be made and stored for future reference.

SNL will finalize the integration of the Training and Controlled Document databases.

Professional development programs will be sought and evaluated for inclusion in the training program.

The Training Manager will work with the Project Office's training staff to have PACS, General Employee Training (GET), and Underground Worker training conducted at SNL by Project Office staff.

Because of requests, the feasibility of conducting another geology course next fiscal year will be explored.

INFORMATION COPY

**Reynolds Electrical & Engineering Co., Inc.**

Post Office Box 98521 • Las Vegas, NV 89193-8521

IN REPLY REFER TO:
580-01-017

October 8, 1993

WBS 1.2.9.1
QA: N/A

Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization
Project Office
U.S. Department of Energy
Post Office Box 98608
Las Vegas, NV 89193-8608

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP) STATUS REPORT (SCP: N/A)

Attached is the September YMP Status Report for Reynolds Electrical & Engineering Co., Inc.'s participation in the YMP.

If further information is required, please contact Rene' R. Knott at 794-7193.

R F Pritchett

R. F. Pritchett, Manager
Yucca Mountain Project Division
YMP Technical Project Officer

RFP:RRK:ufg

Enclosure
Status Report (4 pages)

cy: See page 2

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
(REECo)

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)

SEPTEMBER 1993 - STATUS REPORT

Reeco has no reportable Level 0 or Level 1 Milestones.

WASTE PACKAGE (1.2.2)
WBS 1.2.2.2.4

Task: Fran Ridge Prototype Saw Support (Job Package 93-10)

Supported saw cutting activities at Fran Ridge.

SITE (1.2.3)
WBS 1.2.3.5

Task: Quaternary Fault Trenching (Job Package 92-12)

Completed trench excavation and fencing at Solitario Canyon; performed environmental cleanup at various locations in Crater Flats; completed off site trench excavation at Tarantula Canyon.

Task: USW UZ-14 Drilling (Job Package 92-17)

Continued operations. Borehole was cored and reamed to 12 1/4 inch diameter to 1302 feet. Cementing operations to seal off water producing intervals from 1256 to 1257 feet and from 1266 to 1271 feet were successful. An additional water producing interval from 1275 to 1276 feet, has been identified. Cementing operations were scheduled for October 1, 1993, to attempt to seal off the interval.

Task: UE-25 NRG-2B North Portal Ramp Borehole (Job Package 93-09)

Completed drilling/coring operations on September 14, 1993, at a total depth of 329.46 feet with 5 inch odex casing to 263.60 feet.

Task: C-Well Soil Remediation (Job Package 93-11)

Completed Phase I of the soil remediation at C-Well Complex; installed tortoise fence around excavation pits; graded access roads into complex.

Task: Ghost Dance Fault Roadcuts (Job Package 93-12)

Began excavation for Ghost Dance Fault study.

Task: UE-25 NRG-7, North Ramp Borehole (Job Package 93-14)

Began and completed construction of drill pad for NRG-7.

1.2.3 Capital Equipment

Dust Collector, Tubing Tongs, and Power Spinners were received during this period. The Subdock Breakout Table/Rotary Tool Service is due for delivery in October.

**EXPLORATORY STUDIES (1.2.6)**

WBS 1.2.6.1

Task: Exploratory Studies Facility (ESF)

Continued administrative support for ESF activities to include planning, scheduling and management. Resolved all but three Package 1A and 2A Title II 90% design comments.

Task: Technical Support and Underground Excavation for the ESF

Proposal for 1-YUC-01-2, Modification No. 1 for Fiscal Year (FY) 1994 support of the ESF was received on September 21, 1993. After REECo review, the Subcontractor (Kiewit/PB) submitted a revised proposal on September 27, 1993. Modification was prepared and submitted for review on September 28, 1993. Award was made on September 30, 1993.

Task: ESF North Portal Pad & Facilities (Job Package 92-20)

Completed shotcrete in repair section of North ESF Drainage Channel; resumed rip-rap placement in the Drainage Channel; began grading construction trailer areas on ESF Pad; received six trailers and began cribbing trailers at ESF Pad and placing construction trailers at box car area; hauled tunnel ramp material from portal to stockpile area; and pressure tested supply line to concrete batch plant site.

Pumped 2,365 cubic feet of HLN(cc) - grout returned on 117 rockbolts; drilled, blasted and mucked rounds NP-CB, NB, SB-013 through SB-025 advancing the lower bench to CS 1+97; installed 188 set bolts for personnel safety; applied 147 bags of fibercrete to the ribs between CS 0+90; installed 124 10-foot Williams pattern rockbolts between 0+80 and the face; installed 14 ten-foot Williams pattern rockbolts for the Test Alcove, pull tested 17 pattern rockbolts which all passed.

Task: Procurement Actions

The proposal for 1-YUC-01-2, Modification No. 1 for FY94 support of the Exploratory Studies Facility was received on September 21, 1993. After REECo review, the Subcontractor (Kiewit/PB), submitted a revised proposal on September 27, 1993. Modification was prepared and submitted for review on September 28, 1993. Award was made on September 30, 1993.

Request for Quotation (RFQ) for rental of a Batch Plant was canceled. FY 1993 capital equipment funds for a Getman Scissor Lift and Underground Optical Face Drill Pattern were reprogrammed for procurement. The Request for Proposal (RFP) was issued on September 22, 1993 with a closing date of October 19, 1993.

Aggregate haulage by Wulfenstein Construction Company to Area 25 was suspended during this period when two haul trucks failed to pass a safety inspection.

A purchase order was awarded for procurement of two additional trailers.

Purchase Order 0924-YCA-01-3, Modification No. 1, for a 1:24 scale model was issued on September 28, 1993 in the amount of $9,980. Expected completion is December 7, 1993 with a delivery by December 17, 1993.

**TEST FACILITIES (1.2.7)**
Task: Field Operations Support

Continued support services to participants and maintenance of YMP utilized facilities, utilities, equipment and roads in Area 25.

Continued logistical and tour support for DOE Yucca Mountain Site (YMSO) staff. Fourteen tours and one Open House were held during this period. Support included but was not limited to arrangements for buses, registration of guests, coordination of lunches/beverages, medical service, furniture, and mechanical service. Continued preparations for upcoming tours.

Installed a new pump in the chiller unit for Building 4015, Field Operations Center. No problems have been experienced since installation of bypass piping.

The three vehicles ordered to support the Engineering and Development Division, DOE/YMP, are expected for delivery in December, 1993.

**PROJECT MANAGEMENT (1.2.9)**
WBS 1.2.9
Task: Technical Project Office Management/Project Control

Continued normal administrative level of effort support. Continued status and update of Planning and Control System (PACS); supported ESF Construction activities, drilling activities and completed cost estimates as required.

**QUALITY ASSURANCE (1.2.11)**
WBS 1.2.11
Task: Quality Assurance (QA)

Continued normal administrative level of effort support. Requested an extension for DOE Corrective Action Request (CAR) YMP-93-055 for completion of the determination of adequacy of inspections/tests (dedication) performed on material received to date. Extension was required due to the fact that the design organization had not provided the critical characteristics necessary to complete the determination.

Requested an extension for DOE CAR YM-93-058 for completion of the qualification of a calibration facility for survey instruments. An audit/survey was conducted and the vendor was unacceptable. The additional time is necessary to identify and qualify another vendor.

Closed REECo Corrective Action Report CA-93-002 which identified that inspections were adequately documented. All actions were satisfactorily completed.

Accepted another extension request for additional time to complete the training on the procedure revisions for REECo Corrective Action Report CA-93-004 dealing with material control deficiencies. Revised completion date is November 5, 1993.

Reviewed and accepted the Underground Subcontractor's (Kiewit/PB) Quality Assurance Program Work Plan.

## ENVIRONMENT, SAFETY & HEALTH (1.2.13)

WBS 1.2.13

Task: Safety & Occupational Health

Provided medical, occupational safety, industrial hygiene and fire protection support.

Inspected a van on the Nevada Test Site for possible use on YMP as a mine rescue van.

## SUPPORT SERVICES (1.2.15)

WBS 1.2.15

Task: Administrative Support and Training

Continued to provide procurement, logistical, and information management administrative level of effort support; continued support services to various YMP participants.

Staffed the YMP Technical Information Display at the American Society for Quality Control's Twentieth Annual National Energy and Environmental Quality Division conference held in Indian Wells, California; and at the National Association of Geology Teachers - Far Western Section conference in Lake Shasta, California.

Task: Site Characterization Plan (SCP) Reference Library and Database

There were no SCP sets distributed during this period.