

MONTHLY HIGHLIGHTS AND STATUS REPORT

Yucca Mountain Site Characterization Project

U.S. DEPARTMENT OF ENERGY

**YUCCA
MOUNTAIN
PROJECT**



**Sandia
National
Laboratories**

June 1993



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PROJECT

Monthly Status Report

June 1993

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June Highlights

SNL staff attended Project-level meetings on core-sample packaging and sealing requirements for combined drill holes NRG-5/SD-11 and FY94 drill-hole planning.

See **1.2.3.2.2.2.1 Systematic Acquisition of Site-Specific Subsurface Information** on page 3.

SNL staff prepared logs for NRG-1, NRG-3, and RF-8 boreholes and updated the section map of the north ramp Bow Ridge Fault area.

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

SNL staff submitted data on mechanical properties, triaxial and tensile strengths, average grain density, and thermal conductivity from various NRG-6 samples to the YMP Central Records Facility.

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

June Highlights, Continued

SNL staff is studying mechanical properties of tuff samples from a series of north ramp drill holes.

See **1.2.3.2.7.1.3 Laboratory Determination of Mechanical Properties of Intact Rock** on page 11.

SNL staff conducted seismic blast monitoring, rock quality determination, and construction monitoring activities. Staff also performed the initial installation of load cells to be used to monitor rock bolts.

See **1.2.4.2.1.1.4 In Situ Design Verification** on page 16.

SNL staff is preparing calculational runs for TSPA-II. Staff also submitted an invited paper on drilling releases to the ANS winter meeting and attended an NEA/OECD meeting that addressed developing an international database of the features, events, and processes of radioactive waste isolation.

See **1.2.5.4.1 Total System Performance Assessment** on page 21.

SNL staff submitted a summary memorandum of the Operations and Safety Team's conclusions to both DOE and the SCP Thermal Goals Reevaluation Working Group.

See **1.2.5.4.3 Repository Performance Assessment** on page 23.

SNL staff completed the supplier qualification audit of SNL's calibration facilities.

See **1.2.11 Quality Assurance** on page 33.

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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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**YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
EXECUTIVE SUMMARY**

WBS 1.2.3.2.2.1 Systematic Acquisition of Site-Specific Subsurface Information

SNL staff attended a Project-level meeting on core-sample packaging and sealing requirements for combined drill holes NRG-5/SD-11. The meeting marks the first time that such sampling requirements have been integrated and brought into the test planning package/job package process. After preservation, the core can be viewed by all participants in light of the preliminary field logs, and one-of-a-kind samples can be allocated to the appropriate participant through the Samples Overview Committee.

SNL staff also attended a critical meeting for FY94 drill-hole planning. At the meeting, all participants were invited to specify requirements to be incorporated into the test planning packages for several drill holes and to share concerns regarding construction details, hole locations, and scheduling. The impacts of rapidly-evolving ESF design changes were considered when the group was planning FY94 drilling. The group decided that two SD holes would be incorporated into preliminary planning efforts, and that the proposed locations for these holes would be adjusted slightly to provide maximum design information and ease of physical access should the drilling schedule call for earlier initiation of one or both SD holes.

WBS 1.2.3.2.6.2.1 Surface Facilities Exploration Program

Structural and lithologic logs were prepared for NRG-1, NRG-3, and RF-8 boreholes. NRG-2 was deepened from 215 ft to 294 ft to better define the lithologic contacts proximal to the Bow Ridge Fault. The section map of the north ramp Bow Ridge Fault area was updated to incorporate the most recent information from boreholes NRG-1, NRG-2, NRG-2A, and RF-8.

WBS 1.2.3.2.6.2.2 Surface Facilities Laboratory Tests and Material Property Measurements

Mechanical properties data (ultrasonic velocities, static elastic properties, and unconfined strength) for core from NRG-6 from depths of 345 ft to 427 ft were submitted to the YMP Central Records Facility (CRF). Triaxial strength, tensile strength, and average grain density data for NRG-6 from depths of 22.2 ft to 427 ft were submitted to the YMP CRF. Thermal conductivity testing on air-dry samples have been completed at 30°C, 50°C, and 70°C. The values for unit TCw are within the general range reported in the Reference Information Base (RIB) for dry samples. For samples NRG-6 at 152.9 ft, NRG-6 at 187.0 ft, and NRG-6 at 241.5 ft (unwelded and bedded PTn) the measured values are below 0.5 W/mK. With the exception of sample NRG-6 at 277.5 ft, the measured values for samples from TSw2 (1.1 W/mK) are lower than those reported in the RIB for dry samples (1.6 W/mK). The thermal conductivity of the NRG-6 sample at 277.5 ft is from 2.4 W/mK to 2.5 W/mK for temperatures below 100°C.

WBS 1.2.3.2.7.1.3 Laboratory Determination of Mechanical Properties of Intact Rock

The mechanical properties of tuff samples from a series of north ramp drill holes are being studied. The sample porosity is calculated either from the dry and saturated bulk densities or from the dry bulk density and the measured average grain density. The compressional and shear wave velocities are measured on both the dry and saturated samples.



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YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
EXECUTIVE SUMMARY Continued

WBS 1.2.4.1.1 Repository Coordination and Planning

SNL staff continued work on a series of analyses in support of the design of the ESF north ramp. Three-dimensional thermal/structural analyses of the repository to assess the impact of the potential repository thermal loading on the ESF drifts have been completed. The results support the two-dimensional analysis of several cross sections of the ESF north ramp to evaluate long-term stability.

WBS 1.2.4.2.1.1.4 In Situ Design Verification

Seismic blast monitoring and rock quality determination activities were conducted and the initial installation of load cells to be used to monitor rock bolts as ground support was performed.

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, rock mass quality estimates for the first 100 ft of tunnel were developed, locations were selected for the first two stations of rock bolt load cells, and bolts were installed. SNL is working with the constructor to locate and drill instrumentation holes in the roof. Instruments will be installed after the 200-ft starter tunnel is completed.

WBS 1.2.5.4.1 Total System Performance Assessment

SAND93-1415C, "Analyses of Releases Due to Drilling at the Potential Yucca Mountain Repository," was submitted as an invited paper for the 1993 ANS winter meeting.

Staff attended an NEA/OECD meeting in which the participants addressed the possibility of forming an international database on features, events, and processes (FEPs) related to radioactive waste isolation.

Work on preparing for the calculational runs of major areas of the SNL TSPA-II is progressing rapidly. Progress includes development of percolation flux profiles, including cyclic changes due to glacial and interglacial periods, generation of sorption parameters, and modifications of the formulations of two conceptual models for aqueous flow.

WBS 1.2.5.4.3 Repository Performance Assessment

SNL staff compiled the conclusions of the Operations and Safety Team into a summary memorandum submitted to DOE and the SCP Thermal Goals Reevaluation Working Group. This input was incorporated into a preliminary draft of the SCP Thermal Goals Reevaluation Report.

WBS 1.2.11 Quality Assurance

SNL QA staff completed the Supplier Qualification audit of SNL's calibration facilities by performing an evaluation of the "length/mass/force" calibration lab. With some restrictions, SNL's Standards Laboratory is being approved for metrology services in support of the YMP.



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

No significant activity this reporting period.

1.2.1.2.2 PROJECT-LEVEL REQUIREMENTS DOCUMENTS DEVELOPMENT AND MAINTENANCE

No significant activity this reporting period.

1.2.1.2.1 PROGRAM-LEVEL REQUIREMENTS DOCUMENT DEVELOPMENT

No significant activity this reporting period.

1.2.1.5 SPECIAL STUDIES

No significant activity this reporting period.



1.2.2 WASTE PACKAGE

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

1.2.2.4.3 CONTAINER/WASTE PACKAGE INTERFACE ANALYSIS

No significant activity this reporting period.



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 (1.2.3.2.2.1), Three-Dimensional Rock Characteristics Models (1.2.3.2.2.2), 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 Intack 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 June 2 Sample Overview Committee (SOC) meeting in Area 25 at the Nevada Test Site (NTS). Numerous sample requests were acted upon, and new sample packaging requirements were deferred to the test planning process that accompanies each proposed drill hole (see WBS 1.2.3.2.2.2.1; below). The next SOC meeting is scheduled for July 7.

Status Report on Ongoing Activities

Routine oversight of site investigations activities continues.

1.2.3.2.2.1 SYSTEMATIC ACQUISITION OF SITE-SPECIFIC SUBSURFACE INFORMATION

Major Accomplishments

Revision 1 of the study plan for this activity was issued during June as a Yucca Mountain Site Characterization Project (YMP) controlled document. Principal changes include a revised map showing proposed drill hole locations and incorporation of an additional study making significant use of samples from the systematic drilling (SD) program. (SCP Activity 8.3.1.4.3.1.1)

Significant Meetings Attended

SNL staff attended a Project-level meeting on core-sample packaging and sealing requirements for combined drill holes NRG-5/SD-11 on June 9 in Las Vegas, NV. This meeting marks the first time that such sampling requirements have been integrated and brought into the test planning package/job package process. Previously, all sample *packaging* requirements were approved through the SOC, with the result that approved packaging requests were de facto approved specimen *removal* requests. The many competing sample requests for this combined deep drill hole indicated that a more integrated approach is required to provide all interested investigators equal opportunity to view core and select samples important to their studies. The new process will



preserve initial water contents in a full suite of samples. After preservation of the core, all participants can view it in light of the preliminary field logs, and one-of-a-kind samples can be allocated to the appropriate participant through the SOC process. (SCP Activity 8.3.1.4.3.1.1)

SNL staff also attended a workscope consolidation meeting for FY94 drill-hole planning on June 17 in Las Vegas, NV. All participants were provided the opportunity to specify requirements to be incorporated into the test planning packages for several drill holes and to share concerns regarding construction details, hole locations, and scheduling. Recent, rapidly evolving plans to reorient the main north-south drift of the Exploratory Studies Facility (ESF) were reported at the meeting, followed by significant discussion of how such a major design change would affect planning for FY94 drilling. The group decided that two SD holes would be incorporated into preliminary planning efforts, and that the proposed locations for these holes would be adjusted slightly to provide maximum design information and ease of physical access should the drilling schedule call for earlier initiation of one or both SD holes. Combined drill hole SRG-5/SD-11, originally scheduled to begin about July 1, probably will be deferred, as its original purpose was to provide control at the deep terminus of the south ramp. Depending upon the "final" design of the repository drifts, SD-11 may be located further south than optimal if SRG-5 is replaced by SRG-4 as the ramp/drift transition control point. (SCP Activity 8.3.1.4.3.1.1)

Status Report on Ongoing Activities

The paper entitled "Spatial Variability of Hydrologic Properties in Volcanic Tuff," intended for publication in the journal *Groundwater*, continues in U.S. Geological Survey (USGS) and SNL reviews. 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 Activities 8.3.1.4.3.1.1 and 8.3.1.2.2.3.1)

SNL staff normally assigned to this activity continued to provide geologic support for WBS 1.2.3.2.6.2. (SCP Activity 8.3.1.14.2.1) Geologic logging of core is the principal focus of this support. An additional field geologist with

significant logging experience will be hired to support both the Soil and Rock Properties Study and the Systematic Drilling Program. Staff attended the annual Mine Safety and Health Administration (MSHA) refresher training required for unescorted access to the ESF starter tunnel. (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," remain deferred pending completion of 105°C oven drying and measurement of dried material properties. (SCP Activities 8.3.1.4.3.1.1 and 8.3.1.2.2.3.1)

Major Activities Upcoming Next Three Months

Drafts of reports in preparation will be finalized and reviewed as appropriate. Principal emphasis will be placed on completing all procedures and other prerequisites for initiating the Systematic Drilling Program, probably in early FY94 with either SD-12 or SD-10. (SCP Activity 8.3.1.4.3.1)

Budget preparation for FY94 will continue. (SCP Activity 8.3.1.4.3.1.1)

Geologic support will be provided to the Soil and Rock Properties Study (SCP Activity 8.3.1.14.2.1) through logging core from the north ramp boreholes. Technical procedures to support the Systematic Drilling Program will be finalized as quickly as possible. (SCP Activity 8.3.1.4.3.1.1)



1.2.3.2.2.2.2 THREE-DIMENSIONAL ROCK CHARACTERISTICS MODELS

Status Report on Ongoing Activities

SNL staff provided Dynamic Graphics, Inc. of Alameda, CA with a package of Yucca Mountain information from which their staff will construct a simplified model of the Yucca Mountain site to demonstrate their geologic modeling software package. The Dynamic Graphics package is an alternative to the Lynx Geotechnical Modeling System currently in use by both SNL and the USGS. The package offers superior model display capabilities, but model construction capabilities may be inadequate for the structurally complex, data-sparse problem at Yucca Mountain. Also, the Dynamic Graphics package does not contain geostatistical capabilities for modeling material properties. (SCP Activity 8.3.1.4.3.1.1)

Preparation of the study plan for the Three-Dimensional Rock Characteristics Models study continues using the revised U.S. Department of Energy/Nuclear Regulatory Commission (DOE/NRC) level-of-detail agreement for study plans. Because the Three-Dimensional Rock Characteristics Models study will create custom models to support performance assessment and design evaluation activities, the study plan will be a listing and brief description of tools to create the "numerical rocks" for a particular calculation. (SCP Activity 8.3.1.4.3.2.1)

Major Activities Upcoming Next Three Months

Work will begin to modify the simulation codes to accommodate the soft information provided by the known microstratigraphic units at Yucca Mountain. SNL and USGS staff will discuss 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. of Vancouver, B.C. clarified the mechanics of extracting the required soft information from the geometric model. (SCP Activity 8.3.1.4.3.2.1)

A major effort began in mid-June to design an integrated software structure combining the currently separate GSLIB subroutines to automate creation and evaluation of large simulations. The GSLIB routines have been successfully compiled in the personal computer (PC) environment. A software engineer and several other staff are outlining the scope of the automation effort. This work will attempt to satisfy the needs of a number of user groups at SNL, including YMP, the Fernald (Ohio) Integrated Demonstrations Project, and Environmental Restoration groups. (SCP Activity 8.3.1.4.3.2.1)

SNL staff will contribute text sections to the 1993 Total System Performance Assessment (TSPA) summary document describing the construction of the repository-scale three-dimensional indicator simulations of lithology. Additional TSPA work will be determined as the exercise proceeds. (SCP Activity 8.3.1.4.3.2.1)



1.2.3.2.6.2.1 Surface Facilities Exploration Program

Major Accomplishments

Structural and lithologic logs were prepared for NRG-1, NRG-3, and RF-8 boreholes. NRG-2 was deepened from 215 feet to 294 feet to provide a lithologic contact of high confidence. The section map of the North Ramp Bow Ridge Fault area was updated to incorporate the most recent information from boreholes NRG-1, NRG-2, NRG-2A, and RF-8.

Status Report on Ongoing Activities

Borehole NRG-4 is being drilled. The core interval in NRG-4 was increased to accommodate the enhanced ESF option. Drilling has been completed on NRG-2 (deepened), NRG-2A, and NRG-5; structural and lithologic logs are being prepared. Technical review of the structural and lithologic log for NRG-6 resulted in one comment requiring resolution. This log will be issued upon comment resolution.

Major Activities Upcoming Next Three Months

Boreholes NRG-4, NRG-2B, and SRG-5 will be drilled; structural and lithologic logs will be prepared. The Management and Operations (M&O) ESF design group is investigating a potential change in the ESF design. SNL will investigate borehole requirements to support this enhanced ESF design.

1.2.3.2.6.2.2 Surface Facilities Laboratory Test and Material Property Measurements

Major Accomplishments

Mechanical properties data (ultrasonic velocities, static elastic properties, and unconfined strength for core from NRG-6 from depths of 345.0 ft to 427.0 ft were submitted to the YMP Central Records Facility (CRF). Triaxial strength, tensile strength, and average grain density data for NRG-6 from depths of 22.2 ft to 427.0 ft were submitted to the YMP CRF.

Status Report on Ongoing Activities

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

Samples to depths of 416.0 ft from NRG-6 have been machined and inspected. Eleven samples, from depths of 28.8 ft to 416.0 ft, are undergoing thermal properties testing.

Thermal Conductivity Testing

Samples for thermal conductivity testing are 2-in.-diameter x 0.5-in. disks, nominally. Measurements are made using the guarded-heat-flow-meter method. All measurements use a moisture containment cell so that values obtained on samples with different initial saturations can be compared.

Thermal conductivity testing on air-dry samples have been completed at 30°C, 50°C, and 70°C. The values for unit TCw are within the general range reported in the Reference Information Base (RIB) for dry samples. For samples NRG-6 at 152.9 ft, NRG-6 at 187.0 ft, and NRG-6 at 241.5 ft (unwelded and bedded PTn), the measured values are below 0.5 W/mK, which is out of the calibration range for the standard reference material used to calibrate the test equipment. Because there is no reference material traceable to nationally recognized standards for calibrations in this range, values will be extrapolated from measurements on saturated samples. With the exception of sample NRG-6 at 277.5 ft, the measured values for samples from



TSw1 (1.1 W/mK to 1.4 W/mK) are lower than those reported in the RIB for dry samples (1.6 W/mK). The thermal conductivity of sample NRG-6 at 277.5 ft is from 2.4 W/mK to 2.5 W/mK for temperatures below 100°C.

These thermal conductivity data will be submitted to the project database after an independent review is completed.

Thermal conductivity measurements have begun on saturated samples. For these samples, measurements will be made at 30°C, 50°C, 70°C, 110°C, 155°C, 200°C, 245°C, and 290°C.

Thermal Expansion Testing

For thermal expansion testing, the samples are 1-in.-diameter x 2-in. right cylinders. A single push rod dilatometer with a saturation test apparatus is used for these measurements. Measurements are made during heating and cooling.

Velocity measurements were made at New England Research, Inc. (NER) on the following samples prior to thermal expansion testing: NRG-6 at 28.8 ft, NRG-6 at 98.1 ft, NRG-6 at 111.0 ft, NRG-6 at 152.9 ft, NRG-6 at 277.5 ft, and NRG-6 at 321.1 ft. The velocity measurements will be repeated after the samples are tested to see if there is any evidence of microcracking induced by the thermal cycling.

Thermal expansion testing on air-dry samples have been completed for temperatures to 110°C. The sample environment was maintained at 110°C for 30 hours to determine the time for the thermal expansion to stabilize while the sample is dehydrating.

The ranges of values for the mean coefficient of thermal expansion (CTE) during heating are shown in the table below.

For unit PTn, only data from sample NRG-6 at 152.9 ft are reported. Two runs were made on this sample, with the first run showing the sample shrinking at temperatures starting around 45°C. The sample did not shrink on the second run, which indicates sample dehydration.

Data for samples NRG-6 at 28.8 ft and NRG-6 at 187.0 ft are being compiled. No thermal expansion sample is available for NRG-6 at 241.5 ft because the rock is extremely friable and would not remain intact during machining.

These thermal expansion data will be submitted to the project database after an independent review is completed. Thermal expansion values are not available in the RIB for these thermal/mechanical units.

Thermal expansion testing has begun on saturated samples. For these measurements, the atmosphere surrounding the sample during testing will be controlled at 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 300°C is reached, then the sample will be cooled to ambient temperature.

Mineralogy

Work Agreements (WAs) WA-0087, "Polished Thin Section Preparation of Samples from NRG-6," and WA-0088, "Laboratory Petrologic Determination of Samples from NRG-6," are undergoing technical review. Analysis on selected samples will begin as soon as these WAs are issued.

Unit	Mean CTE (10 ⁻⁶ m/°C)		
	25°C to 50°C	50°C to 75°C	75°C to 100°C
TCw	5.58 to 6.85	7.91 to 8.43	9.36 to 10.0
PTn	0.54 to 4.46	-13.3 to 3.96	-23.4 to 0.96
TSw1	4.13 to 5.33	5.27 to 6.17	6.78 to 7.93

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Major Activities Upcoming Next Three Months

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

Staff will complete testing on samples from NRG-6 and report information to the project database.

Other Items to Report

Priority has been given to thermal properties testing on samples from NRG-6. Additional test equipment has been brought on line so that studies can establish baseline test conditions for site characterization. (See WBS 1.2.3.2.7.1.1 and WBS 1.2.3.2.7.1.2 for discussion of these activities.)

1.2.3.2.6.2.3 Surface Facilities Field Tests and Characterization Measurements

Major Accomplishments

The existing open soil test pits for the north ramp portal and access roads were closed.

Status Report on Ongoing Activities

The M&O has assumed responsibility for earth resistivity testing at the north portal. SNL will provide calibrated test equipment and limited support for these tests.

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). Until additional test equipment is brought on line, the studies to establish baseline test conditions for thermal conductivity measurements have been delayed.

The additional low temperature (LT) instrument delivered to Holometrix is being set up. The LT instrument is used for thermal conductivity testing at temperatures below 100°C.

Samples for the study of the effects of sample saturation on thermal conductivity are ready for testing. 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. Samples have been sent to NER for machining. If fractures are observed to have a significant effect, samples containing natural fractures will be obtained and tested. (SCP Activity 8.3.1.15.1.1.3)

A new oven with a temperature recorder is being set up at Holometrix. The oven will be used to dry samples from NRG-6 and for the studies to determine baseline testing conditions.

The rock crushing laboratory at the University of New Mexico (UNM) is almost completed, including installation of the shatterbox, jaw crusher, and hood for dust control.

Major Activities Upcoming Next Three Months

After the new LT instrument is calibrated, testing activities for the scoping study on the effects of saturation on thermal conductivity will begin. 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 and at five different saturation states (fully saturated, oven-dry, air-dry, and two other intermediate states). A moisture containment cell will be used to control the test environment. (SCP Activity 8.3.1.15.1.1.3)

After test samples are machined and inspected, the study on 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, 5.0 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 procedure for using the rock crushing and grinding equipment at 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). Until additional test equipment is brought on line, the studies to establish baseline test conditions for thermal expansion measurements have been delayed.

The additional dilatometer was delivered to Holometrix. The instrument and saturation test apparatus are being set up.

Samples for the study of the effects of sample size on thermal expansion are ready for testing. 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

After the new dilatometer is operational, experiments to study the effects of sample size on thermal expansion will be initiated. 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 at 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. The sample then 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 of 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 at 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; the sample then 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

Major Accomplishments

SAND92-1810, "Unconfined Compression Experiments on Topopah Spring Member Tuff at 22°C and a Strain Rate of 10^{-9} s⁻¹: Data Report," was approved by the Project Office on June 23. (SCP Activity 8.3.1.15.1.3.2)

SNL and NER staff were in Madison, WI on June 28 through 30 to attend the 34th U.S. Symposium on Rock Mechanics. They presented a paper entitled "The Influence of Strain Rate and Sample Inhomogeneity on the Moduli and Strength of Welded Tuff." (SCP Activity 8.3.1.15.1.3.2)

Status Report on Ongoing Activities

NER is conducting a study of the mechanical properties of tuff samples from a series of north ramp geology drill holes. 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 and triaxial conditions. The sample porosity is calculated either from the dry and saturated bulk densities or from the dry bulk density and the measured average grain density. The compressional and shear wave velocities are measured on both the dry and saturated samples. Other samples are being tested in indirect tensile (Brazil) experiments and for average grain densities. A series of 35 unconfined and 16 confined experiments, 23 Brazil tests, and 43 measurements of average grain density from samples of USW NRG-6 (ranging in depth from 22 ft to 427 ft) have been completed. (SCP Activities 8.3.1.15.1.3.1 and 8.3.1.15.1.3.2)

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 at least six samples of TSw2 to be tested at a pore pressure of 4.5 MPa, a confining pressure of 5 MPa, and a maximum constant differential stress of 80 MPa. Initially, the experiments are performed at room temperature and then at 250°C. The third

experiment was completed in May, and the fourth sample is being prepared for testing beginning in early July. (SCP Activity 8.3.1.15.1.3.2)

SAND92-0119, "Experimental Comparison of Laboratory Techniques in Determining Bulk Properties of Tuffaceous Rocks," was submitted for management review in June. (SCP Activities 8.3.1.15.1.3.1 and 8.3.1.15.1.3.2)

Major Activities Upcoming Next Three Months

SAND92-0847, "The Effect of Frequency on Young's Modulus and Seismic Wave Attenuation in Tuff," has been technically and editorially reviewed. The document is being revised in response to the resulting comments and should begin management review in July. (SCP Activity 8.3.1.15.1.3.2)



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

Status Report on Ongoing Activities

The draft of "Standard Test Method for Normal and Shear Stiffness of Rock Fractures Using a Compression/Rotary Shear Apparatus" completed the first review by the American Society for Testing and Materials (ASTM) Subcommittee D18.12 on Rock Mechanics. This review was discussed at the committee meetings in Atlanta, GA on June 22 and 23. The draft was well received, with relatively few technical comments. The draft will be revised in the next two to three months. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

SAND93-1466A, an abstract entitled "Simple Mathematical Model of a Rough Fracture Using the Concepts of Fractal Geometry," has been submitted for management review. The study will be presented at the national Geological Society of America (GSA) meeting in Boston, MA in October. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

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

Major Activities Upcoming Next Three Months

SAND92-2333, "The Effect of Sliding Velocity on the Mechanical Response of Artificial Joints in Topopah Spring Member Tuff," is being revised in response to the comments generated during technical and editorial review. (SCP Activity 8.3.1.15.1.3.2)

**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" have been started.

Major Activities Upcoming Next Three Months

Work on the study plan will continue.



1.2.3.6.2.1.6 FUTURE REGIONAL CLIMATE AND ENVIRONMENTS

Status Report on Ongoing Activities

Draft responses to remaining Quality Assurance (QA) deficiencies identified in an audit of the National Center for Atmospheric Research (NCAR) have been prepared and are expected to be closed soon. A draft study plan is in preparation.

Major Activities Upcoming Next Three Months

Completion of the study plan draft and preparation for a readiness review are expected during this fiscal year. Procurement of a new, replacement contract for NCAR services is also expected in the next several months.

Other Items to Report

It is expected that needed additional funding requested from DOE for this work will be received.



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 Analysis (1.2.4.2.1.2), Certification of Design Methods (1.2.4.2.3.1), Design Analysis (1.2.4.2.3.2), and Sealing and Design Requirements (1.2.4.6.1).

1.2.4.1.1 REPOSITORY COORDINATION AND PLANNING

Status Report on Ongoing Activities

Work 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. Resolution of comments on Study Plan 8.3.1.15.1.5, "Excavation Investigations," was initiated.

SNL staff continued work on a series of analyses in support of the design of the ESF north ramp. Three-dimensional thermal/structural analyses of the repository to assess the impact of the potential repository thermal loading on the ESF drifts have been completed. Results will support two-dimensional analyses of several cross sections of the ESF north ramp to evaluate long-term stability. Geotechnical data from the NRG holes will be incorporated into the analyses. The analyses were to provide input for the 90% design review in August 1993; however, recent proposed changes in the ESF north ramp design and design schedule will require SNL to break the analyses into smaller segments to correspond to the new design packages.

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, rock mass quality estimates for the first 100 ft of tunnel were developed, locations were selected for the first two stations of rock bolt load cells, and bolts were installed. SNL is working with the constructor to locate and drill instrumentation

holes in the roof. Instruments will be installed after the 200-ft starter tunnel is completed.

Major Activities Upcoming Next Three Months

ESF design analyses will be rescheduled to correspond to the new design schedule. First design north ramp geomechanical analyses will be completed in July.

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 the close of the pilot heading. This work is not part of the design verification study plan (8.3.1.15.1.8), but it 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 incorporating 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

Significant Meetings Attended

A presentation detailing plans and objectives of the experiments contained in Study Plan 8.3.1.15.1.6, "In Situ Thermomechanical Properties," was presented at the dry run for the Nuclear Waste Technologies Review Board (NWTRB) meeting to be held on July 13 and 14.

Status Report on Ongoing Activities

Staff continued work on the rough draft of Study Plan 8.3.1.15.1.6.

The technical comments from an internal SNL technical review for the SAND report entitled "Test Instrumentation for the ESF In Situ Thermomechanical Experiments" were resolved.

Major Activities Upcoming Next Three Months

Staff will continue drafting Study Plan 8.3.1.15.1.6.

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

Under Los Alamos National Laboratory (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.

Plans and objectives of the experiments contained in Study Plan 8.3.1.15.1.6 will be presented to the NWTRB meeting on July 13 and 14. The presentation will address issues forwarded by the NWTRB for this meeting.



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.

1.2.4.2.1.1.4 IN SITU DESIGN VERIFICATION

Significant Meetings Attended

A summary of construction monitoring activities of the ESF north ramp starter tunnel was presented at the 34th U.S. Rock Mechanical Symposium (June 27 through 30) at a special session on the Yucca Mountain Project.

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 and rock quality determination activities were conducted and the initial installation of load cells to be used to monitor rock bolts used as ground support was performed.

As an activity separate from construction monitoring, staff began fielding additional monitoring activities in the north ramp starter tunnel to address safety concerns. Convergence monitoring of the tunnel 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 for future monitoring activities.

Staff will field 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 polycarbonate models continued in June. Data from a number of tests conducted over the last few months were analyzed.

Next month, SNL will complete the data reduction and begin writing a SAND report on the tests.

A study of the surface characteristics of natural fractures and how to relate these to the frictional data gathered on replicas of the surfaces is continuing. This study will place special emphasis on determining whether the fitting parameters in the so-called "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. The majority of the experimental work is being carried out by a University of Colorado (CU) graduate student in the Geomechanics Department laboratory at SNL. The series of eleven rotary shear experiments was completed in March. The results are being organized and analysis will continue for the next several weeks, leading to the data being presented in a SAND report.

A series of experiments designed to study the effects of a non-standard 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 been sent to the Project Office. The first of two analyses SAND reports (SAND92-2247), "Effect of Boundary Conditions on the Strength and Deformability of Replicas of Natural Fractures in Welded Tuff: Comparisons Between Predicted and Observed Behavior," has also finished management review and been sent to the Project Office. The second analysis report is being drafted and should begin SNL review next month.

SNL's support of the M&O's design efforts for the north ramp continued in June. The majority of

the static analyses have been conducted. In these analyses, the in situ, thermal, and equivalent seismic loads were applied to a number of north ramp cross sections. The seismic loads are clearly the dominant loads at most cross sections. Late in June, SNL became aware of new possible alignments for the north ramp that render most analyses performed over the last two months no longer useful. SNL is attempting to support the north ramp design by conducting an analysis of a generic section of the ramp between the starter section and the Bow Ridge fault. It will be very difficult to complete this work before the first design package is due, but all reasonable attempts will be made to provide input to the design.

Major Activities Upcoming Next Three Months

Testing, data reduction, and analysis will begin for a set of layered plate experiments. Design support analyses will be performed for the first section of the north ramp.

1.2.4.2.3.1 CERTIFICATION OF DESIGN METHODS

Status Report on Ongoing Activities

Work at CU in developing joint constitutive models is continuing. CU conducted a literature search to identify the "best" available joint constitutive model in the literature. Experimental data developed in WBS 1.2.4.2.1.2 has been fitted to Plesha's joint constitutive model. This month, the model was being incorporated into a finite element code. CU staff anticipates the implementation will be completed early in July.

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 sub-block concept. This month, staff worked on an augmented lagrangian method to handle block-to-block contact. CU staff believes that the slow convergence rate could be improved by using a variable penalty number in the method. Initial tests indicate that the convergence rate is indeed greatly improved. SNL staff has implemented the augmented lagrangian approach to explore the sub-blocking concept in a two-dimensional research code. Sub-blocking was attained, but the convergence rate was not satisfactory as the number of sub-blocks was increased. Next month staff will look for possible coding errors and explore the use of a variable penalty number, as is being done at CU.

In a separate activity, the coupled finite element-boundary element research is continuing. This month, J. R. Koteris (SNL) implemented a Newton outer loop to the JAC2D code, which allows the explicit solvers to operate on linear systems as opposed to nonlinear systems. The first successful test case in which nonlinear finite elements were coupled to linear boundary elements was conducted in June. The test case involved pressurizing a thick wall cylinder and allowing the plastic front to move in from the inner surface. This result is a significant accomplishment for this activity. SNL is now considering updating this research version of the code so that the jointed rock model can be used with the finite elements.

B. J. Thorne (SNL) has been working to improve SNL's continuum joint model. SNL staff has

identified a number of desired improvements to the model, such as increasing the number of joint sets, allowing for joint sets at arbitrary angles, and joint dilation. Work will progress toward these improvements through the remainder of FY93. These improvements were identified as missing desired features in the two-dimensional model and are desired features for the three-dimensional model.

J. Jung (SNL) presented a paper entitled "Thermal-Mechanical Analyses for the Yucca Mountain Project" at the Rock Mechanics Symposium in Madison, WI on June 29.

Major Activities Upcoming Next Three Months

Testing of a discrete element code sub-blocking concept will continue.

Implementation of the sub-blocking concept into the DDA code will continue.

Development of a coupled finite element-boundary element technology will continue to assess coupling nonlinear finite elements to linear boundary elements.

Work on a SAND report to document JAC2D will begin in July.

JUNE 1993



1.2.4.2.3.2 DESIGN ANALYSIS

Status Report on Ongoing Activities

The development of near-field thermal/structural/seismic models for use in supporting the design of the ESF's north ramp continued. Analyses assuming equivalent-static and dynamic seismic loads are being pursued. The applicability of current results is being evaluated with respect to proposed changes in the alignment of the north ramp.

1.2.4.6.1 SEALING AND DESIGN REQUIREMENTS

Status Report on Ongoing Activities

Work continued on SAND93-1184, "A Strategy to Seal Exploratory Boreholes in Unsaturated Tuff." The draft report is expected to be completed in early July and complete internal SNL review and be submitted to the Project Office by July 30, 1993.



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 barrier, 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 In (1.2.5.3.5), Total System Performance Assessment (1.2.5.4.1), Repository Performance Assessment (1.2.5.4.3), Site Performance Assessment (1.2.5.4.4), Interactive Graphics Information System (1.2.5.4.5), Development and Validation of Flow and Transport Models (1.2.5.4.6), Support Calculations for Postclosure Performance Analyses (1.2.5.4.7), Development and Verification of Flow and Transport Codes (1.2.5.4.9), and Special Projects (1.2.5.5).

1.2.5.1 REGULATORY COORDINATION AND PLANNING

Status Report on Ongoing Activities

Routine oversight of regulatory activities was conducted.

1.2.5.2.2 SITE CHARACTERIZATION PROGRAM

Status Report on Ongoing Activities

Staff participated in organizational and dry run meetings in preparation for an NWTRB meeting on thermal loading. Initial meetings for the next phase of the Integrated Test Evaluation (ITE) effort have been held. This phase of the decision analysis process will be used to prioritize site characterization tests based on the criterion of importance of tests for supplying needed design data. Staff attended an Office of Civilian Radioactive Waste Management (OCRWM) Licensing Workshop in Las Vegas, NV on June 22.



1.2.5.3.5 TECHNICAL DATABASE INPUT

Significant Meetings Attended

SNL staff attended the quarterly database working group meeting in Las Vegas, NV on June 3. Issues discussed included the pending completion of the Parameter Dictionary, submitting the Technical Data Information Form (TDIF) backlog to GENISES, the Data Catalog, ATDT system access for project participants, and data deliverables for GENISES.

Major Activities Upcoming Next Three Months

The FY94 budget needs for WBS 1.2.5.3.5 will be determined.

Issues/Potential Problems Needing Resolution and Potential Impacts

Modification of TDIFs is required to facilitate TDIF usage by technical personnel.

1.2.5.4.1 TOTAL SYSTEM PERFORMANCE ASSESSMENT

Major Accomplishments

SAND93-1415C, "Analyses of Releases Due to Drilling at the Potential Yucca Mountain Repository," by R. W. Barnard, was submitted as an invited paper for the 1993 American Nuclear Society (ANS) winter meeting.

Significant Meetings Attended

Staff attended a meeting of the Thermal Modeling Group in Las Vegas, NV on June 29 to examine current calculational results and to address whether engineering design decisions can be made based on the results of these analyses.

Staff attended two meetings held at LLNL to define the components of the YMIM EBS/near-field module for the TSPA aqueous transport analyses. SNL staff members now have a module that is a component of TOSPAC and of the "Weeps" codes. YMIM includes waste-package lifetime, thermally induced groundwater flow, and several mobilization processes.

On June 25, staff of SNL and Tech Reps Inc. (TRI) met to discuss the climate-change information being gathered by the Waste Isolation Pilot Project (WIPP). WIPP is using a doubling of precipitation as the upper bound of a climate change in the next 10,000 yr.

SNL staff coordinated and hosted an elicitation of sorption data for TSPA-2 in Albuquerque, NM on June 1. The geochemistry experts elicited were from LANL, Jacobs Engineering, and SNL. The elicitation was conducted by SNL, and observers from INTERA/M&O were also present. K_d distributions were elicited for 15 radionuclides. The minutes of the elicitation were written by SNL and will undergo review and revisions by LANL for inclusion in the TSPA report.

Staff attended the NRC technical exchange on Basaltic Volcanism in Las Vegas, NV on June 9.

H. Dockery attended an NEA/OECD meeting in Paris, France on June 17 and 18. The meeting addressed the possibility of forming an international database on features, events, and

processes (FEPs) related to radioactive waste isolation. The meeting was also attended by representatives from Sweden, Switzerland, Canada, USNRC, and WIPP. The consensus of the group was that such a database could be very useful to the international community. The group agreed to work on several methods of incorporating the information already available in the various programs. A second meeting in November will review the results of these efforts. While in Europe, Ms. Dockery also visited the radioactive waste isolation programs at BRGM in Orleans, France and NAGRA in Switzerland. She made presentations on TSPA-91 and TSPA-II at both locations.

Status Report on Ongoing Activities

SNL staff has been developing the radionuclide inventory for the TSPA-2 source term. This source term will include both spent fuel and glass high-level waste. The spent-fuel inventory was built as for TSPA-91, except that the waste stream that describes the proposed emplacement scheme will be used to determine fuel age and burnup. Data for glass high-level waste were obtained from the "Characteristics Data Base" (DOE/RW-0184). Work is proceeding on incorporating the new LLNL source term into SNL performance assessment (PA) codes.

Other SNL code modifications necessary to complete the TSPA-2 calculations are also ongoing. TOSPAC has been modified to allow changes in flux, mesh, and water-table height during a single calculation to simulate climate changes. The new automatic mesh generator for TOSPAC has been debugged, and additional features that should help minimize mass-balance problems during transport calculations have been added.

Definition of the input-parameter probability distributions, except for the source parameters to be defined by LLNL, are almost complete. The input files for TSA runs for TSPA-2 are being compiled.

The weeps model (WEEPSTA) was modified to include thermal effects and to incorporate the source-term information provided by LLNL in YMIM. Work is presently being done to develop the details of the input/output structure. By the

time the thermal data and YMIM are received, the weeps calculations for TSPA-2 should be started.

The integrated finite difference code TOUGH2 has been used to make one-dimensional predictions of the multiphase flow in the vicinity of the proposed underground nuclear waste repository at Yucca Mountain, NV, for times to 10,000 yr. The primary difference between these results and those obtained by participants from LLNL is the amount of dryout calculated in the vicinity of the repository. The SNL version of TOUGH does not have the coding required for the use of a composite material characteristic model. Consequently, these one-dimensional predictions do not include the effect of fracture flow which could account for the lack of dryout. A participant from LLNL has sent the vectorized version of the routines required to implement the composite model. Numerous modifications are required. These changes are currently being added to the SNL version of TOUGH.

SAND93-0852, "The Appropriateness of One-Dimensional Yucca Mountain Hydrologic Calculations," is being reviewed.

A model has been formulated for moisture (liquid and vapor) movement in fractured media driven by fluctuations in barometric pressure. A formulation for describing multiphase flow of water, air, and energy in a porous material has also been developed. This particular formulation is appropriate for numerical treatment when coupled to the simplified description of time-periodic flow in the fracture system. A method-of-lines (MOL) code has been written to obtain numerical solutions to the fracture/matrix problem. The code was tested by computing solutions to a heat-pipe problem. The code was also tested by recomputing a problem done at Lawrence Berkeley Laboratory (LBL) using TOUGH. This consisted of two-phase flow in a 600-m vertical column using TSw material properties. The problem is driven by a geothermal temperature gradient. Fluxes computed with the MOL solver compared well with those reported by a member of LBL. The code is currently being applied to the fracture/matrix barometric pumping problem.

Workers at Disposal Safety Inc. are developing new gas-flow and carbon-14-travel-time calculations that will be used to modify the gaseous flow model.



Preliminary human-intrusion drilling simulations have been done, both for the Site Characterization Plan (SCP) emplacement scheme and the in-drift emplacement. Now that the source term is finished, the final analyses and sensitivity studies can be completed. By including both components of the source term described above, the human-intrusion analyses can reflect the probabilities of drilling into both glass and spent-fuel waste.

The thermal pulse calculation to model an igneous dike near a waste package is being performed. The calculation involves evaluating transcendental functions, which require the application of numerical analysis techniques. When the volcanic source term is completed, aqueous-transport simulations and sensitivity studies will be done.

Final revisions of the nominal flow scenario-selection document are being incorporated and should be ready for internal review by the beginning of July.

Major Activities Upcoming Next Three Months

Work is expected to begin on the document to develop human intrusion scenarios in late August.

1.2.5.4.3 REPOSITORY PERFORMANCE ASSESSMENT

Major Accomplishments

SNL staff compiled the conclusions of the Operations and Safety Team into a summary memorandum submitted to DOE and the SCP Thermal Goals Reevaluation Working Group. This input was incorporated into a preliminary draft of the SCP Thermal Goals Reevaluation Report. Staff also were asked to comment on the draft reevaluation report, which is expected to be issued later this year.

Significant Meetings Attended

SNL personnel attended a performance assessment briefing for DOE on June 29 in Las Vegas, NV. The meeting was the result of the Project's evaluation of the "long-term hot" strategy.

SNL personnel attended a scoping meeting and dry run for the July 13 and 14 NWTRB meeting on thermal loading. SNL participation in the meeting will include presentations on thermal modeling, testing, and performance assessment.

SNL staff met with M&O personnel working on the thermal loading systems study. The M&O provided SNL with a first draft of calculational requirements. SNL is currently evaluating the request.

Status Report on Ongoing Activities

A levelized waste stream approximation was obtained from the M&O for use in thermal calculations required to support the next iteration of TSPA.

Near-field calculations for an in-drift emplacement mode have been completed for TSPA using the results forwarded to the M&O's waste package design team. The M&O will be using these near-field thermal profiles as boundary conditions for their detailed waste package simulations.

Set-up activities continued for far-field thermal models required to support the next iteration of TSPA. The goals of the far-field analyses are to provide PA staff with estimates of the number of packages protected by a boiling front as a function of time and volumetric dry out.



1.2.5.4.4 SITE PERFORMANCE ASSESSMENT

Major Accomplishments

The stratigraphies for the revised columns for TSPA-2 have been completed.

Status Report on Ongoing Activities

Geohydrologic Data Analysis: Input matrix and bulk parameters for all the required hydrogeologic data that will be used by this year's TSPA modelers/calculators have been completed and provided to SNL staff.

Matrix Parameters: The initial distributions derived for matrix properties, as reported last month, were revised and updated based on ten new stratigraphic realizations (columns) generated. This required the upscaling of all the distributions for each parameter based on stratigraphic thickness for each TSPA layer. Development of the matrix parameters was completed and consisted of basic statistics with the corresponding BETA probability distributions. A Spearman Rank Correlation to compare the matrix hydraulic conductivity with matrix porosity was completed to check for significance between these parameters. Four of the twelve layers did display a significant correlation between the two properties.

Bulk Parameters: Values for the bulk conductivities for the 12 TSPA layers were finalized. The values determined for the conductivities were derived in three ways: bulk pump tests; barometric fluctuations (gas permeabilities); and, for the few layers without direct measurements, analog determinations were derived from other layers (based on similarity of lithologic and matrix properties). Fracture frequencies for boreholes USW G-1, G-4, GU-3, and UE 25a#1 were compiled based on the down-hole fracture count data reported in the original USGS Open File Reports of drill logs for each drill hole. The basic data were statistically reduced and BETA probability distributions produced for each TSPA-identified stratigraphic layer. Based on a relationship between the bulk permeabilities as converted from the derived bulk conductivities and fracture frequencies, fracture aperture sets were also derived. A distribution of apertures for each of the 12 layers has been produced.

Documentation of the process for the generation of the matrix and bulk parameters has been started. The outline, introduction, and background has been drafted.

DATA BASE AND GIS MANAGEMENT

GIS Activities Providing Support to the YMP Geostatistical Efforts: A number of programs were written to link various routines in the geostatistical software from the Stanford Center for Reservoir Forecasting. This software can be used for preposterior analysis in a data-worth model and could be used to prioritize site characterization activities at the Yucca Mountain site. Stratified sampling procedures written to optimize sample sets in the elicitation software will be incorporated into the geostatistical software to further increase the efficiency of the analysis.

The Geostatistical Adaptive Grid (GAG) program has been completely rewritten due to problems encountered for the east-west INTRAVAL cross section. The seven north-south cross sections have been rerun using the new version of GAG. The improvements can be stated as norms that are measures of the heterogeneity of all the elements. Average improvement is 48% in the norm for the new GAG versus 12.2% for the old GAG. The reduction in heterogeneity also helps the upscaling algorithms.

A program was written to sample fracture frequency and bulk conductivity distributions to create a distribution of fracture apertures using the cubic law. Distributions for the fracture air entry parameter were also generated. A root-finding subroutine was added to help generate varieties from a beta probability distribution and code was added to allow comment input files to be used.



1.2.5.4.5 INTERACTIVE GRAPHICS INFORMATION SYSTEM

Status Report on Ongoing Activities

A workload spike on color printers caused queuing problems and excessive delays. Staff evaluated several printer replacement options to accommodate the ever-increasing workload. Because no printer evaluated met the requirements of cost and performance, the existing printers will be upgraded. Staff will continue to look for printers that may prove to be good replacements.

Development is continuing on a series of coverages showing the starter tunnel, alcoves, and instrument locations. The plan of the starter tunnel is nearly complete; information on instrument locations are not yet available.

Staff continues to identify users of the VAX 3600 to help plan the retirement of the computer. The Calma/DDM thermal/mechanical model is not scheduled to be made available beyond FY93.

Major Activities Upcoming Next Three Months

Staff will relocate the existing computer systems and local area network (LAN) to the BDM building in a manner that will minimize downtime and disrupted services.

Staff will find alternate platforms for users of the VAX 3600, migrate to the other platform, 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 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 407 for M. L. Jones - Add New Data Coverages
- Job 408 for L. E. Shephard - Profile Through USW G-4



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 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.

Significant Meetings Attended

M. Siegel met with A. Simmons and J. Boak (both of YMPO), and researchers at the University of Nevada at Las Vegas (UNLV) to discuss a collaborative reactive transport experiment using large-scale column apparatus developed at UNLV.

Caisson Test

Systematic studies of sorption of nickel (Ni) by the Wedron 510 sand under atmospheric conditions at two different Ni concentrations in the presence and absence of LiBr were initiated. A draft Technical Procedure for Br analysis by ion-specific electrode was completed. Nickel sorption experiments using the batch sorption techniques described in LANL Detailed Technical Procedures TWS-INC-DP-05-R2 and IANL-INC-DP-86-R0 continued. The effect of separation by ultracentrifugation on the pH-dependent sorption is being investigated. A solution produced by leaching the Wedron 510 sand and adding a Ni spike was prepared for an interlaboratory calibration with UNLV. Techniques for analysis of Ni, Br, Li, Ca, and Mg used at SNL and UNLV for the caisson test will be compared.

Reactive Transport Model Development

A revised draft of the report "User's Manual for LEHGC: A Lagrangian-Eulerian Model of HydroGeological Transport in Saturated - Unsaturated Media - Version 1.0" was completed.

Reactive Transport Experimentation

Development of methods to carry out in-situ batch sorption studies in unsaturated media continued at the Massachusetts Institute of Technology (MIT). A method to estimate the pH of pore water in unsaturated sand from pH titration data obtained at different solution/solid ratios was developed and is being reviewed. Several alternate methods to extract pore solutions from unsaturated sand for pH and uranium analyses are being compared. Kinetic studies of uranium sorption/desorption were carried out. A dedicated Nd:YAG laser for uranium fluorescence imaging studies was installed and is operational at MIT. Studies of fracture-matrix interaction using analog materials are being designed in collaboration with SNL. An extended abstract entitled "Development of Methods to Evaluate Uranium Distribution Coefficients in Unsaturated Media" was prepared for review for the proceedings of the American Chemical Society Emerging Technologies in Hazardous Waste Management Conference, which will be held in Atlanta, GA on September 27 and 28. Actions required by the Corrective Action Requests (CARs) resulting from the QA audit held at MIT in March were carried out.

Planning and instrumentation of the reactive transport laboratory continued. Several unsaturated hanging column experiments with Wedron 510 sand and a LiBr tracer were performed. Both a pulse and a continuous feed of LiBr solution were used, and retardation factors and dispersivities for Li and Br were calculated. Similar experiments with different flow conditions are underway, and experiments with Ni transport are also being designed.

A relatively mild method to clean carbonate cement from the Wedron 510 sand was developed. Approximately 1 kg of sand was cleaned for surface titration and Ni adsorption studies. The sand was used to evaluate the reproducibility and accuracy of potentiometric titration curves.

V. Tidwell (SNL) met with E. Kwicklis and F. Thamir (USGS) on June 11 in Denver, CO to discuss the fractured tuff block/slab experiments to be conducted jointly by several YMP participants. The laboratory holding the tuff block of interest was also visited.

R. J. Glass and M. J. Nicholl traveled to Reno, NV to confer with S. W. Wheatcraft and K. Brewer at the University of Nevada, Reno. This meeting was part of a collaborative effort directed toward analysis of fracture flow data obtained from laboratory experiments in individual analog fractures under both saturated and unsaturated conditions.

Status Report on Ongoing Activities

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.

"Gravity-Driven Infiltration Flow Instability in Initially Dry Non-Horizontal Fractures," by M. J. Nicholl (SNL), R. J. Glass (SNL), and S. W. Wheatcraft (Department of Geological Sciences University of Nevada, Reno), submitted as a journal article to Water Resources Research, completes Level 3 milestone number OS33. A copy of the paper was transmitted to the Project Office. In this paper, experimental evidence demonstrating gravity-driven wetting front instability in an initially dry natural fracture is presented. An experimental approach is developed using a transparent analog rough-walled fracture to explore gravity-driven instability. Three different boundary conditions were observed to produce unstable fronts in the analog fracture: application of fluid at less than the imbibition capacity, inversion of a density-stratified system, and redistribution of flow at the cessation of stable infiltration. The redistribution boundary condition, which is analogous to ponded infiltration, is considered in a series of systematic experiments. Gravitational gradient and magnitude of the fluid input were varied during experimentation. Qualitative observations imply that finger development is strongly correlated to the structure of the imbibition front at the onset of flow redistribution. Measurements of finger-tip velocity are used to develop a first-order relationship with finger-tip length. Measured finger width is compared to theoretical predictions based on linear stability theory.

The following paper was entered into internal review, prior to submission as a journal article: "Behavior of Individual Gravity-Driven Fingers in

an Initially Dry Fracture," by M. J. Nicholl and R. J. Glass.

The methodology to produce epoxy casts of natural fractures was further refined. A group of flat circular samples was prepared to evaluate the wetting, optical, and mechanical properties of various epoxy formulations. The surface wetting properties of these samples were then explored; this work will continue in July. In preliminary fracture-casting operations, alignment of the fracture halves was not tightly controlled. As a result, implementation of boundary conditions and installation of the fracture cast into the test cell required a significant amount of hand fitting. To streamline the process, improved control of specimen alignment is desirable. Several possible casting procedures were developed; relative merit of these methods will be considered in July.

Experimental techniques to explore the effects of air entrapment on fracture permeability and tracer migration were also further refined. Work continued on the image-acquisition and experimental control software. A relay to shut off the camera if flow of cooling fluid ceases was fabricated and will be installed in July. Training of a new technician to run this experiment was initiated. Development of specific experimental procedures was begun and will be completed by early July, along with the data-analysis technique.

Fracture/matrix interaction: Construction was completed on the test chamber for fracture-matrix interaction studies using single or multiple fractured tuff slabs measuring 2 ft² and 1 in. thick. A means of applying the desired boundary conditions to the natural and/or sawn fractures has been improved. A suite of rock slabs has also been cut (from Topopah Spring tuff) for use in these experiments.

Experiments continued in the effort to develop real-time x-ray analysis capabilities. Currently, investigations are conducted in two systems: a simple x-ray detector/image intensifier system and the more sophisticated Siemens Polytron. The goal is to achieve a high degree of image contrast in porous systems with short time constants.

The Phillips industrial x-ray, which was purchased for dedicated use in the YMP Unsaturated Flow and Transport Laboratory, was temporarily set up at the Non-Destructive Testing Laboratory at SNL. The x-ray unit is currently being used in



association with YMP-funded experiments. Design of a facility for permanent operation of the x-ray is in progress.

Comments by Water Resources Research staff have been addressed in the paper entitled "X-ray and Visible Light Transmission as Two-Dimensional, Full-Field Moisture-Sensing Techniques for Laboratory Use," by V. C. Tidwell and R. J. Glass. Final internal review is currently underway.

Experimental apparatus allowing observation of fracture wetted structure as a function of matrix pressure was updated. A high-resolution digital camera was installed; this system yields 1024 x 1024 pixels of spatial resolution at 4096 gray-level-intensity resolution. Low-resolution cameras (512 x 512 pixels, 256 gray levels) to provide back-up data and monitor piezometers were also installed. Software controlling data acquisition and fluid pressures was refined. A series of test images were collected to provide a basis for image analysis; development of the experimental and analytic procedures will be accomplished in July.

Field, lab, and numerical experimentation to determine scaling laws for effective-media properties in heterogeneous media: The automated gas permeameter test system is fully operational. Tests have been performed to evaluate permeameter sensitivity, measurement repeatability, and temporal stability. An improved seal material has been identified and tested (RTV silicone rubber) that will facilitate measurements made on rough rock surfaces. Current efforts involve calibration of the mass flow meters and pressure transducers, as well as the acquisition of rock blocks for testing.

Major Activities Upcoming Next Three Months

Staff will obtain surface complexation constants of Br, Li, and Ni by sand to be used in caisson or in supporting laboratory studies, carry out Li-Ni ion exchange studies with sand, continue isotherm experiments to determine the linear range of sorption of tracers, continue surface potentiometric titration of sand, implement LEHGC code on massively parallel architecture, continue development of the method of unsaturated K_d measurements with Turbula mixer, and optimize the method for laser fluorescence measurements of uranium in sand and fractured media.

1.2.5.4.7 SUPPORTING CALCULATIONS FOR POSTCLOSURE PERFORMANCE ANALYSES

Significant Meetings Attended

S. Sobolik attended the ESF Status Meeting in Las Vegas, NV on June 11 and presented the results and recommendations from ESF PA Analysis #13, which addresses concerns regarding underground water usage in the ESF North Ramp, South Ramp, and Main Test Level tunnels.

S. Sobolik and E. Ryder attended a meeting on Performance Assessment Thermal Modeling. Presentations were made by SNL, LLNL, and LBL staff, and M&O personnel.

Status Report on Ongoing Activities

A new ESF PA Analysis (#14) investigating the sensitivity of previous analyses to uncertainty in the hydrologic properties of the nonwelded Paintbrush Tuff has been initiated. A Work Agreement (WA-0089) has been completed. Summer student Walter Cruz (Universidad del Turabo, Puerto Rico) has begun preliminary calculations. This PA analysis has been identified as a potential activity with Level III Milestones for FY94.

S. Sobolik will participate in a DOE-NRC Technical Exchange on the ESF Title II Design. Information from the underground water analysis (ESF Analysis #13) specifically relating to fire suppression will be presented.

Major Activities Upcoming Next Three Months

A SNL Internal Audit (SNL-A93-1) will be held in July, and 1.2.5.4.7 will once again be investigated.

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

The report SAND92-2248 will be published.

Testing and numerical simulations using TOUGH-2 for the nonisothermal experiments planned with WBS 1.2.5.4.3 will continue.

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

Status Report on Ongoing Activities

Staff continues to work with the Software QAT on rewriting QAIP 3-2.

Processing of software QA records is ongoing.

Work is progressing on qualifying software code VEC/DYNA 3D.

1.2.5.5.2 ENERGY POLICY ACT SUPPORT

Significant Meetings Attended

J. Schelling attended several meetings in Las Vegas, NV as the SNL representative to the Integrated Test Evaluation (ITE) working group.



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

No significant activity this reporting period.

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.

Plans and objectives of the experiments contained in Study Plan 8.3.1.15.1.6, "In Situ Thermomechanical Properties," will be presented to the NWTRB meeting that will be held on July 13 and 14.

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



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

Major Accomplishments

A special session on Yucca Mountain was convened at the U.S. Rock Mechanics Symposium in Madison, WI. Five papers were presented that provided overviews of the mechanical and thermal properties studies and analyses being planned or implemented at Yucca Mountain. As a result, an informal invitation for a follow-on Yucca Mountain session at the 1995 symposium in Reno, NV was extended.

Status Report on Ongoing Activities

Staff participated in a number of project meetings in Las Vegas, NV including budget, thermal loading, design data, field engineering, technical data, National Academy of Science interactions, and the prototype licensing workshop.

SNL YMP staff is planning and supporting the move of SNI YMP offices to new office facilities near the Albuquerque airport.

Major Activities Upcoming Next Three Months

SNI YMP staff will be relocating before FY94.

1.2.9.2.2 PROJECT CONTROL

Major Accomplishments

To date, a total of 21 of 52 milestones have been completed.

SNL YMP staff met with M. A. Jones and N. Trentman of YMP to discuss networking changes and computer-related planned acquisitions. SNL YMP project management staff attended the June Planning and Control System (PACS) participant workstation meeting on June 25. New software and data files received at the meeting have been installed on the PACS workstation.

Significant Meetings Attended

Staff attended a Workstation User Group Meeting in Las Vegas, NV on June 24.

Status Report on Ongoing Activities

Analysis continued on the SNL YMP internal budget, cost, and schedule processes. Staff also initiated the development of the SNL Baseline Configuration Management Plan.

The FY94 internal budget planning exercise continued. Input from the initial steps in the planning process was reviewed and entered into a temporary PACS working file that includes technical and level of effort workscopes, deliverables, milestones, priorities, and projected funding allocations.

Discussions were initiated to define a new SNL YMP case structure based upon the 10-digit case numbering system to be implemented by SNL in FY94. There is support for incorporating the Work Breakdown Structure (WBS) numbers into the case numbers. However, opponents are

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concerned that the WBS structure changes too often and may expand beyond the current number of digits to make it a useful case framework.

Work continued on a further revision of the Milestone Tracking database. The new version, which will reside on the Administrative Information Management System (AIMS) database network and be integrated with the PACS Cost/Budget database, has been prototyped and is undergoing review. Several enhancements are expected to be incorporated before the production version is ready.

Installation of new workstation software and data files was completed, and the new workscope editing utility demonstrated.

SNL project management staff is continuing to develop new capabilities to access financial information in the SNL financial computers.

Major Activities Upcoming Next Three Months

The SNL Baseline Configuration Management Plan will be completed.

Staff will complete the initial FY94 budget exercise after receiving guidance from the Project Office.

SNL staff will prepare and plan for the upcoming budget exercise.



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

SNL YMP QA staff completed the Supplier Qualification audit of SNL's calibration facilities, by performing an evaluation of the "length/mass/force" calibration lab. With some restrictions, SNL's Standards Laboratory is being approved for metrology services in support of the YMP.

Significant Meetings Attended

J. V. Voigt and D. P. Wrobel attended a New Miner Training and First Aid course at the USGS office in Lakeview, CO. J. C. Friend attended the Quality Assurance Requirements and Description (QARD) Orientation at the YMPO in June.

Status Report on Ongoing Activities

Staff continues to implement procedure improvement and transition to the new QARD. The following list summarizes the status of particular procedures.

- QAIP 2-4, Conducting and Documentating Analyses. Issued
- QAIP 2-5, Training (Revised). In Review
- QAIP 3-2, Software QA Procedure "draft." Working with Technical Staff
- QAIP 5-1, Quality Assurance Implementing Procedures. Issued
- QAIP 6-3, Conducting and Documenting Reviews of Documents. In Review
- QAIP 17-2, Participant Data Archive. Issued
- QAIP 20-3, Sample Control. Issued

The SNL YMP QA Program Description was cancelled.

An SNL QA audit of International Technology Corporation (ITC) was conducted June 16 and 17, 1993. The audit resulted in 4 CARs (2 deviations and 2 observations), and two other potential CARs were resolved during the course of the audit.

Major Activities Upcoming Next Three Months

QARD matrix data will be input into the YMP Quality Assurance Division (QAD) data base.

Several site surveillance are being planned to examine ongoing ESF tunnel monitoring activities and core drilling activities.

The annual internal QA audit of the SNL Yucca Mountain Project is scheduled for July 12 through 16.

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

Significant Meetings Attended

SNL YMP staff met with M. A. Jones and N. Trentman of YMP on June 22 to discuss networking changes and computer-related planned acquisitions.

Status Report on Ongoing Activities

Routine oversight of information management coordination and planning was conducted.

1.2.12.2.2 LOCAL RECORDS CENTER OPERATION

Major Accomplishments

Ten boxes of the 22 Series "Procurement" proprietary records and YMP nonrecords are being reviewed for submittal to YMP or the SNL storage facility.

Two hundred pages of duplicate records were found within boxes submitted to the LRC.

Thirteen cited references (160 pages) for publications were copied and submitted to the CRF.

Seven record packages (411 pages) were prepared and submitted to the CRF.

Seven TDIFs were prepared and submitted to the RMS.

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

Status Report on Ongoing Activities

To verify Project and SNL microfilmed records/documents, research was initiated to determine microfilm numbers for the 1986 SAND reports.

Twelve boxes of YMP nonrecord materials were prepared for SNL storage.

All Desk Guidance will be completed. STATUS UPDATE: "YMP Technical Reports and References" was completed.

SNL has published 897 SAND reports in the YMP Program. Seven of these reports have had TDIFs prepared and submitted to the ATDT. All 897



reports must be reviewed and, as appropriate, TDIFs must be prepared.

Training has been conducted this month of a new assistant to initiate the processing of "backlog" technical data for submittal to the Records Management System.

Five new data sets were opened.

Major Activities Upcoming Next Three Months

Staff will assess and redesign the current Local Record Center filing system.

All microfilm will be verified against hardcopy dual storage records from 1989 to the beginning of the Project. Destroy verified hardcopy, if approvals are issued, or box and send the hardcopy to the SNL archives.

Begin research on and propose a phased approach to development of a Disaster Preparedness and Recovery Plan for the YMP Records Management Program.

Continue the review process of SAND reports and develop TDIFs where appropriate.

Establish a technical data team to evaluate SNL YMP processes and integrate requirements, technical efforts and support efforts for improved efficiency of personnel.

Continue review and revision of Desk Guidance for Participant Data Archive (PDA) activities.

1.2.12.2.3 PARTICIPANT RECORDS MANAGEMENT

Major Accomplishments

A new Records Management Supervisor for the YMP Records Management Support efforts has been hired and will begin work on July 7th.

Significant Meetings Attended

The Records Manager attended the DOE Records Manager's Conference in Seattle, WA and presented a paper titled "Identifying Potential QA Records."

Major Activities Upcoming Next Three Months

Obtain Sandia National Laboratory and OCRWM approval/authorization for the identification of YMP Project duplicate storage records as Federal nonrecords. When so designated, obtain approval/authorization for the verification and destruction of said records.

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1.2.12.2.5 DOCUMENT CONTROL

No significant activity this reporting period.



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

Status Report on Ongoing Activities

Routine oversight of support service activities was conducted.

1.2.15.2 ADMINISTRATIVE SUPPORT

Major Accomplishments

During the month of May, one SAND report was printed.

Status Report on Ongoing Activities

Work on the procurements database design continued. Efforts concentrated on developing queries that will provide downloaded financial information from SNL's financial system. The database will be designed to provide detailed procurement information as required by the YMP socioeconomic monitoring plan and will perform three major functions: procurement tracking, financial data downloads, and reporting.

Extensive efforts continue to be made to complete the reclassification of manpower contracts to ensure that year-to-date costs are spread to accurate cases.

Efforts continue to consolidate a list of Nuclear Waste Fund (NWF)/YMP equipment identified as "Uninventoried" in Sandia's Property Management System. Staff are identifying locations and possessors of NWF equipment and updating Sandia's database accordingly. Property staff are also preparing/validating inventory lists in support of the SNL YMP move to a new SNL site.



1.2.15.3 YMP SUPPORT FOR THE TRAINING MISSION

Major Accomplishments

A YMP Manager and the Training Manager completed a three-day workshop entitled "Facilitating Groups in Conflict."

SNL QAIP 2-5 has been revised and submitted to the Technical Project Officer (TPO) for final approval.

The new Training Orientation is ready for immediate implementation. This includes a full half-day session with each new/transfer employee, using one-on-one Performance-based Procedure Training and Abstract Training.

All SNL YMP forms have been redesigned to eliminate shading in significant signature and write-in areas.

The SNL/YMP Employee Orientation manual has been updated to include the reorganization of 6100.

The new Training Database is ready for full implementation. Parallel entry into FoxPro will not be necessary.

Status Report on Ongoing Activities

Staff is continuing to use parallel entry into FoxPro and Informix, continuing to develop a relational database interlocking the Training Database and the Controlled Document System and a plan to revise the "new employee orientation" that includes one-on-one sessions on specific procedures, and designing training to be based on Work Assignment "point of use."

A new "Person" table has been designed to network information shared by the SNL/YMP Training Database and the SNL Controlled Documents Database.

Ten videotapes of the "Geology for Non-Geologist" course are being edited. Training record packages were prepared and submitted to the LRC.

A Training Systems Team is formulating recommendations for improving the effectiveness and adequacy of the training program.

The major steps of the new Training Program flow are in the process of final approval before implementation.

Major Activities Upcoming Next Three Months

A three-day course on "Technical Presentation Skills" will be offered to YMP participants.

A four-day course on "Leadership for the Future" will also be offered to YMP participants.

Editing of the "Geology for Non-Geologists" course tapes will continue. Training for improving computing skills will be initiated.

The training database will be improved and converted to AIMS.

Replacement training support staff may be hired for the summer.

Future education and training required for YMP ESF personnel should be coordinated to have instructors at SNL in Albuquerque or provide video training.



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9 August 1993

Wendy Dixon
Director, Project Operations and Control Division
Yucca Mountain Site Characterization Project
PO Box 98608
Las Vegas, NV 89193-8608

Dear Wendy:

We have received copies of the report and findings for Environmental Management Audit FY93B of Desert Research Institute's archaeological studies program for the Yucca Mountain Project. Enclosed, per your request, is a plan and schedule that addresses the findings of that audit. As you know, the Desert Research Institute is actively committed to excellence in environmental research and stewardship. We have already satisfied some of the audit findings, and will make every effort to comply with all applicable YMP environmental management requirements. I hope you find this plan satisfactory and timely. If you have any questions or comments, please do not hesitate to call me at 702/673-7310.

Sincerely,

David Rhode
Associate Research Professor

cc: Chron File
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8/18/93

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**DESERT RESEARCH INSTITUTE
YUCCA MOUNTAIN PROJECT ARCHAEOLOGICAL STUDIES PROGRAM
ENVIRONMENTAL MANAGEMENT AUDIT FY93B**

AUDIT FINDINGS AND PROPOSED REMEDIES

EMP/BMP-1. Deficiency in Clearly Defined Organizational Structure to Support YMP Environmental Compliance and Protection

Discussion: DRI's organizational structure does not formally address the functions, responsibilities, and authorities for YMP-related environmental compliance and protection. The auditors note that "there does not appear to be any formal statement or other documentation that clearly defines primacy in matters related to YMP environmental compliance and protection . . . no formal policies or directives that identify specific responsibilities, authority, or accountability . . . DRI does not appear to have any formal mechanism for field units to report YMP-related environmental concerns or issues to upper management, and there is no function with an oversight role for YMP environmental protection."

Proposed Remedy: DRI's organizational structure for YMP-related environmental compliance and protection will be formally stated as part of an ES&H Program Plan for DRI's YMP Archaeological Studies. This document will identify specific responsibilities and authority for both management and scientists, and will describe the process for oversight of the program.

EMP/BMP-2. Lack of Formal Environmental Management Program.

Discussion: DRI has no formal environmental protection program to insure that DRI conducts its YMP activities in accordance with YMP procedures and plans. The audit found that "DRI has no auditable policies, standards, and procedures that are supported by controlled documentation to guide environmental compliance and protection . . . Environmental training [beyond GET] is not supported or augmented by any coordinated internal training program. There did not appear to be any formal or identifiable lines of communication between management and field staff relative to YMP-related environmental compliance and protection. Similarly, there appears to be a deficiency in lines of communication between DRI and [YMPO] . . . DRI has not formally documented specific management responsibility and authority for YMP-related environmental compliance and protection . . . [and] has not been included, or sought to be included, on controlled distribution for the YMP procedures and plans for environmental protection."

Proposed Remedy: As noted above, DRI will prepare an ES&H Program Plan for YMP-related archaeological studies. The Program Plan will include: (1) the environmental management structure, including descriptions of responsibilities and authority; (2) procedures for occurrence reporting; (3) procedures to follow for safety and health-related issues; (4) provisions for specific

training of personnel on these procedures; and (5) procedures for self-assessment and oversight of DRI's archaeological activities, as they pertain to environmental management and protection.

EMP/BMP-3. Management Commitment to Environmental Excellence.

Discussion: DRI Managers have not formally stated their commitment to environmental excellence.

Proposed Remedy: DRI is, and has always been, committed to excellence in environmental protection and management. We will make a formal statement declaring that commitment in the ES&H Program Plan.

REC/CF-1. Procedural Non-Compliance.

Discussion: DRI is not in compliance with the provisions of AP-6.18 that establish a process to stop actions when imminent danger is suspected.

Proposed Remedy: Now that DRI is on the controlled distribution for AP-6.18, we will establish an internal process to follow that procedure to stop actions when imminent danger is suspected. This process will be part of DRI's ES&H Program Plan.

RAP/CF-1. Procedural Non-Compliance.

Discussion: DRI is not on the distribution for AP-2.9 and therefore is not in compliance with those procedures that establish specific occurrence reporting and processing guidance for YMP participants.

Proposed Remedy: We are now on the controlled distribution for AP-2.9. We will establish specific procedures within DRI's existing Occurrence Reporting Plan to comply with AP-2.9 for occurrence reporting for YMP-related activities.

RAP/BMP-1. Delegation of Responsibilities.

Discussion: Individual responsibilities for YMP occurrence reporting and processing were not clearly established or defined within the DRI organizational structure.

Proposed Remedy: Individual responsibilities for YMP occurrence reporting and processing will be clearly identified in DRI Occurrence Reporting Plan, and in the ES&H Program Plan.

EPP/CF-1. Procedural Non-Compliance.

Discussion: DRI has not incorporated the required steps from AP-5.43 into their ES&H Program or their Safety and Health Plan. These required steps include having a formal ES&H Plan and conducting internal appraisals of the DRI ES&H Program.

Proposed Remedy: Now that we are on controlled distribution for AP-5.43, we will incorporate the required steps into DRI's ES&H Program, including the development of a formal ES&H Plan and the conduct of internal appraisals of that program.

EPP/BMP-1. Lack of Management Communication.

Discussion: DRI is not on the controlled distribution list for AP-5.43.

Proposed Remedy: We are now on the controlled distribution for AP-5.43.

SUMMARY AND SCHEDULE OF PROPOSED REMEDIES

<u>Task</u>	<u>Schedule</u>
1. Obtain controlled distribution copies of AP 2.9, 5.43, 6.18, and other relevant procedures for environmental management for YMP.	July 1 1993
2. Prepare E S & H Program Plan for DRI's YMP archaeological studies, and submit to YMPO for review.	November 1 1993
3. Submit DRI's Safety and Health Plan and Occurrence Reporting Plan for YMPO Review.	November 1 1993