

**MONTHLY HIGHLIGHTS AND STATUS REPORT**

# **Yucca Mountain Site Characterization Project**

**U.S. DEPARTMENT OF ENERGY**

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# 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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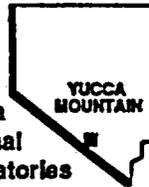


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**YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT  
EXECUTIVE SUMMARY**

**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**

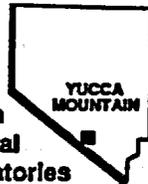
Mechanical properties data (ultrasonic velocities, static elastic properties, and unconfined strength) for core from NRG-6 from depths of 345 ft to 427 ft were submitted to the YMP Central Records Facility (CRF). Triaxial strength, tensile strength, and average grain density data for NRG-6 from depths 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.

### **1.2.1.2.1 PROGRAM-LEVEL REQUIREMENTS DOCUMENT DEVELOPMENT**

No significant activity this reporting period.

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

No significant activity this reporting period.

### **1.2.1.5 SPECIAL STUDIES**

No significant activity this reporting period.

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## 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 Intact Rock (1.2.3.2.7.1.3), Laboratory Determination of the Mechanical Properties of Fractures (1.2.3.2.7.1.4), Ground Motion From Regional Earthquakes and Underground Nuclear Explosions (1.2.3.2.8.3.3), and the Future Regional Climate and Environments (1.2.3.6.2.1.6).

### 1.2.3.1 SITE INVESTIGATIONS COORDINATION AND PLANNING

#### Significant Meetings Attended

Sandia National Laboratories (SNL) staff attended the 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 1.2.3.2.8.2. (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)

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### **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 Tests 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.

Unit	Mean CTE (10 <sup>-6</sup> 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

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.

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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  $10^{-9} \text{ s}^{-1}$ : 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)

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

### **1.2.4.1.1 REPOSITORY COORDINATION AND PLANNING**

#### Status Report on Ongoing Activities

Work 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.

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#### **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.

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

### **1.2.5.1 REGULATORY COORDINATION AND PLANNING**

#### Status Report on Ongoing Activities

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 8.3.5.12.2.2.2 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 ft<sup>2</sup> 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 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

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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.

*Suean*



# United States Department of the Interior



GEOLOGICAL SURVEY  
BOX 25046 *JUL 26 4 36 PM '00*  
DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

IN REPLY REFER TO:

July 23, 1993

WBS: 1.2.9.1.2  
QA: N/A

I-344903

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

**SUBJECT: U.S. Geological Survey (USGS) Detailed Monthly Status Report for May, 1993**

Dear Carl:

Enclosed is the USGS detailed monthly status report for May, 1993. The format has been modified slightly to eliminate redundant titles, objectives, etc., to provide greater visibility of monthly accomplishments and work performed. If you have any questions or comments, please contact Raye Ritchey at 303-236-0517.

Sincerely,

*Raye E. Ritchey*  
for  
Larry R. Hayes  
Technical Project Officer  
Yucca Mountain Project Branch  
U.S. Geological Survey

*329*  
DIVISION \_\_\_\_\_  
CC: *Lori*  
CC: *Simecka*  
CC: *Oyer*  
CC: *Wynn / Jernan*  
CC: *Dehencost / Stucker - ewe*  
CC: *Brody / Wallace - ewe*  
CC: *Jones*  
CC: *Gertz / Smith, & w/o*

Attachment

REC'D IN YMP

*7-26-93*

**cc: D. Appel, USGS/Denver  
R. Bullock, RSN/Las Vegas  
D. Campbell, USBR/Denver  
J. Canepa, LANL/Los Alamos  
W. Clark, LLNL/Livermore  
M. Chornack, USGS/Denver  
R. Craig, USGS/Las Vegas  
W. Dudley, USGS/Denver  
D. Gillies, USGS/Denver  
V. Iorri, DOE/Las Vegas  
R. Luckey, USGS/Denver  
B. Parks, USGS/Denver  
Z. Peterman, USGS/Denver  
R. Pritchett, REECO/Las Vegas  
R. Ritchey, USGS/Denver  
E. Roseboom, USGS/Reston  
D. Porter, SAIC/Golden  
L. Shepard, SNL/Albuquerque  
R. Spengler, USGS/Denver  
R. St.Clair, TESS/Las Vegas  
J. Stuckless, USGS/Denver  
N. Trask, USGS/Reston  
J. Whitney, USGS/Denver  
YMP-USGS Local Records Center 1.1.02**

**LRH/RER/mt  
079318**

Department of the Interior  
United States Geological Survey  
YUCCA MOUNTAIN PROJECT  
Monthly Highlights and Status Report  
MAY 1993

**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. Any information is preliminary and subject to change as further analyses are performed. This report has not been reviewed for conformity with U.S. Geological Survey technical and editorial standards and stratigraphic nomenclature. Company names are for descriptive purposes only and do not constitute endorsement by the U.S. Geological Survey.

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## ACRONYM LIST

A&E	architectural and engineering
ABC	American Borate Corporation
ACD	advanced conceptual design
ACM	alternative conceptual model
ACNW	Advisory Committee on Nuclear Waste
ACP	Area Characterization Plan
ACSR	Activity Control Specification Report
ACS	American Chemical Society
ACWP	actual cost of work performed
ADN	Affected Document Notice
ADP	automated data processing
ADTS	Automated Data Tracking System
AEC	Atomic Energy Commission
AECB	Atomic Energy Control Board
AECL	Atomic Energy of Canada, Ltd.
AEG	Association of Engineering Geologists
AFOS	Automated Field Operating System
AFR	Audit Finding Report
AGU	American Geophysical Union
AIH	American Institute of Hydrology
ALARP	as low as reasonably possible
ALTS	Apache Leap Tuff Site
AMA	Assistant Manager for Administration
AMFM	alternative means of financing and managing
AML	Arc Macro Language
AMP	Administrative Management Procedure
ANS	American Nuclear Society
ANSI	American National Standards Institute
ANSTO	Australian Nuclear Science and Technical Organization
AO	Administrative Officer
AP	Administrative Procedure
APQ	Administrative Procedure Quality
ARR	Area Recommendation Report
ARS	Automated Records System
ASA	American Statistical Association
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASR	Annual Status Report
ASTM	American Society for Testing and Materials
AT	acoustic televiewer
ATC	Asynchronous Terminal Concentrator
ATLAS	Alternatives to License Application Strategies
ATS	Activity Tracking System
AVL	Approved Vendors List
AVS	Application Visual System
BA	Biological Assessment
BAC	budgets at completion

BAMG	Branch of Atlantic Marine Geology
BBC	British Broadcasting Company
BBS	Bulletin Board System
BCWP	budgeted cost of work performed
BCWS	budgeted cost of work scheduled
BDR	Basic Data Recorder
BFD	Basis for Design
BG&H	Bond Gold and Hydrosearch
BGRA	Branch of Geologic Risk Assessment
BIG	Branch of Isotope Geology
BLM	Bureau of Land Management
BP	before present
BPA	blanket purchase agreement
BPO	blanket purchase order
BPG	Branch of Petroleum Geology
BQA	Branch of Quality Assurance
BRC	below regulatory concern
BRG	Branch of Central Regional Geology
BSP	balanced cross section modeling program
C/SCR	Cost and Schedule Change Request
C&C	consultation and cooperation
CA	Construction Authorization
CADD	Computer-Aided Drafting and Design
CAE	Computer-Aided Engineering
CAM	Cost Account Manager
CAP	cost account plan
CAR	Corrective Action Report
CASY	Committee for the Advancement of Science in the YMP
CATS	Corrective Action Tracking System
CBI	Controlled Blasting Investigation
CCB	Change Control Board
CCC	Configuration Control Committee
CD	Consultative Draft
CDP	Career Documentation Profile
CDR	Conceptual Design for the Repository
CFR	Code of Federal Regulations
CFS	cubic feet per second
CGC	Center for Geoscience Computing
ChemTrec	Chemical Transportation Emergency Center
CHLW	commercial high-level waste
CIRF	Configuration Identification Request Form
CMR	Branch of Central Mineral Resources
COB	close of business
COCORP	Consortium for Continental Reflection Profiling
CODMU	Computer Operations and Data Management Unit
COGS	Computer-Oriented Geological Society
COSIM	conditional simulation
CPR	Cost Performance Report
CR	Central Region
CRF	Central Records Facility
CRF	Comment Response Form
CRG	Central Regional Geology

CRGB	Central Regional Geology Branch
CRW	comment resolution workshop
CSCS	Cost Schedule Control System
CSI	Campbell Scientific, Inc.
CSM	Colorado School of Mines
CVO	Cascade Volcanoes Observatory
CWP	Center for Wave Phenomena
CY	calendar year
D&E	development and evaluation
DAA	Design Acceptability Analysis
DAS	data acquisition system
DCP	data collection platform
DDP	Director's Decision Plan
DEC	Digital Equipment Corporation
DECUS	Digital Equipment Corp Users Group
DEIS	Draft Environmental Impact Statement
DFC	Denver Federal Center
DHLW	defense high-level waste
DISA	Downhole Instrument Station Apparatus
DMS	Desktop Mapping System
DOE	Department of Energy
DOE/HQ	Department of Energy Headquarters
DOE/NV	Department of Energy/Nevada Operations Office
DOE/NVO	Department of Energy/Nevada Operations Office
DOP	Department Operating Procedures
DOT	Department of Transportation
DR3M	Distributed Routing Rainfall-Runoff Model
DRC	Document and Records Center
DRI	Desert Research Institute
DRMS	Data Records Management System
DRS	document review sheet
DTN	document transmittal notice
DTP	Detailed Test Plan
DWMD	Defense Waste Management Department (REECo)
DWPF	Defense Waste Processing Facility
DVNM	Death Valley National Monument
EA	Environmental Assessment
EAC	estimate at completion
EAEG	European Association of Exploration Geophysicists
EBS	engineered barrier system
ECD	electron capture detector
ECR	Engineering Change Report
EDBH	engineered design borehole
EDF	Environmental Defense Fund
EDM	Equivalent Discontinuum Model
EDXRF	energy-dispersive x-ray fluorescence
EEI	Edison Electric Institute
EEP	Emergency Evaluation Plan
EFAP	Environmental Field Assessment Plan
EIA	Emergency Information Administration
EIS	Environmental Impact Statement
EKES	Electronic Keyed-Entry System

EM	electromagnetic
EMP	electron-microprobe
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ERC	Engineering Request Change
ERDA	Energy Research and Development Administration
EROS	Earth Resource Observatory System
ERTP	Environment Requirements Training Program
ES	exploratory studies
ESF	Exploratory Studies Facility
ESF/DRD	Exploratory Studies Facility Design Requirements Document
ESR	electron spin resonance
ESSE	Early Site Suitability Evaluation
ESTC	Exploratory Studies Test Coordination
ESTP	Exploratory Studies Test Plan
ESTP-C	Exploratory Studies Test Plan Committee
ET	evapotranspiration
EV	earned value
FEHMS	Finite Element Heat Mass and Stress
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FFS	Federal Financial System
FFT	Fast-Fourier Transform
FID	Flame Ionization Detector
FIS	Federal interim storage
FITS	Facilities Important to Safety
FMMG	Fracture Matrix Mesh Generator
FMN	Fortymile neutron
FOLD	Federally Owned Landsat Data
FP	final procedures
FPC	final procurement and construction
FQI	Federal Quality Institute
FR	Federal Register
FRD	Functional Requirements Document
FRHP	Fractured Rock Hydrology Program
FSU	Florida State University
FTE	full-time equivalent
FWP	field work proposal
FY	fiscal year
GAO	Government Accounting Office
GAP	Geostatistical Analysis Package
GC	gas chromatograph
GCM	Global Climate Model
GCP	Geochronological Procedure
GD	Geologic Division
GEMLink	General Electric Microwave (communications) Link
GEOEAS	Geostatistical Environmental Software
GET	General Employee Training
GETT	grants equal to taxes
GID	Ground Water Site Investigation
GIS	Graphic Information System
GIT	Geochemistry Integration Team

GMP	Geologic Modeling Program
GMS	Geoscience Modeling System
GMT	Greenwich Mean Time
GOCO	government-owned contractor-operated
GOES	Geostatistical Environmental Operational Satellite
GP	Geologic Procedure
GPO	Government Printing Office
GPP	Geophysical Procedure
GPR	ground-penetrating radar
GPS	global positioning satellite
GQA	Graded Quality Assurance
GRESS	Gradient Enhanced Software System
GSA	Geological Society of America
GSA	General Services Administration
GSIS	Geoscientific Information System
GSP	Geologic Studies Program
GTUF	G-Tunnel Underground Facility
GW	ground water
GWE	Gigawatts Electrical
GWTT	ground water travel time
GXP	Geochemical Procedure
HIP	Hydrologic Investigations Program (formerly NHP)
HITF	Hydrology Integration Task Force
HLRW	high-level radioactive waste
HLRWM	High-Level Radioactive Waste Management
HLW	high-level waste
HP	Hewlett Packard
HP	Hydrologic Procedure
HQ	Headquarters
HRF	Hydrologic Research Facility
HRMP	Hydrology and Radionuclide Migration Program
HRU	hydrologic-response unit
HSPF	Hydrological Simulation Program
IBM	International Business Machines
IC	ion chromatograph
ICE	Independent Cost Estimate
ICG	International Geologic Congress
ICIAM	International Conference on Industrial and Applied Mathematics
ICN	Interim Change Notice
ICWG	Interface Control Working Group
IDAS	Integrated Data Acquisition System
IDS	Information Data System
IFS	Iterated Function System
IG	Integration Group
IGIS	Interactive Graphics Information System
IGT	Institute of Gas Technology
IHLWM	International High Level Radioactive Waste Management
IMS	Information Management System
INEL	Idaho National Engineering Laboratory
INSTAAR	Institute of Arctic and Alpine Research
INTRAVAL	International Transport Code Validation

IPA	Intergovernmental Personnel Act
IR	infrared
IRG	Interagency Review Group
ISA	Instrument Society of America
ISD	Information Systems Division
ISM	Interactive Surface Modeling
ISO	International Standards Organization
ITR	Information Technology Resources
IVV	Independent Verification and Validation
JGR	<i>Journal of Geologic Research</i>
LA	license application
LACT	laser alignment and centering target
LAN	local area network
LANL	Los Alamos National Laboratory
LBL	Lawrence Berkeley Laboratories
LCS	Liquid Scintillation Counter
LDRP	litigation discovery request procedure
LDS	lightning detection system
LLNL	Lawrence Livermore National Laboratory
LLP	Lightning Location & Protection, Inc.
LLW	low-level waste
LOE	level of effort
LPRS	large plot rainfall simulation
LRC	Local Records Center
LRE	latest revised estimate
LRGS	Local Read-Out Ground Station
LRP	long-range plan
LRP/IPS	Long Range Plan/Integrated Project Schedule
LRS	Litton Resource System
LSC	liquid scintillation counter
LSP	laser safety plan
LSS	Licensing Support System
LWS	Lathrop Wells aeromagnetic survey
LV	Las Vegas
MAs	Management Agreements
MADS	Meteorological Alert Distribution System
MCL	Maximum Contaminant Level
MEDA	Meteorological Data Acquisition Network
MFC	mass flow controller
MGDS	Mined Geologic Disposal System
MISIS	Micro Integrated Storm Information System
MOA	Memorandum of Agreement
MODFE	Modular Finite Element
MOU	Memorandum of Understanding
MPBH	multipurpose borehole
MPM	Management Procedure Manual
MPU	Manuscript Prep Unit
MRIR	Material Receiving and Inspection Report
MRS	monitored retrievable storage
MSA	major system acquisition
MSHA	Mine Safety and Health Administration

MSIS	Management System Information Strategy
MSL	mean sea level
MSS	Multispectral Scanner
MT	magneto-telluric
M&TE	measuring and test equipment
MTL	materials testing laboratory
mtl	main test level
MTU	metric tons of uranium
MW	mixed waste
NARUC	National Association of Regulatory Utility Commissioners
NBMG	Nevada Bureau of Mines and Geology
NBS	National Bureau of Standards (now NIST)
NCAR	National Center for Atmospheric Research
NCDC	National Climatic Data Center
NCR	Nonconformance Report
NCTM	National Computer Technology Meeting
NEA	Nuclear Energy Agency
NEPA	National Environmental Policy Act
NFS	Nuclear Fuel Services
NGS	National Geodetic Survey
NIST	National Institute of Standards and Technology
NLT	no later than
NMD	National Mapping Division
NMIMT	New Mexico Institute of Mining and Technology
NNWSI	Nevada Nuclear Waste Storage Investigation
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRP	National Research Program
NSTF	near-surface test facility
NTC	National Training Center
NTS	Nevada Test Site
NTSO	Nevada Test Site Office
NVO	Nevada Operations Office
NWF	Nuclear Waste Fund
NWIS	Nevada Water Information System
NWIS	National Water Information System
NWM	Nuclear Waste Management
NWN	<i>Nuclear Waste News</i>
NWPA	Nuclear Waste Policy Act
NWPO	Nuclear Waste Projects Office
NWQL	National Water Quality Laboratory
NWTRB	Nuclear Waste Technical Review Board
OBS	organization breakdown structure
OCRWM	Office of Civilian Radioactive Waste Management
OEVE	Office of Earthquakes, Volcanoes and Engineering
OFR	open-file report
OGR	Office of Geologic Repositories
OMB	Office of Management and Budget
OMR	Office of Mineral Resources
OPCNM	Organ Pipe Cactus National Monument

OPFM	Office of Project and Facilities Management
OPIO	Office of Policy, Integration, and Outreach
ORM	Office of Resource Management
ORNL	Oak Ridge National Laboratory
OSTS	Office of Storage and Transportation Systems
OWQSU	Ocala Water Quality Services Unit
P&S	planning and scheduling
PA	performance assessment
PACE	Performance Assessment Calculation Exercise
PACS	Planning and Control System
PAGEOPH	<i>Pure and Applied Geophysics</i>
PAGIS	Performance Assessment of Geological Isolation Systems
PAL	Project Acronym List
PAMP	Performance Assessment Management Plan
PAP	Performance Assessment Plan
PASP	Performance Assessment Strategy Plan
PBEI	prototype blast effects on instrumentation
PBS	pyramid beam splitter
PC	personal computer
PCBI	Prototype Controlled Blasting Investigation
PCCB	Program Change Control Board/Project Change Control Board
PCM	pivoting camera mount
PCSB	Program Cost and Schedule Baseline/Project Cost and Schedule Baseline
PC&TS	Program Coordination and Technical Support
PD	Position Description
PDA	Participant Data Archives
PDCR	prototype dry coring of rubble
PDHI	prototype drill hole instrumentation
PDM	Problem Definition Memorandum
PDS	Project Decisions Schedule
PEET	prototype excavation effects test
PI	Principal Investigator
PIP	Prototype Investigation Plan
PIR	Precision Infrared Radiometer
PL	Public Law
PMB	Performance Measurement Baseline
PMF	probable maximum flood
PMI	Phase Measuring Interferometry
PMIS	Program Management Information System
PMP	Program Management Plan/Project Management Plan
PMR	performance measurement review
PMS	Program Management System
PNL	Pacific Northwest Laboratories
PPWE	prototype pore-water extraction
PQM	Project Quality Management
PRBP	project review briefing package
PRDA	Program Research and Development Announcement
PRESS	Project-related Engineering and Scientific Studies
PRMS	Precipitation Runoff Modeling System
PSAR	Preliminary Safety Analysis Report

PSI	pounds per square inch
PTP	Prototype Test Plan
PTS	Petroleum Testing Services
QA/QC	quality assurance/quality control
QA	Quality Assurance
QAG	Quality Assurance Grading
QAGR	Quality Assurance Grading Report
QALA	Quality Assurance Level Assignment
QALAS	Quality Assurance Level Assignment Sheet
QAM	Quality Assurance Manager
QAP	Quality Assurance Program
QAPD	Quality Assurance Program Description
QAPO	Quality Assurance Project Officer
QAPP	Quality Assurance Program Plan
QAR	Quality Assignment Records
QARD	Quality Assurance Requirements Document
QASC	Quality Assurance Support Contractor
QMP	Quality Management Procedure
QMPR	Quality Management Policies and Requirements
QRA	Quality Related Activities
QRB	Quality Review Board
QVC	Quality Verification Check
R&D	research and development
R&H	receiving and handling
R&LSD	Research and Laboratory Services Division
RALD	right angle laser deflectometer
RAM	responsibility assignment matrix
RASA	Regional Aquifer Study Assessment
RASRA	radial arm strike rail assembly
RCR	Regional Characterization Report
RCRA	Resource Conservation and Recovery Act
REBS	Radiation Energy Balance Systems
REECO	Reynolds Engineering and Electrical Company
RFP	Request for Proposal
RGEG	Research Grade Evaluation Guide
RIB	Reference Information Base
RIDS	Record and Information Disposition Schedule
RIS	Records Information System
RMF	Records Management Facility
RMNMD	Rocky Mountain National Mapping Division
RMP	Records Management Plan
RMS	Records Management System
ROD	Record of Decision
RPC	Report Package Collection
RQPG	right angle prism goniometer
RRL	reference repository location
RSED	Regulatory and Site Evaluation Division
RSN	Raytheon Services Nevada
RTISA	request to initiate site activity
RW	radioactive waste
RWMNFC	Radioactive Waste Management and the Nuclear Fuel Cycle
RWMS	Radioactive Waste Management Site

s-p ..... surface-propagated  
SA ..... summary account  
SAG ..... Software Advisory Group  
SAGEEP ..... Symposium on the Application of Geophysics to  
Engineering and Environmental Problems  
SAIC ..... Science Applications International Corporation  
SAR ..... Safety Analysis Report  
SAS ..... Statistical Analysis System  
SBTFRD ..... Surface-Based Test Facility Requirements Document  
SBTP ..... Surface-Based Test Prioritization  
SCA ..... Site Characterization Analysis  
SCC ..... substantially complete containment  
SCI ..... Software Configuration Items  
SCIF ..... software checklist and indexing form  
SCMS ..... Software Configuration Management System  
SCP ..... Site Characterization Plan  
SCPB ..... Site Characterization Program Baseline  
SDR ..... Standard Deficiency Report  
SDRD ..... Subsystems Design Requirement Document  
SE ..... Senior Engineer  
SE&D ..... Systems Engineering and Development  
SEG ..... Society of Exploration Geophysicists  
SEM ..... scanning electron microscopy  
SEMP ..... System Engineering Management Plan  
SEPDB ..... Site and Engineering Properties Data Base  
SES ..... Scientific and Engineering Software  
SF ..... spent fuel  
SG ..... Senior Geologist  
SGB ..... Southern Great Basin  
SGBSN ..... Southern Great Basin Seismic Network  
SGR ..... Seismic Group Recorders  
SIP ..... Scientific Investigation Plan  
SIR ..... Scientific Investigations and Research  
SIR ..... Special Investigative Review  
SIT ..... Site Integration Team  
SKB ..... Swedish Nuclear Fuel and Waste Management Company  
SMF ..... Sample Management Facility  
SMS ..... Sample Management System  
SNF ..... spent nuclear fuel  
SNL ..... Sandia National Laboratories  
SNP ..... Scientific Notebook Plan  
SNSN ..... Southern Nevada Seismic Network  
SOBART ..... Southern Basin and Range Transects  
SOC ..... Sample Overview Committee  
SOIR ..... status of open items report  
SOP ..... Standard Operating Procedure  
SP ..... Seismic Procedure  
SP ..... Study Plan  
SPA ..... Study Plan Assessment  
SPE ..... Society of Petroleum Engineers  
SPOC ..... submersible pressurized outflow cell  
SPR ..... Semi-annual Progress Report

SPR	Software Problem Report
SPRS	small plot rainfall simulation
SQA	Software Quality Assurance
SQAP	Software Quality Assurance Plan
SRD	system requirements and description
SRG	strike rail goniometer
SRM	standard reference material
SRR	Site Recommendation Report
SSF	software summary forms
SSF	specified software forms
SSR	Site Selection Report
SSSA	Soil Science Society of America
STC	Southern Tracer Complex
SWO	stop-work order
SZ	saturated zone
T&MSS	Technical and Management Support Services
T&MSS SP	T&MSS Standard Practice Procedure
TAR	Technical Assessment Review
TBD	to be determined
TBM	Tunnel Boring Method
TC	Technical Contact
TC	Training Coordinator
TCD	thermal conductivity detector
TCP	telescoping camera pedestal
TCPAL	Thermocouple Psychrometer Calibration
TDAG	Technical Data Advisory Group
TDB	Technical Data Base
TDD	Test Descriptions Document
TDF	task definition form
TDIF	Technical Data Information Form
TDR	time domain reflectometry
TDS	total dissolved solids
TEF	Test and Evaluation Facility
TESS	TRW Environmental Safety Systems
TFA	Temporary Field Assistant
TIC	Technical Information Center
TM	thematic mapper
TP	Technical Procedure
TPEC	Technical Proposal Evaluation Committee
TPO	Technical Project Officer
TPP/JPP	Test Planning Package/Job Planning Package
TPT	Testing Prioritization Task
TQM	Total Quality Management
TRIG	Technical Review and Integration Group
TRIMS	Technical and Regulatory Information Management System
TRU	Transuranic
TSR	Technical Status Report
TVA	Tennessee Valley Authority
UARW	Upper Amargosa River Watershed
UNE	Underground Nuclear Explosion
UNLV	University of Nevada, Las Vegas

UNR ..... University of Nevada, Reno  
 UNRSL ..... University of Nevada, Reno Seismic Laboratory  
 UPS ..... Uninterrupted Power Supply  
 URL ..... underground research laboratory  
 USBLM ..... U.S. Bureau of Land Management  
 USBR ..... U.S. Bureau of Reclamation  
 USDI ..... U.S. Department of the Interior  
 USFWS ..... U.S. Fish and Wildlife Service  
 USFS ..... U.S. Forest Service  
 USGS ..... U.S. Geological Survey  
 USNSN ..... U.S. National Seismic Network  
 UTM ..... Universal Trans Mercator  
 UZ ..... unsaturated zone  
 UZFRHP ..... Unsaturated Zone Fractured Rock Hydrology Project  
 UZIG ..... Unsaturated Zone Interest Group  
 UZN ..... unsaturated zone neutron  
 UZSBP ..... Unsaturated Zone Surface-Based Borehole Project  
 VAR ..... Variance Analysis Report  
 VARS ..... Video Archival Retrieval System  
 VLF ..... very low frequency  
 VOC ..... Validation Oversight Committee  
 VOG ..... Validation Oversight Group  
 VSP ..... vertical seismic profiling  
 WA ..... Western Atlas  
 WAC ..... Waste Acceptance Criteria  
 WAS ..... Work Authorization Submission  
 WAS/FWP ..... Work Authorization System/Field Work Proposal  
 WBS ..... work breakdown structure  
 WIPP ..... Waste Isolation Pilot Plant  
 WMNFC ..... Waste Management and Nuclear Fuel Cycle  
 WMSD ..... Waste Management Systems Description  
 WNRE ..... Whiteshell Nuclear Research Establishment  
 WORM ..... Write Once Read Many  
 WP ..... waste package  
 WP ..... Weapons Program  
 WPPDRD ..... Waste Package Design Requirements Document  
 WRCC ..... Western Region Climate Center  
 WRD ..... Water Resources Division  
 WRG ..... Western Region Geology  
 WRI ..... Water Resources Investigations  
 WRIR ..... Water Resources Investigations Report  
 WRR ..... Water Resources Research  
 WSA ..... Wilderness Study Area  
 WSNSO ..... Weather Service Nuclear Support Office  
 WSP ..... Water Supply Paper  
 WT ..... water table  
 WVDP ..... West Valley Demonstration Project  
 WY ..... water year  
 XRD ..... x-ray defraction  
 XRF ..... x-ray fluorescence  
 YM ..... Yucca Mountain  
 YMP ..... Yucca Mountain Project

YMPB ..... Yucca Mountain Project Branch  
YMPO ..... Yucca Mountain Project Office

## 1.2.1 SYSTEMS ENGINEERING

### WBS 1.2.1.6 Configuration Management

Development of a YMP-USGS Internal Configuration Item Data Base was begun to assist in performing impact assessments of proposed and/or approved internal/external changes. This data base is to include milestones, Study Plans, Job Packages, and Technical Procedures.

## 1.2.3 SITE

### WBS 1.2.3.1 Coordination and Planning

Principal Investigator - L. Hayes

#### M&I - Geologic Studies Program 0G3193G1

Summary Account Manager - J. Stuckless

J. Stuckless visited the University of Nevada, Reno and attended the GSA meeting where he chaired a session on Yucca Mountain.

J. Stuckless participated in a Test Site tour for WRD managers.

The last two MOAs with Geologic Division Branches were completed, as well as the mid year budget review.

#### Work Performed, but not in Direct Support of the Scheduled Tasks:

Z. Peterman discussed work plan evaluations with B. Marshall, S. Mahan, K. Futa, J. Paces, D. Craft and A. Walker. Work plans for the next evaluation period were revised with the help of the individual employees.

S. Mahan and B. Widmann completed chemistry and Sr isotopic analyses on four water samples from the Paradox Basin area (cooperative study with L. Spangler, Utah District Office).  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios ranged from 0.7095 to 0.7075 which are typical of the brines throughout the basin. This work is part of a continuing study using isotopic compositions of oil-field brines to help characterize ground-water flow paths. Mahan and Widmann also completed Sr isotopic analyses on six water samples from the Pyramid Lake area of Nevada (cooperative project with L. Benson). In addition, 30 tufa samples have been prepared for Sr isotopic analysis for comparison with isotopic compositions of the waters.

S. Mahan completed Sr isotopic analyses on four water samples from the Nebraska Alkali Lakes project. This study focuses on investigating the recharge sites and potential flow paths of water through the Sand Hills of Nebraska, a major recharge area for the Ogalalla Aquifer.

B. Marshall attended a CCC meeting (software QA); and the AGU Spring meeting to hear presentations on YMP-related subjects. Marshall also procured an additional microcomputer for project use, especially for modeling and the preparation of graphics (the computer should be delivered in June).

B. Marshall wrote the documentation section and forms for QMP-3.03, R4 "Software control" (40 hrs) and discussed the overall revision of this QMP with the committee (B. Parks, T. Mendez-Vigo, L. Anna) at five different meetings. (19 hrs)

J. Paces reviewed a completed preliminary draft of QMP-8.01,R3 and forwarded it to the QA office for technical review. (2 hrs) Paces compiled, wrote and distributed the April monthly report of work

accomplished by the Isotope and Geochemistry Group. (10 hrs)

K. Futa completed Rb and Sr isotopic analyses of carbonates associated with Mn deposits from Molango, Mexico, as part of a collaborative project with B. Doe. Isotopic analyses are being used to evaluate the importance of a sea-water versus a terrigenous source for the Sr budget.

M&I QA Implementation, Hydrology 0G3193H2

Summary Account Manager - W. Causseaux

Technical procedures

S. Frans of HIP currently is processing 41 Hydrologic Procedures and Scientific Notebook Plans.

HIP technical procedures - HP-23, R3, HP-229, R2, HP-251, R0, HP-258, R0 and HP-259, R1 were approved.

J. Watson submitted SN-0012 to the QAO for review and closure.

Quality Management Procedures

QMPs - 3.15, R1; 8.01, R3; 17.01, R6; 5.03, R8 and 3.07, R5 were reviewed by J. Watson.

QMPs - 5.01, R5; 3.15, R1; 16.03, R3; 16.04, R0; 18.01, R7; and 6.01, R6 were reviewed by S. Boucher.

QMPs - 6.01, R6, and 3.07, R5 were reviewed by S. Frans.

QMP-5.01, R5 was reviewed by J. Woolverton and G. Severson.

QMPs-16.04, R0, and 18.02, R3 were reviewed by J. Woolverton.

QMP-8.01, R3 was reviewed by L. Flint and K. Schofield.

QMP-17.03, R1 was reviewed by M. Chornack.

QMP-17.01, R6 was reviewed by S. Maloy.

QMP-6.01, R6 was reviewed by K. Thomas.

The concurrence draft for QMP-5.01, R5, reflecting resolution of reviewer comments, was submitted to the YMP-USGS QA office for final processing.

Open Items

S. Boucher initiated NCR-93-23 for failure to calibrate a DCP prior to removal from service.

M. Pabst submitted a response for USGS-NCR-93-10 (Improper receiving review of a Hewlett Packard Instrument). The response was accepted by the YMP-USGS QA office.

J. Woolverton submitted a response for Audit Finding Report #9306-01, on the lack of grading reports for SCP Activities 8.3.1.2.2.8.1 and 8.3.1.2.2.9.1 (UZ modeling activities).

J. Woolverton initiated USGS-NCR-93-29 to document the use of a datalogger being used outside (beyond) the designated calibration interval.

#### Audits

DOE conducted a surveillance of SCP activity 8.3.1.2.2.1.2 (Neutron Moisture Meter Monitoring). No deficient conditions were identified during the surveillance.

The DOE audit of the USGS which has been postponed until June.

#### QA Training

The HIP QA staff attended training on data management (two sessions).

#### Meetings and Travel

The HIP QA staff attended the May Open Items meeting.

M. Pabst and W. Causseaux traveled to the HRF to perform an internal review of J. Rousseau's calibration laboratory.

M. Pabst and W. Rodman performed an internal review of A. Flint's calibration status records.

#### Records Management

S. Boucher submitted the records package for the C. Gertz data transfer package and sent it to the LRC.

Boucher compiled and submitted to the LRC a data package for a report for SCP activity 8.3.1.2.3.1.2.

#### Samples

J. Watson submitted sample collection forms referencing a April 23 - May 2 field trip.

#### Data Transmittals

S. Boucher assisted with the transfer of water-level/earthquake data from SCP activity 8.3.1.2.3.1.2 to C. Gertz.

#### Computer Operation & Data Management. Hydrology 0G3193H3

Summary Account Manager - C. Washington

#### Novell System

The COU received a new virus detection and removal program from DOE to install on our systems. The programs are being tested and will be installed in June.

SYZYG, the project management package, has been tested and is ready for use.

#### Unix System

The COU received an additional controller and two 1GB disk drives for installation on the DG file server. The DG field engineer was not able to install them because the server would not recognize the controller. It is planned to research the problem and proceed with installation in June.

AIS 1.3 was installed on May 15, 1993.

The new version of EDOC was not formatted to print out properly on the DG printers; therefore, a script was written to print through the Novell LAN to the HP Laser Jet 4 using a smaller font. This enabled each line of the EDOC message to print as it was typed.

HRF personnel were provided assistance in configuring their SUN server.

**YMPB, Las Vegas**

Two new PCs, a scanner, a printer and software were installed for D. Zesiger and D. Edwards. All LAN connections were checked and personnel were instructed on use.

**Field Operations Center (FOC)**

A new PC, printer and software were installed for A. Johnson. Software installation and LAN connection were checked. J. Brooks' PC and printer were switched out. Communication software to Denver was installed and checked.

**Hydrologic Research Facility (HRF)**

The COU tested the communication link from Denver to the HRF and found it was inadequate for our needs. The COU is in the process of requesting a communication link of 256KB minimum.

**Scientific Reports and Project Documents, Hydrology 0G3193H4**

Summary Account Manager - T. Brady

**Scientific reports processing**

J. LaMonaca, HIP-YMPB, currently is processing 89 YMP-HIP scientific publications, 66 YMP-GSP scientific publications, 13 YMP-LBL scientific publications, and 38 abstracts.

The HIP review of the following reports was completed by T. Brady: "*Characterizing fractured rock for fluid flow, geomechanical, and paleostress modeling: Methods and results from Yucca Mountain, NV*," by C. Barton, E. Larsen, W. Page, and T. Howard; "*Evidence of prehistoric flooding and the potential for future flooding a Coyote Wash, Yucca Mountain, Nevada*", by P. Glancy; "*Pneumatic testing in 45 degree inclined boreholes in fractured volcanic tuff near Superior Arizona*", by G. LeCain, and "*Streamflow and selected precipitation data for Yucca Mountain and vicinity, Nye County, Nevada, water years 1983-1985*", by M. Pabst, D. Beck, P. Glancy, and J. Johnson.

The HIP review of the following abstracts was completed by T. Brady: "*Analysis of aquifer tests in Miocene tuffaceous rocks with layered fracture and matrix permeability, Yucca Mountain, Nevada*", by A. Geldon, and "*Rapid aftershock deployment for the June 29, 1992 Little Skull Mountain, Nevada, Earthquake*", by A. Sheehan, M. Savage, K. Smith, and Y. Zeng.

The final version of 8.3.1.2.2.9, R0 "*Site unsaturated-zone modeling and synthesis*" was sent to the YMPO on May 14, 1993 for DOE verification and approval.

**WBS 1.2.3.2.2.1.1 Vertical and Lateral Distribution of Stratigraphic Units within the Site Area**

Principal Investigator - R. Spengler

**SCP 8.3.1.4.2.1 Vertical & lateral distribution of stratigraphic units LOE Account 0G32211Z93**

Summary Account Manager - R. Spengler

R. Spengler conducted an internal USGS review of lithologic contacts.

R. Spengler and C. Hunter attended Interim Review meetings, conducted by L. Hayes, relating to

accomplishments and future work schedules for the remainder of FY93.

C. Hunter continued support of the USGS Contracts Section (Central Region) with regard to the seismic reflection contract. This support included technical description of the requirements to Department of Interior legal staff and resolution of appropriate contract language.

C. Hunter received training in data management procedures.

SCP 8.3.1.4.2.1.1 Surface and subsurface stratigraphic studies of the host rock and surrounding units  
0G32211A93

Summary Account Manager - Z. Peterman

Technical Activities:

**3GGU11AA Conduct lithologic logging/synthesize borehole data**

D. Buesch continued refining lithologic logs of core from UE-25 UZ#16. A progress report, in collaboration with J. Rousseau and W. Thordarson (USGS HIP), is underway. The upper lithophysal zone of the Topopah Spring Tuff has been divided into a 13-ft-thick phenocryst-rich lithophysae-bearing subzone, a 25-ft-thick phenocryst-poor nonlithophysae-bearing subzone, and a 153-ft-thick phenocryst-poor lithophysae-bearing subzone. Rocks texturally similar to the 13- and 25-ft-thick subzones were described in USW G-4 (R. Spengler and K. Fox, 1989) and observed in UE-25 NRG-6. Whether these subzones represent regional lithostratigraphic units is under investigation. Lithologic contact information was submitted for internal USGS review.

D. Buesch and J. Palmer collected magnetic susceptibility data from core samples of the Tiva Canyon Tuff from UE-25 UZ#16. A. Boulton prepared graphs comparing depth (elevation) to average magnetic readings of UE-25 UZ#16, USW GU-3, and UE-25 NRG-6 core and Pagany Wash Section surface exposures. These data will be compared to characterize the magnetic susceptibility and further define lithologic zones and subzones.

**3GGU21AA Conduct isotopic sampling/analysis/evaluation/synthesis**

Z. Peterman prepared FY93 interim status report for stratigraphic studies and submitted a final draft to the YMPB-TPO.

B. Marshall and S. Mahan spent time diagnosing a problem that continues to afflict the KEVEX XRF spectrometer at high kV.

B. Marshall, Z. Peterman, S. Mahan, and B. Widmann planned data base needs for upcoming Isotope and Geochemistry Group tasks, and ordered the remaining hardware to network another PC to use the data base.

**3GGU400 Construct isopach and structural contour maps**

J. Nelson assisted R. Dickerson and R. Drake with geologic mapping efforts in the northeast corner of the site area. This field work will assist Nelson in future progress on the lithostratigraphic model.

J. Nelson traveled to LYNX Geosystems, Inc., to use their facilities to obtain output from the lithostratigraphic model. This output, consisting of 24 separate cross sections throughout the modeled area, will be delivered to the engineers performing conceptual ramp design calculations. Nelson also received further training on the LYNX Geosystems software. Software upgrades were installed on the workstation.

Quality Assurance:

Work continued on revising technical procedure GP-20, R0, "*Volumetric estimation of lithophysae*".

Personnel completed all assigned reading requirements and training including "data management policy information and operations".

Meetings were held with DOE, M&O, SAIC, SNL, and USGS to discuss qualifying structure and lithologic log data compiled at the drill site by SAIC/SMF personnel.

K. Futa completed several minor changes in technical procedure GCP-21, R1 to accommodate Nd isotopic analysis using the Finnigan MAT 262 in addition to the VG54E mass spectrometers.

S. Mahan and B. Widmann worked with A. Boulton to compile data for TDIFs associated with publication of the ANS paper by Z. Peterman and others.

Planning and Operations:

Z. Peterman, C. Hunter, and D. Buesch reviewed progress on petrographic distinctions of lithostratigraphic zones in the Tiva Canyon Tuff.

C. Hunter, D. Buesch, and F. Singer met with R. Zimmermann (USGS Central Regional Mineral Resources Division) to evaluate image analysis software that might be applied to petrographic studies of volcanic rocks and analysis of video logs of core.

D. Buesch met with R. Nolting (MK M&O) to discuss the design engineer's request for a series of 3-D model-generated, north-south, and east-west, cross sections on 1000 ft spacing across the potential repository. J. Nelson used LYNX equipment to produce the desired sections.

D. Buesch represented the USGS rock characteristics section at a demonstration in Las Vegas of the geologic and engineering design modules of LYNX Geosystems.

Work Performed but not in Direct Support of the Scheduled Tasks:

D. Buesch met with C. Brechtel (SNL) to discuss and review cross sections along ramp near Exile Hill, possible configurations of the valley-filled graben structure in the valley west of Exile Hill, and drilling of NRG-2b. Buesch met with B. Thompson (SAIC) to discuss geophysical logging, acquisition of the RaaX digital camera, and the need for clean and prepared holes with any video or RaaX logs to be used for stratigraphic purposes.

SCP 8.3.1.4.2.1.2 Surface-based geophysical surveys 0G32211B93

Summary Account Manager - C. Hunter

Technical Activities:

3GGU265 Analysis of bids for seismic contract

Analysis of bids continued, including interactions between rock characteristics and contracts sections and DOE/M&O staff. This will postpone milestone 3GGU265M Award bid: seismic contract.

3GGU250A Conduct magnetic/gravity investigation in Yucca Wash

H. Oliver made a preliminary analysis of the new gravity and ground magnetic data in Yucca Wash obtained in September 1992. Oliver, assisted by R. Sikora, prepared several viewgraphs for the DOE/USGS presentation to the NRC.

3GGU251A Prepare report: map of Yucca Wash

Data on Midway Valley magnetic and gravity investigations are expected to be released in a USGS Open-File Report in July 1993.

**WBS 1.2.3.2.2.1.2 Structural Features within the Site Area**

Principal Investigator - R. Spengler

**SCP 8.3.1.4.2.2 Structural features within the site area LOE Account 0G32212Z93**

Summary Account Manager - R. Spengler

R. Spengler and C. Hunter attended interim review meetings, conducted by L. Hayes, relating to accomplishments and work schedules for the remainder of FY93.

R. Spengler provided geologic interpretations to assist LBL vertical profiling/tomography investigations.

**SCP 8.3.1.4.2.2.1 Geologic mapping of zonal features in the Paintbrush Tuff 0G32212A93**

Summary Account Manager - C. Hunter

**Technical Activities:**

**3GGF183A Conduct struct analysis/mapping-exposed fault zones**

A. Braun, L. Martin, R. Blackburn, and R. Linden assisted by J. Nelson and J. Haney, continued field mapping of fractures and geologic features within the Ghost Dance Fault system. The crew began mapping areas within the northeast wing located on Antler Ridge. It is anticipated that the eastern limits of the Ghost Dance system will be defined at this location upon completion of mapping in these areas.

F. Singer worked on preliminary detailed petrographic examination of a suite of rock samples collected from subunits within the Tiva Canyon Tuff. This work is being performed to determine if devitrification textures (in addition to variability of pumice, crystal content, lithics, and any other characteristics observed in thin section) can be used as distinguishing criteria to better define subunit lithologies within the Tiva Canyon. Thin sections were made from outcrop samples (collected on the flanks of Antler Ridge) of the following Tiva Canyon Tuff subunits: hackly, lower lithophysal, clingstone, upper lithophysal, and upper cliff. Preliminary microscopic examinations of four thin sections from the hackly, four thin sections from the lower lithophysal, eight thin sections from the clingstone, and one thin section from the upper lithophysal have been described and documented by photomicrographs.

**3GGF186A Conduct geologic mapping northeast corner of site area**

R. Dickerson spent three weeks field mapping in Paintbrush Canyon, Fortymile Wash, adjacent canyons, and at Comb Peak. Details of welded and non-welded air-fall and ash-flow tuff, and a possible transition zone of rheomorphic welded tuff, at the base of the Comb Peak Rhyolite lava flow were described. Field relations define parts of the Comb Peak crater rim, and flow foliations within the lava flows indicate the vent locations. Additional map detail included definition of more outcrops in Delirium Canyon, and newly observed debris- and air-flow deposits which help constrain post-Rhyolite of Calico Hills paleotopography. Work in Fortymile Wash included describing post-Calico Hills and pre-Pah Canyon erosional surfaces, and detailed mapping of a major fault.

D. Buesch, R. Dickerson, R. Drake, and J. Nelson reviewed map and unconformity relations in the lowest bedded tuff sequence in the rocks of Calico Hills exposed in upper Paintbrush Canyon. This bedded tuff sequence consists of several pyroclastic flow and fallout deposits interbedded with sediments deposited by debris flows, sheet floods and braided streams. The

complex architecture of the depositional environment appears to result from interaction of syn- and post-eruptive stream grade fluctuation and minor structural deformation. D. Buesch has begun mapping at a scale of 1:2000 in selected parts of the upper Paintbrush Canyon area in order to document these stratigraphic relations.

**3GGF200A Conduct mapping of western YM/northern Crater Flats**

C. Fridrich and M. Murray were in the field from March 14 to May 12. They finished field work for the East of Beatty Mountain 7.5 minute quadrangle and mapped about 70% of the outcrop in the Big Dune 7.5 minute quadrangle. Both participated in a four-day field trip with other members of the USGS-YMP tectonics program and the USGS weapons program on regional detachment-faulting relations; and in a two-day field trip with geologists D. Broxton and R. Warren (LANL) on regional correlations of volcanic units of the southwest Nevada volcanic field. This work also supports SCP 8.3.1.17.4.5, "Detachment faults".

**3GGF201A Conduct sampling/evaluation isotopic/geochem phase 1 & 2**

S. Mahan completed an internal report on the current status and contents of the IGSG analytical data base up through the end of April, 1993. This report provides all spatial, geochemical and isotopic data available for samples of Tertiary volcanic rocks, Paleozoic sediments and Precambrian rocks exposed at the surface in the Yucca Mountain vicinity.

Quality Assurance:

The technical procedure GP-18, "*Petrographic analysis of volcanic rocks*", received final signature and was released May 10, 1993.

A technical surveillance was performed on A. Braun's crew in mid May.

Work Performed but not in Direct Support of the Scheduled Tasks:

The following abstract was presented at the GSA, Cordilleran and Rocky Mountain Section meeting: "*Intraformational deformation in the rocks of Calico Hills near Yucca Mountain, Nevada*" by D. Buesch, and R. Dickerson.

C. Fridrich attended the symposia and field trip concerning the Walker Lane (a tectonic feature that is on trend with the Nevada Test Site region) at the Cordilleran Section Meeting of the Geological Society of America.

C. Hunter, D. Buesch, and F. Singer met with R. Zimmermann (USGS Central Regional Mineral Resources Division) in Denver to evaluate image analysis software that might be applied to petrographic studies of volcanic rocks and analysis of video logs of core. This meeting relates also to SCP activity 8.3.1.4.2.1.1, "*Surface and subsurface stratigraphic studies*".

An abstract entitled "*Petrofabric analysis and spatial clusters of elongate grains in a pyroclastic flow deposit: Implications for processes of flow, deposition, and aggradation of the base*", by D. Buesch and L. Dorcheus, was reviewed and approved for submittal to a meeting sponsored by the International Association of Volcanology and Chemistry of the Earth's Interior. The abstract is an extension of work by Buesch prior to joining the YMP, but methods and results of this work will apply to site characterization studies.

SCP 8.3.1.4.2.2.2 Surface-fracture network studies 0G32212B93

Summary Account Manager - M. Fahy

Technical Activities:

3GGF100 Compile map of Tiva Canyon data area

M. Fahy has completed and submitted (to USBR management) the report relating to milestone "Map of Tiva Canyon for review" (3GGF100M). Data from the Tiva Canyon Tuff suggest that lateral as well as vertical heterogeneities are present. Fracture clustering occurs and may be the rule. Some discontinuities are in the zone of influence (ZOI) of faults or laterally extensive cooling joints and fracture swarms (bursts). Data from OFR 89-92 (by T.L. Morgan) show orientation variations close to faults when analyzed using Azimuth versus Traverse Distance (AVTD) techniques. Fractal models of fracture networks is required to separate scale-independent components from scale-dependent components. Previous work focused on the scale-independent fractal nature of the presence or absence of fractures or joints. Other hypotheses need to be tested to address the spatial hierarchy and scale dependence seen in the fracture fabric. Cooling joint orientations vary and are not uniformly orthogonal. Few stations show the accepted "common knowledge" orthogonality, and some cooling joints are low-angle. Tectonic fractures from the pavement data can be grouped into sets based on orientation when each pavement is analyzed separately and length distributions are bimodal, not lognormal. Two modes of fracturing occur in the bedded tuffs, dilative and ductile. This simple observation requires further evaluation as some models consider the bedded tuffs to be flow-retardation zones. Fahy expects to deliver the report to R. Spengler the first week of June.

**3GGF081 Map and analyze Fran Ridge ESF pits area**

M. Fahy has mapped approximately 46 percent of the area enclosed by P2001. No further progress was accomplished this month; budget will not allow further mapping this fiscal year. A TDIF for the data collected will be prepared to meet milestone "Data transmittal/TDIF: Fran Ridge ESF Pits Area" (3GGF081M) at the end of the fiscal year.

Quality Assurance:

The process to qualify DIPS software continued. D.Gockel will seek independent review for the software. M. Fahy has provided everything that was requested by the SCC.

SCP 8.3.1.4.2.2.4 Geologic mapping of the exploratory shaft and drifts 0G32212D93

Summary Account Manager - S. Beason

Technical Activities:

**3GGF013B Prepare photogrammetrical map - launch chamber**

Mapping of the North Ramp starter tunnel continued throughout May with excavation still in the upper lithophysal zone of the Tiva Canyon Tuff. The pilot bore was mapped to station 0+97, including stereophotography, full-periphery mapping, and detailed line surveys. Mapping of the right and left walls above springline was completed to Station 0+40. Several samples were collected of wall rock, mineral infillings, and fault rubble.

At DOE's request, geologists completed unscheduled field work on a plan-view geologic map and detailed line surveys of the drainage channel above the portal cut.

S. Beason and J. Coe began work on the photogrammetric processing of the first stereophotos of the pilot bore from the starter tunnel. Film diapositives are being processed by Johnson Controls World Services, and the survey data from the photogrammetry targets are being computed by Raytheon Services, Nevada.

Work Performed but not in Direct Support of the Scheduled Tasks:

USBR mapping crews made a presentation to the NRC at the FOC and at the North Ramp starter tunnel. Personnel answered numerous questions about the mapping techniques as well as questions about nomenclature being used and basic geologic information at the portal.

S. Bearon prepared preliminary data and attended a meeting regarding support design and concerns about the stability of the opening. The meeting involved personnel from the M&O, LANL, REECO, and DOE.

Field mapping of the drainage channel above the portal cut and integration with Exile Hill data are completed.

SCP 8.3.1.4.2.2.5 Seismic tomography/vertical seismic profiling 0B32212E93

Summary Account Manager - E. Majer

Technical Activities:

3GGF041 Incorporate/integrate VSP model with Rock Characteristics

E. Majer attended a "dry run" of the DOE-NRC Technical Exchange on Geophysical Integration to be held June 8, 1993 in Las Vegas, Nevada. Majer presented a synopsis of tomographic modeling at the C-hole complex to rock characteristics section staff.

3GGF045 Develop and validate interpretational code

Work continued on the codes VELIN3D and ANI90. Improvements were made to VELIN3D to provide for more stable inversions and to avoid local minima in the inversion using the cubic b-spline methods. The progress report for milestone "Progress Report: Code validation" (3GGF052M) was received the first week in May. Milestone "Preliminary Report: Field VSP" (3FFF050M) is expected to be submitted in July.

3GGF040 Acquire and analyze VSP data

Discussions were held with H. Kalia (LANL) and R. Nolting (M&O) regarding work in the North Ramp portal. Due to unexpected fracture content, the portal work is progressing at a slower rate than planned. Resolution of several questions regarding the extent of the fractured zone, a more precise extent of the Rainier Mesa formation adjoining the Bow Ridge fault and location of hidden faults may be possible by using high-resolution seismic imaging.

Quality Assurance:

All reading assignments were completed on schedule.

Planning and Operations:

E. Majer participated in the interim review meetings.

WBS 1.2.3.2.5.3.2 Effect of Tectonic Processes and Events on Changes in Water-Table Elevation

Principal Investigator - J. Whitney

SCP 8.3.1.8.3.2.5 Effects of faulting on water-table elevation 0G32532E93

Summary Account Manager - C. Fridrich

Technical Activities:

3GTW009 Integrate studies/effects of tectonic processes on water table elevation:

C. Fridrich attended a meeting of the HITF.

WBS 1.2.3.2.5.5.2 Characterization of Igneous Intrusive Features

Principal Investigator - J. Sass

SCP 8.3.1.8.5.2.3 Heat flow at Yucca Mountain and evaluation of regional ambient heat flow and local heat flow anomalies 0G32552C93

Summary Account Manager - J. Sass

Technical Activities:

3GAT016 Maintain laboratory/Calibrate equipment

Completed safety shield and continued tests of high-temperature thermal conductivity apparatus.

Quality Assurance:

Documentation of software for GPP-20, R3, involved in calibration of temperature sondes and calculation of temperatures during logging runs, is awaiting a revision of the QMP covering this simple type of software. Continued dialogue with QA specialists on calibration vendors and on calibration of balances, micrometers and vernier calipers. Maintained and updated QA records as required. Read assignments as required.

Variations:

3GAT012 Collect core samples/prepare thermal specimens

3GAT013 Continue field measurements

No field measurements were carried out. No new holes have been made available and none of the WT holes have been reconfigured. There are also some software QA issues outstanding that preclude obtaining qualified data (see discussion of GPP-20, R3 under 3GAT016).

3GAT018 Prepare interim report

This report is deferred pending resolution of QA software issues.

3GAT045 Evaluate drilling plans and recommendations

No new progress; awaiting the opportunity to provide input on the manner of drilling and completion of corehole USW G-5.

WBS 1.2.3.2.8.3.1 Relevant Earthquake Sources

Principal Investigator - J. Whitney

SCP 8.3.1.17.3.1.1 Identify relevant earthquake sources 0G32831A93

Summary Account Manager - S. Pezzopane

Technical Activities:

3GSS002 Identify (preliminary) relevant Earthquake sources

Conducted field trip in Nevada to assess possible earthquake sources.

3GSS101A Compile information from existing sources

Compiled table of fault parameters for seismic sources.

SCP 8.3.1.17.3.1.2 Characterize the 10,000 year cumulative slip earthquake 0G32831B93

Summary Account Manager - J. Whitney

Technical Activities:

3GSS118A Evaluate and revise deterministic seismic hazard methodology

Conducted discussion and scoping studies with technical experts in USGS and Menlo Park.

3GSS119A Contribute to DOE topical report - seismic hazard approach

Met with colleagues to discuss approach, formulate strategy and draft preliminary outline.

Quality Assurance:

Read three assignments.

Planning and Operations:

Planned follow-up meeting in June to finalize approach and assign tasks to team.

Variances:

3GSS120 Prepare progress report: recommendations and reviews

Planned start May 25, 1993; have not yet begun, but will finish on schedule.

**WBS 1.2.3.2.8.3.3 Ground Motion From Regional Earthquakes and Underground Nuclear Explosions**

Principal Investigator - J. Whitney

**SCP 8.3.1.17.3.3 Ground motion from Regional earthquakes and UNEs 0G32833A93**

Summary Account Manager - J. Whitney

Technical Activities:

3GES010 Develop earthquake ground motion methodology

Attended meetings in Las Vegas and Menlo Park to formulate methodology.

3GES012 Prepare study plan

Attended meeting to develop strategy and approach for seismic hazard methodology.

**WBS 1.2.3.2.8.3.4 Effects of Local Site Geology on Surface and Subsurface Motions**

Principal Investigator - J. Whitney

**SCP 8.3.1.17.3.4.1 Determine site effects from ground motion recording 0G32834A93**

Summary Account Manager - J. Whitney

Technical Activities:

3GSG101A Gather seismograms from prior studies

Assembled recordings made at UNR portable stations near YM for 200 additional earthquakes.

3GSG103A Develop initial standard ground motion model

Continued to develop the computer program to use LSM aftershocks to estimate site effects at YM.

**WBS 1.2.3.2.8.4.1 Historical and Current Seismicity**

Principal Investigator - J. Brune

**SCP 8.3.1.17.4.1.1 Compile historical earthquake record 0G32841A93**

Summary Account Manager - J. Brune

Technical Activities:

3GSM105 Compile historical earthquake records

Photographed original recordings at Cal Tech for historical earthquakes reported to be in vicinity of Yucca Mountain.

Variances:

3GSM102 Prepare progress report: historical earthquake records

Scheduled to begin May 25, 1993; did not start. No change in finish date anticipated.

SCP 8.3.1.17.4.1.2 Monitor current seismicity 0G32841B93

Summary Account Manager - J. Brune

Technical Activities:

**3GSM134A Monitor FY93 seismicity**

Recorded data from SGBSN for all of May, including numerous aftershocks of the May 18 Eureka Valley, California earthquake, except for approximately one hour of downtime. UNR preliminary SGB bulletin now complete through May 18, 1993.

**3GSM148A Data analysis Little Skull Mountain Earthquake**

Applied program to obtain moment, corner frequencies, and stress drop for several larger LSM aftershocks. Calculated b-value and decay rate of LSM aftershock sequence. Continued data base organization for LSM--only 32 days of data remain to be processed.

Quality Assurance:

Polarity checks made on SGBSN recordings with two teleseisms. Successfully completed new seismic instrument calibration procedure for roughly 30 stations--approximately 10 or 12 stations left to calibrate. Software requirements documents prepared for CUSP, PICKEM, and the CALIB programs.

Planning and Operations:

Planned to rewrite CUSP code to conform to new Tustin 2100 A/D convertor. Received and reviewed technical data package from USGS on LSM earthquake.

WBS 1.2.3.2.8.4.2 Location and Recency of Faulting Near Prospective Surface Facilities

Principal Investigator - J. Whitney

SCP 8.3.1.17.4.2.1 Identify appropriate trench locations in Midway Valley 0G32842A93

Summary Account Manager - F. Swan

Quality Assurance:

Continued QA training and updates as necessary. There are no known non-conformances or deviations from established QA procedures during this report period.

Planning and Operations:

This activity is planned to begin on June 1, 1993 and to be completed by June 30, 1993; no delays in this schedule are anticipated.

SCP 8.3.1.17.4.2.2 Conduct exploratory trenching in Midway Valley 0G32842B93

Summary Account Manager - F. Swan

Technical Activities:

**3GFP008 Excavate/log/study trenching near proposed ESF**

Report preparation continued for the trenching investigations near the proposed ESF. Bedrock faults exposed in the "box cut" of the ESF portal were mapped to determine their locations relative to faults and fractures observed in our trenches (now backfilled) in the construction area.

**3GFP021 Clean/modify/relog/study new logs from trench 17 (MWV-T4)**

Field work finished in April; continued to prepare report on MWV-T4. Presented paper at Reno, Nevada GSA meeting on results of logging of trench 17.

Quality Assurance:

Continued QA training and updates as necessary. There are no known non-conformances or deviations with established QA procedures during this report period.

Planning and Operations:

3GFP008 Evaluate/log/study trenching near proposed ESF

A report on this activity is scheduled to be completed August 31, 1993; no delays in meeting this schedule are anticipated.

Variances:

3GFP021 Clean/modify/relog/study new logs from trench 17 (MWV-T4)

New logs from Trench 17 were not completed as planned. It is planned to complete the report during June.

3GFP016 Excavate/log/study extensions of trench A-3

Work on this activity did not start on February 16, 1993 as planned. Time and funding constraints may not allow us to study the trench this fiscal year. During October and November of 1992, additional excavations and study of the area near the proposed ESF (activity 3GFP008) were required on the basis of our prior work. This added work, plus the originally planned work had to be completed by November 23, so that construction activities for the ESF could take place as scheduled. More persons were added to complete the fieldwork for activity 3GFP008 by the deadline, resulting in an unanticipated increase in the amount and rate of spending.

In addition, trench priorities have changed. Newly obtained geophysical data indicates that a fault may be present in the middle of Midway Valley. For purposes of study 8.3.1.17.4.2, a higher priority was assigned to the investigation of this possible fault than to the study of trench A-3. The location of a trench or trenches across this possible fault will depend on the final geophysical interpretation and other information, such as geologic mapping.

Based on these considerations, the priorities for excavation activities are being reevaluated within the context of this study and within the scope of other trenching activities scheduled by the USGS for fiscal year 1993. The excavation and study of trench A-3 will depend primarily on trenching priorities still to be assessed and secondarily, on scheduling with REECO, DOE's excavation contractor.

Work Performed but not in Direct Support of the Scheduled Tasks:

Observation No. 5 of Audit USGS-93-06 was resolved during May.

Geomatrix personnel prepared and presented two talks at the GSA meeting. The talks summarized results of studies of Trench MWV-T4 on the Paintbrush Canyon fault and of trenches and soil test pits in the area of the ESF.

WBS 1.2.3.2.8.4.3 Quaternary Faulting within 100 km of Yucca Mountain

Principal Investigator - J. Whitney

SCP 8.3.1.17.4.3.2 Evaluate Quaternary faults within 100 km of Yucca Mountain 0G32843B93

Summary Account Manager - L. Anderson

Technical Activities:

3GTQ007B . Compile map of Quaternary faults within 100 km/study Beatty scarp  
The map is being drafted. The accompanying text and tables are being readied for final USBR review. A draft report on the Beatty scarp also is being readied for USBR review.

SCP 8.3.1.17.4.3.4 Evaluate Bare Mountain fault zone 0G32843D93

Summary Account Manager - L. Anderson

Technical Activities:

3GTQ065 Conduct detailed Quaternary surficial geologic mapping on the east side of Bare Mountain  
Analysis of low-sun-angle aerial photographs of the Bare Mountain frontal fault zone continued.  
Compilation of a preliminary surficial geologic map of the Bare Mountain frontal fault zone is continuing.

3GTQ060 Analyze trenches, Bare Mountain fault zone  
Prepared for the NRC field trip, which included a visit to this trench, and presented preliminary findings.

Variances:

3GTQ060 Analyze trenches, Bare Mountain Fault Zone  
The start of this activity was delayed beyond March 1, 1993 because archeology clearances for trench BMT-1 (Tarantula Canyon) were lacking. Excavation is anticipated to begin July, at the earliest. Trench BMT-2 was excavated on May 12, 1993.

WBS 1.2.3.2.8.4.4 Quaternary Faulting within Northeast-Trending Fault Zones

Principal Investigator - J. Whitney

SCP 8.3.1.17.4.4.1 Evaluate the Rock Valley fault system 0G32844A93

Summary Account Manager - D. O'Leary

Technical Activities:

3GTN011 Work on study plan/Conduct fieldwork Rock Valley fault system  
The study plan is at NRC for final approval. Prepared for field work in June.

WBS 1.2.3.2.8.4.5 Detachment Faults

Principal Investigator - J. Whitney

SCP 8.3.1.17.4.5.1 Evaluate significance of the Miocene-Paleozoic contact 0G32845B93

Summary Account Manager - W. Hamilton

Technical Activities:

3GTD017B . Complete map of the Calico Hills/Write report  
PI attended talks pertinent to geologic complexities in the Calico Hills while at the GSA meeting. The draft report was informally reviewed for conformance with USGS editorial standards.

3GTD009B Evaluate Miocene-Paleozoic contact  
PI attended talks on topics that pertain to features observed at the Miocene-Paleozoic contact in the Calico Hills, while at the GSA meeting.

Variances:

3GTD017B Complete map of the Calico Hills/Write report

Due to the delay in completion of the task "Complete field mapping/submit map for review" (3GPF026A) in SCP activity 8.3.1.17.4.6.1, this map and report may not be completed as scheduled.

Work Performed but not in Direct Support of the Scheduled Tasks:

Work in preparation for the midyear review of studies under the GSP tectonics section, was conducted.

SCP 8.3.1.17.4.5.2 Evaluate postulated detachment faults in the Beatty-Bare Mountain area 0G32845B93  
Summary Account Manager - W. Hamilton

Technical Activities:

3GTD012B Evaluate and conduct mapping, Bare Mountain and Crater Flat

C. Fridrich and M. Murray were in the field from March 14 to May 12 and accomplished the following: 1) finished field work for the East of Beatty Mountain 7.5 minute quadrangle; 2) mapped about 70% of the outcrop in the Big Dune 7.5 minute quadrangle; 3) participated in a 4-day field trip with other members of the USGS-YMP tectonics program and the USGS weapons program on regional detachment faulting relations; and 4) participated in a 2-day field trip with LANL geologists D. Broxton and R. Warren on regional correlations of volcanic units of the southwestern Nevada volcanic field. In addition, Fridrich went to the Cordilleran Section Meeting of the GSA to attend symposia and a field trip concerning the Walker Lane, a tectonic feature that is on trend with the NTS region.

3GTD005B Evaluate extension in Miocene rocks - Bare Mountain and Crater Flat

C. Fridrich and W. Hamilton continued synthesis of geologic data pertinent to an evaluation of extensional history of Crater Flat.

Quality Assurance:

3GTD013B Collect field and lab data - Thermobarometry studies

Arrangements were made for a QA specialist to accompany T. Hoisch in the field.

Planning and Operations:

3GTD013B Collect field and lab data - Thermobarometry studies

Prepared for field work to begin at Bare Mountain and Bullfrog Hills starting in June.

SCP 8.3.1.17.4.5.5 Evaluate age of detachment faults using radiometric ages 0G32845E93

Summary Account Manager - W. Hamilton

Planning and Operations:

Prepared for field work which will begin in June.

WBS 1.2.3.2.8.4.6 Quaternary Faulting within the Site Area

Principal Investigator - J. Whitney

SCP 8.3.1.17.4.6 Evaluate Quaternary faulting within the site area LOE Account 0G32846Z93

Summary Account Manager - C. Menges

Work related to preparations for the NRC field trip was charged to this account. Prepared a talk and poster presentation for the GSA meeting.

SCP 8.3.1.17.4.6.1 Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain

0G32846A93

Summary Account Manager - J. Whitney

Technical Activities:

3GPF026A Complete field mapping/submit map for review

Completed drafting and lettering on the map this month. The map was informally reviewed and drafting errors and labeling problems were identified. Continued work on an accompanying report. PI attended talks pertinent to Quaternary faulting while at GSA meetings.

Variations:

The final map at 1:24,000 scale and its accompanying report will not be submitted for USGS review on time. At DOE's request the PI was called away to work on the erosion topical report. The other co-author was similarly pulled away to work on monthly and mid-year review reports. Despite these and other administrative distractions, the map is nearing completion and should be ready for submittal in mid-June.

SCP 8.3.1.17.4.6.2 Evaluate age and recurrence of movement on suspected and known Quaternary faults

0G32846B93

Summary Account Manager - C. Menges

Technical Activities:

3GPF19P Study faults on the west and east side of Busted Butte

J. Paces completed chemistry on two whole-rock aliquots, each from two samples of buried soils in Trench 14d showing offset by the Bow Ridge fault. Isotopic compositions currently are being analyzed by alpha counting. Chemistry on an additional three aliquots, each from the same two samples, were initiated. In addition, K. Futa initiated U-series chemistry on several aliquots of a rhizolith sample from Stagecoach Road Trench 1.

B. Widmann initiated thermoluminescence procedures for a second set of five samples from trenches crossing the Bow Ridge (Trench 14D), Paintbrush Canyon (Busted Butte), Solitario (Trench SCF-T8) and Windy Wash (Trench CF1) faults. This work includes pretreatment, wet sieving, silt separation and disk preparation.

D. Craft completed preparation of mineral separates of an ash-rich soil sample from Stagecoach Road to assess the potential for dating using Ar/Ar techniques. Examination of separates by Z. Peterman suggest that hornblende offers the most potential for successfully determining the age of ash eruption; however, it was determined that additional material would need to be collected to provide sufficient mineral concentrations for dating.

Signification work went into preparing for the NRC field trip. Prepared preliminary log of natural exposure of wall #4 and presented findings to the NRC.

3GPF035A Study trenches excavated on Yucca Mtn. faults

Continued work on Stagecoach Road trenches 1 and 3. Mapped trench walls and prepared for the NRC field trip. C. Menges prepared and presented a talk on Bow Ridge fault at the GSA meetings. A. Ramelli completed trench logs for the southern trench on the Solitario Canyon fault. The results were presented to the NRC during the field trip.

3GPF032A Scarp degradation and evolution north Windy Wash

C. Harrington (LANL) did field work on Windy Wash and Solitario Canyon fault scarps.

3GPF039A Study geophysical survey - Windy Wash Fault

Prepared for survey, which will begin in June.

Quality Assurance:

B. Widmann met twice with P. Reilly to discuss technical procedure GCP-29, R0 "Thermoluminescence dating" and with W. Rodman to discuss calibrations and operational checks for instruments used in the procedure.

Variations:

3GPF36 Prepare interim report: c/d trenches

Completion of trench 14D logs and reports are still behind schedule. The primary log has been completed (TDIF submitted and trench log digitized), but the report has been delayed until approximately early June. Logging of the remaining walls of trench 14D is in progress. The delay is due to unanticipated work on the ESF seismic design in March and April.

Work Performed but not in Direct Support of the Scheduled Tasks:

J. Whitney searched for surface breaks after the Rock Valley earthquake.

WBS 1.2.3.2.8.4.10 Geodetic Leveling

Principal Investigator - J. Whitney

★ SCP 8.3.1.17.4.10.2 GPS Base - station survey 0G3284AB93

Summary Account Manager - J. Whitney

Technical Activities:

3GTM020 Resurvey GPS base stations

A field crew resurveyed GPS base stations this month.

Quality Assurance:

Personnel were trained before beginning field work.

WBS 1.2.3.2.8.4.12 Tectonic Models and Synthesis

Principal Investigator - J. Whitney

SCP 8.3.1.17.4.12.1 Evaluate tectonic processes and tectonic stability at the site 0G3284CA93

Summary Account Manager - W. Hamilton

Technical Activities:

3GTE072 Compile geologic map of the Death Valley area

Map author consulted with map editor and reviewers about USGS procedures and requirements for map publication. The revised map was colored.

3GTE08JA Integration of tectonic data

W. Hamilton continued to integrate published and unpublished tectonic data and prepared to examine analog tectonic structures at the Sever Desert detachment fault.

SCP 8.3.1.17.4.12.2 Evaluate tectonic models 0G3284CB93

Summary Account Manager - W. Hamilton

Technical Activities:

3GTE045 Evaluate tectonic models

Evaluation of tectonic models continued. Project personnel attended talks on tectonic models in the southern Great Basin presented at the GSA meeting.

Variances:

3GTE050 Perform boundary element modeling  
Prepared for work which will start in June 1993.

WBS 1.2.3.3.1.1.1 Precipitation and Meteorological Monitoring for Regional Hydrology

Principal Investigator - A. Flint

SCP 8.3.1.2.1.1.1 Precipitation and meteorological monitoring 0G33111A93

Summary Account Manager - A. Flint

Technical Activities:

3GMM035 Collect/analyze synoptic weather/reg/site met data

Data collection continued in May. Site data were downloaded weekly from the five weather stations and two tipping bucket rain gage sites. Satellite and weather chart data were received and archived on tape cartridges every third day. No precipitation was recorded at Yucca Mountain during May. Frequent frontal passages brought windy but dry conditions to the Yucca Mountain region. Plans are being made to add radar data collection during the thunderstorm season - July and August. Hourly radar data are available via dial-up into the WeatherBank, Inc. data base. Radar data will complement satellite imagery and lightning data to track thunderstorm activity and locate areas of precipitation within the Upper Amargosa River Watershed. Radar data will also be archived. A procedure for the use of storage gauges (HP 264) was submitted for technical review.

Statistical analysis of precipitation data obtained from the tipping bucket gages (both heated and non-heated) for the period 1990 through 1993 was initiated. This data is important for characterizing the temporal distribution of precipitation events, including the probability of storm occurrence, storm duration, and storm intensity. The preliminary analysis included a comparison of the tipping bucket data with daily accumulations obtained using the storage gage network. A comparison of the tipping bucket data with lightning strike data, meteorological data (wind, air temperature), satellite data (cloud cover, storm type), and the video record (for daytime events) is in progress. This analysis will be used to more accurately characterize seasonal storm types, and for a more detailed characterization of individual storm events (hourly verses daily isohyetal mappings, snow verses rain mappings, storm intensity mappings, storm movement and genesis, etc.). Results from this work are needed for the purpose of analyzing natural infiltration at Yucca Mt. using rainfall-runoff models.

3GMM038 Prepare technical report FY92 synoptic/reg/site met data

It is planned to produce at least two reports. The first on the FY93 data taken from the five weather stations, and the second the synoptic/regional weather patterns for the year. Included in the synoptic/regional report will be information on the trajectories of weather systems impacting the west coast of the US and the frequency of weather types matching the 5 major types cataloged by Elliott (1943). Lightning data and satellite data may also be included. Regional precipitation patterns for the year will also be presented in either tabular or graphical format. The work is going more slowly than expected and will not be completed according to the planned schedule and a variance is requested.

Variances:

3GMM038 Prepare technical report FY92 Synoptic/reg/site met data

The reports scheduled to be completed by June 30, 1993, must be slipped to September 30, 1993. Manpower limitations and workload are the main contributor to this slippage. An attempt is being made to stay on schedule despite the fact that an approved Meteorology-2 position went unfunded for FY93. The time of personnel (J. Hevesi and W. Davies) required to do a major portion of the statistical analyses has been divided with other projects which also have milestones. This delay should have no impact on site characterization.

WBS 1.2.3.3.1.1.2 Runoff and Streamflow

Principal Investigator - D. Beck

SCP 8.3.1.2.1.2.1 Surface-water runoff monitoring 0G33112A93

Summary Account Manager - T. Kane

Technical Activities:

3GRS031A Complete reduction of FY86-FY89 data and preparation of report  
Progress continues on this activity and is forty percent complete.

3GRS025A Reduce FY92 runoff data and prepare report  
This activity is to be rescheduled into FY94, as noted in the April monthly report.

3GRS023A Collect FY93 runoff and streamflow activity  
The month of May was a relatively dry month. Three sites recorded rainfall of only 0.04 inches. The Regional and Yucca Mountain Network Sites, for the most part, were dry, except for the Tecopa gage, which is presently at base flow.

T. Kane reviewed the technical procedure for the collection of rainfall data.

T. Kane and D. Bauer ran levels at Unnamed tributary to Stockade Wash, to determine if any changes had occurred to the gage datum, as a result of the winter storms on May 19.

C. Martinez and W. Nylund ran the monthly field trip.

3GRS017A Install three additional gages on Yucca Mountain  
Site approval has been received from DOE. Work has begun and will continue into the summer months. Installation began May 6 on the Amargosa River at Stateline gage.

Quality Assurance:

Quality assurance activities conducted by C. Martinez this month included: work on TDIFs and reading assignments, and updated HPs, QMPs, and APs.

Planning and Operations:

3GRS028A Apply for site prerequisite survey  
Permits were received from DOE on May 11.

Variances:

3GRS017A Install three additional gages on Yucca Mountain  
This activity had been delayed due to the inability to receive site permits from DOE; however, the activity started May 6.

Work Performed but not in Direct Support of the Scheduled Tasks:

T. Kane accompanied P. Glancy, D. Grasso, D. Beck, and G. Dixon on a field trip to the lower reaches

of the Amargosa River. Past and present flow occurrences were investigated.

T. Kane worked on performance appraisals.

**WBS 1.2.3.1.1.3 Regional Ground-Water Flow System**

Principal Investigator - J. Czarnecki

**SCP 8.3.1.2.1.3 Regional ground water flow system LOE Account 0G33113Z93**

Summary Account Manager - J. Czarnecki

**Support Project Operations**

**Technical Activities:**

J. Czarnecki helped organize and participate in a meeting of the HITF. The meeting included overviews by J. Rousseau on findings during the construction of corehole UE-25 UZ#16 and by M. Umari and A. Geldon on planned testing at the C-hole complex. Also included was a short presentation by G. Barr (SNL) on a preliminary 3-D numerical model to examine the effect of specifying hydraulic conductivity values as a function of the spatial distribution of geologic units.

**Planning and Operations:**

J. Czarnecki performed an annual employee appraisal of C. Savard and revised his employee work plan.

Project staff attended an all-day workshop on current and future YMP data bases.

F. D'Agnese, C. Faunt and J. Czarnecki prepared monthly PACS reports for their respective activities.

F. D'Agnese, K. Turner and J. Czarnecki attended a HIP PI/SA Manager meeting to discuss related work activities.

**Collect FY93 Moisture Data**

**Technical Activities:**

Project staff collected ground-water levels in UE-29a#1, UE-29a#2, and UE-29UZN#91; took readings from rain wedges at UE-29UZN#91 and UE-29UZN#92; and collected neutron moisture logs from UE-29UZN#91 and UE-29UZN#92. Data collection frequency was decreased from previous months which documented ground-water recharge from rainfall/runoff events in the Fortymile Wash watershed.

**SCP 8.3.1.2.1.3.2 Regional potentiometric level distribution and hydrogeologic framework studies**

**0G33113B93**

Summary Account Manager - J. Czarnecki

**Technical Activities:**

**3GRG011A Test small diameter wells**

A bailed water sample was obtained from a 1-1/4" diameter piezometer in a dual-piezometer borehole (NA-10) north of the IMV plant in the Amargosa Desert. Attempts to obtain a sample from the deep piezometer (2000 ft deep) in NA-10 resulted in dewatering the well to a depth of 700 ft; subsequent pumping one week later resulted in no water being produced. Pumping

was done two weeks following the initial pump installation and a small amount of water was produced.

**3GRG068 Survey water wells in Amargosa Desert FY93**

G. Buchanan monitored several wells in the Amargosa Desert as part of the periodic water level monitoring program.

Planning and Operations:

**3GRG011A Test small diameter wells**

J. Czarnecki prepared a form to record pumping rates, specific conductance and temperature for use during small-diameter well testing; he reviewed it with G. Buchanan. A summary table of wells being monitored in the Amargosa Desert was also prepared.

**3GRG010 Prepare interim status report**

J. Czarnecki prepared an interim six-month status report and reviewed its contents at a meeting with L. Hayes and other USGS-YMP staff.

Work Performed but not in Direct Support of the Scheduled Tasks:

J. Czarnecki discussed casing corrosion observed in well USW H-5 with D. McCright (LLNL) and provided the appropriate contacts for obtaining possible samples during the removal of tubing during the hydraulic testing of the WT holes. (2 hrs.)

SCP 8.3.1.2.1.3.3 Fortymile Wash recharge study 0G33113C93

Summary Account Manager - C. Savard

Technical Activities:

**3GRG023B Evaluate southern Nevada and California streamflow**

C. Savard prepared a seminar to be given at USGS Headquarters on applications of chaos theory to hydrology and implications for Yucca Mountain hydrology.

**3GRG026 Conduct ponding and infiltration tests**

C. Savard continued writing and bench testing a program to control the water level in infiltration tanks and model streamflow hydrographs during storm events.

**3GRG020 Prepare interim status report**

C. Savard finished drafting the report and supplied it to J. Czarnecki for review.

WBS 1.2.3.3.1.1.4 Regional Hydrologic System Synthesis and Modeling

Principal Investigator - J. Czarnecki

SCP 8.3.1.2.1.4.2 Subregional two-dimensional areal hydrologic modeling 0G33114B93

Summary Account Manager - J. Czarnecki

Technical Activities:

**3GRM028A Draft report on preliminary simulation of large hydraulic gradient**

J. Czarnecki continued to run simulations on the NHPSUN computer, which examined the removal of the barrier to ground-water flow responsible for representing the large-hydraulic gradient north of Yucca Mountain. A breakthrough was made in automatic plotting of head-difference contours for each reported time step.

Work Performed but not in Direct Support of the Scheduled Tasks:

J. Czarnecki presented seminars on characterization of the regional ground-water flow system of Yucca Mountain and vicinity at the USGS District Office in Boston and in the WRD of the Department of Civil Engineering at the Massachusetts Institute of Technology. Czarnecki also met individually with staff from each group to discuss various strategies for site characterization.

J. Czarnecki technically reviewed a paper entitled "*A theoretical model for thrust induced deep groundwater expulsion with application to the Canadian Rocky Mountains*" for the Journal of Geophysical Research. (16 hrs.)

SCP 8.3.1.2.1.4.4 Regional three-dimensional hydrologic modeling 0G33114D93

Summary Account Manager - J. Downey

Technical Activities:

3GFH022C Refine 3-d hydrogeologic model

C. Faunt continued plotting horizon data in three-dimensions. Some problems with the software were encountered, but a work around was developed. All of the data was transferred to digital point files. The hydrogeology map and topography data were combined to make point files of the surface hydrogeology.

The paper on structural analysis is completed. Final maps and figures are being prepared. A rough draft is being reviewed by K. Turner. These comments are being incorporated into the manuscript. The report is being updated by incorporating earthquake epicenter data and statistical analyses.

K. Turner continued review of map and text developed for "*Hydrogeology of Death Valley Region, Nevada and California*", by C. Faunt and F. D'Agnese.

K. Turner finished review of text developed for "*Preliminary digital geologic maps of the Mariposa, Kingman, Trona, and Death Valley sheets, California*", by C. Faunt, F. D'Agnese, and K. Turner. The paper was submitted to R. Luckey to begin the technical review process.

3GRM041A Generate model input arrays

F. D'Agnese finalized preliminary vegetation maps and worked on the report for Regional Vegetation mapping Death Valley Region. A field trip was conducted April 21 - May 3, 1993 to field check resulting density and land cover classes. A final map and report are projected for summer. In addition, another field trip was scheduled for the first week in June to check the last of the northern areas for mapping accuracy.

K. Turner continued to complete report on the Amargosa Desert vegetation mapping originally conducted by L. DeMarco. Land cover classes were correlated with regional vegetation mapping conducted by F. D'Agnese.

K. Turner, F. D'Agnese, C. Faunt and E. Gutentag reviewed progress on regional and Amargosa vegetation maps and outlined schedules for completion of work for this summer.

F. D'Agnese revised water balance accounting for Death Valley Region based on earlier investigations (numerical models and water resource studies) and data from Nevada State Engineer supplied by R. LaCamera. A complete accounting of water use has been added to the account, along with information on what kind of water use the withdrawals are.

F. D'Agnese continued working with B. Meier (Intergraph) to develop a 2.5 dimensional terrain

model of the study area to be used in visualization of the 3-dimensional model, YMP tour demonstrations, and presentations.

F. D'Agnese continued work on a regional potentiometric surface map. Map revisions continued through the month. The map is also being compared to other published maps and topographic data. Additional data on strontium isotope results was also reviewed for this activity.

F. D'Agnese continued preparing report on the "*Hydrogeology (conceptual and numerical models) of the Death Valley Region*". The chapter on "Physical setting, previous investigations, and geologic framework" was completed.

F. D'Agnese continued an analysis of regional spring discharge and its relation to regional flow. This included analyzing spring discharge, temperature and chemistry to determine if the spring was indeed, a regional discharge component. Additional spring localities in the northern portion of Death Valley were located and added. Springs in the Pahute Mesa-Timber Mountain Area also were checked. This activity in conjunction with past discharge will direct future sampling trips for faunal, isotope and chemical characterization of ground-water, as well as aid in the characterization of major regional flow-paths.

**3GFH009C Continue testing with chemical models**

Cluster analyses of the chemical data are being reviewed and interpreted. The clusters are being compared with spatial and geologic information.

D. Perfect and C. Faunt attended a week long course by Plummer, Parkhurst, and Glynn on "Reaction path models". The different models were examined and example problems were worked with the models. From the course Faunt and Perfect decided that NETPATH will be the best to use for the flow path modeling.

**3GFH014C Evaluate GIS methods**

F. D'Agnese and K. Turner developed an outline of the paper on GIS and Ground-water modeling for the NCGIA Breckenridge Conference. They also developed the schedule for finalizing paper for review and publication.

**WBS 1.2.3.3.1.2.1 Unsaturated Zone Infiltration**

Principal Investigator - A. Flint

**SCP 8.3.1.2.2.1 Unsaturated zone infiltration LOE Account 0G33121Z93**

Summary Account Manager - A. Flint

Support project operations, FY93

Activities for May included preparation of monthly PACS.

L. Flint, L. Hofmann, J. Curtis, and M. Nash were involved with public tours. A. Flint, L. Flint, W. Davies, J. Halves, L. Hofmann, W. Guertal, and D. Hudson were involved with preparing, organizing and running the USGS Headquarters Tour; five 1-hour small group tours of the HRF.

L. Flint, A. Flint, D. Hudson, W. Guertal, and W. Davies attended QA procurement training on May 11. QA reading assignments were completed. J. Curtis attended GET, GERT, First Aid

and Radiation Worker Training. Hudson and Guertal were involved with a QA surveillance of the Neutron Logging program. Hudson and Flint had a meeting with REECO procurement agent to learn the proper procedure using performance criteria for obtaining an unsaturated flow apparatus using.

W. Guertal participated in a Public Update Meeting at Beatty, Nevada. Guertal and A. Flint participated in a Public Update meeting at Las Vegas, Nevada, and Reno, Nevada.

A. Flint and D. Hudson attended the Hydrologic/Thermal Modeling Interchange, the Infiltration Project review, and the USGS-YMP Hydrologic Database Management Workshop and visited the fracture flow lab. W. Guertal and W. Davies attended the USGS-YMP Hydrologic Database Management Workshop.

#### Neutron Moisture Monitoring FY93

All 97 neutron holes and UZ-7 were monitored this month.

#### SCP 8.3.1.2.2.1.1 Characterization of hydrologic properties of surficial materials 0G33121A93

Summary Account Manager - A. Flint

##### Technical Activities:

##### 3GUI012 Collect/analyze consolidated/unconsolidated materials

Samples for gravimetric and volumetric water content were collected at selected locations along the transects of tensiometers in WT-2 Wash. Six closed, spaced bead cone samples were taken around N-54. These samples were used to look at the variation of bulk density in alluvial material at a point location.

The monthly surficial sampling project continued. The field sampling procedure was amended so that samples are being sieved in the field. Only the less than 2 mm fraction is being used for the laboratory analysis of the soil moisture potential and gravimetric moisture content. The field sieving greatly facilitates the laboratory processing of the samples.

##### 3GUI015A Develop preliminary geohydro/surficial/infiltration/runoff map

Map unit descriptions for geomorphic surfaces, depth to bedrock, and soil classification are being defined and evaluated in the field. When the GIS software (ARC/INFO) arrives, the preliminary geomorphic surface map will be digitized.

##### 3GUI010 Prepare interim status report

The interim status report was completed.

#### SCP 8.3.1.2.2.1.2 Evaluation of natural infiltration 0G33121B93

Summary Account Manager - A. Flint

##### Technical Activities:

##### 3GUI305 Conduct water balance studies FY93

The five 30 cm deep field tensiometers were monitored. Two tensiometers in the shallow soils on Yucca Crest (N27 and N71) and the tensiometer on the sideslope of WT-2 Wash (N55) dried to tensions above the tensiometer range, but the two tensiometers in deeper soils in the washes (N14 and N54) dried but remained in the tensiometer range. Soil samples were collected near each of these tensiometers at 5 cm intervals to 30 cm to provide more field retention data. The Bowen ratio data were collected.

**3GUI307 Develop small scale watershed model**

Data collection for modeling the WT-2 Wash watershed continued. Slopes and aspects were measured for use in a radiation load model to estimate spatially variable evapotranspiration across the whole wash. Soil water potentials and water contents also were measured along the three tensiometer transects in WT-2 Wash. A literature review was done to search for existing watershed models for arid and semi-arid environments. The results of this search indicate that most existing models are for wetter environments than Yucca Mountain. A primary problem with these models is the need for a unit hydrograph for calibration and the lack of runoff events at Yucca Mountain. Preliminary work on writing a site specific model was started.

**3GUI310 Evaluate shallow/deep infiltration process FY93**

Shallow and deep water content profiles from the historical neutron logs were evaluated for evidence of water movement in preparation for a meeting between the total system performance assessment (TSPA) group at SNL and the infiltration group. Percolation rates and processes at the proposed repository level were discussed. The modeling efforts by the TSPA group were also discussed.

Preliminary analysis of 11 neutron holes in WT-2 Wash and the six neutron holes on the crest above WT-2 Wash was used to describe simple conceptual models and mechanisms of shallow infiltration in this small arid watershed.

**3GUI050 Prepare report historical neutron hole data**

The process of verifying the neutron hole data in the PARADOX data base began. Historical neutron probe standardization counts were extracted from the data base and graphed for each of the nine neutron probes used to collect this data.

**3GUI300 Prepare interim status report**

This report was completed and submitted on its due date. All work is progressing satisfactorily without any delays.

**SCP 8.3.1.2.2.1.3 Evaluation of artificial infiltration 0G3312!C93**

Summary Account Manager - A. Flint

**Technical Activities:**

**3GUI636 Conduct infiltrometer study/prepare OFR**

The first draft of a manuscript which describes the operation and performance of the ring infiltrometers and water storage system was completed. The manuscript currently is undergoing internal review at the HRF.

**3GUI640 Conduct prototype ponding/SPRS/LPRS study-finalize methods**

Neutron readings at N-85 showed the internal drainage of water had stopped. Therefore, the plastic, which was covering the ground surrounding the hole, was removed allowing moisture to evaporate from the soil surface. The periodic neutron readings showed that the upper 30 cm dried quickly, but that below this depth the water content is not changing quickly. The periodic neutron readings will be continued for the remainder of the year so that the depth of the drying front at this site may be determined.

Bulk density samples were collected at all of the TDR probe locations at N-85. Bulk density was determined, for each of the sampling locations, at a depth of 0 to 30 cm. This depth was used because it is the length of the TDR probes. An attempt is being made to correlate measured volumetric water content with TDR determined volumetric water content.

3GUI630 Prepare interim status report  
The interim status report was completed.

WBS 1.2.3.3.1.2.3 Percolation in the Unsaturated Zone - Surface Based Study  
Principal Investigator - J. Rousseau

SCP 8.3.1.2.2.3 Percolation in the unsaturated zone, surface-based study LOE Account 0G33123Z93  
Summary Account Manager - M. Chornack

HRF borehole monitoring and sensor recalibrations  
Monitoring of the HRF boreholes continued.

Monthly PACs status reports for month of May, were prepared.

Interim progress reports for three activities: surface based boreholes, vertical seismic profiling, and integrated data acquisition system were prepared and submitted.

USGS annual employee performance appraisals were prepared (seven appraisals prepared).

Select staff attended Novell Netware 3.11 training class.

The price proposal for a 5 year procurement contract, for insulated instrument shelters, was submitted by R/P International, Inc., of Cincinnati, Ohio, and was reviewed. Comments and a request for additional information and/or clarification were prepared and submitted to the Central Region Contracting Officer.

Select staff attended a YMP-USGS training class on technical data management and submission of TDIFs.

M. Kurzmack attended a class on data base systems and presented a summary of the Deep UZ's data base management program. Kurzmack also completed a technical review of QMP-3.03, Rev 3, Mod 4, and QMP-3.03, Rev 4.

Inventoried and consolidated all PDP 11/73 computers, disk drives, controller boards, manuals, etc., in preparation for turn-in.

HDAS software was installed to take over the local data acquisition system at the HRF boreholes.

Prepared for the NRC presentation on June 8, 1993 in Las Vegas, Nevada. The title of the presentation is "Vertical Seismic Profiling - Deep Unsaturated Zone Studies, Yucca Mountain, Nevada."

J. Rousseau presented a paper in Knoxville, Tennessee, at the Fourth Technology Information Exchange meeting hosted by DOE. The title of the presentation was "Practical utilization of thermocouple psychrometers."

Reviewed and prepared comments to vendor proposals for supplying pressure transducers for the UZ borehole instrumentation and monitoring program. Comments were submitted to the Central Region contracting officer.

A staff meeting for project PIs was held.

Completed the camera-ready review of the USW UZ-6s report and performed extensive processing software documentation for QA purposes. Four documentations were completed and given to M. Pabst.

Notification that psychrometers for UE-25 UZ#4, UE-25UZ#5, USW UZ-7, USW UZ-13, and USW UZ-14 were ready for delivery.

**Support project operations**

The Rotronics sensor was returned in working condition and was replaced in the relative humidity oven prior to use of HP-229.

There was an all day public tour of the HRF.

L. Flint attended a meeting with REECo procurement personnel to help in the preparation of a package to procure an unsaturated flow apparatus to measure unsaturated hydraulic conductivities on rock core using a centrifuge.

L. Flint performed a technical review of procedure QMP-8.01.

L. Flint attended a meeting at SNL of performance assessment modelers concerned with infiltration processes and rates.

SCP 8.3.1.2.2.3.1 Matrix hydrologic-properties testing 0G33123A93

Summary Account Manager - D. Soeder

Technical Activities:

3GUP005A Measure rock properties/state variables FY93

The first 300 ft of core from UE-25 UZ#16 were processed through HP-229, and the remaining cans were requested from the SMF.

3GUP025A Determine matrix permeability FY93

Permeabilities are being continued on the samples from the Prow transect. About half of the data interpretations have been completed and several samples that were too slow to get flow were rerun. These samples will all be run again once the high pressure permeameter is assembled.

3GUP031A Determine moisture characteristic curves FY93

Moisture release curve measurements in CX-2 are continuing on samples of fine soil and coarse fragments. Moisture release curves on nine additional rock disks were finished to provide modeling parameters for UE-25 UZ#16 modeling efforts. All rock units were characterized except for the Prow Pass unit which was not anticipated in UE-25 UZ#16.

3GUP000A Prepare interim status report

Interim status report was submitted as scheduled.

SCP 8.3.1.2.2.3.2a Surface-based boreholes studies 0G33123B93

Summary Account Manager - J. Rousseau

Technical Activities:

3GUP052A Test and calibrate equipment

Began development of an electronic diagnostic testing scheme for the thermocouple psychrometer calibration bench. Shipped electronic data acquisition system components to Ball Aerospace for calibration. Began preparation of a final checkout scheme to test and certify assembled DISAs (downhole instrument station apparatuses) as field-ready for downhole instrumentation.

**3GUP054A Calibrate sensors**

Continued with calibration of pressure transducers and thermistors for the air permeability testing program.

**3GUP056A Prepare UE-25 UZ#16 completion report**

A draft write-up of the UE-25 UZ#16 fracture log was completed; the draft is in internal review.

**SCP 8.3.1.2.2.3.2b Vertical seismic profiling 0G33123C93**

Summary Account Manager - J. Rousseau

**Technical Activities:**

**3GUP081B Conduct VSP prototype field test and analysis**

Drilled two 4 1/4" diameter boreholes at CSM Experimental Mine Site. Oyo geophone will lock in the new holes; the previous boreholes were too big and had cavernous zones. Logs run in the new holes were velocity, TV camera, caliper, and deviation. Plans were made to resume cross hole experiments in early June.

A University of Utah tomography program was adapted to the CSM computer system. Final testing of the software was successful.

**Planning and Operations:**

**3GUP084B Provide velocity measurements UE-25 UZ#16 core**

Twenty-six cores have been prepared for velocity measurement. These will be delivered to our contractor, PBT, the second week of June. Additional specimen preparation continued at NTS.

**Work Performed but not in Direct Support of the Scheduled Tasks:**

Prepared slides, booklet material, overheads, and oral presentations for the NRC geophysics integration technical exchange; presentation will be June 8 in Las Vegas.

Performed additional reprocessing of the Yucca Mountain physical model data, along with the enhancement of images. (150 hrs.)

**SCP 8.3.1.2.2.3.2c Integrated data acquisition system 0G33123D93**

Summary Account Manager - J. Rousseau

**Technical Activities:**

**3GUP072C Develop, test, review, and integrate software**

The HDAS system was installed at the HRF borehole facility in May and generally is working correctly. Additional work will be necessary to test and refine the system. Some preliminary tests were performed that indicate that the TCP/IP implementation used with the radio modems will work correctly with the Netware Lite operating system used on the HDAS computers.

**3GUP076C Evaluate prototype data from HRF borehole**

Evaluation of data from the HRF boreholes continued throughout the reporting period. Sensors in these boreholes have been operating for over 19 months and continue to provide reliable data.

The new PC-based data acquisition system took over the data collection in early May.

Planning and Operations:

3GUP070C Prepare interim status report

Work was completed on the interim status report.

SCP 8.3.1.2.2.3.2d Air-permeability and gaseous-tracer testing 0G33123E93

Summary Account Manager - G. LeCain

Technical Activities:

3GUP033D Construct and test backup packer assembly

Work on the backup packer assembly has been halted until questions as to the design of the load bearing connections are answered.

SCP 8.3.1.2.2.3.2e USW UZ-14 Support 0G33123F93

Summary Account Manager - L. Hayes

Technical Activities:

3GUP304A Conduct tracer injection and monitoring support FY93

Conducted tracer-gas injection and monitoring at USW UZ-14. The concentration of tracer-gas is added to the drilling air by adjusting the mass-flow controller to maintain concentration at approximately 1.5 ppm of SF<sub>6</sub>. Two sample ports, one on the down-hole drilling line and the other on the up-hole drilling line, were used to draw mixed gas samples for analyses by gas chromatograph. An automated system for tracer injection was initiated mid-May 1993. However, the system still has some problems in maintaining a constant SF<sub>6</sub> concentration.

3GUP302A Provide PI and other site support - FY93

Began logging the first 450 ft of core from UZ-14.

3GUP303A Conduct assessment of perched water - FY93

No perched water has been encountered as of June 1, 1993.

Planning and Operations:

3GUP301A Procure and test equipment

Arrangements are under way to purchase fiberglass pipe for constructing USW UZ-14. Orders for teflon tubing and electrical cable have been forwarded to USGS Central Region Procurement Division. DISAs are on hand. The pressure transducer order still needs to be awarded. Thermistors and psychrometers have been delivered. Sliding screen apparatus, a prototype unit, is being manufactured by Baker Oil Tools. Sliding screen units will be ordered in October, 1993, due to insufficient funding in FY93.

WBS 1.2.3.3.1.2.4 Percolation in the Unsaturated Zone - ESF Study

Principal Investigator - M. Chornack

SCP 8.3.1.2.2.4 Percolation in the unsaturated zone, ESF study LOE Account 0G33124Z93

Support project operations, FY93

Continued writing a technical procedure on calibrating and using thermocouple psychrometers; and completed a first draft of a technical procedure on calibrating pressure transducers.

Reviewed AP-5.1Q, R3, "Control and transfer of technical data on the Yucca Mountain Site

Characterization Project", and AP-1.10Q, R6, "Preparation, review, approval, and revision of Site Characterization Plan Study Plans", as reading assignments.

B. Britain attended training and a conference sponsored by Borland, Int. Emphasis was placed on C++ object-oriented programming and Pascal classes.

A controlled property inventory was conducted with J. Brooks.

A technical review of USGS-QMP-5.01, R5, "Preparation of technical procedures", was completed. This review included a meeting with the authors of this QMP and the technical reviewers. A technical review of a paper, "Spatial variability in hydrologic properties of a volcanic tuff", by Istok et al, was started and will be completed before the June 21, 1993 deadline.

Comment resolution of the technical review of USGS-QMP-3.15, R1, "Application of graded quality assurance" was completed.

S. Anderton continued supporting the Percolation Test and the Block E experiments as well as the tests on sample 13B. The thermocouple psychrometers used in the Block E experiment are still being re-calibrated to check for drift during the experiment. This began in March and will continue into June.

Work began on setting up the equipment for air-k testing (post) on Block E for the Percolation Test.

All staff members attended the HIP general meeting and a technical data workshop; G. Severson and L. Anna attended a full-day workshop on USGS-YMP Hydrologic Database Management workshop, as well as a HIP Database Management workshop; L. Anna attended a CCC meeting; and several meetings were attended to rewrite QMP-3.03 R4.

Prepared, reviewed and submitted the interim status report; performed performance appraisals; prepared April PACS reports; prepared and processed considerable number of purchase requests; and read all QA reading assignments.

Met with M. Fahy, USBR, to review his report on fracture characteristics of Yucca Mountain. Also discussed future work, including a strong need for lineament mapping with Landsat or SPOT imagery.

#### SCP 8.3.1.2.2.4.1 Intact fractures testing in the ESF 0G33124B93

Summary Account Manager - G. Severson

##### Technical Activities:

3GUS015J Complete journal paper: detailed moire

This draft is still being written and will be submitted to the HIP reports section for formal technical review. The draft of the first two sections (classic moire and stereoviewing approaches) is being written by G. Severson.

3GUS020J Design and conduct tests

Consideration was given to the design of the tests to be conducted under this activity. The air permeability manifold and the mass flowmeters have been set up for use by the intact fracture test and the percolation test. Some of the materials for the packers have been fabricated, but

this work is not completed. A castable, machinable engineering plastic material has been selected for use as a "blank" that has essentially a zero permeability and good physical properties. A vendor has been located and drawings for the "blank" will be submitted in June. A design for a sample preparation cradle was completed and most of the needed materials have been delivered. For the intact fracture test, the laboratory vacuum saturation table must be enlarged and modified. A sketch was drawn and the table was dismantled. The machine work on the modified table top will be finished by mid-June. The actual start of testing under this activity is dependent on the completion of the design and fabrication of the vessel.

**3GUS024J Complete OFR on projection moire**

Progress toward this "final report" continued. A draft of this OFR will be submitted for review after the journal paper on detailed moire is completed.

**3GUS028J Design/fabricate vessel**

Most of the pieces for the low-pressure vessel have been completed. Two pieces of the vessel remained to be machined at the beginning of May. One piece was completed but due to several problems with the end mill in the USGS machine shop, one piece remains incomplete. Some of the plumbing hardware has been received, but a number of items still need to be obtained.

A preliminary design was decided upon for the test stand for the low-pressure vessel. This was submitted to a machine shop for estimates of cost and time involved for fabrication in April. Conversations with the shop indicate an estimate should be available in mid-June.

**3GUS022J Select analog site-fracture sampling-evaluate/develop axial fractures**

The "north test pit" (test pit #1) at Fran Ridge, Yucca Mountain, Nevada, has been inspected and could be used as a possible sampling site. However, discussions concerning the mapping work to be done in this pit still indicate that this work will probably not be completed during FY93 due to budgetary restraints.

Planning and Operations:

**3GUS018J Prepare Interim Status Report**

The interim status report was completed and was discussed with USGS-YMPB/HIP management.

SCP 8.3.1.2.2.4.2 Percolation testing in the ESF 0G33124B93

Summary Account Manager - F. Thamer

Technical Activities:

**3GUS034B Prepare analytical report on imbibition experiments**

An experiment was repeated to confirm results from an earlier experiment. Both experiments indicated that water flow rate through a fractured sample under unsaturated conditions is significantly affected by what appeared to be bacterial and algae growth. After the biological growth was observed, the flow rate under similar conditions became less than half the initial flow rate when the water did not have noticeable biological growth. Also, the flow rate fluctuated and became unpredictable after the biological growth was observed. Bacteria does occur in the unsaturated zone; however, the types and concentrations in the Yucca Mountain region have not been thoroughly studied.

**3GUS035B Plan and design ESF percolation test**

Work on the new revision to the ESF percolation test study plan, SP-8.3.1.2.2.4.2, continued.

**3GUS036B Prepare interim status report**

Work on this report was completed.

SCP 8.3.1.2.2.4.5 ESF excavation effects test 0G33124E93

Summary Account Manager - F. Thamir

Technical Activities:

3GUS003D Plan and design ESF excavation effects test

Several technical procedures from SNL, WIPP site, were reviewed with the possibility of using them for the ESF test. The procedures discussed two types of instruments that will be used for this ESF test. The instruments are hydraulic pressure cells for measuring changes in rock pressure, and extensometers for measuring rock deformation. The SNL procedures were developed with DOE funds and were subject to a QA program similar to the one being followed.

SCP 8.3.1.2.2.4.7 Perched water tests in the ESF 0G33124G93

Summary Account Manager - M. Whitfield

Technical Activities:

3GUS012G Begin monitoring ESF for perched water

Monitoring for perched water in the starter tunnel by USBR and LANL continued in conjunction with geologic mapping. To date 97 ft have been mined and no natural water flows have been encountered.

Work Performed but not in Direct Support of the Scheduled Tasks:

An estimated 24 hours were spent on the following:

Scheduling work for HIP machinist; ordering maps from EG&G for Yucca Mountain participants; and providing tracers, fluids and materials data to LANL for proposed boreholes.

SCP 8.3.1.2.2.4.8 Hydrochemistry tests in the ESF 0G33124H93

Summary Account Manager - A. Yang

Technical Activities:

3GUS400 Investigate locations, short hole drilling, ESF

No progress this month. There is expected to be several short holes drilled in the starter tunnel and one short hole at the location of the radial borehole alcove. The alcove location will probably not be reached for several months.

3GUS403 Research gas-sampling system

The bid is expected to be accepted by September, 1993. The contract requests delivery in nine months or about June 1, 1994. The current schedule calls for the alcove to be completed for testing in about April or May, 1994.

WBS 1.2.3.3.1.2.6 Gaseous-Phase Movement in the Unsaturated Zone

Principal Investigator - M. Chornack

SCP 8.3.1.2.2.6.1 Gaseous-phase circulation study 0G33126A93

Summary Account Manager - M. Chornack

Technical Activities:

3GGP06B Plan tracer tests in selected UZ boreholes

Collected Baseline CO<sub>2</sub> and Clty samples from 14 Hilde Holes. Met with K. Stetzenboch (DOE tracer consultant) and discussed our tracer needs and how his lab studies can help meet those

needs. Stetzenboch will send a draft copy of his proposed lab work scope in June.

**3GGP08B Plan modeling and gas flow interference tests**

Gas flow and chemistry data were collected from USW UZ-6, USW UZ-6s, and the neutron access boreholes are being analyzed for utilization in the 3-D gas flow and transport model.

**3GGP02B Collect UZ borehole data - FY93**

Constructed a vertical downhole air flow instrument and collected flow measurements from zero to 1170 ft in UE-25 UZ#16.

Constructed a 6 ft standpipe for USW UZ-6s, mounted an air flow direction indicator in it and began collecting air flow, flow direction, and temperature data at USW UZ-6s.

**3GGP04B Tabulate and analyze gas samples**

USW UZ-6, USW UZ-6s, USW UZ-13, and neutron access borehole gas samples are still being processed at SMU for carbon 14 and 13/12 analysis.

Planning and Operations:

**3GGP08B Plan modeling and gas flow interference tests.**

Gas flow and chemistry data collected from USW UZ-6, USW UZ-6s, and the neutron access boreholes are being analyzed for utilization in the 3-D gas flow and transport model.

**3GGP01B Prepare interim status report.**

The report was completed and submitted to L. Hayes.

At the mid-year review meeting, the need for baseline information from NRG, SRG, and existing boreholes, the need to work with K. Stetzenboch on tracer permitting and laboratory tracer tests, and possible plans for 3-D for physical and chemical model development were discussed.

**WBS 1.2.3.1.2.7 Unsaturated Zone Hydrochemistry**

Principal Investigator - A. Yang

**SCP 8.3.1.2.2.7 Unsaturated-zone hydrochemistry LOE Account 0G33127Z93**

Summary Account Manager - A. Yang

Technical Activities:

**Conduct information seminars on model for project staff**

Two seminars were held for hydrochemistry personnel. Topics are hands-on applications of the PHREEQUE model in solving carbonate-mineral dissolution in different concentrations of carbonic acid solution. The reaction products are various species concentrations and final Ph of the solution.

**Procure, test borehole sampling system (12" Hole)**

The bid for the SEAMIST system is expected to be accepted by September 1, 1993.

The packer handling system (winch, hoist, etc.) has arrived. The USBR engineer was assembling the system for a practical downhole test next month.

**Prepare hydrologic procedures, FY93**

J. Higgins completed a draft of a technical procedure for preparation of core samples for pore-water extraction by compression. The draft is presently being prepared for technical review.

A. Yang revised the technical procedure HP-208, R1, "Method for preparing tracers for addition to a water supply system".

G. Rattray revised and sent HP-242 out for review.

**Support project operations, FY93**

M. Beasley, J. Higgins, K. Scofield, and A. Yang attended a 2-hour training session on "Technical data management day-to-day operations".

A. Yang, G. Rattray, C. Peters, and J. Ferarese attended a 2-hour training session on "Technical data management policy information".

A. Yang and J. Ferarese each made 10-minute presentations at the USGS-YMP Hydrologic Database Management workshop.

A. Yang spent the last week in May conducting the annual performance appraisals for his project members, and also wrote up employee work plans for the period starting April 1, 1993, through March 31, 1994.

A. Yang attended the "Yucca Mountain Site Characterization Colloid" workshop sponsored by LANL. The workshop invited several colloid experts from around the world.

A. Yang and J. Higgins prepared the Mid-year status report on PACS. Yang and C. Peters met with L. Hayes and HIP management, to discuss the milestone progress and delay problems.

All hydrochemistry personnel participated in preparing the monthly status reports, which were coordinated by J. Higgins.

All UZ-hydrochemistry personnel completed their QA reading assignments.

J. Higgins completed a second technical review of HP-259, R0

J. Ferarese procured gas standards for use with the gas chromatograph.

An analytical balance used by UZ hydrochemistry personnel, but owned by another HIP project required quality assurance calibration. J. Ferarese effected the necessary paperwork and documentation to assure UZ hydrochemistry is in QA compliance.

The renovation of the UZ hydrochemistry lab in Bldg 56 has been scheduled for July 1, 1993. Prior to this date, the entire lab will need to be moved to a location suitable for continuation of lab operations.

J. Higgins discussed with USBR personnel the feasibility of developing a formal agreement for use of the USBR vibration lab load frame for one-dimensional compression tests. No formal agreement has been reached to date.

**SCP 8.3.1.2.2.7.1 Gaseous-phase chemical investigations 0G33127A93**

**Summary Account Manager - A. Yang**

**Technical Activities:**

**3GUH011 Evaluate existing export models gaseous C<sub>14</sub> export**

How to proceed on this task was discussed during the six-month project review. It was determined that D. Thorstenson will contact other NRP and USGS researchers concerning their cooperative work in this modeling.

D. Thorstenson had preliminary discussions with E. Weeks, J. Weeks, and Parkhurst (NRP personnel) as to how to proceed on the  $C_{14}$  modeling problem. No decisions have been made to date.

**3GUH012 Prepare, analyze and tabulate data**

J. Ferarese analyzed gas samples from one-dimensional compression tests for  $CO_2$  concentrations.

Analyzed  $CO_2$ ,  $CH_4$ , and  $SF_6$  concentrations from five depths at UE-25 UZ#16 borehole.

**3GUH013 Oversee drilling/collect gas and water vapor**

G. Rattray spent a week monitoring tracer gas injection at USW UZ-14 and UE-25 NRG-5. P. Striffler and K. Scofield monitored the same holes from May 10-28 and an additional hole from UE-25 NRG-2a.

M. Beasley and C. Peters prepared eight packers at the NTS for gas sampling of UE-25 UZ#16. UE-25 UZ#16 was sampled at four intervals for two days.

Collected additional  $CO_2$ ,  $CH_4$ , and  $SF_6$  samples from UE-25 UZ#16.  $CO_2$  levels are typical of  $CO_2$  levels in other holes.  $SF_6$  concentrations have decreased to about background levels.

The packer and packer handling system, etc., are undergoing final preparation for packer insertion in late June or early July after the geophysical loggings are completed.

Variations:

**3GUH011 Evaluate existing export models gaseous C-14 export, and**

**3GUH017 Modify/develop selected geochemistry codes**

Adequate modeling capabilities will require a fully coupled transport and geochemical model (such as PHREEQE). Generation of such a reaction-transport model is beyond D. Thorstenson's abilities, and will require a cooperative effort with one, or perhaps several, NRP researchers. No such effort currently is in progress, and thus attempts to schedule progress on this problem simply is not possible. Thorstenson is in the process of discussing the problem with researchers in NRP to determine the best resolution.

Work Performed but not in Direct Support of the Scheduled Tasks:

Awaited the arrival of the new gas chromatograph system which will include the thermo conductivity detector, the flame ionization detector, the electron capture detector, and data acquisition system. The Dionex DX-100 ion chromatograph and anion column arrived. J. Ferarese developed a working method and calibrated the instrument. The method devised will accommodate anion samples in the concentration range of approximately 0.1-10 mg. Ferarese still is in the process of determining precision and accuracy statistics for the method. Other methods will be developed to include a wider range of concentrations. When the cation column arrives, similar operations will be performed for cation parameters. (24 hrs.)

J. Ferarese heat evacuated twenty-three stainless steel molecular sieve collection cylinders. Technicians were also trained in this process. (15 hrs.)

G. Rattray continued testing the adsorption of  $CO_2$  onto dry and partially saturated (50% by

weight) crushed tuff and began testing adsorption of CO<sub>2</sub> onto solid cores. (40 hrs.)

G. Rattray tested the automated trace gas injection equipment and wrote a computer program to calculate drilling air flows, adjust tracer gas flow, and to transmit data to a storage data base. (40 hrs.)

SCP 8.3.1.2.2.7.2 Aqueous-phase chemical investigations 0G33127B93

Summary Account Manager - A. Yang

Technical Activities:

**3GUH030A Export, prepare, extract and analyze core**

J. Ferarese prepared and analyzed tritium concentrations in pore waters distilled from borehole cores of USW UZN55. The remainder of the sample water was sent to the NWQL for stable isotope analysis.

G. Rattray analyzed CO<sub>2</sub> concentrations in gas samples collected during one-dimensional compression of UE-25 UZ#16 cores.

M. Beasley computed moisture contents, degree of saturation, and volume of water for cores from UE-25 UZ#16 to determine priority of one-dimensional compression tests.

J. Higgins, C. Peters, K. Scofield, and M. Beasley met to discuss analysis of the carbonate system during one-dimensional compression. Plans were developed for the first set of experiments (detailed below).

M. Beasley ran staged, first generation one-dimensional compression tests on UE-25 UZ#16 core (1358.05-1358.4 ft). Also, staged tests were completed for UE-25 UZ#16 core from a depth of 1389.36 - 1389.64 ft.

K. Scofield performed Ph, specific conductance and dissolved CO<sub>2</sub> analysis of pore-water extracted from sample UZ-16 (1358.05-1358.4 ft). Pore water and gas were extracted by one-dimensional compression, and tests were performed immediately upon extraction of pore water/gas at various pressures. These tests were run in an attempt to determine what (if any) changes occur in the carbonate system during one-dimensional compression. CO<sub>2</sub> content in gas extracted showed a slight increase with pressure for four sets of tests. Aqueous CO<sub>2</sub> showed no change with pressure for 10 analyses. Aqueous Ph showed a slight increase with time after water was extracted from the core for 11 sets of analyses. More tests will be run to increase the data base and allow final interpretation of the process.

K. Scofield performed pore-water extraction by distillation for UE-25 UZ#16 cores. The extracted pore water is to be analyzed for tritium, O18/16 and D/H.

**3GUH032A Design aqueous tracer container size/prepare solution**

The subject aqueous-tracer container design and preparation of 20 ppm bromide tracer solution were thought to be done by UZ hydrochemistry project. However, it was learned that REECO personnel, B. Schuete, currently is preparing the tracer solution for adding into ESF underground construction water. Therefore, this task will be eliminated.

**3GUH039A Prepare/review journal article: pressure vs pore H<sub>2</sub>O chemistry**

Start has been delayed due to lack of personnel.

Quality Assurance:

3GUH030A Export, prepare, extract and analyze core  
K. Scofield performed carbon dioxide microelectrode calibrations.

Planning and Operations:

3GUH030A Export, prepare, extract and analyze core  
J. Ferarese trained a graduate student on use of the liquid scintillation counter.

Variances:

3GUH039A Prepare/review journal article: pressure vs pore H<sub>2</sub>O chemistry  
Start of work on this paper will be delayed due to the lack of project personnel to complete chemical modeling, data analysis, and compression experiments on time. Personnel that are involved in this task are busy with gaseous-phase activities. The schedule for completion of this task is likely to be impacted if additional positions are not filled.

Work Performed but not in Direct Support of the Scheduled Tasks:

An estimated 5 hours were spent on the following:

M. Beasley cleaned the rock saw and dust collection system in building 20 to prepare new system for core preparation. (4 hrs.)

J. Higgins discussed repairs required for the load frame in the USBR vibration lab with F. Travers (USBR), and discussed USGS use of the load frame with J. Prizio (USBR), A. Yang, C. Peters, and M. Chornack. An attempt is being made to design a formal agreement for USGS use of the facility.

WBS 1.2.3.3.1.2.8 Fluid Flow in Unsaturated Zone Fractured Rock

Principal Investigator - L. Anna

LBL Principal Investigator - G. Bodvarsson

SCP 8.3.1.2.2.8.1 Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock 0G33128A93

Summary Account Manager - L. Anna/E. Kwicklis

Technical Activities:

3GUF026 Model imbibition experiments

A report has been started, but there was little progress on the report this month.

3GUF020 Conduct scoping and bounding calculations.

Continued to develop techniques to calculate fracture porosity from measured total porosity and acoustic properties of rock. Continued to search Yucca Mountain literature for total porosity and acoustic properties of rock data. Liquid water flux rates are being calculated from water saturation and water potential profiles from data from four surface-based boreholes. Because the initial phase of this work was successful, it is planned to investigate other surface based boreholes for similar information.

3GUF022 Model large block percolation experiment

Data collection for the large block percolation experiment was terminated in January. Transformation of the large volume of data as input into the numerical model has begun. Formulation of the modeling strategy has begun by experimenting with model runs using hypothetical data.

3GUF027 Adapt fracture network model to uz flow

A contract with Golder Associates has been finalized to help and advise the USGS adapt a fracture network model to UZ flow. Initial discussions have started between the USGS and Golder to define strategies and goals. L. Anna attended a one week training workshop on Golder's FracMan code. The code has been adapted to the USGS computer systems. As part of the conceptual design of this activity, data and information about fracture orientation, dip, frequency, density, orientation and flow rates in differential stress regimes, and fracture characterization at different scales will continue to be compiled. This information will be in the formulation of the fracture network model.

3GUF029 Prepare interim status report  
Report was prepared and sent to the TPO.

Variances:

3GUF026 Model imbibition experiments

This activity has been delayed because the imbibition experiment has been changed. Changes include a new non-fractured sample and continuous data collection instead of periodic collection. This change of technique will give more meaningful information when comparing numerical simulation. Also, the large block percolation experiment had syphoned manpower and computer systems support from the imbibition test; however, data collection from that activity is now complete.

3GUF022 Model large block percolation experiment

This activity did not finish as scheduled because there is still large volumes of data from the block that have not been interpreted from SCP activity 8.3.1.2.2.4.2. Reports from each activity (8.3.1.2.2.8.1 and 8.3.1.2.2.4.2) will be combined into a composite report. There is no impact from the short delays of these studies nor on future studies.

Work Performed but not in Direct Support of the Scheduled Tasks:

An estimated 10 hours were spent on the following:

L. Anna has begun compiling information on bulk permeabilities and/or transmissivities of fractured rock reservoirs on a world wide basis. Most of the data comes from analyzing production and pressure changes with time (in years). Three of the six reservoirs researched to date are in fractured volcanic tuffs. The objective is to determine some possible ranges of bulk permeabilities/transmissivities in fractured rock using very long term "pump" tests.

SCP 8.3.1.2.2.8.1L Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock 0B33128A93

Summary Account Manager - G. Bodvarsson

Technical Activities:

3GUF217L Complete semi-analytical methods report

The writing of the report on the semi-analytical dual-porosity code has been completed. The report contains discussion of dual-porosity models, fracture/matrix interaction equations, shape factors and equilibration times for matrix blocks, and sample problems illustrating the use of the new code for modeling infiltration processes at Yucca Mountain.

Work Performed but not in Direct Support of the Scheduled Tasks:

Revision and updates to the QMP were installed.

Staff members completed various reading assignments.

WBS 1.2.3.3.1.2.9 Site Unsaturated Zone Modeling and Synthesis

Principal Investigator -- E. Kwicklis  
LBL Principal Investigator - G. Bodvarsson

SCP 8.3.1.2.2.9.1 Conceptualization of the unsaturated-zone hydrogeologic system 0G33129A93  
Summary Account Manager - E. Kwicklis

Technical Activities:

3GUM002A Develop conceptual models of UZ - FY93

A literature review of papers recently published in the proceedings of the Third High-Level Waste Management Conference was undertaken in order to remain current on what has been observed concerning the geochemistry, geologic structure and hydrology of the unsaturated zone at Yucca Mountain.

3GUM028A Conduct hypothesis tests/2-d cross-sectional models

A two-dimensional cross-section of Pagany Wash was created based on the stratigraphy of boreholes UE-25 UZ#4 and UE-25 UZ#5. Hydrologic simulations using the USGS unsaturated flow and transport code VS2DT will be used to estimate the flux through this cross-section. Comparisons between observed and predicted water potentials, saturations and water ages will be used to constrain the model results.

Work Performed but not in Direct Support of the Scheduled Tasks:

Approximately 16 hours were spent providing informal technical review on a draft report on "Prototype pneumatic testing at Apache Leap, Arizona", by G. LeCain.

SCP 8.3.1.2.2.9.2L Selection, development, and testing of hydrologic-modeling computer codes 0B33129B93

Summary Account Manager - G. Bodvarsson

Technical Activities:

3GUM12L Prepare TOUGH testing report

Writing of the report on the testing of decoupled TOUGH has started.

Work Performed but not in Direct Support of the Scheduled Tasks:

G. Bodvarsson worked with D. Langmuir and other members of the NWTRB to select speakers and prepare the agenda for the July meeting. Bodvarsson prepared material for a scoping meeting for the NWTRB meeting.

Revision and updates to the QMP were installed.

Staff members completed various reading assignments.

SCP 8.3.1.2.2.9.3L Simulation of the hydrogeologic system 0B33129C93  
Summary Account Manager - G. Bodvarsson

Technical Activities:

3GUM32L Complete report moisture flow

The moisture flow draft report has been completed and will undergo internal review during the next two months.

3GUM20L Prepare report on grid effects

A finer numerical grid for one of the cross sections of the 3-dimensional site scale model has

been developed. This grid has been developed by halving the vertical and horizontal dimensions of all elements, resulting in about four times as many elements. Numerical simulations will be run with this fine grid and the results compared to the original coarse grid.

3GUM15L Collect/incorporate new data into moisture-flow model

Several new reports were received and reviewed in terms of data impact for the site-scale model.

Variations:

3GUM35L Evaluate gas-flow data/develop gas component in model

3GUM17L Evaluate gas-effects using sub-models, FY93

3GUM22L Begin investigation the effect of infiltration

These tasks have not been started due to extra work required for CASY and NWTRB meetings, but shall start in the next month.

Work Performed but not in Direct Support of the Scheduled Tasks:

G. Bodvarsson worked with D. Langmuir and other members of the NWTRB to select speakers and prepare the agenda for the July meeting. Bodvarsson prepared material for a scoping meeting for the NWTRB meeting.

Revision and updates to the QMP were installed.

Staff members completed various reading assignments.

WBS 1.2.3.3.1.2.10 Prototype Hydrologic Tests that Support Multiple Site Characterization Activities

Principal Investigator - M. Chornack

Prototype Cross-Hole Testing 0G3312AC93

Summary Account Manager - G. LeCain

Technical Activities:

3GUT004 Prepare open file report on ALTS testing and analysis

The prototype testing report was returned to the author after in-house review. The reviews were comprehensive, and the author has started the task of revising the original draft to include the reviewers suggestions.

Variations:

3GUT004 Prepare open file report on ALTS testing and analysis

Completion of the prototype reports has been delayed due to the shortage of PIs. This staff shortage has meant that scientists are acting PIs for several studies, consequently the report work is usually given a low priority.

Prototype Tracer Testing 0G3312AD93

Summary Account Manager - A. Yang

Technical Activities:

3GUT016D Prepare WRI report on gaseous tracer tests

G. Rattray compiled adsorption experiments completed to date. Discussions were held with A. Yang, D. Thorstenson, and C. Peters to determine what work needs to be completed and included in the WRI report.

Variations:

**3GUT016D Prepare WRI report on gaseous tracer tests**

It is expected that the completion of the WRI report will be delayed until September 30, 1993 because of the strong adsorption observed in the tuff and stemming materials by the author during the experimental tests. Additional tests on semi-wet materials are needed to complete investigations.

**Prototype Pore-Water Extraction 0G3312AG93**

Summary Account Manager - A. Yang

**Technical Activities:**

**3GUT050G Evaluate and & analyze chemistry and compression techniques**

J. Higgins, C. Peters, K. Scofield, and M. Beasley met to discuss analysis of the carbonate system during one-dimensional compression. Plans were developed for the first set of experiments (detailed in the 8.3.1.2.2.7.2 section). Specific conductance, Ph, and dissolved CO<sub>2</sub> analysis of pore-water extracted from sample UE-25 UZ#16 (1358.05-1358.4 ft) were performed. Pore water and gas were extracted by one-dimensional compression, and tests were performed immediately upon extraction of pore water/gas at various pressures. These tests were run in an attempt to determine what (if any) changes occur in the carbonate system during one-dimensional compression. CO<sub>2</sub> content in gas extracted showed a slight increase with pressure for four sets of tests. Aqueous CO<sub>2</sub> showed no change with pressure for 10 analyses. Aqueous Ph showed a slight increase with time after water was extracted from the core for 11 sets of analyses. More tests will be run to increase the data base and allow final interpretation of the process.

**3GUT052G Prepare OFR on pore-water chemistry vs pressure data**

C. Peters was unable to spend time on this task due to his commitment to the gaseous-phase activities this month. Therefore, no progress was made on his verification of chemical data accuracy.

J. Higgins met with D. Berger to discuss data files of chemical data and how they would best be retrieved and edited to a usable format for the OFR.

**3GUT053G Prepare journal paper on development of 1-D compression**

J. Higgins met with D. Berger to discuss data files and plots pertinent to this task. Higgins is studying LOTUS so that plots can be produced for the paper.

J. Higgins acquired and reviewed the journal guidelines for paper format.

**Variances:**

Progress on all tasks has been adversely affected this month due to a shortage of personnel, especially for data analysis. It is expected that the schedules will continue to slip unless more help is obtained. Some relief should be realized in June and July when J. Higgins increases his time commitment to the USGS assignment agreement. However, this will not completely solve the problem.

**WBS 1.2.3.3.1.3.1 Site Saturated Zone Ground-Water Flow System**

Principal Investigator - M. Umari

**SCP 8.3.1.2.3.1 Site saturated-zone ground-water flow system LOE Account 0G33131Z93**

Summary Account Manager - R. Luckey

Support project operations

#### Site potentiometric-level evaluation (8.3.1.2.3.1.2)

P. Tucci performed routine project operational tasks, including scheduling and coordinating field operations to maintain the water-level monitoring network, overseeing project budget items and spending, preparing personnel actions, attending section meetings, meeting with project personnel, and other miscellaneous administrative and operational tasks for the site potentiometric levels project.

M. Boucher gave QA support to various activities, evaluating QA and organizing QA support for other groups of activities; prepared TDIFs for information used in the report "*Precision and accuracy of water levels*"; and attended training classes on Database Management, Data Management, and Records Management.

Field personnel performed required maintenance on steel tapes and the multiconductor cable unit used to obtain water-level measurements.

P. Tucci attended meetings of the HITF and the Office of Ground Water Borehole Geophysics Advisory Group; Tucci attended training classes for Database Management and Data Management; and participated in the USGS/Department of Interior (DOI) Open House.

T. Campbell attended a training class on Advanced Data Collection Platform Operation and Programming.

#### Saturated-zone fractured-rock hydrology (8.3.1.2.3.1.3)

M. Umari prepared the monthly PACS report for May 1993, and the interim status reports for three Summary accounts (and discussed them with the USGS TPO), tracked spending under accounts 4889-12001, -12002, -12005, and -12006, prepared and conducted performance appraisals for J. Gemmell, G. Patterson, A. Geldon, and J. Earle. Gemmell prepared and conducted the performance appraisal for J. Darnell.

#### Plan and schedule project operations

Communications continued with W. Sublette, SAIC (T&MSS), to finalize activities prerequisite to commencement of C-hole testing. These activities include, but are not restricted to, pump support, water disposal through a discharge pipeline for eventual infiltration into Fortymile Wash near J-13 using infiltration ponds, and obtaining permits from the state of Nevada for the discharge of the water.

Discussions were also held with C. Johnson (hydrology contact with the M&O contractor) regarding the amounts of tracers that will be used in the future cross-hole tracer tests at the C-holes.

J. Gemmell has prepared a specific plan to ship various components of the multi-zone packer string to the NTS, some from Denver and some from Raymond. The shipping may involve contracting for a driver from the USBR.

#### Prepare procurement documents

Procurement paperwork was initiated for the hardware of the LabView data acquisition (DAQ) system that will function in parallel with the LabWindows DAQ system already purchased. Also, paperwork was initiated to purchase non-submersible ParoScientific pressure transducers to monitor the air pressure in the reference lines of the differential Druck pressure transducers that be used in the upcoming C-hole tests. This monitoring is necessary because temperature changes will change the air pressure and, therefore, the reference pressure.

#### Participate in training

M. Umari, G. Patterson, A. Geldon, J. Earle, and J. Gemmell attended the Technical data management policy information, and the Day-to-day operations, training sessions. J. Darnell attended a week-long procurement class intended to make him the resident expert on procurement issues, which are very important to the SZFRH project.

#### Prepare for and attend technical and administrative meetings

M. Umari and A. Geldon attended, and gave presentations at, a meeting of the HITF. Members of the HITF had requested that they be updated on the plans for the upcoming C-hole tests. Geldon presented the results of his analysis of previously-conducted tests at the C-holes, which provide lessons for the planned tests.

#### Do operational tasks

Conducted work at the Raymond Quarry site, which will be used to prototype the C-holes-bound packer string.

M. Umari, R. Luckey, G. Patterson, J. Gemmell, J. Earle, and J. Darnell spent a week at the Raymond site. During this week, the packer system being prototyped for the c-holes was pulled out of the two 10-inch holes to allow a borehole-radar team from Finland to conduct cross-hole radar surveys between all nine of the boreholes at the site (two 10-inch holes, seven 6-inch holes). During the same week, a field trip and presentations were organized by the USGS and LBL for R. Levich (DOE International Program Coordinator), and C. Newbury (DOE hydrology WBS manager) and their staff.

#### Oversee LBL's effort to complete analysis of seismic profile

Awaiting the final seismic-velocity map and associated report from LBL that would integrate the raw arrival time data that they had collected, with geologic and geophysical information provided to E. Majer (LBL) by A. Geldon.

#### Convert scientific notebook to technical procedure

The SN for the field simulation of the C-hole testing, which had been approved in February 1993, will be used for the initial stages of the actual testing at the C-holes (tests are planned to start in 7/93), and as such, the conversion to a technical procedure is not imminent. Such conversion will only take place after conducting cross-hole testing for a long enough period of time, and acquiring enough experience with the process, to be able to articulate the methodology specifically enough for a technical procedure.

#### Develop software QA for analysis programs

All, except one, of the software applications are in the developmental stages in the SZFRHP, and are exempt from full software QA stipulations according to the ACSR YMP-USGS-ACS-G1233131-1, R0. The only possible exception is the program for automated data acquisition that is being partly contracted out to a software engineering design firm. This program may have to be entered into the software QA process upon receipt from the vendor.

#### Begin 1993 water-level data collection

The following routine tasks were completed in this reporting period: monitored 17 zones in 17 wells on a monthly basis; monitored 18 zones in 12 wells on an hourly basis; and obtained continuous analog data from four zones in two wells (included in count of hourly sites above) in order to monitor water-level responses to earthquakes and UNEs. Several earthquakes occurred in the Region and near Yucca Mountain on May 17-19. These earthquakes had a maximum magnitude of about 6.0 (near Bishop, CA), but most were less than magnitude 5.0. Water-level and fluid-pressure responses to the earthquakes generally were small scale and short

duration (< one hour).

Obtained real-time data on 18 zones in 12 wells using DCPs (included in count of hourly sites above); evaluated status of network at end of each month; and monitored real-time data on a daily basis, looking for water-level excursions and equipment malfunctions.

The following special tasks completed in this reporting period: calibrated transducers at the following wells: USW G-2, USW H-3 (lower zone), USW G-3, WT-3, and USW H-1 (tubes 2, 3, and 4); removed transducer from well USW H-1, tube 2. This tube will now be monitored on a monthly basis. The transducer in well USW G-2 was also removed from service subsequent to its failure. This well has gone through multiple transducers since becoming a part of the hourly network. No new transducers will be installed until the cause of the problem is determined.

Other equipment calibrated this month: multiconductor cable unit (failed calibration).

A water-level measurement was obtained in well UE-25 UZ#16. Water levels appear to be stable, at a depth of about 1,605 ft below the top of casing.

**Reduce 1992 transducer calibrations**

Work was done on calibrations for wells G-3, WT-6, WT-11, WT-13, and WT-16 in order to convert the transducer data to water levels. All WT-series wells are now completed for 1992. Work was done on calibrations (1993) for wells USW H-5 and USW H-6 in order to look at the effects of May 17-19 earthquakes on water levels.

**SCP 8.3.1.2.3.1.2 Site potentiometric-level evaluation 0G33131B93**

Summary Account Manager - P. Tucci

**Technical Activities:**

**3GWF064A Complete 1990-91 water-level report**

Water-level data for wells H-1, WT-2, WT-6, WT-11, WT-13, and WT-16 were reviewed for inclusion in the report.

Continued revising and editing previous drafts of the report in response to review comments by R. Luckey.

**3GWF025A Reduce 1992 water-level data**

Reduction of all 1992 periodic water-level data has been completed, and checked. Water-level data for well VH-1 was revised because of an error in the height of the measuring point. New information concerning reference point elevations for wells J-11, J-12, and VH-1 was obtained by Nevada District personnel as part of the environmental monitoring program, and this data is being reviewed before inclusion to the data base.

**Work Performed but not in Direct Support of the Scheduled Tasks:**

G. O'Brien worked on revisions to QMP-5.01. (24 hrs)

G. O'Brien worked on analysis of the effects of earthquakes on May 17-19, 1993 on water levels in the Yucca Mountain area; assisted in preparation of a letter to DOE documenting the effects of the earthquakes on water levels; and worked with a new computer program to calculate hydraulic diffusivity from water-level fluctuations caused by earthquakes. (56 hrs)

G. O'Brien reviewed data and analyzed problems with several wells used to continuously monitor water levels, and worked with personnel at NTS to correct the problems. (40 hrs)

G. O'Brien attended a class on Memory Development, participated in the USGS/Department of Interior Open House, and attended the Hydrology Integration Task Force meeting held on May 18, 1993. (24 hrs)

Status of approved reports awaiting publication

The text of the approved report "*Water levels in continuously monitored wells in the Yucca Mountain area, Nevada, 1985-88*" is at the Colorado District for final formatting and processing. Work has begun on preparation of camera-ready copies of illustrations by the Colorado District.

The report, "*Earthquake-induced water-level fluctuations at Yucca Mountain, June, 1992*", by G. O'Brien received USGS Director's approval on March 3, 1993, and the galley proofs were sent to the author for review.

SCP 8.3.1.2.3.1.3 Analysis of single- and multiple-well hydraulic-stress tests 0G33131C93

Summary Account Manager - M. Umari

Technical Activities:

3GWF010D Complete intraborehole flow and stress test report

A. Geldon had completed a manuscript for the report in April. The manuscript was submitted for typing in May. After typing, the report will have to be prepared for colleague review, which is anticipated to be around July 1, 1993. The completion date of the report is now projected to be September 1, 1993 (date at which the report, having received colleague review, would be sent simultaneously for WRD Region/Headquarters review, and for DOE concurrence).

3GWF008D Monitor/analyze strain-related pressure response

No progress; awaiting placement of the multi-zone packer system in the C-holes, to conduct strain-related pressure monitoring during "down" times in the cross-hole testing.

3GWF004D Write journal article on the reanalysis of past C-hole aquifer tests

A. Geldon has been assigned this task. The plan is to use the "Intraborehole flow and stress test report" as a basis for this article which will be submitted for publication in the Proceedings of the October 25-28, 1993 GSA meeting in Boston. Geldon wrote an abstract and got it reviewed and approved in May.

3GWF001D Prepare interim status report

The report, in the form of a memorandum to the USGS TPO, was written in May and discussed in a meeting with the TPO.

SCP 8.3.1.2.3.1.4 Multiple-well interference testing 0G33131D93

Summary Account Manager - M. Umari

Technical Activities:

3GWF007F Complete design memoranda - 5-zone packer string

The final agreement with the USBR, in the form of a TA, stipulates that the USBR will document its design of the packer string system by design memoranda (DM). These DM also would include instructions on assembly of the string prior to field deployment. The final review and revision process of these DM were due to be completed by May 28, 1993.

J. Bowen (USBR) completed an initial draft of the DM in May. The DM package will receive technical review by J. Boernge (USBR), and J. Gemmill (USGS) in June. After that it will be transmitted to the USGS by a formal memo from the USBR. This transmittal date is projected

to be around July 1, 1993.

**3GWF030F Expand packer strings to 5-zones**

The work of making "extension cords" of various lengths to get through the initial testing at the C-holes was completed. These are variable-length segments of multi-conductor cable that do not go through the packers, which are interchangeable, and are used between packers and from the top packer to land surface (and from there to the data acquisition trailer).

A long-term test of the integrity of the water-proofed, soldered, connections between the electric connectors and multi-conductor cable, and of the canister for the transducer reference line electric motor valve, was completed. The test showed that there were no leaks in any of the parts tested.

The effort of soldering electric connectors to the multi-conductor cable segments that go through the packers, and water-proofing these connections, was completed. All 30 packers, needed for the three 5-zone packer strings, are now ready to ship to the NTS. Eighteen of these are in Denver and 12 in Raymond. Arrangements have been made with R. Martin at the NTS to receive them and place them at the "sub-dock", located near the c-holes.

The present activity, "Expand packer strings to 5-zones" (3GWF030F), can now be considered 100% complete.

**3GWF014F Develop techniques for (and begin) analysis of cross-hole test results**

The HST code was run in May using the input file representing a geohydrologic model of the cross-section between UE-25c #1 and UE-25c #3 that had been constructed in April. Initial problems with the format of the input file were resolved. The program aborted indicating that some machine-specific program statements (that Kipp had included to make the program run on his Mascomp workstation) would have to be removed. This will be done in June.

P. Wallman (Golder and Associates) and E. Ervin planned Wallman's next visit to Denver in mid June to help with the FracMan fracture-network model of the c-hole complex. A. Geldon provided Ervin and Wallman with information on the previously-conducted aquifer tests at the C-holes to aid in the conceptualization of flow through fractured rocks.

**3GWF006F Prepare interim status report**

The report, in the form of a memorandum to the USGS TPO, was written in May and discussed in a meeting with the TPO.

Quality Assurance:

**3GWF007F Complete design memoranda - 5-zone packer string**

J. Bowen (USBR) completed an initial draft of the DM in May. The DM package will receive technical review by J. Boernge (USBR), and J. Gemmell (USGS) in June. After that it will be transmitted to the USGS by a formal memo from the USBR. This transmittal date is projected to be around July 1, 1993.

Variations:

**3GWF007F Complete design memoranda - 5-zone packer string**

The DM package was scheduled to be reviewed and finalized by May 28. By that date, only an initial version of the package had been prepared by J. Bowen. Final transmittal of the DM package from the USBR to the USGS is projected to be around July 1, 1993.

The DM package is a sizable document representing a "user's manual" for the multi-zone packer

system. Probably the main cause of the variance is incorrect estimation by J. Bowen of the time needed to prepare such a document. The impact of receiving the finalized package by July 1, 1993 (or soon thereafter), rather than May 28, is very minimal. This is because J. Gemmell has most of the information contained in the package in one form or another. Corrective action is not required at this time.

SCP 8.3.1.2.3.1.5 Testing of the C-hole sites with conservative tracers 0G33131E93

Summary Account Manager - M. Umari

Technical Activities:

**3GWF169A Continue Development of Techniques for Analysis of Tracer Test Results**

The HST code was run in May using the input file representing a geohydrologic model of the cross-section between UE-25c #1 and UE-25c #3 that had been constructed in April. Initial problems with the format of the input file were resolved. The program aborted indicating that some machine-specific program statements (that Kipp had included to make the program run on his Mascomp workstation) would have to be removed. This will be done in June.

P. Wallman (Golder and Associates) and E. Ervin planned Wallman's next visit to Denver in mid June to help with the FracMan fracture-network model of the c-hole complex. A. Geldon provided Ervin and Wallman with information on the previously-conducted aquifer tests at the c-holes to aid in the conceptualization of flow through fractured rocks.

**3GWF170A Complete tracer injection system**

A tracer mixing tank will be required at the surface during the tracer tests at the C-holes. \$5,000 have been earmarked for this purpose in FY93, and the Isotope Geology Machine Shop is the most likely candidate to do the work.

The completion date for the construction of the tank has been delayed from April 1, 1993 to September 30, 1993.

The downhole tracer injection system requires, in addition to the components already purchased from Baker, 1.66" O.D. pipe to deliver the tracer from land surface to the downhole system. This pipe will be requested from NTS contractors through a criteria letter.

**3GWF168A Prepare interim status report**

The report, in the form of a memorandum to the USGS TPO, was written in May and discussed in a meeting with the TPO.

WBS 1.2.3.3.1.3.2 Saturated Zone Hydrochemistry

Principal Investigator - W. Steinkampf

SCP 8.3.1.2.3.2.1 Assessment of saturated-zone hydrochemical data availability and needs 0G33132A93

Summary Account Manager - W. Steinkampf

Technical Activities:

**3GWH001A Assessment of extant data, phase II**

D. Perfect continued cluster analysis of the hydrochemical data base. Using log transformed preclustered "means" data, the "farthest neighbor" method, combined with a "normalized Euclidean distance" option, yielded nine well-separated clusters that can be interpreted in a physical sense. Each of the 2203 hydrochemical analyses included in the cluster analysis were assigned to one of these nine clusters and were plotted spatially in ARC, using the geologic map

as a background. In addition, major ion data corresponding to these clusters were plotted on Piper plots. These plots were interpreted in view of previous plots based on lithologic data. Because for some analyses lithologic information was available in the data base, a plot of lithology frequency was made for each cluster. In addition, plots of cluster versus concentration were made for several chemical parameters.

Planning and Operations:

3GWH00A Prepare interim status report

B. Steinkampf presented the interim report to YMP and HIP staff.

Work Performed but not in Direct Support of the Scheduled Tasks:

An estimated 80 hours were spent on the following: D. Perfect attended a workshop for the introduction of investigators to the use of geochemical models for analysis of ground-water chemical and isotopic data in geohydrologic investigations.

B. Steinkampf attended Data Management System training.

SCP 8.3.1.2.3.2.2 Hydrochemical characterization of water in the upper part of the saturated zone

0G33132B93

Summary Account Manager - W. Steinkampf

Technical Activities:

3GWH006B Develop mobile lab and downhole collection equipment

B. Steinkampf and T. Oliver met with a Dionex service representative at the NTS to perform routine maintenance on the ion chromatograph system and to begin Oliver's familiarization with the system. Updated proprietary software was installed, and a problem was identified with either the computer interface hardware or the electrochemical detector. A re-visit was scaled

3GWH910 Collect/analyze/evaluate regional samples - FY93

B. Steinkampf and T. Oliver collected preliminary samples for  $^{238}\text{U}/^{234}\text{U}$  analyses at four sites in the Grapevine Ranch area of DVNM.

**WBS 1.2.3.3.1.3.3 Saturated Zone Hydrologic System Synthesis and Modeling**

Principal Investigator - E. Ervin

LBL Principal Investigator - K. Karasaki

**SCP 8.3.1.2.3.3.1 Conceptualization of saturated zone flow models within the boundaries of the accessible environment 0G33133A93**

Summary Account Manager - E. Ervin

**Technical Activities:**

3GWM10AA Collect outcrop samples - hydrologic properties

Discussions were held between E. Ervin, L. Hayes, and R. Luckey, during the project review for the interim-status report, on collecting the outcrop samples. Ervin estimated that the time required for sampling the outcrops would be approximately one week and would yield less than 30 samples. It is unclear, at this point, who would perform the hydrologic measurements on the samples once they are collected.

**Planning and Operations:**

3GWM000 Prepare interim status report

E. Ervin completed the interim status report for this activity and met with L. Hayes to discuss the progress of the work.

**Work Performed but not in Direct Support of the Scheduled Tasks:**

An estimated 8 hours were spent on the following:

E. Ervin attended two meetings on data. One meeting was sponsored by the HIP data section, where data base needs, current status, and future format were discussed. The second meeting was run by P. McKinley on USGS-DOE data accounting and transfer requirements.

**SCP 8.3.1.2.3.3.2 Development of fracture network model 0G33133B93**

Summary Account Manager - E. Ervin

**Technical Activities:**

3GWM013B Complete fracture mapping/prepare report: Crater Flat

E. Ervin completed the text and figures for the report entitled "*Fracture data and comparison of mapping techniques from the Bullfrog Member of the Crater Flat Tuff near Yucca Mountain, Nevada*". The report next goes to the section chief for review.

3GWM005B Develop conceptual model fracture network FY93

P. Wallmann of Golder and Associates and E. Ervin planned Wallmann's next visit in mid-June to Denver to help with the FracMan fracture-network model at the UE-25 C-hole complex. A. Geldon provided information on the old aquifer tests at the multiple-well complex to help in the conceptualization of flow through fractured rocks.

**Planning and Operations:**

3GWM004B Prepare interim status report

E. Ervin completed the interim status report for the USGS part of the work and also for the LBL work on the fracture-network model being done by K. Karasaki. Ervin met with L. Hayes to

discuss the progress of the work.

Variances:

3GWM013B Complete fracture mapping/prepare report: Crater Flat

This activity and related milestone "Report/TDIF: Crater Flat tuff fracture mapping" (3GWM013M), will be in variance at the end of this month because the report, while finished, is in the USGS review process. The reason for the delay is that the PI needed to devote time to other priorities. This activity will be finished by the end of the fiscal year and will not cross the fiscal-year boundary.

Work Performed but not in Direct Support of the Scheduled Tasks:

An estimated 8 hours were spent on the following:

E. Ervin attended a HITF meeting that was held in Denver to discuss plans for aquifer testing at the UE-25 C-hole complex.

A requisition for the purchase of a 486/66 desktop computer was prepared by E. Ervin. The powerful computer is needed for this activity to efficiently run the FracMan model.

SCP 8.3.1.2.3.3.2L Development of fracture network model 0B33133B93

Summary Account Manager - K. Karasaki

Technical Activities:

3GWM18CA Study outcrop fracture bias and prepare report

Development of methods of generating random fields with known correlation structure continued. In addition to the turning bands method, the random coin method for random field generation for application to studying fracture networks is being investigated. Work has been initiated on the estimate bias of hydrologic parameters based on comparing flow through 3-dimensional random fracture networks with that of flow through 2-dimensional random fracture networks.

3GWM21CA Complete TRINET users manual

A few example cases of TRINET runs for the user manual were finalized.

A TRINET test run was made on the 16 processor CRAY C-90 with roughly 200,000 elements, which took about five minutes of CPU.

3GWM23CA Study prediction error and design test

K. Karasaki attended the HITF meeting, where UE25 C-hole test plans and UE-25 UZ#16 data were discussed.

Variances:

Revision and updates to the QMP were installed.

Staff members completed various reading assignments.

WBS 1.2.3.6 Climatology and Meteorology

WBS 1.2.3.6.2.1.1 Modern Regional Climate

Principal Investigator - B. Parks

SCP 8.3.1.5.1.1.1 Synoptic characterization of regional climate 0G36211A93

Summary Account Manager - R. Forester

Technical Activities:

3GCR005B Develop study plan

USGS review comments have been addressed, and the final study plan has been submitted to the USGS QA office for its approval prior to submittal to DOE.

WBS 1.2.3.6.2.1.2 Paleoclimate Study of Lake, Playa, and Marsh Deposits

Principal Investigator - B. Parks

SCP 8.3.1.5.1.2 Paleoclimate study of lakes, playas, and marshes LOE Account 0G36212Z93

Summary Account Manager - B. Parks

Prepared schedules for tasks assigned to this activity. Provided status reports of planned activities and prepared variance analysis reports. Performed administrative duties and managed personnel. Participated in the YMP-USGS mid-year review of the project.

SCP 8.3.1.5.1.2.2 Analysis of stratigraphy-sedimentology of marsh, lacustrine, and playa deposits 0G36211B93

Summary Account Manager - R. Forester

Technical Activities:

3GCL013B Collect cores

Cores collected in April were transported to Denver and placed in temporary storage. Additional cores are scheduled to be collected in June.

3GCL016B Paleontological preparation/assessment

Prepared samples collected during the southern Nevada coring trip for calcareous microfossils and other materials.

Extracted ostracodes and other biota from 25 samples collected during the January 1993 sampling trip and from three samples collected during the April coring trip to southern Nevada.

3GCL014B Stratigraphic analysis

Due to the heavy winter precipitation in southern Nevada and the delays in completing the coring, the interim assessment of the stratigraphic analysis will be completed approximately one month late. The initial assessment will be enhanced by information collected during the April coring trip.

WBS 1.2.3.6.2.1.3 Climatic Implications of Terrestrial Paleocology

Principal Investigator - B. Parks

SCP 8.3.1.5.1.3.1 Analysis of pack rat middens 0G36213A93

Summary Account Manager - P. Wigand

Technical Activities:

3GCL110 Management oversight/scientific coordination

A summary of DRI activities was completed and a copy was submitted to the USGS for information purposes only.

Variances:

Because field work was delayed due to weather, the status report (milestone 3GCL110M) will be delayed until the middle of June. This will have no effect on the overall products of this activity.

WBS 1.2.3.6.2.1.4 Paleoenvironmental History of Yucca Mountain

Principal Investigator - B. Parks

SCP 8.3.1.5.1.4.2 Surficial deposits mapping of Yucca Mountain area 0G36214B93

Summary Account Manager - S. Lundstrom

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities:

3GCH040A Isotopic analysis

K. Futa initiated Sr isotopic analysis of glass separates from three spiked samples of pedogenic units rich in volcanic glass to determine Sr concentration and isotopic composition for tephrochronological studies. Resulting data will be compared to literature values of Sr isotopic compositions from major Late Tertiary and Pleistocene plinian eruptions throughout western North America and will test the current hypothesis that the ashy units represented at Bishop Tuff erupted at 740 Ka.

D. Craft completed preparation of seven samples of pedogenic soil carbonate from trenches in Midway Valley, and rhizoliths from an eolianite deposit in Fortymile Wash. Samples will be used for U-series age determinations.

3GCH035A Airphoto/fieldcheck/sampling/analysis northern third of YM

Airphoto interpretation and field checking of surficial deposits for this area continues to be an ongoing process. Analyses are being entered onto map products.

3GCH055A Airphoto/fieldcheck/sampling/analysis central third of YM

Airphoto interpretation and field checking of surficial deposits for this area continues to be an ongoing process. Analyses are being entered onto map products.

WBS 1.2.3.6.2.2.1 Quaternary Regional Hydrology

Principal Investigator - R. Luckey

SCP 8.3.1.5.2.1 Quaternary regional hydrology LOE Account 0G36221Z93

Summary Account Manager - R. Luckey

Collect hydrologic data FY93

Continued data collection at the Stewart Creek and Kawich Creek analog recharge sites. The data collection system consists of two stream-flow sites, four meteorological sites, and six to eight water quality sites. On a daily basis, T. Oliver checks the NWIS data base for DCP data and performed weekly data pulls from the LRGS to fill missing data. In addition, Oliver prepared for a field trip to the analog sites for general data retrievals and to perform periodic maintenance and calibration of equipment at the sites. M. Ciesnik will assist Oliver on this trip.

Support project operations

During this reporting period, the PIs responsible for this study, planned, scheduled and monitored routine project operations, prepared routine procurement documents, monitored rate

of spending, and held or participated in routine administrative meetings.

E. Gutentag prepared for a field trip on the northern portion of Nellis Air Force Base Bombing Range. Activities to this end included gathering and preparing equipment for use on the trip and getting the field truck ready for use. As on the previous trip, focus will be on sampling various playas and springs in the area.

E. Gutentag prepared USGS employee evaluations.

During the reporting period, the QA specialists involved in this study monitored all project activities for QA compliance, tracked all open items, and attended QMP training sessions and bi-weekly USGS-HIP SZ QA meetings.

J. Watson performed reviews of QMP-3.15, R1; QMP-8.01, R3; QMP-17.01, R6, QMP-5.03, R8; and QMP-3.07, R5; and submitted SN 0012 to QA office for review and closure.

USGS-NCR-93-09: Awaiting QA Office verification.

USGS-NCR-93-12: Awaiting acceptance of response by the QA Office.

USGS-AFR-92-07: This item is closed.

SCP 8.3.1.5.2.1.1 Regional paleoflood evaluation 0G36221A93

★ Summary Account Manager - D. Grasso

Technical Activities:

3GQH010A Prepare preliminary summary of YM paleoflood studies

D. Grasso prepared draft copies of hydrologic charts and tables for the preliminary summary of Yucca Mountain paleoflood studies. These materials show various aspects of modern-day and paleoflood discharge rates, storm runoff volumes, and the recurrence intervals for large magnitude floods of the upper Amargosa River drainage. The precipitation-runoff relationships shown by the hydrologic charts are of particular importance because of their paleoflood implications for the Yucca Mountain area drainages. Additionally, text describing these graphic materials was prepared for the preliminary report and also presented as a brown-bag seminar to the staff of the USGS-WRD Nevada Subdistrict Office in mid-May.

Work Performed but not in Direct Support of the Scheduled Tasks:

An estimated 120 hours were spent on the following:

D. Grasso prepared and presented a brown-bag seminar, entitled "Flood flows of the upper Amargosa River: a progress report," to the staff of the USGS-WRD Nevada Subdistrict Office. The seminar was useful in that it provided an excellent format to present many of the findings, to date, of the regional paleoflood evaluation.

D. Grasso conducted a field reconnaissance of the upper Amargosa River, the lower reaches of the Fortymile Wash tributary drainage system, and the Amargosa Desert. A field evaluation was also made of modern-day hydrologic conditions of Salt Creek, which drains the northern Death Valley area. The purpose of these reconnaissances was to assess the validity of numerical estimates of flood-flow discharge that have been developed during this study and by other previous researchers in the area. An additional goal for the reconnaissance, was to establish the probable areal extent and volume of Death Valley's Holocene lake, as originally proposed by C. Hunt in 1966.

D. Grasso attended a paleoclimate workshop entitled "Ongoing paleoclimatic studies in the Northern Great Basin," which was particularly applicable to this study. Methods and the results of ongoing paleoclimate studies of paleolakes and paleoflood discharges were presented that have direct implications

for the regional paleoflood evaluation.

SCP 8.3.1.5.2.1.3 Evaluation of past discharge areas 0G36221C93

Summary Account Manager - E. Gutentag

Technical Activities:

**3GQH025 Analyze water and lithologic samples NWQL/GSP/GD**

The following papers were published and presented at the ANS HLRWM meeting "*Isotopic evidence of complex ground-water flow at Yucca Mountain, Nevada, USA*", by Z. Peterman and J. Stuckless; "*Late Quaternary history and uranium isotopic compositions of ground water discharge deposits, Crater Flat, Nevada*", by J. Paces, E. Taylor and C. Bush; and "*<sup>234</sup>U/<sup>238</sup>U as a ground-water tracer, SW Nevada - SE California*", by K. Ludwig, Z. Peterman, K. Simmons and E. Gutentag.

Z. Peterman completed a week-long technical training course entitled "Principles and applications of modeling chemical reactions in ground water" given through the International Ground Water Modeling Center. The course focused on theories of low temperature equilibrium thermodynamics of water-rock reaction by utilizing a number of computer codes available for the PC. The information learned and software obtained will be useful for ground water isotopic and chemical characterization work being done within the IGSG.

Z. Peterman, B. Marshall and S. Mahan initiated a procedure to spike water samples with a known isotopic tracer solution in order to obtain accurate Sr concentrations from the same samples analyzed for Sr isotopic compositions. Sr in water currently is being determined by XRF analysis which suffers in precision due to lack of appropriate water standards. In order to more accurately model geochemical and isotopic data from water samples, it was determined that more reliable concentration data are required than those currently being produced by XRF. At present, an existing calibrated spike is being used, however assessments are underway to determine whether a more dilute spike might be preferable.

J. Paces examined thin sections of rhizolith and nodular carbonates from the Crater Flat spring discharge deposits. Observed textures and microfabrics do not support a hypothesis involving extensive recrystallization or addition of substantial secondary carbonate fillings that would complicate interpretation of U-Th results. Also, rhizolith contains apparent organic carbon residues outlining original plant cell structures. Analysis of total C and inorganic C by T. McConnaughey for scoping purposes indicates approximately 1% of the total C is derived from organic fraction. These materials will be prepared and submitted for <sup>14</sup>C dating on both organic and inorganic fractions to help verify U-series results.

J. Paces spent two days at the NTS examining tufa mound and paludal spring deposits with I. Winograd, W. Carr and E. Taylor. The purpose of the trip was to examine field evidence that would contribute to a better understanding of the history of deposition at Crater Flat given the concerns of secondary modification of carbonates exposed at the surface expressed by Winograd.

B. Widmann completed XRF geochemical analyses of approximately 40 water samples received from E. Gutentag and B. Steinkampf. Chemical separation of Sr for all these samples was completed in preparation for Sr isotopic analysis. Appropriate tracking documentation for these samples has also been completed. Sr isotopic analyses of a subset of these samples were completed by S. Mahan.

S. Mahan provided a copy of the Sr isotopic data base to C. Faunt so that ground water isotopic

data from springs and wells can be incorporated into the integrated GIS data base.

S. Mahan and B. Widmann planned logistics for a water collecting trip to the Oasis Valley and Spring Mountains areas to be conducted in early June. This work is in cooperation with staff at the Las Vegas WRD District Office.

NWQL has finished all nutrient analyses for samples collected last month. One complete water analysis was received.

GSP is awaiting repair of the XRF before completing the SR 87/86 analyses.

**3GQH003 Vegetation mapping phase II**

K. Turner continued to complete the draft report on the Amargosa Desert vegetation mapping. Turner is fine tuning the various vegetation classes using statistical methods. Land cover classes have been revised to correlate with regional vegetation mapping conducted by F. D'Agnese. Turner expects to complete report by June 30, 1993.

F. D'Agnese finalized preliminary vegetation maps and continued to work on a report for "Regional vegetation mapping of the Death Valley Region".

**3GQH021 Collect/prepare/analyze faunal/water/soil outcrop**

K. Conrad is preparing samples collected last month for ostracode identification.

**3GQH037 Determine discharge mechanism in hydrologic units**

F. D'Agnese continued the analysis of regional spring discharge and its relation to regional flow. Data collected from prior trips were analyzed to determine if these springs represented local or regional flow system. Parameters such as spring discharge, water temperature, cations, anions, SR 87/86 were used to determine if the flow path was local or regional.

**3GQH019 Prepare report on origins of surface deposits**

This report took a long time to review. The senior author was directed by the PI to spend time on other important work. The report is expected to be finished on time.

**3GQH002 Prepare interim status report**

This report was completed.

Quality Assurance:

S. Mahan and B. Widmann worked with A. Boulton to compile data for TDIFs associated with publication of the ANS paper by Z. Peterman and J. Stuckless.

Planning and Operations:

**3GQH003 Vegetation mapping phase II**

A field trip by E. Gutentag, C. Faunt, and F. D'Agnese is planned to check the northern part of the regional study area on the Nellis Air Force Bombing Range.

**3GQH021 Collect/prepare/analyze faunal/water/soil outcrop**

A field trip was planned by E. Gutentag, F. D'Agnese, and C. Faunt to collect springs in area where data are scarce. The PI borrowed a logging unit and a bailer to collect water samples from wells greater than 200 feet.

Variations:

**3GQH003 Vegetation mapping phase II**

This activity will be completed in two steps. K. Turner is completing the first product by revising some of the original L. DeMarco vegetation classes using dedrograms and other statistical methods. This should be completed by June 30, 1993. The second step is the regional vegetation map that is expected to be completed by July 30, 1993. This report was delayed because it needed additional field work to complete field checking vegetation due to a wet winter and spring producing a desert in bloom.

SCP 8.3.1.5.2.1.4a Analog recharge sites 0G36221D93

Summary Account Manager - R. Lichty

Technical Activities:

**3GQH12CA Prepare data reports FY92**

T. Oliver continued development of tables and station summary narrative for inclusion in the data report.

**3GQH14CA Test PRMS model**

B. Lichty completed the test of PRMS model applications to analog recharge sites. Model estimates of ground-water recharge for Stewart Creek watershed range from about 6 to 8 inches annually, or about 30 percent of average annual precipitation. Model estimates of ground-water recharge for Kawich Creek watershed are much lower, on the order of about 0.5 inch, or less than five percent of average annual precipitation.

**3GQH10CA Prepare interim status report**

Report was completed and transmitted to Chief, YMPB.

SCP 8.3.1.5.2.1.4b Geochemistry of arid-zone infiltration 0G36221E93

Summary Account Manager - A. Riggs

Technical Activities:

**3GQH003D Collect watershed inputs and meteorological data**

During this month, the long-term meteorological data logger program was corrected so that the pyranometer now functions as it should. Also, the correct offsets for the thermometer calibration curves was determined and the newly calibrated thermometer/hygrometers were installed on the tower. Long-term meteorological data collection has continued uninterrupted for all parameters since the above-noted changes were made.

No watershed inputs were collected during this period because the instrumentation is not yet completely installed; but considerable progress was made with installation. Five instrument shelters complete with data loggers, batteries, solar panels, and voltage regulators were installed. Three soils pits were dug and one was described pedologically. Four tipping bucket rain gages were installed, as were five water level detectors associated with the five weirs. Much of the wiring from the various instruments to the data logger was installed and some of the initial data logger programming was worked out.

**3GQH005D Conduct misc site characterization activities**

Inquiries into the best way to initiate a contract for aerial photography and topographic mapping were made. It is unclear whether any aerial photography or aerial mapping will be completed this fiscal year.

Quality Assurance:

**3GQH001D Prepare long-term meteorological data report**

The first draft of the report was completed and sent out for preliminary review. Reviews were

not completed by the end of the month. It appears that the report will not be completed before the end of October due to time competition from other duties. A. Riggs attended the "Technical Data Management Day-to-day Operations" class.

SCP 8.3.1.5.2.1.5 Studies of calcite and opaline silica vein deposits 0G36221F93

Summary Account Manager - J. Whelan

Technical Activities:

3GQH833A Prepare isotope composition / fluid inclusion history

The following papers were published and presented at the ANS HLRWM meeting "*Strontium isotopic evidence for a higher water table at Yucca Mountain*", by B. Marshall, Z. Peterman and J. Stuckless; and "*Lead isotopic compositions of Paleozoic and Late Proterozoic marine carbonate rocks in the vicinity of Yucca Mountain, Nevada*", by R. Zartman and L. Kwak.

K. Futa submitted 13 samples of soil from pits in Midway Valley to European Analytical Services, Inc. for  $^{90}\text{Sr}$  determinations. Results from these samples will be used to assess the feasibility of using  $^{90}\text{Sr}$  to model the chemical behavior and rates of mobility of Sr in the pedogenic environment. As an initial attempt to determine the presence of  $^{90}\text{Sr}$  in these soils (for scoping purposes), a 50 gram soil sample was leached in 1N Hcl in house and the solute was passed through a cation-exchange column to attempt to separate Sr from solution. A beta-particle count on the extracted sample showed no radiation from  $^{90}\text{Sr}$  decay. This null result may indicate that either  $^{90}\text{Sr}$  is not present in the soils, that an inadequate mass of soil was processed, or that the analytical techniques used are inappropriate.

3GQH816B Collect specimens from cores and field sites

T. McConnaughey (with the help of P. Hern) spent four days at and around the NTS measuring concentrations of soil gas  $\text{CO}_2$  and collecting soil profiles and soil gas profiles for measurement of the stable isotopic compositions of  $\text{H}_2\text{O}$  and  $\text{CO}_2$ . Permanent soil gas sampling probe arrays were monitored at Fran Ridge, Exile Hill, Fortymile Wash, Pagany Wash, the southern flank of Rainier Mesa (roadcut on Holmes Road), and at the US Ecology low-level waste disposal site near Beatty and a permanent site was installed on the top of Rainier Mesa. Approximately 135 samples of soil, soil gases, and soil carbonate were collected during this trip.

T. McConnaughey extracted  $\text{CO}_2$  from ~40 soil gas samples and performed coulometric determinations of the organic and inorganic carbon contents of 20 soil samples. No work specific to this activity was performed this month.

R. Moscati logged in 40 samples from drill holes UE-25 UZ#16, B-1H, UE-25 C#1, UE-25 C#2, and UE-25 C#3.

3GQH832A Prepare mineralogic/petrologic description of specimens

R. Moscati performed petrologic description and sampling for 10 samples from drill core VH-2.

Variances:

The Kiel automated carbonate extraction contraption still has not produced reliable data. For the past two months the other mass spectrometer has been set up for H/D analyses, it has not been possible to collect any stable isotope data from carbonates during that time.

Work Performed but not in Direct Support of the Scheduled Tasks:

J. Whelan revised technical procedures GCP-14, -17, and -27 (relating to stable isotopic analyses of water samples) and sent them to SAIC.

J. Whelan spent one-half day in Data Management training; spent several hours with Dr. Young-Kook Hong of the Korea Institute of Geology, Mining and Materials discussing various aspects of low-temperature geochemistry and radioactive waste management and showing him around the stable isotope facilities; spent one day preparing a progress report and forecast of activity for the remainder of FY93 for the mid-year review; spent two days working on the study plan for "Synoptic Climate"; spent two days reviewing a paper for "Economic geology"; and spent one week testing and making repairs to the Kiel automated extraction attachment.

T. McConnaughey prepared a technical procedure entitled "*Extraction of soil gas CO<sub>2</sub> for stable isotope analysis*" and began preparation of a technical procedure entitled "*Coulometric analysis of the inorganic and organic carbon content of soils and tuffs*".

R. Moscati spent the last five days of the month in the field with G. Smith and I. Friedman collecting precipitation samples from Utah, Nevada, and California. His work is funded by Global Climate Program and the data is of regional significance to Yucca Mountain Climate Studies.

#### WBS 1.2.3.7.2.1 Natural Resource Assessment

Principal Investigator - C. Hunter

#### SCP 8.3.1.9.2.1.1 Geochemistry assess of Yucca Mountain 0G3721A93

Summary Account Manager - Z. Peterman

#### Technical Activities:

##### **3G NR003B Compile radiometric data, known mineral occurrences**

Z. Peterman completed a proposal for work in FY94 that emphasizes a geochemical approach to natural resource assessment involving studies of ground water and paleopathways of fluid flow through the rock mass. The proposed study would be conducted in cooperation with scientists at the University of Nevada (Reno and Las Vegas). The completed proposal was submitted to the YMPB-TPO.

K. Futa completed 1N Hcl leaches of 17 Paleozoic carbonates from Bare Mountain for analysis of unspiked Sr isotopic compositions. <sup>87</sup>Sr/<sup>86</sup>Sr ratios will be used, along with Pb isotopic data to characterize alteration of marine carbonates from their primary isotopic compositions. S. Mahan completed Sr isotopic analyses on these samples and currently is reducing the data.

B. Widmann, along with B. Marshall, used digital elevation model data to produce topographic base maps of Bare Mountain and the Striped Hills areas and plotted the location of all limestone samples collected to date. In addition, Sr isotopic compositions and average ages of the rock units were compiled and compared to the marine Sr isotopic evolution curve of Burke, et al. (1982). Deviations of observed <sup>87</sup>Sr/<sup>86</sup>Sr compositions are presumably caused by secondary alteration, and the extent of deviations and their spatial distributions currently are being evaluated.

D. Craft completed preparation of samples of six dacite dikes from Bare Mountain submitted by D. Noble. Samples also have been analyzed for the suite of XRF elements and will be submitted for Sr and Pb isotopic analyses. These materials are being geochemically characterized since they have commonly been assumed to represent part of the igneous system responsible for hydrothermal precious metal mineralization of Paleozoic limestones in Bare Mountain.

Work on map plots of data for the report on isotopic age information for mineralization in the vicinity of Yucca Mountain continued. Verification of data and production of supporting data are underway. J. Bergquist began entering data into GIS format for producing map plots of location and age information.

Quality Assurance:

E. McKee and J. Bergquist completed reading assignments and training as required.

Work Performed but not in Direct Support of the Scheduled Tasks:

J. Bergquist continued revisions (requested by DOE/M&O) of the original USGS administrative report to DOE, Yucca Mountain Project, 1991, on mineral occurrences near Yucca Mountain. Bergquist expects to submit this as an OFR.

SCP 8.3.1.9.2.1.4 Assessment of hydrocarbon resources 0G3721D93

Summary Account Manager - Z. Peterman

Planning and Operations:

J. Grow attended a field trip in the Virgin and Beaver Dam Mountains for three days preceding the GSA meetings. Grow is preparing to participate in field work in the Pancake Range, and in the Nevada Petroleum Society field trip to examine the central Nevada thrust belt.

Work Performed but not in Direct Support of the Scheduled Tasks:

J. Grow attended the GSA meetings and was co-author on the following oral presentations:

Grow, J.A., Potter, C.J., and Miller, J.J., 1993, Seismic constraints on fault angles in Railroad Valley, NV: Geological Society of America Cordilleran and Rocky Mountain Section Abstracts with Programs, Reno, Nevada, May 19 through 21, v. 25, no. 5, p. 45;

Perry, W.J., and Grow, J.A., 1993, Structure and timing of deformation in the central Pancake Range, Nye County, Nevada: Geological Society of America Cordilleran and Rocky Mountain Section Abstracts with Programs, Reno, Nevada, May 19 through 21, v. 25, no. 5, p. 133;

Potter, C.J., Grow, J.A., and Miller, J.J., 1993, Controls on cross-sectional geometry of extensional basins -- a seismic-stratigraphic approach: Geological Society of America Cordilleran and Rocky Mountain Section Abstracts with Programs, Reno, Nevada, May 19 through 21, v. 25, no. 5, p. 135.

C. Barker did not attend the GSA meeting, but was a co-author on the following report:

Cole, J.C., Harris, A.J., Lanphere, M.A., and Barker, C.E., 1993, The case for pre-middle Cretaceous extensional faulting in norther Yucca Flat, southwestern Nevada: Geological Society of America Cordilleran and Rocky Mountain Section, Reno, Nevada, May 19 through 21, v. 25, no. 5, p. 22.

## 1.2.5 REGULATORY AND INSTITUTIONAL

Reviewed W. Dudley's draft presentation for NRC Technical Review session. Responses have been made to reviewer comments on Study Plans 8.3.1.5.2, Rev 0 and 8.3.1.15.2.2, Rev 0.

Geomatrix personnel were involved in the NRC site visit. The preliminary results of Trench MWV-T7

were presented at the Field Operations Center in Area 25 of the Nevada Test Site.

Discussed preliminary results of Quaternary map compilation and studies on the Death Valley--Furnace Creek fault system.

Participated in NRC field review, which included a visit to BMT-2.

Work in progress was described at trenches and exposures at Busted Butte, Stagecoach Road fault, Solitario Canyon fault, Fatigue Wash fault, and the newly excavated trench on the Bare Mountain fault for the NRC field trip. J. Whitney C. Menges, A. Ramelli, and L. Anderson presented work and participated in the field trip.

#### WBS 1.2.5.2.2 Site Characterization Program

Principal Investigator - W. Dudley, Jr.

J. Stuckless participated in a two-day trip for the NRC as part of a Site visit. He spent two days on comment resolution and revision for the Trench 14/Busted Butte issue closure paper.

R. Spengler participated in scoping and dry-run sessions in preparation for the NRC geophysical integration technical exchange scheduled for June 8, 1993 in Las Vegas, Nevada.

Staff of the borehole geophysics investigations currently are preparing for the NRC technical exchange concerning geophysical integration (scheduled for June 1993).

#### Study Plans (DOE/YMPO/HQ comment resolution)

The PI began addressing the 88 reviewers comments on the major faults study plan (8.3.1.2.2.4.10). The PI spent two days addressing the minor and irrelevant comments and estimates that it will require approximately two weeks to address the major comments.

D. Thorstenson reviewed a LANL study plan on proposed experiments on radionuclide transport column experiments. (16 hrs)

S. Mahan completed an internal report on the results of Sr concentration determinations by isotope dilution on previously-analyzed calcites from Swedish boreholes and submitted the report to Z. Peterman.

B. Widmann initiated examination of crystalline rocks associated with the Swedish waste isolation project by documenting and describing 25 borehole samples. Further sample preparation requirements were determined including both whole rock powder preparation and subsampling of fracture-fill coatings and vein material.

Two final copies plus the original copy of YMP-USGS SP 8.3.1.2.2.9, R0 "Site unsaturated zone modeling and synthesis" was delivered to W. Causseaux, HIP.

#### Study Plan Status

The USGS Author responses to State of Nevada comments on Study Plan 8.3.1.2.1.3 - "Regional ground water flow system", were sent to the YMPO on May 13, 1993.

**WBS 1.2.5.3.5 Technical Data Base Input**  
Principal Investigator - L. Hayes

**Standard database maintenance**

Routine jobs were performed throughout the month, including the retrieval of the water quality data from the WRD NWQL, entering the data into the water quality (QW) subsystem of the WRD/HIP NWIS data base. The maintenance and cleanup of the SATIN and ADAPS logs and directories were accomplished on schedule. Both ADAPS and SATIN are also subsystems within the HIP NWIS data base. Backup of all the NWIS data base subsystem files was performed and the backup tape sent to the LRC for storage in their fire proof vault.

Several operating system level errors and some MIDASPLUS operating errors occurred on the PRIME system. The DMU traced the errors through the logs and ran various PRIMOS utilities to clean up the system. The data base utilities were run to protect the data base files and all files were secured, with no data loss.

**Satellite Transmissions**

D. Burkhardt completed work on converting transducer output to water levels on wells UE-25 C#2 and UE-25 C#3 for 1990-91; and UE-25 WT#6, USW WT-11, UE-25 WT#13 and UE-25 WT#16 for 1992. All water level conversions for the WT wells are now accomplished through 1992, and all wells are now converted through 1991. Burkhardt also worked on collecting data, calculating water levels, and calculating regressions for the USW G-3 well for 1992.

D. Burkhardt spent a great deal of time this month coordinating field changes to collect programs at several DCP sites. These changes had to be coordinated through USGS Headquarters, the Colorado District and several backup nodes in order to maintain data integrity. This also entailed coordination of changes to formatting programs at each of these distributing sites.

**Data logger data**

A 21X calibration was performed by D. Burkhardt in response to a request by G. O'Brien.

**User assistance**

A. Riggs needed to eliminate duplicate data on floppy disks to save space. D. Burkhardt assisted Riggs in moving the data from floppy disk to PRIME, editing out duplicate data, and loading the cleaned data sets back onto the floppy disks.

D. Burkhardt also assisted G. O'Brien in analyzing some hydrologic data sets.

B. Oatfield reviewed, edited, and entered three sites into the HIP NWIS data base for B. Steinkampf. Oatfield also completed two sets of retrievals on wells with water use information for F. D'Agnese.

D. Burkhardt and B. Kerans assisted the YMPB administrative staff throughout the month on problems they were experiencing with the mail system, the Administrative Financial Information Management System (AFIMS), and the Career Development Program (CDP) software packages.

**Data administration**

B. Oatfield investigated double entries for the C-wells in both the HIP NWIS data base and the Nevada District data base. Oatfield is verifying the correct site IDs for these wells, and will be cleaning up the incorrect sites in the data base. Oatfield will work to assure the correct site IDs are the ones entered in other USGS and YMP data bases.

B. Oatfield spent substantial time reviewing the QW analysis data that is not entered in the NWIS files due to incorrect site IDs or mandatory entry fields. Oatfield will be working with the PIs to clear up this data.

B. Kerans prepared an overview of the DMU's 1993 goals and accomplishments for the YMPB data management coordinator.

**Training (taken)**

B. Kerans attended the Data Management training given by P. McKinley.

B. Oatfield completed the reading assignment for AP-5.1Q.

**Training (given)**

The DMU personnel spent the majority of their time this month in preparing and presenting their portions of the HIP Database Management workshop. This workshop provided the HIP participants, and others present, an opportunity to discuss specific data base problems and solutions involved in technical data collection. Presentations by the DMU staff provided: historical information on the WRD data bases and their use by YMP; overviews of the current NWIS-I system and current applications; and overviews of the future NWIS-II system including its design and possible YMP applications.

Individual YMP projects also presented some of their data collection techniques. Discussions centered on further ways of coordinating and sharing data within YMP projects, and passing approved data to the proper DOE facilities and data bases.

**WBS 1.2.5.4.4 Site Performance Assessment**

Principal Investigator - A. Flint

**Technical Activities:**

**3GPA004 Develop 1-D and 2-D matrix models**

The 1-D and 2-D matrix models are complete and two papers have been written. The 1-D model and results were presented at the IHLWC. The paper is entitled "*The influence of long term climate change on net infiltration at Yucca Mountain, Nevada*" by A. Flint, L. Flint and J. Hevesi. The paper is in the Proceedings. The second paper presents the results of the 2-D matrix model and is entitled "*Numerical modeling of lateral infiltration into the Paintbrush unit at Yucca Mountain, Nevada*", by M. McGraw, G. Bodvarsson, L. Flint and A. Flint. This paper currently is in review by SNL and USGS and will be published as a SAND report.

**3GPA008 Analyze fracture/fault fill and develop model**

The water retention curves and saturated permeabilities are complete for the fracture fault fill.

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

Principal Investigator - A. Flint

**Technical Activities:**

**3GVF003 Develop and refine data for INTRAVAL program**

The final data set was completed for the INTRAVAL modeling group. No additional data will be collected as part of the INTRAVAL program.

### **3GVF007 Develop and test hydraulic functional relations**

Moisture retention curves have been developed for the INTRAVAL data. These relations were tested and preliminary functions were used as part of the 1-D and 2-D matrix models in "Develop 1-D and 2-D matrix models" (3GA004). The final functional relations are being analyzed and will be reported under "Prepare technical report on functional relations" (3GVF012).

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

Principal Investigator - A. Flint

### **Technical Activities**

#### **3GPC007 Measure thermal effects on rock properties**

All rock property measurements are complete and are being incorporated into a technical report on functional relations (3GVF012).

## **1.2.9 PROJECT MANAGEMENT**

### **WBS 1.2.9.2.2 Participant Project Control**

Principal Investigator - R. Ritchey

Graphic analysis for GSP accounts was prepared comparing the work plan against the earned value and actual costs for the year to date. "Soon-To-Come-Due" reports, comparison reports and bar charts were prepared displaying current schedule status against the baseline. Analysis was prepared on those activities/tasks that have slipped from their original completion dates.

A milestone report was generated for all USGS Level 3 & 4 milestones showing the baseline date, the promise or planned date and the actual completion date (if applicable). This report will facilitate the tracking of milestone completion and slippage throughout the fiscal year, as well as provide an additional tool by which to monitor progress.

## **1.2.11 QUALITY ASSURANCE**

### **WBS 1.2.11.1 Quality Assurance Coordination and Planning**

Principal Investigator - T. Chaney

A draft matrix for the DOE QARD has been completed which identified 15 existing QMPs requiring revision, four new QMPs to be developed, and seven QMPs requiring modification.

Teams working on software, samples, data, and technical procedure preparation are being tracked by a schedule prepared by project control techniques.

### **WBS 1.2.11.2 Quality Assurance Program Development**

Twenty-two QMPs are in the process of revision or modification to fully satisfy requirements of the QARD.

Input of data, tracking dates of assignment, and other details necessary to keep the open items data base current were handled.

#### WBS 1.2.11.3.1 Quality Assurance Verification - Audits

Principal Investigator - T. Chaney

The Audit Report for Internal Audit USGS-9308 of several QA Program criteria was written, resulting in three audit findings and four audit observations. The audit also verified eleven deficiency document corrective actions, ten were recommended for closure and one was recommended to be reissued.

Supplier requalification Audit USGS-93-09 of the USGS Branch of Quality Assurance was performed and a draft report was prepared recommending retention on the Approved Supplier List.

Evaluations of six suppliers were conducted and two additional ones were initiated to determine if they could be included or kept on the Approved Suppliers List.

Twenty-two deficiency documents were verified and closed.

#### WBS 1.2.11.3.2 Quality Assurance Verification - Surveillances

Surveillance USGS-93-S05 of YMP-USGS SCP activity 8.3.1.4.2.1.3, Borehole geophysical surveys, was completed.

The performance of surveillance USGS-93-S04, for SCP activity 8.3.1.4.2.2.1 - Geologic Mapping of Zonal Features in the Paintbrush Tuff and USGS-93-S06, for SCP activity 8.3.1.4.2.2.4 - Geologic mapping of Exploratory Studies Facility (ESF) is nearing completion. The field visit of ongoing activities in these two studies has been accomplished.

#### WBS 1.2.11.5 Quality Assurance - Quality Engineering

Principal Investigator - L. Hayes

Branch reviews and/or resolution of comments were completed and documented for thirteen YMP-USGS procedures.

Work was coordinated with the configuration management specialist for review and consolidation of YMPB review comments for five DOE/YMPO Administrative Procedures/Plans.

Information and support were provided for the FY92 Management Assessment Report now being completed.

Approximately 40 software documents have been received, reviewed, and/or processed by the SCM coordinator in accordance with QMP-3.03, R3.

### 1.2.12 INFORMATION MANAGEMENT

#### WBS 1.2.12.2.2 Local Records Center Operation

Principal Investigator - L. Hayes

Three hundred three (303) individual records, 119 current criteria packages, and two cited reference lists were received into the Local Records Center (LRC). Only two percent (2%) of LRC receipts required corrective actions by the LRC staff.

Current material transmitted to the Central Records Facility from the LRC included 62 individual records and 39 criteria packages (1786 pages); no publication or packages were transmitted (as these are not being received from the publications processing unit for LRC processing); and two current cited references. Backlog material included six publications packages, 78 other criteria packages, and no backlog cited references (1,727 pages).

#### WBS 1.2.12.2.5 Document Control

Technical procedures GP-18, R1; GP-43,R0-M1; HP-176, R2; HP-178, R1; HP-229, R2; HP-243, R0; HP-251, R0; and HP-260, R1 were distributed.

Technical procedure field modifications HP-256,R0-M1 and HP-262,R0-M1 have been rescinded.

### 1.2.13 ENVIRONMENT, SAFETY, AND HEALTH

#### WBS 1.2.13.4.7 Water Resources

Principal Investigator - R. LaCamera

##### Technical Activities:

##### 3GWR021 Conduct ground-water monitoring FY93

Ground-water levels were measured at 26 sites. Discharge data were collected at one flowing well and five springs. Ground-water data collected during April were checked and filed. Water-level recording instrumentation was re-installed and field calibrated at well AD-7 (to replace stolen equipment) and replacement equipment was ordered. The owner of a well near Amargosa Valley, at the south end of Crater Flat was contacted regarding access to the well for water-level measurement. Collected well-construction and operational data for the well, which is being evaluated as a replacement for well AD-6.

##### 3GWR033 Environmental program support, FY93

Prepared and delivered status report for April to DOE and Hydrologic Investigations Program (HIP). Reviewed Environmental Program FY93 Annual Plan. Prepared FY93 interim status report and participated in mid-year HIP/YMPB project reviews. Participated in Nevada District Ground-Water Technical Review. Investigated future computer needs, developed specifications, and discussed procurement with WESTON/DOE.

##### 3GWR035 Prepare water-resources report through FY92

Submitted report outline to Las Vegas Subdistrict YMP section chief for review and comment. Discussed format of report graphs with groundwater specialists during District groundwater review on May 11, 1993. Continued to update and enter data into project data base.

##### 3GWR031 Prepare report, well JP-3

Checked equipment calibration data, discrete water-level measurements, and continually recorded data. Applied corrections and reprocessed data.

##### Variances:

**3GWF021 Conduct ground-water monitoring FY93**

Water-level data were not collected at MV-1, AD-3, or AD-6. MV-1 was not measured because it does not have an access tube to allow water-level measurements. Debris and/or an obstruction in well AD-3 prevented a water-level measurement. The well will be revisited in June and an attempt will be made to remove or bypass the obstruction to obtain access to the water surface. AD-6 is currently the owner's only pumping well and the owner feels that a water-level measurement may affect operation of the well. Nearby well AD-5 is currently measured and provides monitoring data for the area.

Work Performed but not in Direct Support of the Scheduled Tasks:

R. LaCamera was selected as an instructor for nationally coordinated water-quality training in Nevada. He attended a two-week training course for instructors in Denver.

**1.2.15 SUPPORT SERVICES**

WBS 1.2.15.3 Yucca Mountain Site Characterization Project Support for the Training Mission  
Principal Investigator - L. Hayes

Assistance was provided to in preparing for Data Management classroom sessions. Coordination meetings regarding YMP-USGS training records and the general status of the YMP-USGS training program were attended.

YMP-USGS personnel were scheduled and classroom announcements were distributed for the following classroom sessions:

- YMP-USGS Orientation - Denver
- Procurement Workshop - NTS
- Procurement Workshop Make-up Session - Denver
- Records Management - Denver
- Data Management Policy Information - Denver
- Data Management Day-to-Day Operations - Denver
- New Underground Worker Training - Denver
- General Employee Training - Denver
- Initial Instructor Training for Subject Matter Experts - Denver

Mass reading assignments were distributed for two AP-Qs.

Technical procedure reading assignments were distributed for six HP technical procedures.