

Department of Energy

Washington, DC 20585

JUN 24 1992

Mr. Joseph J. Holonich, Director  
Repository Licensing and Quality Assurance  
Project Directorate  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

Dear Mr. Holonich:

The enclosed Yucca Mountain Site Characterization Project participant monthly status reports are forwarded for your information. If you have any questions on the enclosed reports, please contact Priscilla Bunton at (202) 586-8365.

Linda J. Desell, Chief  
Regulatory Integration Branch  
Office of Civilian Radioactive  
Waste Management

Enclosures:

- (1) EG&G Progress Report, March 1992
- (2) EG&G Progress Report, April 1992
- (3) Lawrence Livermore National Laboratories Yucca Mountain Project Status Report, March 1992
- (4) Lawrence Livermore National Laboratories Yucca Mountain Project Status Report, April 1992
- (5) Los Alamos Monthly Activity Report, February 1992
- (6) Los Alamos Monthly Activity Report, March 1992
- (7) REECO Yucca Mountain Project Status Report, March 1992
- (8) REECO Yucca Mountain Project Status Report, April 1992
- (9) Sandia National Laboratories Monthly Highlights and Status Report, March 1992
- (10) USGS Detailed Status Report, March 1992
- (11) USGS Yucca Mountain Project Summary, March 1992
- (12) USGS Yucca Mountain Project Summary, April 1992
- (13) USGS Water Resources Monitoring Program Status Report, April 1992

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PDR WASTE

WM-11

PDR

cc:w/o encl.

C. Gertz, YMPO

cc: w/encl.

K. Hooks, NRC

R. Loux, State of Nevada

M. Baughman, Lincoln County, NV

J. Bingham, Clark County, NV

B. Raper, Nye County, NV

P. Niedzielski-Eichner, Nye County, NV

G. Derby, Lander County, NV

P. Goicoechea, Eureka, NV

C. Schank, Churchill County, NV

F. Mariani, White Pine County, NV

V. Poe, Mineral County, NV

E. Wright, Lincoln County, NV

J. Pitts, Lincoln County, NV

R. Williams, Lander County, NV

J. Hayes, Esmeralda County, NV

M. Hayes, Esmeralda County, NV

B. Mettam, Inyo County, CA

# EG&G ENERGY MEASUREMENTS

Santa Barbara Operations

EG&G ENERGY MEASUREMENTS, INC. 101 CONVENT CENTER DRIVE LAS VEGAS, NEVADA 89109 TEL 702 796 1000

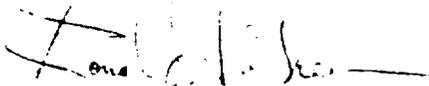
April 9, 1992  
LV92-RAG-088  
WBS 1.2.5.4.7  
NQA

Kathleen F. Grassmeier, Chief  
Project and Operations Control Division  
Yucca Mountain Project Office  
DOE Field Office, Nevada  
P. O. Box 98518  
Las Vegas, NV 89193-8518

## PROGRESS REPORT - MARCH 1992

Attached is the March 1992 progress report on biological studies and support activities conducted by EG&G/EM for the Yucca Mountain Project. Please contact me (293-7762) or Kent Ostler (794-7474) if you have questions regarding this report.

EG&G Energy Measurements, Inc.



Thomas P. O'Farrell, Manager  
Environmental Studies Project  
611 Avenue H  
Boulder City, NV 89005

mak

Enclosure

cc: W. Dixon, DOE/YMP  
D. Sorensen, SAIC  
P. Niles, SAIC

*Dixon*  
*10/17/90*  
*Dyer / Schlick*  
*Ryckert / Grassmeier*  
*Best / Brodsky*  
*Gandi / Phillips*  
*Wilton*  
*S. Jones*  
*McCann / SAIC*  
*4/14/92*

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ENCLOSURE 21

**YUCCA MOUNTAIN PROJECT  
BIOLOGICAL RESOURCES PROGRAM  
MONTHLY PROGRESS REPORT  
MARCH 1992**

Summary of Work Accomplished During Report Period

EG&G Energy Measurements (EG&G/EM) conducted work for the Biological Resources task (WBS 1.2.5.4.7) for the Project Office. Activities included conducting preactivity surveys; continuing site characterization effects studies, support studies for the radiological monitoring program, desert tortoise studies, and habitat reclamation studies; development of work instructions and study designs for new studies; and responding to requests for biological support by Project Office.

**Monitoring and Mitigation**

- ✓ ● EG&G/EM biologists examined and excavated two desert tortoise burrows near Exile Hill prior to the start of construction activity for the Midway Valley rock and soil test pits and North Portal Facility. Both burrows were empty. All tortoises in this area were monitored during construction and excavation activity.
- The preactivity survey report for Neutron Boreholes 15-16 and 36-17 (Request #91-023b) was sent to the Project Office. The movement of equipment onto and off of drill pads was monitored for boreholes 15, 16, and 17.
- A preactivity survey was conducted for a USGS stream monitoring station at Stateline, CA (part of original request #1990-1143).
- EG&G/I 1 met with the Project Office (D. Williams) to determine the depth of topsoil to salvage at the rock and soil test pits in Midway Valley and at the North Portal site. It was determined that 50-100 cm of soil could be salvaged.
- EG&G/EM met with LANL, RSN, REECo, YMP, SAIC, DRI, and LLNL personnel to look at potential conflicts of proposed drilling activities at Busted Butte.
- An on-site biologist was provided to monitor Project activities at Cima Dome in California.
- No adverse impacts or effects were documented in March during surveys or monitoring activities.
- Additional EG&G/EM staff scientists were trained to conduct preactivity surveys.

## Habitat Reclamation

- The study design for reclamation trials on site 1 (north end of Yucca Ridge) was developed. The site was ripped and all available topsoil was distributed. Study plots were located, staked, and cleared of existing vegetation.
- The reclamation sites #2 (on the southern end of Yucca Mountain ridge) and #4 (north end of Midway Valley) were prepared by ripping the soil to reduce compaction.
- Planting of containerized transplants was completed at the Forty-Mile Wash site (#3). A water-repelling treatment also was applied on the desert strip treatments at this site.
- The weather data from the computerized collector at the Forty-Mile Wash site was downloaded to a computer.

## Site Characterization Effects Program

- Weather and soil moisture and temperature data were collected weekly at the 48 ecological study plots (ESPs).
- Traffic count data were collected weekly at 9 locations. Counters were moved to new locations each week.
- Data entry and verification of the vegetation density data were completed.
- Invertebrate specimens were prepared for shipment to taxonomic experts for identification to the species level.
- Line and belt transects were established on 19 ESPs in the transition zone between the adjacent disturbances and undisturbed habitat to monitor disturbance effects on vegetation. Soil moisture and temperature cells also were placed in the transition zones of each of these ESPs.
- The collectors (petri dishes lined with filter paper) used for sampling dust were changed on all 48 ESPs.
- Staff scientists received their annual refresher training for trapping small mammals.

### **Radiological Monitoring Program**

- EG&G/EM received a revised State of Nevada animal handling permit allowing the capture and marking of Gambel's quail. Ten quail were captured and fitted with solar assisted radio transmitters. Four were radiomarked in Forty-Mile Wash in the vicinity of J-13 Well and H-Road. Five were radiomarked at the south end of Exile Hill, and one near the subdock.
- Predator surveys were completed at Yucca Mountain and in Crater Flats.

### **Desert Tortoise Program**

- No tortoises other than # 423 have been relocated or displaced. EG&G/EM biologists monitored all the tortoises near the North Portal construction area on Exile Hill.
- The relocated tortoise (# 423) was monitored in its new burrow. A rock was placed in front of its burrow to prevent it from leaving. The rock was removed in late March, and the tortoise moved approximately 160 m from the burrow.
- Corrals were placed around burrows of hibernating tortoises with dead radio transmitters. The corrals were used to prevent tortoises from moving before their transmitters could be replaced. Transmitters were replaced on 12 tortoises after they emerged from hibernation. Two tortoises escaped with dead transmitters. The corral fell at one burrow due to weather conditions and another had to be removed because of restricted access due to military activity.
- All radiomarked tortoises at Yucca Mountain and the control area were located and monitored each week during the month. Starting in mid-March, all tortoises were located twice each week.
- One new tortoise (MCL = 130 mm) was found and radiomarked on the south end of Exile Hill.
- One hundred-twenty-eight tortoises have been marked for the Yucca Mountain Site Characterization Project. Eighty-seven radiomarked tortoises are being monitored.
- EG&G/EM received a revised federal handling permit allowing the handling of tortoise eggs.

- Two tortoise nests were located during a follow-up of the reproduction pilot study. One nest, in Midway Valley east of the Test Pits, contained only egg-shell fragments. The second nest was near the north portal area. The nest contained four cracked eggs containing partially developed tortoises and one hatchling tortoise. A transmitter was placed on the tortoise and placed in a separate burrow. This tortoise is <50 m from a proposed Test Pit. EG&G/EM biologists will monitor this tortoise and relocate or move it if necessary.
- Annual training was conducted for scientific staff involved in studying desert tortoises.

### **Support Items**

- Sent the February monthly report of Yucca Mountain Site Characterization Project activities and accomplishments to the Project Office. Weekly reports of activities were submitted to the Project Office.
- Attended meetings to discuss the space requirements and facility needs for a new Environmental support building on the NTS and the coordination and share soils information with other project participants.
- EG&G/EM met with SAIC (G. McNeill) to discuss modifications to the Terrestrial Ecosystems display at the Field Operation Center.
- Provided a response to Project Office (K. Grassmeier) regarding a letter from the State of Nevada (B. Loux) on reclamation trials and the interaction of the reclamation documents.
- Prepared documentation for the POCD mid-year financial review.



# EG&G ENERGY MEASUREMENTS

Santa Barbara Operations

EG&G ENERGY MEASUREMENTS, INC. 101 CONVENTION CENTER DRIVE LAS VEGAS, NEVADA 89109 TEL: (702) 794-7463

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May 8 2 21 PM '00

May 7, 1992  
LV92-RAG-100  
WBS 1.2.5.4.7  
NOA

**Kathleen F. Grassmeier, Chief**  
Project and Operations Control Division  
Yucca Mountain Project Office  
DOE Field Office, Nevada  
P. O. Box 98518  
Las Vegas, NV 89193-8518

## PROGRESS REPORT - APRIL 1992

Attached is the April 1992 progress report on biological studies and support activities conducted by EG&G/EM for the Yucca Mountain Project. Please contact me (293-7762) or Kent Ostler (794-7474) if you have questions regarding this report.

EG&G Energy Measurements, Inc.

*for* Thomas P. O'Farrell, Manager  
Environmental Studies Project  
611 Avenue H  
Boulder City, NV 89005

mak

Enclosure

cc: W. Dixon, DOE/YMP  
D. Sorensen, SAIC  
P. Niles, SAIC

*Handwritten notes:*  
Dixon  
Dietrich  
Ryder / Grassmeier  
Bost / Phillips  
L. Jones  
Plett 30/5/8/92  
Netton  
Joni / Gorb - 640  
Brodsky  
5/8/92  
Hickman  
SAIC

**YUCCA MOUNTAIN PROJECT  
BIOLOGICAL RESOURCES PROGRAM  
MONTHLY PROGRESS REPORT  
APRIL 1992**

Summary of Work Accomplished During Report Period

EG&G Energy Measurements (EG&G/EM) conducted work for the Biological Resources task (WBS 1.2.5.4.7) for the Project Office. Activities included conducting preactivity surveys; continuing site characterization effects studies, support studies for the radiological monitoring program, desert tortoise studies, and habitat reclamation studies; development of work instructions and study designs for new studies; and responding to requests for biological support by Project Office.

**Monitoring and Mitigation**

- EG&G/EM received four requests to conduct preactivity surveys at 69 different sites; 1) 15 REM/EM stations (# 92-006), 2) the Busted Butte pavement study site (# 92-007b), 3) 52 rock and soil test pits (# 92-008b), and 4) neutron borehole N27 (# 92-023b). Two of the 15 REM/EM are new sites for small mammal collection related to changes (Alternative 30) in the Exploratory Studies Facilities. EG&G/EM is responsible for marking the boundaries of these sites before surveys are conducted. The new site for Plot # 14 was marked south of the North Portal site in April. The second site, near the proposed South Portal, has not been marked. This site will be marked in early May.
- Two surveys were completed, and four reports were submitted to Project Office in April. Surveys were completed and reports submitted for neutron borehole N27 (# 92-023b) and 12 of the 15 REM/EM stations (# 92-006). The survey report was submitted for the USGS surface water monitoring sites at Eagle Mountain and Stateline, California (Request #1990-1143). The report for this survey was formatted, at Project Office request, according to Bureau of Land Management specifications for inclusion in an Environmental Assessment. A letter also was submitted to Project Office describing the on-site tortoise monitoring activities in March at the USGS Cima Dome study site in California.
- EG&G/EM provided on-site reclamation and biological expertise at three sites. Reclamation scientists were provided to monitor soil-moving work along the access route to neutron borehole N64 and to give advice on how to protect existing topsoil stockpiles and where to place drill cuttings at the UZ16 borehole. A biologist was provided to assist in determining the best location for the SRG1 drill pad and access route.

## Habitat Reclamation

- The seeding and mulching was completed on the reclamation trial plots at the north end of Yucca Mountain. This site is being used to test effects of topsoil depth.
- Seedling density was measured on 35 reclamation trial plots at Forty-Mile Wash study site.
- Reclamation trial plots at the Forty-Mile Wash study site scheduled to receive supplemental water were irrigated.
- Perennial and annual plant seedling densities were measured on one permanent plant succession study plot.

## Site Characterization Effects Program

- Weather and soil moisture and temperature data were collected weekly at the 48 ecological study plots (ESPs). As soil moisture levels approach zero and become unmeasurable at the three depths (15, 30, and 45 cm), data will be collected monthly instead of weekly. The soil moisture levels have nearly reached unmeasurable levels on some plots. Precipitation data were summarized for the period December 1991 through March 20, 1992.
- Traffic count data were collected weekly at eight locations. Counters were moved to new locations each week. The collectors (petri dishes with filter paper) used for measuring dust deposition were changed on all ESPs.
- The vegetation field studies were started. The scientific staff was given their annual training on plant identification and methods used to collect and record plant density, cover, and production data. Perennial and annual plant seedling densities were measured on 13 ESPs. Plant cover was measured on 22 ESPs. Plant cover measurements in the *Larrea-Ambrosia* vegetation association have been completed. All cover measurements in the *Larrea-Lycium-Grayia* association have been completed except for two study plots.
- Plywood covers on the reptile pitfall buckets were replaced with plastic lids to better ensure that animals cannot fall or crawl into the buckets during non-sampling periods.
- Small mammal data from four of eight ESPs trapped in March and April were entered into computer databases.

## Radiological Monitoring Program

- Attempts were made to locate all radiomarked quail once each week. One to three quail usually could not be located. Several quail radiomarked in Midway Valley near Exile Hill have moved more than 1 km between weekly relocations. However, all movements have been within Midway Valley, and no movement has been documented between the Forty-Mile Wash trap sites and the Midway Valley sites. One radiomarked female in Sever Wash near Forty-Mile Wash is nesting and incubating a clutch of 13 eggs. One mortality occurred. A radiomarked male quail first captured in Forty-Mile Wash was found about 300 m north of H-Road in Forty-Mile Wash during the last week of April. The remains (both legs, including leg bands; feathers; a few bones; and the transmitter) suggests that it was killed by a predator. This bird was known to be alive the week before.
- Small mammals were trapped and collected on the eight radiological monitoring plots. Both long-tailed pocket mice and Merriam's kangaroo rats are abundant this year because of good reproduction last year. Therefore, specimens of both species were collected on six plots (#'s 5, 12, 14, 37, 59, 69). One sample of Merriam's kangaroo rats was collected from the control plot (# 58) in Crater Flats, and one sample of long-tailed pocket mice was collected from Plot #2 in Drill Hole Wash. This completes the spring collection of small mammal specimens for the Radiological Monitoring Program. SAIC (K. Prince) was notified that samples were in the freezer and ready for analysis.

## Desert Tortoise Program

- ✓ ● Three tortoise mortalities were documented in April. A dead, unmarked tortoise was found on H-Road between Exile Hill and Roy Hill. The tortoise had been run over by a vehicle. This is the first incidental take for YMP. EG&G/EM (T. O'Farrell) contacted U.S. Fish and Wildlife Service on April 16. A report of the incident was sent to the Project Office. A marked tortoise (# 200) was found dead east of Exile Hill. The plastron was intact but only several pieces of the carapace remained. Predation by either a mammalian or avian predator is the suspected cause of death. This tortoise was originally radiomarked in 1991. The third mortality was tortoise # 518 located on the south end of Exile Hill. It appears that the tortoise also was killed by a predator.
- The tortoise (# 423) relocated from Midway Valley was monitored throughout the month after it was released from its burrow. During the month of April, the tortoise moved south from the relocation burrow crossed H-Road west of the Canyon Substation. The tortoise now is about 3.6 km from its release site and continuing to move south.
- Tortoises near the Midway Valley test pits and trenching activities were monitored during construction activity. No tortoises were displaced or relocated in April because of these activities.

- Radiomarked tortoises were located every week. Most tortoises were located twice each week. Two radiomarked tortoises are missing. The radio transmitters were changed on six tortoises (#'s 227, 558, 411, 503, 418, and 508). Five tortoises still have working transmitters that need replacing.
- Six new tortoises were found in April. One was radiomarked in the vicinity of the proposed South Portal facilities. Three tortoises were found in the control area. All three were marked, but only one (female) was radiomarked. One tortoise was found north of the Area 25 camp near the former landfill site. This tortoise was marked only. One tortoise was found in Drill Hole Wash during the Public Outreach tours on Saturday, April 25. This tortoise was radiomarked.
- An Impact Mitigation Study was started for the South Portal Exploratory Studies Facilities. Seventy-four ha had been searched by the end of April. Searches will continue in May. Only one tortoise has been found during the searches. This tortoise was radiomarked.
- Raven surveys were conducted at Yucca Mountain and in the control area northwest of Crater Flats. Each survey route was monitored on five different days. The raven nest on the Sample Management Facility was monitored. The nest contained seven eggs in early April. During the third week in April the nest contained six nestlings.

#### Support Items

- The March monthly report of Yucca Mountain Site Characterization Project activities and accomplishments was sent to the Project Office. Weekly reports of activities in April were submitted to the Project Office.
- EG&G/EM provided the following input at the Project Offices request; 1) Planning and Control System (PACS) financial information for FY93, 2) scopes of work for the new Work Breakdown Structure for Terrestrial Ecosystems, 3) list of environmental laws and regulations that direct or require ecosystem monitoring and reclamation, 4) input for the Annual Environmental Report, and 5) written response to comments by the State of Nevada on the Reclamation Implementation Plan and the Reclamation Feasibility Trials.
- EG&G/EM met with SAIC (G. McNeill) to discuss modifications to the Terrestrial Ecosystems display at the Field Operation Center.
- EG&G/EM attended a meeting with the Project Office, TRW and other YMP contractors to integrate needs and time requirements for obtaining environmental permits.

- EG&G/EM met with Project Office (W. Dixon, G. Ryder, and K. Grassmeier) for a mid-year financial and project status review.
- DOE/YMP approved the Yucca Mountain Biological Resources Monitoring Program FY91 Annual Report with minor changes requested. Changes were made, and the report was distributed.
- A description and slides were provided of the YMP Habitat Reclamation Program to SAIC (C. Binzer). The slides and text will be used for the YMP public update meetings in May to illustrate the establishment of the Forty-Mile Wash reclamation trial plots.
- EG&G/EM reviewed and updated the YMP Technical Database Parameter Dictionary for the Terrestrial Ecosystems component.
- EG&G/EM assisted with the Public Outreach tour on Saturday, April 25.



Lawrence Livermore National Laboratory

LLYMP9204087  
April 9, 1992

WBS 1.2.9  
QA: N/A

Carl Gertz, Project Manager  
Department of Energy  
Yucca Mountain Project Office  
P.O. Box 98518  
Las Vegas, Nevada 89193-8518

SUBJECT: Yucca Mountain Project Status Report - March 1992

Attached is the March Project Status Report for LLNL's participation in the Yucca Mountain Project.

If further information is required, please contact Elizabeth Campbell of my staff at FTS 532-7854.

Sincerely,

*Gertz (2)*  
*Boyer*  
*Strickland*  
*Law*  
*Johnson*  
*Bradsky*  
*Blanchard*  
*Dym*

*W. L. Clarke*  
W. L. Clarke  
LLNL Technical Project Officer  
for YMP

WC/EC

cc:  
Distribution

4-16-92 DISCLAIMER

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The LLNL Yucca Mountain Project 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.

LAWRENCE LIVERMORE NATIONAL LABORATORY YUCCA MOUNTAIN PROJECT  
MARCH 1992 TECHNICAL HIGHLIGHTS AND STATUS REPORT

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LAWRENCE LIVERMORE NATIONAL LABORATORY  
(LLNL)  
YUCCA MOUNTAIN PROJECT (YMP) STATUS REPORT

FEBRUARY 1992

EXECUTIVE SUMMARY

(Items Proposed for Reporting in YMPO or OGD Reports)

- 1) **WBS 1.2.1.3** Major restructuring of the sets of basis and auxiliary aqueous species used in EQ3/6 calculations was initiated. This restructuring will result in significantly improved flexibility with regard to the range of geochemical problems that can be addressed using the EQ3/6 modeling package.
- 2) **WBS 1.2.2.4** LLNL began a study of the internal temperatures of a large drift-emplaced waste package for a variety of thermal loadings and spent fuel ages.
- 3) **WBS 1.2.2.3** Samples of the fluids from the UO<sub>2</sub> leaching experiments were analyzed for colloids using the photon correlation spectrometer (PCS), and large (~1 - 10 μm) particles were observed. The nature of these particles will be examined using electron diffraction and imaging, and energy dispersive elemental analysis.
- 4) **WBS 1.2.2.2** R. Dyer visited LLNL on March 19 to discuss future workscope possibilities in WBS 1.2.3. These activities will characterize the impact of the waste package on the site (the altered zone). Waste Package Environment (WBS 1.2.2) activities will continue to assess the impact of the near field environment on the waste package.
- 5) **WBS 1.2.2.2** Hydrothermal calculations were conducted to determine the bulk permeability at which convection can dominate far-field heat flow. A transition to convection dominated behavior was observed in the bulk permeability range typical of the TSw<sub>2</sub> unit. Substantial boiling and rock dry-out benefits were evident for both conduction dominated and convection dominated cases. Future calculations will investigate the influence of the permeability distribution on repository dry-out; the distribution among the rock matrix, small fractures and large fractures, is expected to be much more important than the bulk value of the permeability.
- 6) **WBS 1.2.2.2** In situ heater tests have been proposed to evaluate the critical hypothesis that convection may dominate far-field heat flow in rock similar to the repository horizon. Calculations show that, ten years after emplacement, a 114 kW/acre repository with 60-yr-old fuel has a 25 m thick region with temperatures at or above boiling. If convection is strong (because permeability is increased in the calculation), the region shifts upward 7 m. These calculations are encouraging since they indicate that in situ heater tests will have an easily measurable result to determine if convection dominates far-field heat flow.

## 1.2.1 SYSTEMS

### 1.2.1.1 Management and Integration

LLNL staff provided input to the M&O for the 2001 budget and scheduling exercise.

The LLNL-YMP Software Quality Manager and the Lead Software Engineers and/or Principal Investigators conducted informal walkthroughs of the Individual Software Plans and Software Configuration Management Systems for the EQ3/6 geochemistry code family, GEMBOCHS geochemistry database control software, and PANDORA performance assessment code.

### 1.2.1.2 Systems Engineering

#### 1.2.1.2.4 Systems Engineering Implementation

T. Buscheck and J. Blink participated in the kickoff meeting in Las Vegas on March 20 for the thermal loading study being led by P. Gottlieb of M&O-Vienna. LLNL will be supporting M&O by conducting repository-heat-driven hydrothermal calculations and assisting in drafting a Phase I report on thermal strategies by the end of June. LLNL will also be conducting calculations and assisting in drafting Phase II of the thermal strategies report.

The February 1992 Interface Status Log Report was reviewed and the open Interface Memorandums of Understanding with LLNL were identified. These items are being evaluated with the responsible Technical Area Leader/Task Leader to determine the appropriate course of action to reach closure.

#### 1.2.1.2.6 YMP Support to Management Systems Improvement Strategy

No significant activities.

### 1.2.1.3 Technical Data Base Management

#### 1.2.1.3.5 Technical Data Base Input

Major restructuring of the sets of basis and auxiliary aqueous species used in EQ3/6 calculations was initiated. This restructuring will result in significantly improved flexibility with regard to the range of geochemical problems that can be addressed using the EQ3/6 modeling package.

Restoration was completed of GEMBOCHS and its software library to their pre-crash state. (This crash occurred during the President's weekend).

LLNL staff discussed a draft agenda and preparations for the Technical Data Workshop with representatives from the M&O and YMPO. Tentatively scheduled for April 30, the workshop will cover an overview of the YMP Technical Database and the evolution of its components, data tracking and the Data Dictionary.

## 1.2.1.4 Performance Assessment

### 1.2.1.4.2 Waste Package Performance Assessment

The merging of the PANDORA prototype and mainline versions was carried out and quantitative testing is in progress.

The Yucca Mountain Integrating Model (YMIM) is being extended to evaluate extended dry repository concept issues.

W. Halsey, W. O'Connell, J. Gansemer, R. Stout, and J. Blink attended a YMPO EBS Performance Assessment meeting in Las Vegas March 10-11. Presentations were given as follows:

- 1) "EBS-PA on a Budget: Models, Iterations, and Statistics" - W. Halsey
- 2) "What Does the Program Need from EBS-PA?" - W. Halsey
- 3) "PANDORA and Diffusion Model Status and Verification" - W. O'Connell
- 4) "Use of Probabilistic Distributions in Source Term Modeling" - W. O'Connell
- 5) "Achievements of SF Modeling in 1991 and SF Issues Affecting EBS/PA" - R. Stout
- 6) "Implications of the Modeling Program e.g., on Using Cladding, etc. as Additional Barriers" - R. Stout

The report entitled "Diffusion Releases Through One and Two Finite Planar Zones" by T. Ueng and W. O'Connell was expanded due to the technical reviewer's comments and is back in the technical review process.

W. O'Connell attended an EBS performance assessment meeting in Las Vegas on March 18.

W. Halsey participated in a National Academy of Sciences Partitioning and Transmutation meeting in Washington, D.C. on March 19-20.

### 1.2.1.4.5 Geochemical Modeling and Data Base Development

Effort is now focused on the technical review of the four EQ/6 user manuals recently completed and reported. The documents are also being reviewed from a software QA standpoint. Present plans call for completion of these reviews, final revision and publication by the end of FY92.

The EQ3/6 qualification activity is currently underway. This is being conducted independently of the code author. The code author is available for consultation.

Time was spent this month planning for the resumption of EQ3/6 code development. A memorandum concerning this subject is being prepared.

### 1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses

This WBS element has not been funded in FY92.

## 1.2.2 WASTE PACKAGE

### 1.2.2.1 Management and Integration

LLNL staff provided input to the M&O for the 2001 budget and scheduling exercise.

The LLNL-YMP Software Quality Manager and the Lead Software Engineer conducted an informal walkthrough of the Individual Software Plan and Software Configuration Management System for the V-TOUGH hydrology code.

W. Lin attended the Sample Overview Committee meeting on March 3 in the Sample Management Facility at NTS.

### 1.2.2.2 Waste Package Environment

R. Dyer visited LLNL on March 19 to discuss future workscope possibilities in WBS 1.2.3. These activities will characterize the impact of the waste package on the site (the altered zone). Waste Package Environment (WBS 1.2.2) activities will continue to assess the impact of the near field environment on the waste package.

The Preliminary Near Field Environment Report is completing internal review and resolution of comments in preparation for submittal to YMPO in mid-April.

T. Buscheck and A. Meike attended a meeting on March 25 which summarized the DOE-sponsored review of the natural barrier system and engineered barrier system work conducted during the Stripa Project.

#### 1.2.2.2.1 Chemical and Mineralogical Properties of the Waste Package Environment

B. Viani participated in the geochemistry core-team teleconference on March 23. A revised agenda for the hydrology-geochemistry meeting was discussed.

B. Glassley met with YMP staff in Las Vegas on March 27 to discuss plans for geochemistry and mineralogy modeling activities.

Work continued on planning for model validation activities.

#### 1.2.2.2.2 Hydrologic Properties of the Waste Package Environment

The feasibility study of using resonant cavity to measure relative humidity in rock samples continued. A prototype resonant cavity of about 1.0 cm in diameter and 2.29 cm in length was fabricated. This is the smallest size currently possible due to the frequency limitation of the network analyzer on hand. Testing and calibration measurements on the prototype resonant cavity will commence as soon as the network analyzer is calibrated.

The modification of the constant humidity chamber was completed so that feed-throughs can be installed. The feed-throughs are necessary for the calibration of the chamber itself and for measurements within the chamber, such as the calibration of

resonant cavity. The chamber will be calibrated when the humidity sensor of the LLNL calibration shop is calibrated and certified.

Eight discs of Topopah Spring Tuff sample from U3hg-1 hole, at a depth of 1312 feet, were prepared. These discs are 2.54 cm in diameter and about 0.6 cm thick. These discs will be used to measure the characteristic curves. Imbibition studies have been done on this rock before. The characteristic curve information will be added to the results of the previous imbibition study for the estimation of relative permeability of this rock. Although the sample is not from Yucca Mountain, the relative permeability and other hydrologic properties of this rock can be used for scoping model calibration and validation.

T. Buscheck continued repository-scale and drift-scale hydrothermal model calculations of repository-heat-driven hydrothermal flow with an emphasis on looking at conditions which may lead to heat convection-dominated far field heat flow. As noted last month, boiling and rock dry-out occur because the thermal loading conditions and heat conductance of the dry-out zone can carry heat to the boiling front faster than the far field can dissipate it. Therefore, heat convection-dominated heat flow in the far field tends to reduce boiling and dry-out benefits. In past analyses for 57 kW/acre and 30-yr-old fuel, it was found that for  $k_b < 10^{-11} \text{ m}^2$  (where  $k_b$  is the bulk permeability of the fractured rock mass), far-field heat flow is dominated by heat conduction. Recently, calculations were conducted for a range of  $k_b$  for 114 kW/acre and 60-yr-old fuel. For  $k_b$  between  $10^{-11}$  and  $10^{-10} \text{ m}^2$ , there is a transition from heat conduction-dominated to heat convection-dominated far field heatflow. Substantial boiling and rock dry-out benefits were evident even in the presence of significant far-field heat convection effects. Reduction of repository temperatures due to far-field heat convection was no stronger at the edge of the repository than at the center. The bulk permeability range studies is typical of that for TSw2. However, the distribution of permeability among the matrix, small fractures and larger fractures is far more important than the bulk permeability value; these issues will be investigated in future months.

S. Daveier translated a Fortran boundary element code into C. She also worked on the V-TOUGH User Manual and is in the process of collecting sample problems. She sent out the requirements and design document for the prototype V-TOUGH time-history generator for internal review. She added additional variable options to the prototype V-TOUGH time-history generator and she also added a color bar to color images produced by EXTOOL.EXVIEW.2.5.

L. Lin, T. Buscheck, J. Nitao and D. Wilder participated in the USGS tour of TSw2 on March 6 and 13. Discussions were held with USGS personnel on recent laboratory and field work at the Hydrological Laboratory Facility at Area 25.

#### 1.2.2.2.3 Mechanical Attributes of the Waste Package Environment

Study Plan 8.3.4.2.4.3, "Characterization of the Geomechanical Attributes of the Waste Package Environment", is at T&MSS. It is expected to be returned to the reviewers for comment resolution verification in mid-April.

S. Daveier continued to assist S. Blair in debugging a prototype geomechanical code.

#### 1.2.2.2.4 Engineered Barrier System (EBS) Field Tests

W. Lin, D. Wilder and J. Blink attended the prototype test planning meeting at Busted Butte, NTS, on March 13. , Blink attended a follow-up meeting in Las Vegas on March 17. Test planning information for LLNL prototype tests was submitted to LANL.

Analysis of potential prototype EBS field tests began. In order to investigate whether in situ heater testing (in rock which is similar to that in the repository horizon) is useful in evaluating the critical hypothesis that heat convection may dominant far-field repository heat flow, focus was centered on the temperature and saturation distributions during the first 10 years of the repository-scale calculations. Repository-scale calculations are used to investigate the impact of far-field heat convection because drift-scale calculations used periodic boundary conditions that constrain the size of convection cells. It was found that there were very striking differences in both the temperature and saturation distribution between cases with heat conduction-dominated and heat convection-dominated far-field heat flow.

When heat conduction dominates far-field heat flow, vapor flow is driven both vertically upwards and downwards from the boiling zone. Local boiling pressure gradients (which drive water vapor away from the boiling zone) tend to be more dominant than the buoyancy-driven pressure gradients which drive convection cells on the scale of the unsaturated zone (UZ). The result is that roughly equal quantities of water vapor are driven above and below the dry-out zone, resulting in roughly equal quantities of condensate above and below the dry-out zone.

When far-field heat convection dominates far field heatflow, the UZ-scale buoyancy-driven pressure gradients are more dominant than the local boiling pressure gradients. Therefore, although local boiling pressure gradients below the dry-out zone tend to drive vapor downwards, UZ-scale convection cells dominate vapor flow, resulting in water vapor being driven upwards. Consequently, nearly all of the water vapor is driven upwards where it condenses above the dry-out zone. Therefore, if far-field heat flow is dominated by heat convection, it would be expected that nearly all of the condensation would occur above the dry out-zone and that there would be a modest reduction in drift-wall temperatures. More notably, it would be expected that a reduction in the vertical extent of the boiling front would be reduced. For example, ten years after emplacement, a 114 kW/acre repository with 60-yr-old fuel has a 25 m thick region with temperatures at or above boiling. If convection is weak, the region extends from 12 m below to 13 m above the repository horizon. If convection is strong (because permeability is increased in the calculation), the region extends to 5 m below to 20 m above the repository horizon. These calculations are encouraging since they indicate that in situ heater tests will have an easily measurable result to determine if convection dominates far-field heat flow.

W. Lin completed GET training. He is certified to do YMP field work.

### 1.2.2.2.5 Characterization of the Effects of Man-Made Materials on Chemical & Mineralogical Changes in the Post-Environment

A proposed change to the Site Characterization Baseline was submitted for YMPO review. This change will split the Man-Made Materials part of Study Plan 8.3.4.2.4.1 (Characterize the Chemical and Mineralogical Changes in the Post-Environment) into a new Study Plan (8.3.4.2.4.5).

AP-5.28Q-QA grading was completed and submitted to the QRB for the Fundamental Materials Investigation Task of the USDOE/AECL Subsidiary Agreement (SA-2).

### 1.2.2.3 Waste Form and Materials Testing

#### 1.2.2.3.1 Waste Form

##### 1.2.2.3.1.1 Waste Form Testing - Spent Fuel

The Preliminary Waste Form Characterization Report was sent to YMPO for review on March 4. YMPO has elected to perform a limited QMP-06-04 review. Prior to approval and submission to the Reference Information Base (RIB). This submission will complete Milestone T360.

#### Spent Fuel Oxidation

The drybath tests continued without incident. The next scheduled interim examination begins March 30.

R. Stout and R. Einziger attended a YMPO EBS Performance Assessment meeting in Las Vegas March 10-11. They gave presentations on spent fuel testing and modeling activities, emphasizing the oxidation and dissolution work and spent fuel cladding as a barrier. L. Thomas and Einziger have been working on the fundamentals of an experimental plan to address the remaining questions regarding spent fuel oxidation.

Preliminary interpretation of low temperature (<200°C) spent fuel oxidation indicates that over a wide range of variables, the low temperature and first phase for the oxidation behavior of spent fuel appears to depend on the fuel type in only a transitory manner. Eventually, all the tested spent fuels attain a  $U_4O_{9+x}$  metastable plateau phase at O/M of 2.4. Based on higher temperature data gained in other programs, the time to transition through this metastable plateau seems to have an Arrhenius behavior. The importance of this  $U_4O_9$  lattice metastable state is that its phase transformation and volumetric contraction would not destroy the cladding. It is expected that eventually the fuel will continue to oxidize to a higher state that does have a significantly (~30%) lower density, but very little information is available to predict the time for this to occur over the domain of potential repository temperature histories. Waste form performance assessment implications of the fuel remaining in the metastable  $U_4O_{9+x}$  state necessitate the acquisition of data in the oxidation activities to determine the time-temperature domain when transition

from  $U_4O_{10}$  to higher oxidation phases occurs during decreasing temperature histories.

PNL provided input to LLNL for future planning for the spent fuel oxidation work.

#### Spent Fuel Dissolution

The flow through dissolution apparatus is being modified to prevent permeation loss of oxygen from the solutions and to allow on-line measurement of oxygen content. Measurements show that leaching solutions lost 90% of their dissolved oxygen by the time they contact the  $UO_2$  samples. This means that all the measurements were done at 1/10 the expected oxygen activity. The four atmospheric tests are being repeated. In principle, the existing measurements are still meaningful, but they did not include the highest values of oxygen concentration desired.

$UO_2$  sample cells are being redesigned to allow use of standard (available) stainless steel components should the present plastic cells prove deficient at higher temperatures.

Five of the ten planned tests at 1% to 10% of atmospheric oxygen fugacity have been started at PNL. However, the day to day uranium concentration in some tests is highly irregular. Start up of additional tests at reduced oxygen fugacities will be delayed until the cause of this problem is identified and corrected.

PNL provided input to LLNL on future planning for the spent fuel dissolution tasks.

A paper entitled "Parametric Study of LWR Spent Fuel Dissolution Kinetics" is in internal review. It was co-authored by W. Gray (PNL), H. Leider, and S. Steward, (LLNL). It will be submitted to the "Journal of Nuclear Materials". The  $UO_2$  data will be submitted separately to the SEPDB at a later date when the tests are completed.

Activity Plan D-20-53b "Flow-through Dissolution Tests on Spent Fuel" was updated.

#### **1.2.2.3.1.2 Waste Form Testing - Glass**

This WBS element has received limited funding in FY92. These funds are being used to maintain the N2 and N3 tests at ANL.

The N2 tests (SRL actinide-doped glass) continue with no sampling period occurring this month. These tests have been in progress for 316 weeks. The N3 tests (ATM-10, a West Valley actinide-doped glass) continue and have been in progress for 234 weeks.

### 1.2.2.3.2 Metal Barriers

J. Blink met with Professor D. Jones of UNR in Las Vegas on March 6 to discuss integration of UNR Cooperative Agreement work with the LLNL-YMP Metal Barriers work. Professor Jones is interested in working on microbiological induced corrosion (MIC) and plans to spend part of the summer at LLNL working on stress corrosion phenomena.

### 1.2.2.3.3 Other Materials

This WBS element has not been funded in FY92.

### 1.2.2.3.4 Integrated Testing

#### 1.2.2.3.4.1 Integrated Radionuclide Release

##### G-20-2 Determination of Elemental Profiles in Rocks, Minerals, and Glasses using the Ion Microscope

Samples of zeolite to be used for elemental depth-profiling studies have been collected and begun to be characterized by optical and x-ray techniques. Technical issues related to the measurement of elemental profiles for alkalis, alkaline earths, and uranium in zeolites and small particles have been identified. Reduction of previously collected elemental data continued.

Several samples of tuff-wafers that had previously been exposed to radionuclides were placed in contact with alpha-particle sensitive autoradiography paper in an attempt to identify the distribution and pathways of radionuclides on the millimeter scale. These samples are similar to those for which elemental profiles were measured using the ion-microscope. Exposure times on the order of one to two weeks have not resulted in any visible radiographic pattern. Longer exposures and "hotter" samples will be used.

##### G-20-3 Interactions of Actinide-bearing Solutions with Rock Core Samples

The flow testing of the flow-through system, which is designed to study the adsorption and hydrology of pore fluid with radionuclide tracers, was completed. The system was tested to 150°C. The system is shutdown so that the transducers can be calibrated along with the pressure-transmitting diaphragm. We expect that the calibration will be completed next month. Then the system will be assembled for flow-through experiments.

A more detailed scanning electron microscopic (SEM) analysis of the core sample to be used in the flow-through experiment was made with the SEM instrument in the Chemistry Department. This instrument is capable of higher spatial resolution and can be used to make elemental "dot maps". Elemental maps for iron and potassium revealed these elements to be localized and not distributed randomly over the fracture surfaces.

Samples of the fluids from the UO<sub>2</sub> leaching experiments were analyzed for colloids using the photon correlation spectrometer (PCS), and large (~1 - 10 μm) particles were observed. The nature of these particles will be examined using electron diffraction and imaging, and energy dispersive elemental analysis.

#### G-20-6 Source Term Development

The acid/base titrations of goethite in the presence of background electrolyte have been completed at elevated temperatures. The results indicate the goethite surface becomes more basic with increasing temperature.

##### **1.2.2.3.4.2 Thermodynamic Data Determination**

This WBS element has not been funded in FY92.

##### **1.2.2.3.5 Nonmetallic Barrier Concepts**

This WBS element has not been funded in FY92.

#### **1.2.2.4. Design, Fabrication, and Prototype Testing**

##### **1.2.2.4.1 Waste Package Design**

This WBS element has not been funded in FY92.

##### **1.2.2.4.2 Container Fabrication and Closure Development**

This WBS element has not been funded in FY92.

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

T. Doering visited LLNL on March 19 to meet with D. Ruffner and G. Johnson. G. Johnson is beginning a study of the internal temperatures of a large drift-emplaced waste package for a variety of thermal loadings and spent fuel ages.

#### **1.2.5 REGULATORY AND INSTITUTIONAL**

##### **1.2.5.2 Licensing**

###### **1.2.5.2.1 NRC Interaction Support**

T. Buscheck, R. Van Konynenburg and J. Blink attended the NRC Technical Exchange held in Albuquerque, NM on March 17-18. T. Buscheck presented a paper entitled "Modeling Repository-Heat-Driven Flow at Yucca Mountain".

###### **1.2.5.2.2 Site Characterization Program**

M. Revelli participated in the March 12-13 Integrated Test Evaluation (ITE) meeting in Las Vegas. The primary objectives for this meeting were to discuss and agree upon the scope of the evaluation and the ITE implementation plan.

As a result of the March 12-13 ITE meeting, an ITE subgroup met in Albuquerque, NM on March 19 to refine the list of technical issues and eliminate those not directly related to potentially unsuitable site conditions. M. Reveili represented LLNL at this meeting and will present the results to the ITE Core Team.

#### **1.2.5.2.4 Technical Support Documentation**

No significant activities.

#### **1.2.5.2.5 Study Plan Coordination**

S. Blair is reviewing Sandia National Laboratory Study Plan 8.3.1.15.1.4, "Laboratory Determination of Mechanical Properties of Fractures"

J. Nitao reviewed USGS Study Plan 8.3.1.2.2.2, Rev. 1, "Water Movement Test" and the Document Review Sheets were submitted to YMPO.

#### **1.2.5.2.6 Semi-Annual Progress Reports**

Guidance on the 6th Progress Report (PR) for reporting period October 1, 1991 through March 31, 1992 was received on March 10th. The report was submitted to YMPO on March 31.

### **1.2.9 PROJECT MANAGEMENT**

#### **1.2.9.1 Management and Integration**

##### **1.2.9.1.1 Management**

W. Clarke and J. Blink attended the TPO meeting in Las Vegas on March 6

J. Blink participated in the following:

- 1) served as a management reviewer for the Title II Design package 1-A, North Portal Area,
- 2) participated in the Determination of Importance & Grading Enhancement (DIGE) meeting in Las Vegas on March 12,
- 3) attended the UNLV Cooperative Agreement on March 24. He arranged for Professor J. Cardle to visit LLNL on April 23 to discuss integration of his work with LLNL hydrology work,
- 4) attended a YMP Safety Committee meeting in Las Vegas on March 12.
- 5) completed "New User" training on the YMP-LV vax cluster on March 31. He made be reached on E-mail as user BLINKJ, and
- 6) participated in the Boy Scout Atomic Energy Merit Badge Workshop at the YMIO on March 7.

Six Affected Document Notices (ADN) were completed and submitted to YMPO.

LLNL provided a copy of the Climax videotape to OCWRM at the request of G. McNeill.

#### 1.2.9.1.4 Records Management

Document Control issued five Change Notices and three new documents under controlled distribution. Routine follow-up for receipt acknowledgements continues.

A total of 224 items were logged into the LLNL-YMP tracking system. This includes 99 records/records packages that were processed through to the CRF. Four action items were closed.

B. Bryan attended a Project Office Records Workshop in Las Vegas on March 4-5.

#### 1.2.9.2 Project Control

The monthly actual costs for the February PACS database were submitted to YMPO. The FY94 Field Work Proposal for the Yucca Mountain and Atomic Energy of Canada Limited (AECL) projects was prepared.

The internal PACS database budgets were analyzed and reconciled with the YMPO database. The technical scopes were reviewed and modifications made as required. The Work Authorization sheets were processed and distributed to the Technical Area Leaders for review and signature.

The Independent Cost Estimate (ICE) team visited LLNL on March 25-26. Discussions were held regarding the detail of planning and methods for estimating labor requirements and total costs for the following WBS elements:

- 1) Chemistry and Mineralogic Properties of the Waste Package,
- 2) Hydrologic Properties of the Waste Package,
- 3) Engineered Barrier System Field Tests,
- 4) Waste Form - Spent Fuel, and
- 5) Metal Barriers.

LLNL provided the ICE team with extensive cost information including wage rates, indirect rates, subcontract estimates, and methods of calculating outyear budgets. Considerable effort was also expended to technically acquaint team members with the technical scope of areas being analyzed.

Responses were provided to several GAO inquiries.

W. Clarke, J. Blink and J. Podobnik attended a DOE/M&O briefing in Las Vegas detailing modifications to the 2001 planning process in Las Vegas on March 5. J. Blink was named as LLNL-YMP point of contact to provide cost and schedule information for activities through 2001. This effort is to culminate on April 20. Participants will then prepare a detailed, bottoms-up Long Range Plan. The objective is to have a current plan completed by early July. J. Blink and J. Podobnik participated in a follow-up meeting on March 30.

The LLNL response report for the January DOE/YMPO Property Management audit was completed. All findings have been resolved and most equipment has been located and placed within the control system. All NWF equipment is being tagged

with Property of Others - NWF" labels. This activity is about 60% complete. By mid-April, this activity will be reduced to routine maintenance, and the property management function will primarily be carried out by the LLNL Energy Program Property Center Representative. Three training sessions were provided for LLNL-YMP staff regarding the LLNL property management system and additional requirements imposed by NWF regulations. Sessions were held on March 12, 17 and 26.

J. Podobnik attended a Project Control Steering Committee meeting in Albuquerque, NM on March 20. Topics discussed included ICF review background and requirements, integration and planning out to 2001, and transition of tasks to the M.O. The charter was to include full voting membership to all major participants. The Steering committee also heard a progress report from the Training Subcommittee. J. Blink attended a Training Subcommittee meeting in Las Vegas on March 12.

Workscopes and budget projections for the LLNL Institutional Plan were completed.

### 1.2.9.3 Quality Assurance

Dean Wolfe has been hired by LLNL as the LLNL-YMP Quality Assurance Manager. He started work on March 23.

Internal Audit 92-04, Waste Form Characterization, was conducted on March 3 - 17.

Audit Report 92-03, "Near Field Environment Characterization", was completed and distributed on March 19. One Corrective Action Report was issued.

The Energy Program Leader was notified of the requirement for the annual Management Assessment to be performed in accordance with Quality Procedure 33-YMP-QP 23.

TIP-YM-12, "Electronic Record Keeping", was finalized and forwarded to Document Control for distribution.

Work continues on revisions of Quality Procedures 40 and 170.

R. Monks and D. Wolfe attended the ASME Committee on Nuclear Quality Assurance meeting in Denver, CO on March 30 - April 1.

## LLNL PROJECT STATUS REPORT DISTRIBUTION

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May 11, 1992

WBS 1.2.9  
QA: N/A

Carl Gertz, Project Manager  
Department of Energy  
Yucca Mountain Project Office  
P.O. Box 98518  
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SUBJECT: Yucca Mountain Project Status Report - April 1992

Attached is the April Project Status Report for LLNL's participation in the Yucca Mountain Project.

If further information is required, please contact Elizabeth Campbell of my staff at FTS 532-7854.

Sincerely,

*W. L. Clarke*  
*W. L. Clarke*  
W. L. Clarke  
LLNL Technical Project Officer  
for YMP

WC:FC

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DISCLAIMER

The LLNL Yucca Mountain Project 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.

ENCLOSURE 24

LAWRENCE LIVERMORE NATIONAL LABORATORY YUCCA MOUNTAIN PROJECT  
APRIL 1992 TECHNICAL HIGHLIGHTS AND STATUS REPORT  
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YUCCA MOUNTAIN PROJECT (YMP) STATUS REPORT

APRIL 1992

EXECUTIVE SUMMARY

(Items Proposed for Reporting in YMPO or OGD Reports)

1) **WBS 1.2.1.4.2** The merged prototype version of PANDORA was tested extensively. Two sets of previous applications were rerun: Working Group 2-1990 applications and high water flux scenarios run in April 1991 as part of a Sandia and LLNL application. Additional cases check performance within the wide range of input values which are of physical interest. Revised specifications were also completed for input data structures and solubility-based radionuclide release, with attention to code releasability and to generality and correctness for a wide range of input values.

2) **WBS 1.2.1.4.5** Planning of the development of Version 8.0 of EQ3/6 began. Several major new capabilities are being discussed, including pressure corrections, redox disequilibrium, and redox kinetics. Some thought has also been given to incorporation of surface chemistry models and their linkage to rate law models, as for redox processes and mineral dissolution and growth; these, however, may have to be put off to Version 9.0.

3) **WBS 1.2.2** The Preliminary Near Field Environment Report was sent to YMPO for review on April 27. YMPO has elected to perform a limited QMP 06-04 review prior to approval and submission to the Reference Information Base (RIB). Submission to the RIB will complete Milestone T359.

4) **WBS 1.2.2.3.1** A report entitled "Spent Fuel Acquisition Plan" is being prepared by the Materials Characterization Center for submission to LLNL for technical review. In this report, recommendations are made for fuels to be acquired for characterization as testing materials. The five fuel types suggested for the testing program are:

- 1) high burnup fuel (>60 MWd. kgM) with strong rim effect,
- 2) low fission gas release (<10%), high burnup fuel,
- 3) low fission gas release (<10%), low burnup fuel,
- 4) burnable poison fuel (5 to 8 wt %  $Gd_2O_3$ ) with relatively high burnup, and
- 5) high fission gas release BWR fuel.

## 1.2.1 SYSTEMS

### 1.2.1.1 Management and Integration

LLNL staff provided input to the M&O for the 2001 budget and schedule exercise.

#### 1.2.1.2.4 Systems Engineering Implementation

LLNL comments on the PNL draft report, "Incentives for Selection of Spent Fuel for Delivery to the Federal Radioactive Waste Management System - A Preliminary Analysis" were discussed and clarified with staff at the Battelle Washington office. This draft report is currently under revision in preparation for a peer review.

A meeting was held with P. Gottlieb, M&O in Las Vegas on April 14 with attendees B. Clarke, T. Buscheck, D. Ruffner and J. Blink. LLNL is supporting TRW by conducting repository-heat-driven hydrothermal calculations and providing technical assistance to support drafting the report "Systems Implications of Repository Thermal Loading, Phase I Analysis Methodology". LLNL will also be conducting calculations and assisting in drafting Phase II of that study.

T. Buscheck and D. Ruffner reviewed P. Gottlieb's draft paper entitled "Systems Implications of Repository Thermal Loading, Phase I Analysis Methodology".

#### 1.2.1.2.6 YMP Support to Management Systems Improvement Strategy

No significant activities.

### 1.2.1.3 Technical Data Base Management

#### 1.2.1.3.5 Technical Data Base Input

A review of the draft Parameter Screens that will be used as input for the YMP Parameter Dictionary is in progress.

The Technical Data Workshop with LLNL, YMP and M&O staff that was tentatively set for April 30 in Livermore has been postponed due to numerous scheduling conflicts. The meeting will be rescheduled later in May.

J. Blink attended the Technical Data Base Administrators meeting in Las Vegas on April 8.

### 1.2.1.4 Performance Assessment

#### 1.2.1.4.2 Waste Package Performance Assessment

The merged prototype version of PANDORA was tested extensively. Two sets of previous applications were rerun: Working Group 2-1990 applications and high water flux scenarios run in April 1991 as part of a Sandia and LLNL application. Additional cases check performance within the wide range of input values which are of physical interest. The revised specifications for input data structures and solubility-based radionuclide release were completed, with attention to code releasability and to generality and correctness for a wide range of input values. The software will next be modified to these specifications.

D. Chesnut presented a paper entitled "The Demands Placed on Waste Package Performance Testing and Modeling by Some General Results of Reliability Analysis", UCRL-JC-106758, at the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 12-16.

The paper by T. Ueng and W. O'Connell entitled "Diffusion Releases Through One and Two Finite Planar Zones" completed technical review and was submitted to YMPO on April 30.

The paper by W. O'Connell entitled "Simplified Source Term Model for Total System Performance Assessment" was submitted for LLNL-YMP technical review.

#### 1.2.1.4.5 Geochemical Modeling and Data Base Development

Work is continuing to plan the development of Version 8.0 of EQ3/6. Several major new capabilities are being discussed, including pressure corrections, redox disequilibrium, and redox kinetics. Some thought has also been given to incorporation of surface chemistry models and their linkage to rate law models, as for redox processes and mineral dissolution and growth; these, however, may have to be put off to Version 9.0.

The pressure corrections may be of considerable importance in the near future in order to deal with analyses of deep groundwaters and samples of waters from proposed natural analog studies. Currently, the effect of pressure on thermodynamic properties is fixed as a function of temperature: 1.013 bar (1 atm) up to 100°C and the steam/liquid water equilibrium pressure up to 300°C. Actual pressures in systems of interest may be higher by as much as 300 to 500 bars (hydrostatic pressure alone corresponds to a gradient of 100 bars/km). Pressure corrections require additional thermodynamic data for volume functions. A good deal of such data is presently in the GEMBOCHS relational data base, but is not passed on to EQ3/6.

A guideline was prepared documenting the rationale for the organization of chemical species and reactions in future versions of the EQ3/6 data files. The organization of the data file is very important to code usage, as the code utilizes reaction coefficients to define mass balance relations. Depending on how these reactions are written, the mass balance totals for chemical components may or may not correspond to the quantities reported by chemical analysts.

Major restructuring continued of the set of basis and auxiliary basis aqueous species used in EQ3/6 calculations. This restructuring will result in significantly improved flexibility with regard to the range of geochemical problems that can be addressed using the EQ3/6 modeling package.

DBAPP and D0OUT were used to generate a revised suite of thermodynamic datafiles (DATA0.[sup,nea,com,pit,hmw].R14) that support the EQ3/6 geochemical software package (version 7.0). These new datafiles were then piped through EQPT to generate the corresponding DATA1 suite, which was transferred to the Alliant FX/80 where it can be accessed by local users of EQ3/6.

On April 8, the document "The LLNL GEMBOCHS Database and Software Library: YMP-TDB Quarterly Report: First Quarter, 1992" was submitted to YMPO.

Extensive restructuring and modification of DBAPP continued. This update will expand the capabilities of the software to facilitate interactive review of all data in the data base, tighten access controls on user modification of data, and broaden the range of information that can be included in the data base.

Work began on the presentation by S. Lundeen entitled "Reverse/Re-engineering an Existing Database", to be presented at the conference "Ingres World '92" in Tarpon Springs, FL, May 17-21, 1992.

The Individual Software Plan (ISP) for DBAPP was modified in response to the LLNL-YMP Software Quality Manager's comments.

#### **1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses**

This WBS element has not been funded in FY92.

### **1.2.2 WASTE PACKAGE**

#### **1.2.2.1 Management and Integration**

LLNL staff provided input to the M&O for the 2001 budget and schedule exercise.

J. Blink and D. Wilder provided planning information to H. Kalia of the LANL Test Coordination office on tests appropriate for the proposed Yucca Mountain Test Facility.

J. Blink attended a North-South Working Group decision meeting on April 15 in Las Vegas.

D. Chesnut presented a paper entitled "Characterizing the Altered Zone at Yucca Mountain: The Beginning of a Testing Strategy", UCRL-JC-109231, at the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 12-16.

#### **1.2.2.2 Waste Package Environment**

The Preliminary Near Field Environment Report was sent to YMPO for review on April 27. YMPO has elected to perform a limited QMP 06-04 review prior to approval and submission to the Reference Information Base (RIB). Submission to the RIB will complete Milestone T359.

##### **1.2.2.2.1 Chemical and Mineralogical Properties of the Waste Package Environment**

W. Glassley participated in the Oklo Working Group meeting in Brussels, Belgium and meetings in Paris, France with Andra representatives, April 4-11. These meetings were called to explore possible sites for natural analog studies that may be useful for radionuclide and code validation activities.

A paper by W. Glassley and B. Christenson entitled "Water-Rock Interactions in New Zealand Hydrothermal Systems: Comparison of Some Simulated and Observed Geochemical Processes" was presented at the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 12-16. (This paper was funded by the New Zealand Division of Scientific and Industrial Research during W. Glassley's sabbatical).

A paper by B. Viani and C. Bruton entitled "Modeling Ion Exchange in Clinoptilolite Using the EQ3/6 Geochemical Modeling Code" completed technical review and was submitted on April 3. This paper will be submitted to the 7th International Symposium on Water Rock-Interaction to be held in Park City, UT on July 13-18, 1992.

A paper by B. Viani and C. Bruton entitled "Modeling Fluid-Rock Interaction at Yucca Mountain, Nevada: A Progress Report" was submitted for LLNL-YMP technical review.

#### **1.2.2.2 Hydrologic Properties of the Waste Package Environment**

The feasibility study of using a resonant cavity to measure relative humidity in laboratory rock samples continued. Calibration was completed of the prototype resonant cavity at 85°C and a range of relative humidity levels from 50% to almost 100%. The borrowed microwave source that was used in the calibration had to be returned. Calibration will continue at higher temperatures when the microwave source is again available.

Eight discs of Topopah Spring Tuff sample from U3hg-1 hole, at a depth of 1312 feet, were prepared. The discs are 2.54 cm in diameter and about 0.6 cm thick. These discs will be used to measure the characteristic curves. Imbibition studies have been done on this rock before. The characteristic curve information will be added to the results of the previous imbibition study for the estimation of relative permeability of this rock. Although the sample is from Area 3, far away from Yucca Mountain, the relative permeability and other hydrologic properties of this rock can be used for model validation. The porosities of these samples were determined. Then, the discs were saturated with water. When saturated, these samples will be put in a constant humidity chamber for measuring the characteristic curves during draining.

J. Nitao attended an INTRAVAL meeting at the YMP Hydrology Laboratory at Area 25 of the Nevada Test Site on April 7 to discuss the Yucca Mountain model test case of the transect between neutron boreholes USW-N54 and USW-N55. Plans are to develop several alternative conceptual models of the hydrologic system in the vicinity of the transect, including the welded Tiva Canyon (TCw) unit, the various subunits of the nonwelded vitric Paintbrush tuff (PTn), and the upper welded Topopah Spring (TSw1) unit. The related numerical modeling study will include various combinations of nonequilibrium fracture-matrix models and equivalent continuum models in order to analyze the impact of episodic nonequilibrium flow and steady-state matrix-dominated flow. The impact of the geothermal gradient and vapor movement will be investigated with nonisothermal models. Because the critical dimensionality of the system does not coincide with the transect between USW-N54 and USW-N55, the site-specific models will be augmented with an

analysis of the mechanisms affecting the moisture balance in the vicinity of the transect.

J. Nitao extracted the liquid and gas velocity fields from long-term hydrothermal calculations of the repository in order for W. Glassley to calculate Damkohler numbers which indicate whether the assumption of local geochemical equilibrium is valid.

S. Daveler has added the capability of plotting numerical gridblock meshes to EXTOOL.XVIEW.2.9. She also added a color setting option to the addlines file of EXTOOL.XVIEW.2.11. This capability can now specify the linestyle for plotting gridblock meshes.

A paper by T. Buscheck and J. Nitao entitled "The Impact of Thermal Loading on Repository Performance at Yucca Mountain", UCRL-JC-109232, was presented at the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 12-16.

A paper by J. Nitao entitled "The Implications of Episodic Nonequilibrium Fracture-Matrix Flow on Site Suitability and Total System Performance", UCRL-JC-109216, was presented at the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 12-16.

Professor J. Cardle of UNR visited LLNL on April 23 to discuss possible collaboration efforts on modeling.

#### **1.2.2.2.3 Mechanical Attributes of the Waste Package Environment**

Study Plan 8.3.4.2.4.3, "Characterization of the Geomechanical Attributes of the Waste Package Environment", was sent by the M&O to the YMPO reviewers for comment resolution verification.

S. Daveler continued to assist S. Blair in developing a prototype version of the ASTOOL geomechanical code which is a statistical model for predicting crack growth behavior in fractured rock. This modeling capability will eventually be combined with our hydrothermal models to investigate repository-heat-driven alteration of the fracture properties of the altered zone. She has added postscript capability to ASTOOL's graphics postprocessor.

#### **1.2.2.2.4 Engineered Barrier System (EBS) Field Tests**

D. Wilder was the Chairman for the Probabilistic Risk Assessment in Waste Processing session at the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 12-16.

The PACS logic network for EBS Field Tests was revised to be consistent with the M&O's proposed accelerated ESF schedule.

### 1.2.2.2.5 Characterization of the Effects of Man-Made Materials on Chemical & Mineralogical Changes in the Post-Emplacement Environment

The YMPO-level QA grading report for the AECL-DOE SA-2 work on Fundamental Materials Investigations was accepted by the QRB. No QA controls are required.

### 1.2.2.3 Waste Form and Materials Testing

#### 1.2.2.3.1 Waste Form

##### 1.2.2.3.1.1 Waste Form Testing - Spent Fuel

###### Spent Fuel Oxidation

An interim examination of the spent fuel in the dry baths at PNL was conducted. There were no unusual results. There was no indication of excessive weight gain indicating formation of the next phase change above  $U_4O_9$ .

As part of the oxidation investigations, issues are being considered that might have been overlooked and which would affect the data interpretation. There is a possibility that higher oxides might be forming on the surface of the fuel grains, and the new phase might be falling off the grains in powder form. Since only individual spent fuel grains from each dry bath crucible are examined, any powders falling off the grains into the bottom of the crucibles would be missed and the data interpretation would be incorrect. The entire contents of one of the crucibles containing fragments with O/M-2.4 was examined. No powder was observed in the crucible, putting this concern to rest.

A paper by R. Einziger, L. Thomas, H. Buchanan (all of PNL) and R. Stout entitled "Ceramographic Determination of Spent Fuel Oxidation Rate" was presented at the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 14-16.

###### Spent Fuel Dissolution

Work to repeat the  $UO_2$  dissolution measurements at high oxygen activity is proceeding at LLNL. In earlier work, low oxygen levels due to permeation loss made the oxygen activity uncertain. Some reassurance tests at lower oxygen levels will also be done.

The inconsistent spent fuel test results reported last month from PNL were found to be caused by loose end fittings on the flow-through columns. This apparently resulted from reuse of columns that had been used in previous tests. The end fittings were not sufficiently tightened in the hot cell after new spent fuel specimens were installed. Use of new columns that allow pretightening of the end fittings outside the hot cell should eliminate the problem. New spent fuel specimens will be installed in new columns, and testing at reduced oxygen fugacities will be restarted.

Colloid distribution was measured using photon correlation spectroscopy at ANL. Several different types of observations were made. First, measurements on the nonreacted EJ-13 water injected into the system detected colloids. Secondly, the results show that the laser scattering measurements are reproducible for duplicate aliquots. Third, since the mean size and size distribution did not change significantly over a month after the aliquots were taken, the colloids seem to be stable. Fourth, the results show that the colloids in EJ-13 water have a different size distribution than those found in the solution from unirradiated  $UO_2$ .

A paper by W. Gray, L. Thomas and R. Einziger (all of PNL) entitled "Dissolution Rates of As-Received and Partially Oxidized Spent Fuel" was presented at the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 14-16.

The paper by D. J. Wronkiewicz, J. K. Bates, T. J. Gerding and E. Veleckis (all of ANL) entitled "Uranium Release and Secondary Phase Formation During Unsaturated Testing of  $UO_2$  at 90°C" was submitted to YMPO on April 2. It will be published in a special issue of "The Journal of Nuclear Materials" upon approval. (This paper was previously entitled "Leaching Patterns and Alteration Phase Production by Unsaturated Testing of  $UO_2$ ").

The paper entitled "Parametric Study of LWR Spent Fuel Dissolution Kinetics" by W. Gray (PNL), H. Leider, and S. Steward was submitted to YMPO on April 27.

#### Material Characterization Center (MCC) Support

A report entitled "Spent Fuel Acquisition Plan" is being prepared for submission to LLNL for technical review. In this report, recommendations are made for fuels to be acquired for characterization as testing materials. The five fuel types suggested for the testing program are:

- 1) high burnup fuel (>60 MWd/kgM) with strong rim effect,
- 2) low fission gas release (<10%), high burnup fuel,
- 3) low fission gas release (<10%), low burnup fuel,
- 4) burnable poison fuel (5 to 8 wt%  $Gd_2O_3$ ) with relatively high burnup, and
- 5) high fission gas release BWR fuel.

The report has been delayed as there has been some difficulty defining what constitutes a high burnup fuel. The data suggest that burnup has little effect on the oxidation processes of spent fuel, but this has not been confirmed for a high burnup fuel (>60 MWd/kgM).

It might be thought that one only needs to obtain a fuel of this burnup and then test it. However, when fuels are allowed to achieve higher burnups, microstructure reorientation (rim effect) can occur. This restructuring may effect oxidation kinetics. However, it may not be possible to identify any fuels which would have sufficient restructuring to allow systematic evaluation of this effect. Also, a review of the current literature data has not shown that there is a correlation between burnup and the amount of restructuring that may occur. This is contrary to the popular belief that higher burnup will equate to more restructuring.

Work is continuing to resolve this issue and still publish this report in a timely manner. It may be decided to release the report with this particular issue remaining open for future discussions.

#### Increased MCC Hot Cell Costs

The funds allocated (\$80K) by YMPO in FY92 for maintenance of the MCC hot cells will be insufficient to meet obligations. The budget is similar in size to that spent in FY91. However, with the increased regulatory requirements and consequent cost increases during FY92, it is estimated that there will be an overrun of about \$56K. A letter requesting the additional funds is currently being drafted and will be sent to YMPO in early May.

#### **1.2.2.3.1.2 Waste Form Testing - Glass**

This WBS element has received limited funding in FY92. These funds are being used to maintain the N2 and N3 tests at ANL. The N2 tests (SRL actinide-doped glass) continue with no sampling period occurring this month. These tests have been in progress for 320 weeks. The N3 tests (ATM-10, a West Valley actinide-doped glass) continue and have been in progress for 238 weeks.

Work continued on the analyses of glasses that have been reacted in water vapor (100% RH) at 75°C for time periods up to three years.

#### **1.2.2.3.2 Metal Barriers**

This WBS element has received limited funding in FY92. No significant activities.

#### **1.2.2.3.3 Other Materials**

This WBS element has not been funded in FY92.

#### **1.2.2.3.4 Integrated Testing**

##### **1.2.2.3.4.1 Integrated Radionuclide Release**

B. Viani participated in the geochemistry core-team teleconference on April 26. The agenda for the geochemistry integration meeting to be held June 9-11 was finalized. The meeting will focus on hydrology and geochemistry.

QA grading of Activities G-20-3 and G-20-5 was initiated.

#### G-20-2 Determination of Elemental Profiles in Rocks, Minerals, and Glasses using the Ion Microscope

Additional autoradiography on tufts has not shown any observable radiographic patterns.

### G-20-3 Interactions of Actinide-bearing Solutions with Rock Core Samples

The testing and calibration of the flow-through system continued. This system is designed to study the adsorption and hydrology of pore fluid with radionuclide tracers. The calibration of the transducers along with the pressure-transmitting diaphragm was completed. The system is being assembled so that it can be transported to Bldg. 281, where the flow-through experiments will be conducted.

Scanning Electron Microscopy (SEM) analysis of the core samples to be used in the flow-through apparatus continued.

Preliminary Transmission Electron Microscopy (TEM) analysis of the particles in fluids from the UO<sub>2</sub> leaching experiment indicated that some of these particles may be contaminants. Work is continuing on identifying the source of contamination.

### G-20-6 Source Term Development

Work has begun on measurement of the adsorption of uranyl ions on hematite at elevated temperatures.

#### **1.2.2.3.4.2 Thermodynamic Data Determination**

This WBS element has not been funded in FY92.

#### **1.2.2.3.5 Nonmetallic Barrier Concepts**

A summary of prior work was prepared and submitted to YMPO and the M&O. This WBS element has not been funded in FY92. Resumption of work in FY93 has been proposed.

### **1.2.2.4. Design, Fabrication, and Prototype Testing**

#### **1.2.2.4.1 Waste Package Design**

This WBS element has not been funded in FY92.

#### **1.2.2.4.2 Container Fabrication and Closure Development**

This WBS element has not been funded in FY92.

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

A thermal analysis is being done to evaluate drift emplaced robust waste emplacement with areal power densities up to 114 kW/acre with 60 year old fuel. The model is complete and the first validation runs are in process.

J. Podobnik and J. Blink attended a meeting with the Engineering and Development Division Director, the Field Engineering Branch Chief, and M&O representatives to discuss waste package strategy and LLNL responsibilities.

## 1.2.5 REGULATORY AND INSTITUTIONAL

### 1.2.5.2 Licensing

#### 1.2.5.2.1 NRC Interaction Support

W. Halsey and A. MacIntyre attended the NRC Technical Exchange on Scenario Development meeting in Albuquerque, NM on April 28-29.

#### 1.2.5.2.2 Site Characterization Program

M. Revelli was named as LLNL's representative to the Integrated Test Evaluation (ITE) task and has completed the training required by YMPO to support this effort. He participated in the April 3, 4 and 21st ITE meetings in Las Vegas to:

- 1) identify the tests and evaluation criteria, and
- 2) develop definitions for the technical issues.

Work is also in progress to begin the study plan screening process.

#### 1.2.5.2.4 Technical Support Documentation

No significant activities.

#### 1.2.5.2.5 Study Plan Coordination

S. Blair completed the review of Sandia National Laboratory Study Plan 8.3.1.15.1.4, "Laboratory Determination of Mechanical Properties of Fractures".

Internal review by the Near Field Environment staff has been initiated for the Lawrence Berkeley Laboratory report on "A Review of Rainier Mesa Tunnel and Borehole Data and Their Possible Implications to Yucca Mountain Site Study Plans".

#### 1.2.5.2.6 Semi-Annual Progress Reports

No significant activities

## 1.2.9 PROJECT MANAGEMENT

### 1.2.9.1 Management and Integration

#### 1.2.9.1.1 Management

Eight LLNL-YMP employees visited Area 25 on April 22. J. Blink and T. McCarthy were guides.

J. Blink attended the YMPO Safety Committee meeting in Las Vegas on April 2.

W. Clarke, D. Wolfe and J. Blink attended TPO meeting in Las Vegas on April 10.

W. Clarke, J. Blink, D. Kurrner, W. Lin, R. van Noyenbourg, D. Wolfe and E. Campbell attended the 3rd International High Level Radioactive Waste Conference held in Las Vegas, NV on April 12-16.

J. Blink briefed C. Gertz on the LESSON program to train elementary school teachers on science education.

#### 1.2.9.1.4 Records Management

Document Control issued five Change Notices and three new documents under controlled distribution. Routine follow-up for receipt acknowledgements continues.

A total of 184 items were logged into the LLNL-YMP tracking system. This includes 63 records/records packages that were processed through to the CRF. One action item was closed.

#### 1.2.9.2 Project Control

The PACS actual cost and schedule data and the FTE Report for the period ending March 31, 1992 were submitted to YMPO. The PACS variance analysis for the quarter ending March 31, 1992 was submitted to YMPO. A listing of LLNL 1.2.9 FTEs and description of responsibilities was provided to YMPO on April 30.

The cost computation worksheets were developed and submitted to the Independent Cost Estimate (ICE) team for the Waste Form Characterization, Metal Barriers and Near Field Environment technical areas. Also transmitted were additional Activity Plans and Study Plans for areas being examined by the ICE Team.

W. Clarke, J. Podobnik and P. Comstock attended the GAO audit exit conference held at LLNL on April 21. The following three audit findings were discussed:

- 1) appropriateness of assessing LLNL IR&D taxes on NWF funds;
- 2) proportion of management and administrative funds as compared to technical/research funds and
- 3) frequency of sole source procurements.

Documentation was prepared to sell excess NWF equipment as previously authorized by DOE-YMPO Property Management. The last property management training session for YMP/NWF participants was held on April 30. All personnel working on projects funded by NWF have now received formal training on property management procedures.

J. Podobnik and J. Blink attended a kick-off meeting for Mission 2001 planning effort on April 23 in Las Vegas.

J. Podobnik attended the YMPO Project Control Steering Committee meeting in Albuquerque, NM on April 24. Topics discussed included ICE Review background and requirements; integration and planning of the project out to 2001; PACS workstation progress; FY93 budgets; additional workscope for the steering

committee in 1995 project planning, budgeting and monitoring procedures, subcommittee roles; and transition of tasks to the M&O.

### 1.2.9.3 Quality Assurance

Internal Audit 92-05, Training and Qualification of Personnel/Review of Technical Publications, was conducted in April. R. Constable of DOE-Las Vegas attended the audit as an observer.

External Audit 92-11, LLNL-Mechanical Engineering/Engineering Measurements and Analysis Calibration Laboratory, was conducted on April 6-8. Three CARs were issued.

Audit Report 92-04, LLNL Waste Form Characterization, was distributed. Three CARs were issued.

Closure notifications of Corrective Action Report CAR-LLNL-006 and Adverse Finding Report AFR-LLNL-017 were transmitted to YMPO. Corrective action for these reports has now been completed and verified.

Activity Plan D-20-53b-0-3 Change Notice, Flow Through Dissolution Tests on UO<sub>2</sub>, was finalized and distributed on April 3.

Quality Procedure Change Notice 16-2-2, Organization, was completed and distributed.

LLNL QA Procedure 4.0 - Procurement was revised; the effective date will be in May.

D. Wolfe attended a "Determination of Importance and Grading Enhancement Workshop" meeting in Las Vegas on April 24.

## LLNL PROJECT STATUS REPORT DISTRIBUTION

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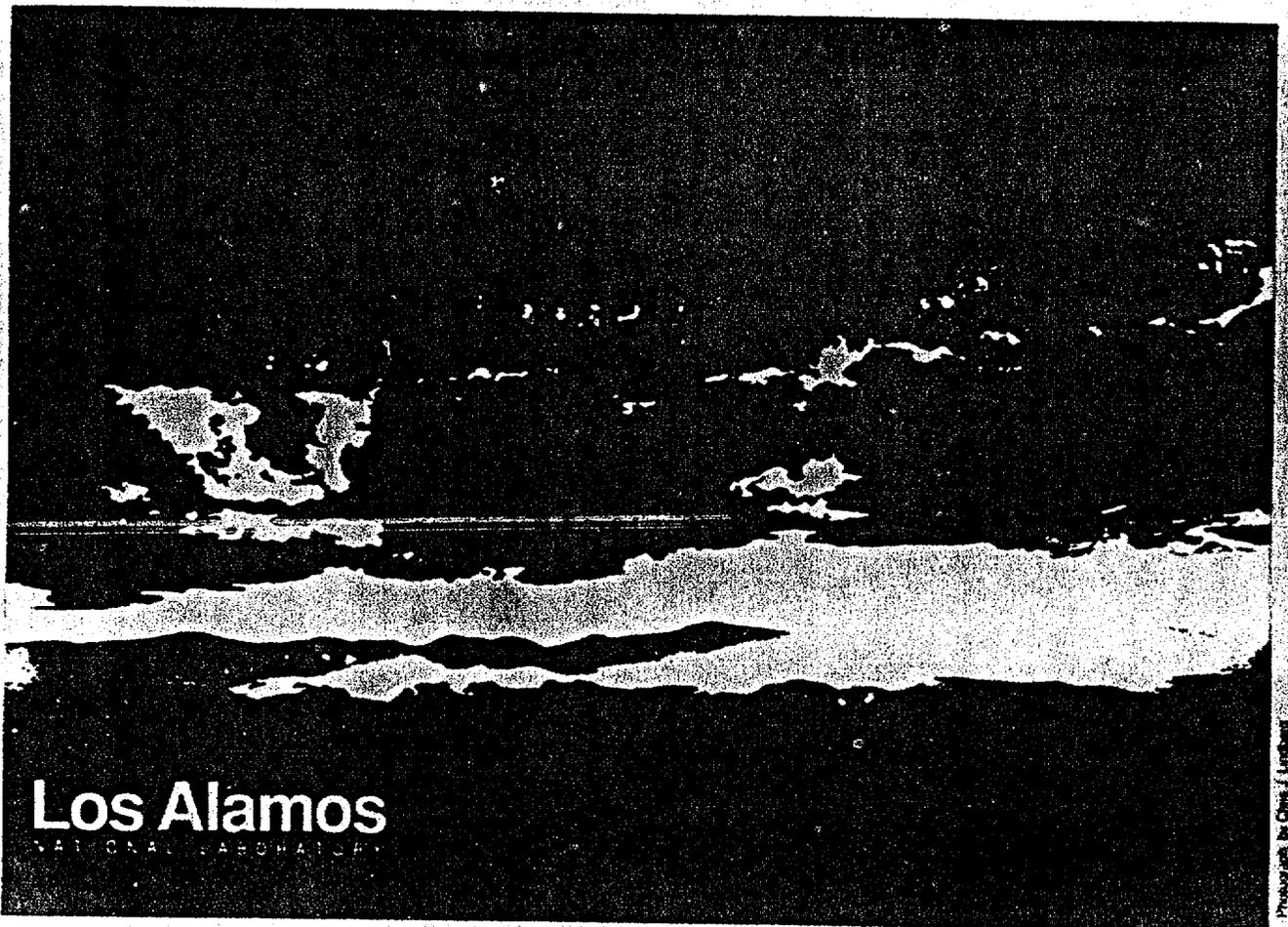
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*Yucca Mountain  
Site Characterization Project*

*Monthly Activity Report*

*February 1992*



*Attachment to TWS-EES-13-04-92-089*

This document has not received formal technical or policy review by Los Alamos National Laboratory or by the Yucca Mountain Site Characterization Project. Data presented in this report represent work progress and are not intended for release from the US Department of Energy.

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**Planned Activities**      Travel to SNL to discuss the lower-boundary condition with SNL staff.  
Prepare caisson for filling with sand.  
Continue standard operating procedure to prepare for caisson experiment.  
Continue writing paper for special issue of *Radioactive Waste Management*.

**Publications**            E. P. Springer and M. D. Siegel  
*An Integrated Intermediate-Scale Caisson Experiment to Validate Models of Fluid Flow and Contaminant Transport in the Unsaturated Zone*  
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle, Special issue on the Yucca Mountain Project*  
In preparation.

**Performance Assessment Computational Support (WBS 1.2.1.4.7)**

**Activities and Accomplishments**      No activity to report.

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## WBS 1.2.3.1 Site Management and Integration

### Site Management (WBS 1.2.3.1.1)

<b>Objective</b>	The objective of this task is to manage and integrate site characterization activities.
<b>Activities and Accomplishments</b>	A charter for the Radionuclide Solubility Working Group was written. For further information, see Appendix.
<b>Publications</b>	<p>J. A. Canepa  <i>Strategy for Testing the Applicability and Validity of Radionuclide Transport Models for Yucca Mountain, Nevada</i>            Conference Paper, Migration '91, Jerez de la Frontera, Spain, 14-18 October 1991            In revision.</p> <p>A. M. Simmons and J. A. Canepa  <i>Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, Nevada</i>            Conference Paper, Waste Management '92 Symposium            In preparation.</p>

### Surface-Based Test Management and Integration (WBS 1.2.3.1.1.)

<b>Objective</b>	The goal of this investigation is to provide coordination for Los Alamos surface-based test planning package development.
<b>Activities and Accomplishments</b>	The test planning package for UZ-16 in support of the Water Movement Tracer Tests (Study Plan 8.3.1.2.2.2 under the Site Characterization Plan Geohydrology Program) was approved for implementation. Wrote requirements letter requesting space for the Field Operations Center.
<b>Planned Activities</b>	Complete the job package and drilling start for the UZ-16.

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## WBS 1.2.3.2.1.1.1 Mineralogy, Petrology, and Rock Chemistry of Transport Pathways

**Objective** The purpose of this activity is to define the important mineralogic and geochemical variables along fracture and rock-matrix transport pathways at Yucca Mountain, in support of performance assessment and to evaluate the impact of repository construction on natural waste-transport barriers.

**Activities and Accomplishments** Participated in internal audit 3-21 February.

Fracture mineralogy efforts focused on writing a draft of journal article on fracture-lining manganese minerals at Yucca Mountain (Milestone 3123).

D. Broxton guided a field trip to Busted Butte at the Nevada Test Site on 28 February at which he presented information about a database of mineralogic, chemical, and petrographic information that might be used for locating adits at Busted Butte and other surface sites around Yucca Mountain.

To obtain additional information about mineralogy of rocks and fractures at depths greater than 200 feet below the water table, participants in the surface-based testing plan have been asked to deepen target depths for several future SD, UZ, and WT holes.

Cuttings from drill hole USW H-5 were analyzed by quantitative x-ray diffraction (XRD) methods. The results of these studies will extend our knowledge of mineral distributions beneath the northwestern part of the exploration block at Yucca Mountain.

**Planned Activities** During the next few months we will (1) continue analysis of Mn-oxide fracture fillings in the Crater Flat and Paintbrush tuffs to determine their distribution and factors controlling that distribution; (2) complete paper on Mn-oxides for publication in a refereed journal; (3) continue analysis of calcites to understand transport and precipitation mechanisms; and (4) determine quantitative mineralogy from XRD data for Milestone 3137.

A new microdiffractometer (purchased for another program) is expected to arrive next month and will be used to analyze many fracture-coating minerals that occur in small patches rather than continuous coatings. As soon as the journal article (3123) on Mn-oxides is completed, work will resume on fracture coatings in the Topopah Spring Member.

**Problem Areas** None

**Milestones** 3120  
29 May 1992  
*Calcite in the Upper Paintbrush Tuff*  
35% complete.

3123  
2 March 1992  
*Mn Fracture Minerals at Yucca Mountain*  
Undergoing extensive revision.

Continued on next page

3130

17 August 1992

*Fracture Mineralogy of the Paintbrush Tuff*

3137

30 September 1992

*Mineralogy of Calico Hills for Adit Development*

75% complete

**Publications**

D. Bish and S. Chipera

*Detection of Trace Clays and Clay Minerals Amounts of Erionite Using X-ray Powder Diffraction: Erionite in Tuffs of Yucca Mountain, Nevada, and Central Turkey*Journal article, *Clay and Clay Minerals*

Published.

D. E. Broxton

*Chemical Changes Associated with Zeolitization on the Tuffaceous Beds of Calico Hills at Yucca Mountain, Nevada*Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992

In YMPO review.

B. Carlos, D. Bish, and S. Chipera

*Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff*Journal article, *Chemical Geology*

Undergoing extensive revision.

G. D. Guthrie, D. L. Bish, and B. T. Mossman

*Quantitative Analysis of Zeolite-Bearing Dusts Using the Rietveld Method*Journal article, Submitted to *Science*

D. Vaniman, D. Bish, D. Broxton, B. Carlos, S. Chipera, and S. Levy

*Mineralogy as a Factor in Radioactive Waste Transport Through Pyroclastic Rocks at Yucca Mountain, Nevada*Journal article, *J. Geophys. Res.*

Draft complete; may be revised for a different journal.

February 1992

## WBS 1.2.3.2.1.1.2 Mineralogical and Geochemical Alteration

### Objective

The objective of this task is to characterize past and present natural alteration processes that have affected the potential geologic repository and to predict future effects of natural and repository-induced alteration.

### Activities and Accomplishments

G. WoldeGabriel completed mineral separations, weighing, and sample packaging in preparation for K/Ar analysis at Case Western Reserve University in March and sent samples to Case Western Reserve for preparatory degassing.

We received a new supply of Topopah Spring lower-vitrophyre core from the USGS, which will be characterized and used for steam-atmosphere experiments. Long-term zeolite heating experiments continued.

D. Vaniman processed root samples from Trench 14 in a low-temperature asher to obtain mineral residues. Mineralogy and chemistry of the residues will be determined in order to constrain the role of roots in generating calcite-silica deposits.

S. Levy is examining surface deposit samples for possible hydrothermal origin. They include concretions, fault deposits, breccias, fracture fillings, and altered tuffs.

Several quality assurance procedures were revised.

### Planned Activities

S. Levy and B. Rundberg will examine outcrop sites of the Topopah Spring candidate host rock for possible sources of fractured blocks to be used in laboratory studies. S. Levy will work with USGS to map the deepened portion of Trench 14 and will revisit sample collection sites to study surface alteration.

G. WoldeGabriel will travel to Case Western Reserve University to conduct K/Ar analyses of secondary mineral separates from altered rocks in the Yucca Mountain area and other nearby locations.

### Problem Areas

None

### Milestone Progress

3138  
30 October 1992  
*Chemical Transport in Zeolitic Alteration*

3141  
31 March 1992  
*Laminated Zone in Trench 14*

3142  
3 April 1992  
*K/Ar Dating of Clays and Zeolites*  
Research continuing; new draft in preparation.

3143  
15 January 1992  
*Experimental Dehydration of Volcanic Glasses*  
Interim draft complete.

Continued on next page

Publications

G. WoldeGabriel, *et. al*

*Preliminary Assessment of Clinoptilolite K/Ar Results from Yucca Mountain, Nevada: a Potential High-Level Radioactive Waste Repository Site*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
In YMPO review.

S. Levy and C. Naeser

*Bedrock Breccias Along Fault Zones near Yucca Mountain, Nevada*

Chapter in USGS Bulletin on Yucca Mountain studies  
In USGS editorial review.

S. Levy

*Natural Gels in the Yucca Mountain Area, Nevada, USA*

Conference paper, European Materials Research Society Symposium  
Approved by YMPO.

D. Vaniman, D. Bish, and S. Chipera

*Dehydration and Rehydration of a Tuff Vitrophyre*

Journal article, *J. Geophys. Res.*

Interim draft complete.

D. Vaniman, *et. al*

*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
In YMPO review.

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### **WBS 1.2.3.2.1.2 Stability of Minerals and Gases**

**Objective**

The objective of this activity is to produce a model for past and future mineral alteration in Yucca Mountain. The model is intended to explain the natural mineral evolution resulting from the transformation of metastable mineral assemblages to more stable assemblages and the effects of a repository emplacement.

**Activities and Accomplishments**

This activity has been deferred.

---

### WBS 1.2.3.2.5 Postclosure Tectonics

**Objective** The objective of these volcanism studies is to determine the hazards of future volcanic activities with respect to siting a high-level radioactive waste repository at Yucca Mountain.

**Activities and Accomplishments**

We evaluated the K-Ar and  $^{40}\text{Ar}/^{39}\text{Ar}$  database for the Lathrop Wells volcanic center and found that both data sets are positively skewed, with mean larger than median. Both data sets also contain outliers that are greater than 1.5 times the interquartile range. Removing the outliers reduces, but does not eliminate, the positive skewness; including the outliers greatly modifies the weighted mean and associated error. Regression plots of the  $^{40}\text{Ar}/^{39}\text{Ar}$  data have influential cases that control the slope and y-intercept of the regression plots; they should be examined for errors or suitability to the data set.

A poster session was prepared for the Waste92 meeting in Tucson next month. We have developed tables showing the recurrence rate of volcanic vents and the probability of repository disruption, using a range of alternative models for both attributes. Mean values of the two-part probability of  $\text{Pr}(E2 \text{ given } E1)\text{Pr}(E1)$  where  $E1$  is the recurrence rate and  $E2$  is the disruption probability are less than  $10^{-6}$  per year. A formal conservative value of the two-part probability has not been established. However, if the probability of  $E3$  ( $\text{Pr}(E3)$ ) is less than 1, volcanism cannot be judged as a significant licensing issue based on the criteria established in 40 CFR 191, Appendix B.

Aerial photographs and digitized data for volcanic centers were ordered through EG&G.

A talk on volcanism was presented to a Nevada legislative group.

Volcanism staff participated in the DOE/HQ and M&C tours of Yucca Mountain.

We revised a detailed technical procedure, DP-605, "Preparation of powders from rock, cinder and ash samples."

We obtained and processed digitized data on the locations of basaltic volcanic vents in the San Francisco volcanic field using data from Tanaka *et. al.* (1986). We found that the field has a vent density of about 1.1 vents per square kilometer.

**Work in Progress.** We completed the first draft of Study Plan 8.3.1.8.1.2, and it is being processed for internal technical review.

We began an issue resolution report on the risk of volcanism; we are writing an introduction, that describes the history of volcanism in the Yucca Mountain.

We began a statistical analysis of trace-element geochemical data for the Lathrop Wells volcanic center. We are evaluating the data for use to discriminate field units established from mapping and trenching activity.

We began to revise Test Plan Package 91-32 to include construction of test pits in the Cima volcanic field.

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*Continued on next page*

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We have started compiling the geologic literature and examining the geologic setting of Quaternary basaltic volcanic vents in the southern Great Basin. These investigations are concerned with dike emplacement mechanisms, dike orientations relative to surface faults and vent locations relative to topographic features (valleys, range fronts, range interiors). Topographic and geologic maps needed for this work have been identified and ordered.

**Planned Activities**

We will begin trenching at the Cima Volcanic Field (permission has already been obtained from the Bureau of Land Management) and Lathrop Wells Volcanic Field next month. Trenching at the Lathrop Wells center and the Cima volcanic field will also begin next month.

We are evaluating field-study sites to test development chronology methods. Possible sites are the SP Crater in the San Francisco Volcanic Field and the Tabernacle Flow in Utah.

**Problem Areas**

None

**Milestones**

3174

8 January 1992

*Effects of Magmatic Disruption on the Repository (Study Plan 8.3.1.8.1.2, R0)*

First draft is complete.

3071

September 1992, expected completion April 1992

*Status of Geochronology Studies at the Lathrop Wells Volcanic Center*

3129

10 July 1992, expected completion April 1992

*Geochemistry of Lathrop Wells Eruptive Sequences*

3034

30 September 1992

*Report on Magma System Dynamics*

3035

30 September 1992, expected completion April 1992

*Effects of Strombolian Eruption*

3109

30 September 1992

*Report of Subsurface Effects*

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*Continued on next page*

3111  
30 September 1992  
*Preliminary Geologic Mapping of Volcanic Centers*

3164  
30 September 1992  
*Progress Report on Thermoluminescence*

Publications

B. M. Crowe *et al.*  
*Lathrop Wells Volcanic Center: Status of Field and Geological Studies*  
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992  
In YMPO review.

B. M. Crowe *et al.*  
*Recurrence Models of Volcanic Events: Applications to Volcanic Risk Assessment*  
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992  
In YMPO review.

F. V. Perry and B. M. Crowe  
*Geochemical Evidence for Waning Magnetism and Polycyclic Volcanism at Crater Flat, Nevada*  
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992  
In YMPO review.

G. A. Valentine, B. M. Crowe, and F. V. Perry  
*Physical Processes and Effects of Magnetism in the Yucca Mountain Region*  
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992  
Approved by YMPO.

S. G. Wells, *et al.*  
*Multiple Eruptive Events at Small Volume Basaltic Centers: Evidence From the Cima and Crater Flat Volcanic Fields*  
Journal article  
in preparation.

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### WBS 1.2.3.3.1.2.2 Water Movement Tracer Tests

#### Objective

The objective of the water movement tracer tests is to obtain measurements of chlorine isotope distributions to help quantify the percolation of precipitation in the unsaturated zone.

#### Activities and Accomplishments

J. Fabryka-Martin collected 66 surface-soil samples from locations within the conceptual Perimeter Drift Boundary (PDB). The samples, collected along a transect spaced about 400 m apart, are to be analyzed for chloride/bromide (Cl/Br) ratios as part of an effort to assess the spatial variability of the meteoric Cl/Br ratio. This ratio is important as an indicator of the extent to which meteoric chloride has mixed with rock chloride in the rock samples collected during drilling. To complete this set, approximately 24 more surface-soil samples will be collected from within the PDB on future field trips. Ninety ream-bit cutting samples collected from the first 2 of 12 neutron-access boreholes were received by the subcontractor and logged in. The collection of cuttings was completed for the third and fourth holes of this set and was begun on the fifth hole.

J. Fabryka-Martin presented guidelines for the collection of samples for the Water Movement Test task during drilling of UZ-16 and described other types of sampling activities planned for this study to Drilling Support Division staff at its YMP field office.

J. Fabryka-Martin made a presentation, "Proposed Sampling Program for the Water Movement Test: Who, What, When, Where, Why," to the Hydrology Integration Task Force. Its purpose was to make other YMP participants aware of the study's sampling program and to identify possible places for coordinating field sampling efforts. As a result of discussion following the talk, she arranged to collect soil profiles from pits to be excavated under the auspices of a USGS study in Midway Valley next month. Analytical work by Hydro Geo Chem focussed on defining precision and bias in the determination of chloride and bromide and revising the draft detailed technical procedure for ion chromatographic analysis accordingly.

Review comments on a detailed technical procedure (DP) for determining bulk density were addressed, and the DP is in the approval process.

#### Planned Activities

Complete additional DPs: process cuttings samples from neutron-access boreholes; process USGS water samples; collect soil samples from Yucca Mountain area.

#### Milestone Progress

3191  
*Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples*  
30 September 1992

**WBS 1.2.3.3.1.2.5 Diffusion Tests in the ESF**

<b>Objective</b>	The objective of this task is to determine <i>in situ</i> the extent to which the nonsorbing tracers diffuse into the water-filled pores of the Topopah Spring welded unit.
<b>Activities and Accomplishments</b>	No significant activity in this study.
<b>Milestone Progress</b>	No level II milestones are planned this fiscal year.

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### WBS 1.2.3.3.1.3.1 Site Saturated Zone Ground-Water Flow System (Reactive Tracer Testing)

<b>Objective</b>	Experiments will be conducted at the C-Well complex (boles UE25 C#1, UE25 C#2, and UE25 C#3) and other wells in the vicinity of Yucca Mountain using reactive tracers to characterize retardation and transport properties at a larger scale than currently used in laboratory experiments.
<b>Activities and Accomplishments</b>	<p><b>Software Qualification.</b> Review comments of two software baselines are being processed: the software design document for the FRACNET application and the implementation baseline for the SORBEQ application.</p> <p><b>LiBr Sorption Studies.</b> Error statistics have been compiled for the analyses of all dissolved species being measured by ion chromatography. This requirement is specified by the detailed technical procedure (DP) for ion chromatograph analysis.</p>
<b>Planned Activities</b>	<p>Continue the effort to bring the computer codes FRACNET FEHMN, GZSOLVE, and SORBEQ and other software into compliance with the SQAP. This consists of compiling existing documentation on these codes and writing any new material required by the SQAP.</p> <p>Begin batch sorption experiments using lithium bromide.</p> <p>Continue to develop techniques to measure the concentration of polystyrene microspheres in solution.</p>
<b>Problem Areas</b>	None
<b>Publications</b>	<p>W. L. Polzer, W. L. M. G. Rao, H. R. Fuentes, and R. J. Beckman <i>Thermodynamically Derived Relationships Between the Modified Langmuir Isotherm and Experimental Parameters</i> Journal article, <i>Environmental Science and Technology</i> Undergoing revision.</p> <p>B. A. Robinson <i>FRACNET-Fracture Network Model for Water Flow and Solute Transport</i> LA-series report In preparation.</p> <p>B. A. Robinson <i>SORBEQ-A One-Dimensional Model for Simulating Column Transport Experiments</i> LA-series report In preparation.</p>

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Continued on next page

**Milestone Progress**

3188  
16 January 1992  
*Documentation for SORBEQ*

3194  
1 April 1992  
*Batch Sorption Experiments with Lithium*

T112  
22 June 1992  
*Final Documentation for FEHMN*

3196  
27 July 1992  
*FRACNET Documentation*

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February 1992

### WBS 1.2.3.4.1.1 Groundwater Chemistry Model

**Objective** The goal of this investigation is to provide conceptual and mathematical models of the groundwater chemistry at Yucca Mountain. These models will explain the present groundwater composition in relation to interactions of minerals and groundwater and will be used to predict groundwater compositions as a result of anticipated and unanticipated environments.

**Activities and Accomplishments** A paper, "Water-rock interactions and the pH stability of groundwaters from Yucca Mountain, Nevada," is still in YMPO review. The paper describes compositional analyses of water samples from the tuff aquifer at Yucca Mountain and carbonate water from UE 25p#1, which were used in a modeling study of pH stability.

Modeling evaporation of different Yucca Mountain waters and waters from the surrounding area continued. A paper, "Precipitation of calcite, dolomite, sepiolite, and silica from evaporated carbonate and tuffaceous waters of southern Nevada," by D. Vaniiman, M. Ebinger, D. Bish, and S. Chipera is still in YMPO review.

M. Ebinger attended a Geochemical Modeling short course sponsored by the USGS.

QA Activities. No additional progress to report on the IMOU between LLNL and Los Alamos. IMOU is in review in Las Vegas.

**Planned Activities** Track Study Plan 8.3.13.1.1 during YMPO review.

USGS collaboration will continue. Dissolved gas compositions (e.g., fugacities of CO<sub>2</sub>g and O<sub>2</sub>g) from existing and new water-table wells will be used to determine Eh conditions independently of Pt electrode measurements. The gas composition data will also be used in further pH buffering capacity modeling and for refined models of the overall ground-water chemistry.

Continue support of QA efforts. Continue tracking IMOU mentioned above.

**Problem Areas** None

**Milestones** 3006  
31 March 1992  
*Eh and pH Buffering Capacity*

3415  
30 September 1992  
Letter Report: Most Active Groundwater Chemistry

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Continued on next page

**Publications**

M. Ebinger

*Water-Rock Interactions and the pH Stability of Groundwaters from Yucca Mountain, Nevada*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
In YMPO Review.

D. Vanniman, D. Bish, M. Ebinger, S. Chipera

*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
In YMPO Review.

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February 1992

## WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 Batch Sorption Studies and Sorption Models

**Objective** The objective of this task is to provide sorption coefficients for elements of interest to predict radionuclide movements from the repository to the accessible environment.

**Activities and Accomplishments** The experiments to evaluate the effects of crushing on the sorption coefficients obtained by batch techniques have been completed. We are awaiting mineralogic analyses to properly interpret the data. Surface-area determinations have been completed on approximately 3/4 of the samples.

Testing of the atomic-force microscope continued. This instrument will ultimately be used to image substrates before and after sorption reactions that involve the important radionuclides. It will also be used to characterize the detailed textures of Yucca Mountain tuffs at the nanometer scale.

We began to conduct experiments in conjunction with the Stanford contract. This work will focus on the dependence of solution composition (i.e., ground waters) on sorption coefficients for uranium and neptunium on several pure mineral phases.

**Planned Activities** Continue study of radionuclide sorption on pure mineral phases. Complete Study Plan revisions.

**Milestone Progress** 3009  
20 February 1992  
*Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff*

3212  
30 September 1992  
*Progress Report on Single Mineral Experiments*

**Publications** A. Meijer  
*A Strategy for the Derivation and Use of Sorption Coefficients in Performance Assessment Calculations for the Yucca Mountain Site*  
Conference proceedings, *Proceedings of a Workshop on Sorption*, Los Alamos, New Mexico, 11-12 September 1990.  
In preparation.

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## WBS 1.2.3.4.1.2.2 Biological Sorption and Transport

<b>Objective</b>	The purpose of this research is to determine whether microbial activity can influence the movement of plutonium in tuff. Because fluids are used extensively in the exploration of locations for a nuclear repository, those micro-organisms capable of utilizing drilling fluids as growth substrates are of special interest.
<b>Activities and Accomplishments</b>	<p>A paper, "Preliminary Evidence of Siderophore/Plutonium Complexation," submitted to <i>Applied and Environmental Microbiology</i> in May 1991, was revised and resubmitted.</p> <p>Work was begun on Milestones 3080, "Chelation," and 3092, "Colloidal Agglomeration."</p> <p>A preproposal "Biodegradation: Vadose Zone Column Studies" was prepared and sent to DOE Headquarters. A study of microbial activity, as affected by vadose-zone conditions in soil columns was presented. Results would be applied to YMP studies.</p>
<b>Planned Activities</b>	<p>Continue plutonium <math>K_d</math> experiments.</p> <p>Continue colloidal agglomeration experiments.</p>
<b>Problem Areas</b>	None
<b>Milestone Progress</b>	<p>3080 30 September 1992 <i>Report on Chelation</i> In preparation.</p> <p>3092 30 September 1992 <i>Report on Colloidal Agglomeration</i> In preparation.</p> <p>3176 30 September 1992 <i>Procedure for Determination of Formation Constants</i> In progress.</p> <p>3177 30 September 1992 <i>Procedure for Determination of Effects on Colloidal Agglomeration</i> In preparation.</p>
<b>Publications</b>	<p>L. R. Hersman, D. E. Hobart, and T. W. Newton <i>Preliminary Evidence of Siderophore-Plutonium Complexation</i> Journal article, <i>Journal of Applied and Environmental Microbiology</i> Resubmitted.</p>

February 1992

### WBS 1.2.3.4.1.3 Radionuclide Retardation by Precipitation Processes

#### Objective

The objective of the solubility determination task is to determine the solubilities and speciation of important waste elements under conditions characteristic of the repository and along flow paths from the repository into the accessible environment.

#### Activities and Accomplishments

The Study Plan is being revised in response to DOE comments; the revision should be complete by 15 August.

**Speciation Studies.** We prepared new Pu(IV) colloid and Pu(VI) stock solutions and continued efforts to produce a stable Np(V) stock solution ( $10^{-5}$  M in Np at pH=8.5) in J-13 water for the Sorption Task, 1.2.3.4.1.2.1/3. High-purity americium-243 was ordered from ORNL for nuclear magnetic resonance (NMR) studies, and synthesis on actinide model complexes continued.

We used new Pu(IV) stock solution to produce single crystals of the several Pu(IV)-EDTA complexes that have been shown to exist in the system. Our initial attempts failed because of competition for colloid formation; however, we subsequently discovered that an excess of EDTA was competitive with colloid formation and observed a color change from red/brown to yellow with increasing pH, consistent with our observations from UV-VIS-NIR experiments. We also observed that heating of Pu(IV) in the presence of EDTA results in reduction to Pu(III) under certain conditions. Our attempts to grow single crystals of Pu(IV)-EDTA complexes look promising. We plan to characterize these species by single crystal x-ray diffraction.

We continued to determine the speciation and stability quotients of actinyl carbonate complexes via solution NMR as this technique provides a species-sensitive probe for unequivocally unravelling molecular structure and solution dynamics in these complicated actinide carbonate systems. The dynamic behavior of ligand exchange between free and coordinated carbonate on actinyl carbonate complexes of Pu(VI) was examined by  $^{13}\text{C}$  NMR line-broadening techniques. Scoping experiments were performed for Am(VI) under the same conditions, and these constitute the first direct observation of the Am(VI) carbonate species by NMR techniques. Eyring analysis provided average activation parameters of 38 kJ/M for the enthalpy of activation and -60 J/K for the entropy of activation for the plutonyl triscarbonate system at 295K. Our activation parameters agree with Stout, Sullivan, and Choppin for the uranyl and neptunyl triscarbonate systems, but disagree with Brucher, Glaser, and Toth for uranium. The origin of the discrepancy between activation parameters for uranium are not clear. With the exception of the data of Brucher *et al.*, the enthalpies of activation for each system are relatively small and positive, while the entropies are large and negative. The negative entropy values suggest a highly ordered transition state, and similar parameters have been reported for the acid-catalyzed aquation of bidentate carbonate complexes. The rate-determining step in the aquation reaction mechanism involves protonation of the carbonate ligand, which opens a chelate ring formed by one of the bidentate carbonates attached to the central metal ion. This is followed by rapid dissociation of the monodentate bicarbonate species. Stout, Choppin, and Sullivan proposed an analogous mechanism, which is also supported by our new data. In this mechanism, the addition of carbonate or bicarbonate (acid-catalyzed pathway) forms an intermediate stage in which four carbonates are bound, two in a monodentate manner, and such a transition state is expected to be highly ordered. Protonation of this complex is followed by a rapid dissociation of bicarbonate and the reforming of a metal-oxygen bond by one of the monodentate carbonate ligands.

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Additional NMR ligand-exchange studies of actinyl(VI) carbonate complexes are required before the intimate mechanism of carbonate exchange can be more accurately described. We have examined the variable temperature  $^{13}\text{C}$  NMR of the plutonyl carbonate system at six different carbonate concentrations, but the line broadening was such that only two of these samples were suitable for actual pulsed NMR T2 measurement. It has been suggested that the effect of field inhomogeneity on such broad lines will be negligible and a standard approximation should be applicable providing that the NMR lines are lorentzian. Therefore, we anticipate that we will be able to extract T2 values from lorentzian line fits on the two samples for which we have experimentally determined T2. If, as anticipated, there is little difference in the T2 data, then rate constants as a function of carbonate concentration can be extracted from the six experimental spectra already collected. We also plan to examine the rate constants as a function of pH in order to probe the proposed acid-catalyzed mechanism. With these two studies completed, we can make more informed judgements concerning the intimate mechanism of carbonate self-exchange for the  $^{242}\text{PuO}_2(^{13}\text{CO}_3)_2^+$  complex.

Experimental work on the PAS system continues to focus on the Pu(IV) carbonate systems. Specifically, we continue to map-out speciation boundaries as a function of both pH and total carbonate (i.e. combined bicarbonate and carbonate anion) concentrations. To explore the different peak intensities found as bicarbonate concentration is varied, we have recently used 250 nM Pu(IV) samples to complement the 1.0  $\mu\text{M}$  samples used last month. The Pu solubility in J-13 water is  $>250$  nM, so the new samples should not lose intensity because of Pu precipitation. The peaks have been found to be in the same ratios as in the 1.0  $\mu\text{M}$  samples, implying an intrinsically weaker intensity at lower bicarbonate concentrations or a slower relaxation time resulting in lower PAS intensity. This latter possibility may suggest possible plutonium clustering. Because our signal to noise is still excellent at 250-nM Pu concentration, we are presently trying to extend our work to 25-nM Pu concentration. Weak interference from water/bicarbonate becomes important compared to the weak Pu signal at 25 nM, but initial results are encouraging. However, several days accumulation seems to be required to achieve a believable signal (signal to noise ratio of at least 2). Nonetheless, this would be a significant advance and would allow studies to be done to neutral pH's at environmentally relevant concentrations.

**Solubility Studies.** The neptunium (Np) solubility experiments have reached steady-state. We are unsure why the last two assays in the pH-7 experiment show a change in concentration, but we are looking into possible causes. Until an answer is found, this experiment will continue and more assays will be taken. UV/visible absorption-spectrophotometry studies of the Np experiments have been performed to determine the solution species, and the results are being worked up now. We will begin the undersaturation experiments soon, starting with Np at pH 6, then with pH 8.5 because these two oversaturation experiments have already reached steady-state for some time. The three plutonium solubility experiments have also reached steady-state, and we plan to perform oxidation-state separations to determine the Pu species present. After this, undersaturation experiments with the Pu solids will begin.

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The Am/Nd solubility experiments require much more work. The low Am solubility in UE25p#1 at 60°C leads to assays with very low count rates. Np and Pu samples usually have enough activity so that results can be obtained with relatively short counting times. The irregular approach to equilibrium plots for the Am experiments are probably caused by the relative concentration inaccuracy because of insufficient counting times and the lack of consideration of the low-level counter background. To avoid extra long counting times for the gamma-pulse height analysis of each sample, we tried to use alpha liquid-scintillation counting because of its high efficiency. We found, however, that this method will not work for the following reason: Am/Nd has a very low solubility in UE25p#1, while <sup>237</sup>Np the daughter of <sup>241</sup>Am, has a rather high solubility relative to Am/Nd. Even though the daughter impurity is very small in the initial stock solution, we have enriched the Am/Nd/UE25p#1 solution with <sup>237</sup>Np to a significant degree with regard to gross alpha activity. Liquid-scintillation counting does not have the resolution to distinguish between these alphas, and is, therefore, unsuitable for this situation. We must now perform low-level gamma pulse height analysis of all Am/Nd samples, which necessitates the use of very long counting times as well as periodic background counts.

The problems we experienced with our personal computer multichannel analyzers have been corrected, and low-level gamma-pulse height analysis of Am/Nd assays has begun, including the assays from the second filtration experiment.

Regarding the Lawrence Berkeley Laboratory (LBL) QA effort, we completed a draft detailed technical procedure (DP), "Operating and Calibrating the Mettler H6T Analytical Balance," WS-LBL-DP-14, R0. Work continued on the draft DP, "Concentration Determination of Soluble Radionuclides from Data Provided by the Low Energy Gamma Counting System," TWS-LBL-DP-01, R0.

**Meetings Attended or Planned.** D. Clark presented a seminar on Am and Pu carbonate speciation probed by 13-C NMR at Lawrence Berkeley Laboratory (LBL) on 30 January. D. Hobart and P. Palmer met with H. Nitsche at LBL on 13 February along with I. Triay and A. Mitchell of WBS 1.2.3.4.1.4 to discuss the solubility of Np(V) and problems in preparing stock solutions at Los Alamos for sorption experiments. Experimental differences in CO<sub>2</sub> pressures were identified as a possible problem (altitude difference between LBL at Sea Level and Los Alamos at 7,000 ft) and are now being investigated. D. Hobart met with G. Seaborg, Associate Director of LBL, and N. Edelstein to discuss actinide research and D. Hoffman, Director of the GTS-Institute for Transactinium Science (ITS), and C. Gatrousis, Deputy Director LLNL, to discuss potential Los Alamos collaborations with the ITS.

**Problems**

Problems with the gamma counters were solved by re-installing the old system until hardware problems can be corrected. The Am/Nd assays have had long counting times because of low solubility of these elements in UE25p#1 water. In the future, we plan to use liquid scintillation counting for the assays, which will reduce assay time for Am/Nd to ten minutes.

**Planned Work**

Efforts in all above mentioned areas will continue.

**Milestone Progress**

3031  
30 September 1992  
*Speciation Measurements*

*Continued on next page*

3329

30 September 1992

*Report on Neptunium, Plutonium, and Americium Solubility Experiments from Oversaturation*

3330

15 January 1993, (anticipated early completion)

*Evaluation of Alternative Distribution Schemes in PAS*

## Publications

J. M. Combes, C. J. Chisholm-Brause, G. E. Brown, Jr., G. A. Parks, S. D. Conradson, P. G. Eller, I. R. Tnay, D. E. Hobart, and A. Meijer,  
*EXAFS Spectroscopic Study of Neptunium(V) Sorption at the  $\alpha$ -FeOOH/Water Interface*  
Journal article, *Environmental Science and Technology*.  
In press.

L. E. Hersman, P. D. Palmer, and D. E. Hobart, *Preliminary Evidence of a Siderophore/Plutonium Complex*  
Journal article, *Journal of Applied and Environmental Microbiology*  
Undergoing revision.

H. Nitsche, R. C. Gatti, E. M. Standifer, S. C. Lee, A. Miller, T. Prussin, R. S. Deinhammer, H. Maurer, K. Becraft, S. Leung, and S. A. Carpenter  
*Measured Solubilities and Speciations of Neptunium, Plutonium, and Americium in a Typical Groundwater (J-13) from the Yucca Mountain Region*  
LA-series report  
In preparation.

C. D. Tait, D. E. Morris, J. M. Berg and W. H. Woodruff  
*Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy*  
In preparation.

C. D. Tait, D. E. Morris, S. A. Ekberg, P. D. Palmer, and J. M. Berg  
*Plutonium Carbonate Speciation Changes with pH*  
Abstract, American Chemical Society National Meeting, San Francisco, California, April 1992  
In YMPO review.

Clark, *et al*  
*Carbonate Complexation of Pu(IV)*  
LA-series report  
In preparation.

Report  
*Molecular Models for Actinide Speciation*  
Submitted 5/30/91.  
Internal technical review completed.

H. Nitsche  
*The Importance of Transuranium Solids in Solubility Studies for Nuclear Waste Repositories*  
Conference paper, European Materials Society Meeting  
In YMPO Review.

#### WBS 1.2.3.4.1.4 Radionuclide Retardation by Dispersive, Diffusive, and Advective Processes

##### Objective

The objectives of this task are to determine the rate of radionuclide movement along the potential flow paths to the accessible environment and to examine the effect of diffusion, adsorption, dispersion, anion exclusion, sorption kinetics, and colloid movements in the flow geometries and hydrologic conditions expected to exist along the flow path to the accessible environment in the scenarios used for performance assessment.

##### Activities and Accomplishments

Staff continued the study of the transport behavior of radionuclides as a function of mineralogy. The most likely reasons for the discrepancies between batch sorption coefficients and sorption coefficients obtained via column experiments (reported in May 1991) are pseudocolloid formation, precipitation, slow speciation kinetics, or slow mass-transfer kinetics. Staff completed stability experiments with neptunium (Np) solutions of the type used for the column transport experiments.

Staff designed and completed a Np stability experiment in collaboration with P. Palmer and D. Hobart of WBS 1.2.3.4.1.3, (speciation studies). P. Palmer prepared a Np stock solution with a molarity of  $1 \times 10^{-2}$ , checked it spectrometrically, and found the Np to be Np(V). R. Lopez prepared two Np solutions with a molarity of  $1 \times 10^{-3}$  (from Palmer's Np stock solution). One solution was prepared in J-13 water and the second in a  $1 \times 10^{-3}$  M sodium bicarbonate solution (made with distilled water). After the  $1 \times 10^{-3}$  M Np solutions (in J-13 and  $1 \times 10^{-3}$  M sodium bicarbonate) were prepared, aliquots of these solutions were filtered. All solutions had a pH of approximately 8.0. No addition of NaOH was necessary for pH adjustment, and the filtered and unfiltered Np solutions were monitored by liquid-scintillation counting for 25 days. The unfiltered solutions were stable for 25 days, with a deviation from the average Np activity measured of  $\pm 2\%$ . The filtered solutions appeared to increase in Np concentration (up to 4%); the reason for this is the in-growth of protactinium that appears in the liquid scintillation counting region, monitored for Np. P. Palmer monitored the unfiltered and filtered  $1 \times 10^{-3}$  M Np solutions spectrometrically; he reports spectra consisting of a neptunyl peak and a peak for the carbonate-Np complex (which agrees with the speciation data reported by H. Nitsche).

Consequently, it appears that the Np precipitation reported in the last two monthly reports was caused by the addition of NaOH when the pH was adjusted (during the preparation of Np solutions in J-13). The NaOH apparently converts some of the bicarbonate in the J-13 water to carbonate (causing precipitation of Np). The speciation and dynamic transport tasks have agreed on the optimal method for stable Np solutions preparation.

P. Palmer and D. Hobart of the speciation task and I. Triay and A. Mitchell of this task met with H. Nitsche to discuss several aspects of YMP Np work. Previous assumptions had been that conditions for Nitsche's solubility work at pH of 8.5 are similar to conditions encountered at Los Alamos (under atmospheric conditions). This is probably a reasonable assumption; however, the partial pressure of  $\text{CO}_2$  at Los Alamos is  $2.48 \times 10^{-4}$  atmospheres and, the partial pressure of  $\text{CO}_2$  used by H. Nitsche for his pH 8.5 solubility work is  $5.73 \times 10^{-4}$  atmospheres and this difference will affect the distribution of Np species in solution. However, our hypothesis is that this difference won't affect the Np sorption behavior

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to a significant extent. The spectra that H. Nitsche has collected for Np in J-13 at a pH of 8.5 agrees well with Palmer's spectra for Np in J-13 under atmospheric conditions at Los Alamos. Palmer, Mitchell, and Triay also discussed this potential problem with C. Bruton and B. Viani (at LLNL), and their assumption appears to be consistent with previous calculations performed by C. Bruton on Np speciation and solubility in J-13.

Upon return to Los Alamos, solubility task staff (Hobart and Palmer), dynamic transport task staff (Triay, Lopez, and Mitchell) and an expert in actinide chemistry (T. Newton) discussed the direction that this combined Np work should follow. The decision was made for speciation personnel (with the assistance of T. Newton) to begin developing signal-averaging UV/VIS spectrometric techniques to determine Np speciation in solutions down to the micromolar level. This effort will require development work that will be extremely useful to the radionuclide transport work at Los Alamos.

I. Triay, A. Mitchell and P. Rogers (of WBS 1.2.3.4.1.2.1/3) will coordinate sorption and transport experiments that integrate the knowledge of solution speciation (determined by the solubility task) and the interaction of Np with solid phases. The interaction among the LBL (Nitsche), LLNL (Viani and Bruton), and Los Alamos staff was very productive. This type of integrated approach will allow us to describe the interaction of Np with Yucca Mountain tuffs (which is needed for performance-assessment calculations).

Staff began Np transport work using crushed-tuff columns made from G4-1530 and G4-275 and concentrated on obtaining sharp breakthroughs for tritium elutions in order to determine the physical parameters of the columns.

Staff of the dynamic-transport column experiments and diffusion tasks met with P. Adams of Sandia National Laboratory to develop a format for input of all our dynamic transport and diffusion data to the SEPDB.

A detailed technical procedure (DP) to study radionuclide diffusive behavior using tuff wafers was implemented. The DP for the study of radionuclide diffusion behavior using diffusion cells was reviewed and sent to the QAL.

M. Ott and R. Lopez attended the YMP orientation.

I. Triay attended the Geochemistry Integration meeting at Las Vegas, NV.

#### Planned Activities

Continue work described above.

#### Milestone Progress

3040

30 September 1992

*Kinetics of Sorption on Columns of Pure Minerals*

3044

31 August 1992

*Letter Report on Assessment of Available Techniques for Unsaturated Column Transport Experiments*

In preparation.

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*Continued on next page*

February 1992

3027

31 March 1992

*Report on Sorption by Batch and Column Techniques*

**Publications**

I. R. Triay

*Radionuclide Migration in Cluff under Diffusive Conditions*

Conference Paper, *Proceedings of the Migration '91, Jerez de la Frontera, Spain, 14-18 October 1991*

In preparation.

I. R. Triay, A. J. Mitchell, and M. A. Ott

*Radionuclide Migration Studies for Validating Sorption Data—Past, Present, and Future*

Conference paper, *Proceedings of the Radionuclide Adsorption Workshop, Los Alamos, NM, 11-12 September 1990*

In preparation.

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### WBS 1.2.3.4.1.5.1 Retardation Sensitivity Analysis

<b>Objective</b>	The objectives of this task are to construct a geochemical/geophysical model of Yucca Mountain and to use this model to examine the physical and chemical controls on radionuclide transport along flow paths to the accessible environment.
<b>Activities and Accomplishments</b>	<p>A paper, "Three-Dimensional Simulations of Radionuclide Transport at Yucca Mountain," by K. Birdsell, K. Eggert, and B. Travis was prepared for publication in a special issue of <i>Radioactive Waste and the Nuclear Fuel Cycle</i>.</p> <p><b>QA and Programmatic.</b> Certification of TRACRN continued. Code modifications to incorporate memory management, as specified in SVA-6, were completed with the exception of the restart capability. The design phase of TRACRN has been submitted to the SCM for an in-process review. Several verification examples for TRACRN have been completed, and the user's manual was almost completed.</p>
<b>Planned Activities</b>	Staff attended the Los Alamos project orientation class.
<b>Milestone Progress</b>	<p>3052 30 March 1992 <i>Baseline Documentation for TRACRN</i></p>
<b>Publications</b>	<p>K. Birdsell, K. Eggert, and B. Travis <i>Three-Dimensional Simulations of Radionuclide Transport at Yucca Mountain</i> Journal article, Special issue of <i>Radioactive Waste Management and The Nuclear Fuel Cycle</i> In preparation.</p>

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## WBS 1.2.3.4.1.5.2 Demonstration of Applicability of Laboratory Data

### Objective

The purpose of this study is to design and conduct experiments to evaluate the applicability of laboratory data and to test models used in the Radionuclide Transport Program to determine far field radionuclide transport. Both intermediate- and field-scale experiments and natural analogs will be assessed for their potential to provide the required data.

### Activities and Accomplishments

A meeting was held with Lawrence Berkeley Laboratory (LBL) investigators 19 February to discuss current experimental design for testing radionuclide transport at Yucca Mountain. In the meeting held in January, ideas were proposed to use boreholes for both geophysical and hydrological measurements before alcove construction, and the February meeting expanded further on this idea. The length scale between fast paths for the proposed testing region at Yucca Mountain is currently unknown but it is expected to be long. Detecting fast paths is difficult, and one of the few tools that can be used particularly at a repository scale is geophysics. To test this potential, geophysics will be an integrated component of the radionuclide transport test proposed in this study.

The revised design will initially explore an area with two boreholes from the main drift to identify zones where fast flow may occur. If a zone is identified, then initial entry will be made, and two boreholes perpendicular to the first ones will be drilled. A suite of geophysical, hydrological, and transport tests will be conducted in these boreholes. The current assumption is that fast paths (most likely fractures or another discontinuity) can be identified. Flow and transport response times on these paths are expected to be short (days or weeks), and the lower alcove will provide a location for observing breakthrough. Following the effort to characterize and predict response of the zone through boreholes, the upper alcove will be mined, and the two alcove experiment will be implemented. Data obtained from the borehole phase of characterization can be used for model parameters to predict response of test block between alcoves thus providing data from another scale for model evaluation.

A key to this proposed design is the geophysical methods that will be used to detect test locations, and a prerequisite for implementation of this experiment will be to determine the required data for the geophysical methods. The feasibility will also be evaluated during the early phases of test implementation.

E. Springer was selected as the Los Alamos representative to the Integrated Test Evaluation (ITE); he attended the first meeting on 14 February. On 26 February he attended a second meeting to discuss consolidation of test categories for further evaluation.

A Hydrology Integration Task Force (HITF) meeting was held at Los Alamos on 6 February. Testing in the high-gradient area north of Yucca Mountain using an existing borehole, G-2, was the major focus of the meeting; however, a decision on this was postponed until better cost estimates for preparing G-2 are available. A workshop in conjunction with the Geochemistry Working Group was discussed; a date will be set following the Geochemistry Core Team meeting in February.

The SCPB change to break this study into four activities was submitted to the Project Control Branch following AP-06.1.

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*Continued on next page*

**Planned Activities**

Continue to develop study plan.

Travel to Lawrence Berkeley Laboratory to discuss field test design, schedule and resources for this effort. This will have been entered into PACS.

Attend ITE meetings.

**Problem Area**

None

**Milestone Progress**

No FY91 milestones.

**Publications**

E. P. Springer

*The Use of Anthropogenic Analogues in Site Characterization of Low-Level Radioactive Waste Sites*

Conference Paper, *Proceedings of the 13<sup>th</sup> Annual DOE Low-Level Waste Management Conference, Atlanta, Georgia, 11 November 1991*

In preparation.

C. Woloshun

*A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada*

LA-series report

Received YMPO approval on 29 October 1991.

Accession numbers for references are being obtained.

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February 1992

## WBS 1.2.5 Regulatory and Institutional

- Objective** The purpose of this task is to coordinate the regulatory and institutional Project requirements within the Los Alamos programmatic structure. The focus of this coordination effort is on the integration of the technical work within the regulatory and institutional framework.
- Study Plans**
- Water Movement Test, R1 (8.3.1.2.2.2).** R0 has been approved by DOE and the NRC. R1 has been approved by DOE but not the NRC. A revision incorporating NRC and State of Nevada comments was submitted to the YMPO on 17 October 1991. We have not received a response.
- Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5).** A revision incorporating DOE/HQ and Project Office comments was submitted to Dr. Dobson on 11 June 1991.
- Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7).** Was issued by DOE/HQ as a controlled document, and sent to the NRC on 10 April 1990. On 13 January 1992 we were requested by DOE to revise NRC comments. We are in the process of doing this.
- Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1).** Accepted by the NRC on 20 August 1990. On 24 October 1991 we were asked to revise study plan. On 27 January 1992 we submitted revised comments to T. Bjerstedt.
- History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2).** Project Office approved the study plan on 18 December and submitted it to the NRC on 31 January 1992.
- Kinetics and Thermodynamics of Mineral Evolution and Conceptual Model of Mineral Evolution, R0 (8.3.1.3.3.2; 8.3.1.3.3.3).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 14-15 March 1990; revision activity has been deferred.
- Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3).** Comment resolution meeting for DOE/HQ and Project Office comments was held in February 1990; revision is in progress.
- Biological Sorption and Transport, R1 (8.3.1.3.4.2).** Revision, incorporating DOE/HQ and Project Office comments, were submitted on 20 May 1991. Additional revised text were submitted on 28 August 1991. The comment resolution verification was complete on 7 December 1991 and is in the process of being approved by the Project Office.
- Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2).** Submitted to Project Office on 17 August 1990. Comments were returned to Los Alamos for a revision; that revision is in progress.
- Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 28-30 August 1990; revision is in progress and is expected to be complete by March 1990.

**Diffusion, R0 (8.3.1.3.6.2).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 28-30 August 1990; revision is in progress and is expected to be complete by March 1990.

**Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1).** This study plan was approved by the Project Office on 19 September 1990 and by the NRC 5 October 1991.

**Physical Processes of Magmatism and the Effects on the Repository, R0 (8.3.1.8.1.2).** In preparation, expected target date is 30 May 1992.

**Characterization of Volcanic Features, R0 (8.3.1.8.5.1).** Accepted by NRC on 4 September 1990.

**Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1).** A revision incorporating DOE/HQ and Project Office comments was submitted on 18 June 1991. On 17 October additional comments were received from SAIC, P. Cloke. We submitted revised comments to P. Cloke on March 6, 1992.

**Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1).** Submitted to Project Office on 15 March 1991.

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## WBS 1.2.6 Exploratory Studies Facility

<b>Objective</b>	These Exploratory Studies Facility (ESF) tasks address the issues and information needs associated with the ES based characterization of Yucca Mountain to determine the suitability of permanently isolating high-level nuclear waste from biosphere in a geologic repository.
<b>Activities and Accomplishments</b>	<p>Initiated work on developing Tracers, Fluids and Materials (TFM) management program consistent with plan issued by Project (YM 91-23) prepared by Los Alamos. Developed methodology to manage TFM. Held meeting at Las Vegas to brief participants on use of TFM at YMP. Continued to participate in Test Integration (TIG) meetings and Sample Management Facility meetings. Prepare briefings for weekly ESF management meeting on Fridays. Started activities to develop ESF-based sample requirements for laboratory tests and developing test information for tests to be performed in north-portal area.</p> <p>Meetings. Met with participants regarding TFM. Participated in ESF replanning meetings and RSED-guided TIG meetings. Attended surface-based drilling and testing meetings, and Field Operations Center weekly meetings.</p>
<b>Planned Activities</b>	<p>Continue to support meetings on management of water used during site characterization.</p> <p>Initiate work to identify administrative procedures to be changed to manage TFM during the site characterization.</p> <p>Implement strategy to gather TFM information from participants.</p> <p>Develop design related information for tests to be performed in the launch chamber.</p> <p>Continue to support integration meetings such as ESF design, TIG, SMF surface-based testing and its interface with ESF testing.</p> <p>Continue to replan Los Alamos effort.</p> <p>Develop interfaces for testing and the ESF design.</p> <p>Revise and update the PSAR, if required.</p> <p>Prepare Title II Test Planning Packages.</p> <p>Develop new networks for ESF testing.</p>
<b>Problem Areas</b>	None
<b>Milestones</b>	None

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**WBS 1.2.6.8.4 Integrated Data System**

**Objective**

The integrated data system (IDS) supports the Exploratory Studies Facility (ESF) test program by providing a central facility to automatically measure and control aspects of the ESF tests. The primary purposes of the IDS are to assist the principal investigators (PI's) in acquiring high-quality test data in a uniform, controlled fashion and to transfer those data to the PI's organizations for data management and analysis.

**Activities and Accomplishments**

This activity has been deferred.

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February 1992

## WBS 1.2.9.1.2.4 Technical Software Management

### Objective

The purpose of this activity is to manage the development, implementation, and use of all software employed on activities that will support a license application; to manage the configurations of all software and computational data; and to provide tools and procedures that support these activities. Technical software management continued to perform the quality assurance, configuration management, and engineering tasks that are required by the Los Alamos Software Quality Assurance Plan for the Yucca Mountain Project.

### Activities and Accomplishments

Software configuration management (SCM) staff reviewed software, both formal, CCB-initiated reviews, and informal internal reviews of various baseline components of applications currently under development.

The DOCGEN application (October 1991 Monthly Report) continues in prototype development.

The design of the command-line parser, which will enable developers to easily define legal command lines for their applications and obtain information from the Unix command line, is almost complete. This is the first application that incorporates a full, object-oriented analysis and design.

Processed two baseline submissions, storing the submitted material in the certification environment, generating the attendant SCM documentation, performing the physical and functional configuration audits on each and generating software review packets to support CCB review of each. SCM sanctioned eight software applications and updated the Computer Program Library for each. Two CCB meetings were held at which six reviews were approved and two SCM Variance Authorizations were issued.

### Planned Activities

#### Configuration Management:

- Continue management of submitted baselines and change requests.

#### Software Engineering:

- Continue work on the object-oriented design of the command line parser.
  - Continue support of the schedule update effort for the Project Control Section.
  - Continue support of the SCM effort.
  - Continue technical support of the software review process.
-

### WBS 1.2.9.1.4 Records Management

**Objective**

The objective of this task is to manage records and documents related to the licensing of a geologic repository for the disposal of high-level radioactive waste by developing, implementing, and maintaining a comprehensive, automated, and integrated information management system.

**Activities and Accomplishments**

The Records Processing Center rejected 9 records and accepted 238 records in February.

The records procedure was revised, and QP-17.4, R0, and 17.5, R0, were issued on 28 February 1992.

---

### WBS 1.2.9.3 Quality Assurance

<b>Objective</b>	The Quality Assurance (QA) Program supports Los Alamos Yucca Mountain Site Characterization Project participants and ensures that their efforts provide data and evidence admissible for the repository-licensing process.
<b>Activities and Accomplishments</b>	<p><b>Software.</b> Two software Configuration Control Board (CCB) meetings were held (131 software change requests were submitted and 58 applications were approved). The process to approve commercial-grade software requests was streamlined.</p> <p><b>Grading.</b> Los Alamos has 33 approved grading packages and 1 package is in YMPO review. S. Bolivar attended a grading workshop in Las Vegas.</p> <p><b>Document Control.</b> Detailed technical procedure DP-609 "Balance Calibration", and quality administrative procedures QP-1.2, "Stop Work Control"; QP-1.3, "Conflict Resolution"; QP- 8.2, "Identification and Control of Samples"; QP-17.4, "Prepare Records"; and QP-17.5, "Process Records"; were issued.</p> <p><b>Training.</b> The new indoctrination class was attended by 25 YMP staff. R. Shay completed the Project Office lead auditor course.</p> <p><b>Program Development.</b> Twenty QPs are in various stages of revision. Efforts to stream line the QP process continued. The top ten QPs were prioritized, and a QP tracking mechanism was introduced. The Los Alamos quality assurance organization is conducting an internal assessment of 1991 activities.</p> <p><b>Deficiencies.</b> Actions for CARs YMP-92-002 and 003 were completed. SDR-597 was closed by the Project Office.</p> <p><b>Audits.</b> The audit (AR 92-01) of EES-1 was completed.</p>
<b>Planned Activities</b>	Grading package and QP revisions will continue. Uncompleted survey reports and the criterion 18 audit report will be completed. The 1991 annual quality assurance progress report will be sent out for technical and editorial reviews. An indoctrination class will be offered in March. There will be an audit of EES-13/Las Vegas and associated subcontractor activities (AR 92-02,3,4,5) next month. The DOE will conduct a limited-scope audit of Los Alamos activities in March.
<b>Problem Areas</b>	The current software quality assurance plan is being examined, and modifications will be determined by budget constraints.
<b>Publications</b>	<p>S. L. Bolivar <i>The Los Alamos National Laboratory Yucca Mountain Site Characterization Project Quality Program.</i> A Progress Report for January 1, 1990 - December 31, 1991. In internal review.</p>

APPENDIX

ATTACHMENTS AND LEVEL III MILESTONE REPORTS

## RADIONUCLIDE SOLUBILITY WORKING GROUP

### 1. Role of Working Group

a. Integrate the radionuclide solubility and speciation activities supporting the waste package and near-field activities of LLNL and the far-field activities of Los Alamos.

This integration will allow Project programmatic changes such as new design concepts to be easily incorporated in site and performance activities. The meeting of the working group will allow more effective communication of technical progress in the YMP as well as sharing knowledge of progress in radionuclide research outside the YMP.

b. Function as a decision making body to determine the best radionuclide thermodynamic solubility and speciation data to be submitted to the Project geochemical data base, GEMBOCHS.

This will provide a better link between the data collection activities and data management activities for this complicated issue.

### 2. Process of Working Group for Evaluation of Data

GEMBOCHS is more than a data repository (the data base is interfaced with geochemical modeling codes), and therefore, it must continually be tested as new data is made available. Much of the thermodynamic data comes from the literature. For example, in a phosphate system some nuclide phosphate species have been measured. These literature data are included in the data base. New data on Pu from Nitsche was included in a user's version of the data base. Modeling done by Silva indicated a phosphate species should form. No phosphate species were observed by Nitsche. In Silva's considered opinion, the modeling results are unreasonable and he suggests that the phosphate data in GEMBOCHS may be suspect. He believes experiments should be carried out to corroborate or reject the literature data. This kind of modeling and evaluation is an example of the kind of data base testing required.

Only users with thermodynamic knowledge of chemical systems can know when the model is producing reasonable or unreasonable results; therefore, the testing and evaluation is conducted as part of the solubility/ speciation tasks. The working group would function as a liaison between the scientific data gathering and the data base management function for GEMBOCHS by providing evaluation and acceptance of the data and a recommendation for inclusion into the data base.

The solubility/ speciation task evaluates the present data base and decides whether testing is needed. Test problems are defined and sensitivity studies are identified. The modeler carries out the work and provides the results through written report and presentation. The results are brought to the working

group and evaluated. The working group decides if the data should be added to the GEMBOCHS and, if necessary, whether other data currently in the GEMBOCHS should be revised or deleted from the data base as a result of the modeling.

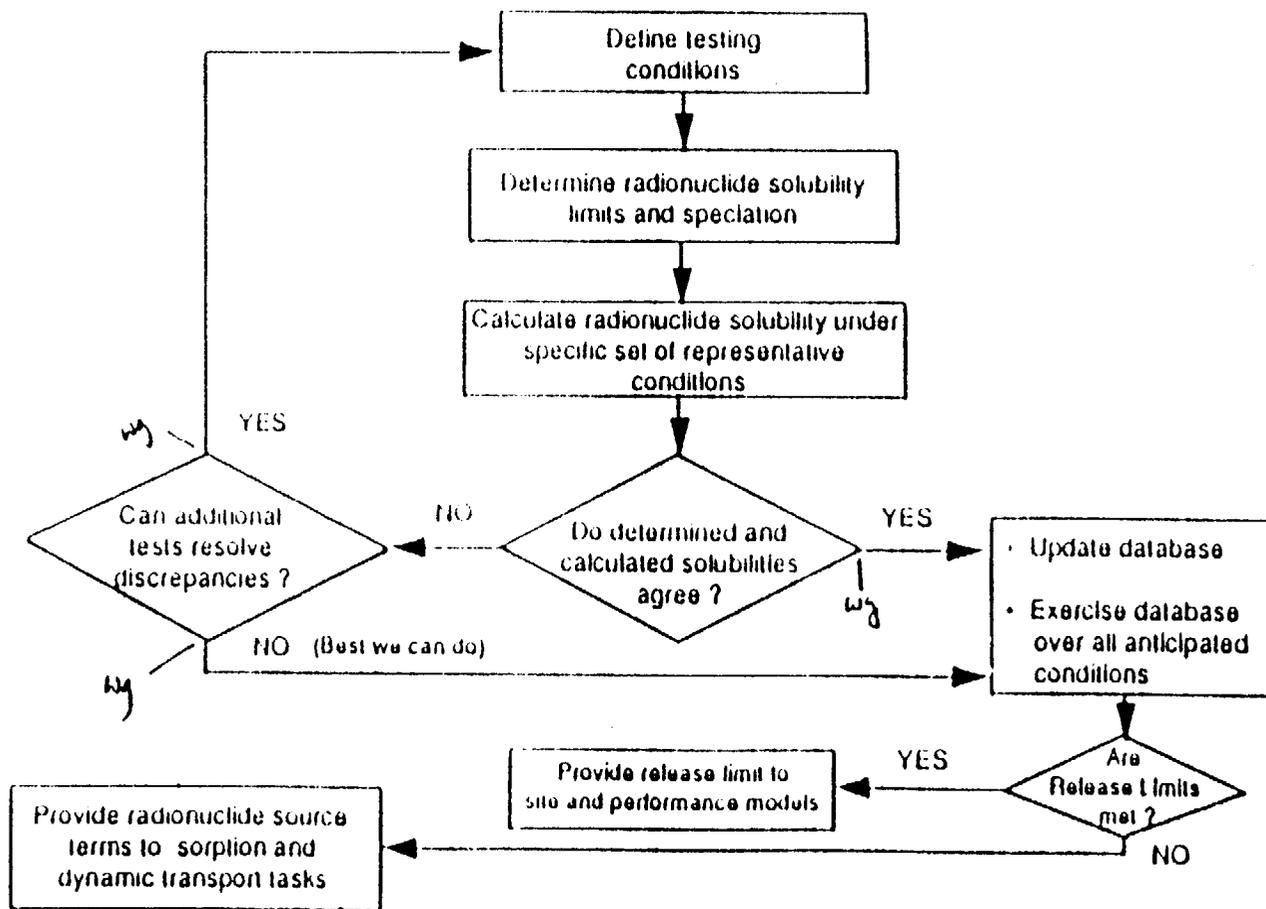
Data gaps may be identified as a result of the modeling. The solubility/speciation task decides whether sensitivity studies are needed to determine if laboratory work should be initiated. If lab work is necessary, the conduct of the work is evaluated against the current work scope and prioritized. This change is communicated to the working group so that necessary interfaces, constraints, or problems are identified.

The process described is shown in the attached Figure. The interface with the working group is shown. At certain points, interface with the working group would allow the data gathering tasks to tap expertise outside the existing work performing participant if necessary, and provide a vehicle for communication where clear overlap between the near- and far-field exist.

It is acknowledged that members of the working group may be called upon to provide formal review of data base submissions following prescribed data management procedures. The working group is not envisioned to function as the review body for the GEMBOCHS data base. The working group is not to be institutionalized i.e. management plans and procedures. The working group should be seen as a virtual team of the formal Geochemistry Core Team and only be a tool for integration, not the result of integration.

wg = interface with working group required

### Strategy for Dissolved Species Concentration Limit Studies



Preliminary Data-Do Not Reference

RADIONUCLIDE SOLUBILITY WORKING GROUP-FUNDING SUPPORT

1. Los Alamos support requested of WBS 1.2.1.3.5

The working group is planning on meeting twice this Fiscal Year. The meetings would be scheduled for 2 days. Los Alamos participation would consist of 6 staff present for the meetings.

Staff hours supporting the meetings = 202

Staff preparation hours = 32

Staff post-meeting summary hours = 48

Additional hours-unanticipated effort = 50

Total = 300

(Cost- FTE + overhead) = \$53K

Dave Morris will be the working group lead. His duties include:

- a) preparation of meeting agenda
- b) Conduct of meeting
- c) Preparation of summary
- d) identification of any milestones
- e) direction of effort of working group participants

2. LLNL support

LLNL will be involved in the working group. Funding support for LLNL will be from other WBS elements or funds associated with International Programs.

C. P. Gertz, DOE/YMP,  
Las Vegas, NV

**Los Alamos** Los Alamos National Laboratory  
Los Alamos, New Mexico 87545

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# Los Alamos

Los Alamos National Laboratory  
Los Alamos, New Mexico 87545

May 21/WBS L2.9  
QA/N/A

May 14, 1992

TWS-EES-13-05-92-032

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

MADE  
NO MAIL  
LIST

Dear Mr. Gertz:

**SUBJECT: LOS ALAMOS MONTHLY ACTIVITY REPORT - MARCH 1992**

Attached is the Los Alamos Monthly Activity Report for March 1992. This internal document describes our technical work in detail; however, the report has not received formal technical or policy review by Los Alamos or the Yucca Mountain Site Characterization Project. Data presented in this document represent work progress, are not referenceable, and are not intended for release from the US Department of Energy. If you have changes to our distribution list, please call Susan Klein at (505) 667-0916.

Sincerely,

*Julie A. Canepa*  
Julie A. Canepa

*See distribution list (1992)  
Fleming  
Bredbeck  
James S(2)  
Hull  
Klein  
Krupka  
Livingston  
Lowder  
Myers  
Newbury  
Petrie  
Prestholt  
Pritchett  
Simmons  
St. Clair  
Voegelé  
WCC  
Yucca*

JAC/SHK/ajs

Attachment: a/s

Cy w/att.:

- M. B. Blanchard, YMPO, Las Vegas, NV
- T. E. Blejwas, SNL, Albuquerque, NM
- M. Brodeur, SAIC, Las Vegas, NV
- R. L. Bullock, RSN, Las Vegas, NV
- U. S. Clanton, YMPO, Las Vegas, NV
- W. L. Clarke, LLNL, Livermore, CA
- P. L. Cloke, SAIC, Las Vegas, NV
- M. O. Cloninger, YMPO, Las Vegas, NV
- J. L. Cooper, YMPO, Las Vegas, NV
- J. Docka, Weston, Washington, DC
- J. R. Dyer, YMPO, Las Vegas, NV
- L. Engwall, M&O/Fluor, Las Vegas, NV
- L. D. Foust, M&O/TRW, Las Vegas, NV
- G. P. Fehr, SAIC, Las Vegas, NV
- L. R. Hayes, USGS, Denver, CO

- C. Johnson, M&O/WCC, Las Vegas, NV
- K. Krupka, PNL, Richland, WA
- D. E. Livingston, YMPO, Las Vegas, NV
- R. E. Lowder, MACTEC, Las Vegas, NV
- C. W. Myers, EES-DO, MS D446
- C. M. Newbury, YMPO, Las Vegas, NV
- T. H. Petrie, YMPO, Las Vegas, NV
- P. T. Prestholt, NRC, Las Vegas, NV
- R. F. Pritchett, REECo, Las Vegas, NV
- A. M. Simmons, YMPO, Las Vegas, NV
- R. K. St. Clair, M&O/TRW, Las Vegas, NV
- M. Voegelé, SAIC, Las Vegas, NV
- TWS-EES-13 File, MS J521
- RPC File (2), MS M321

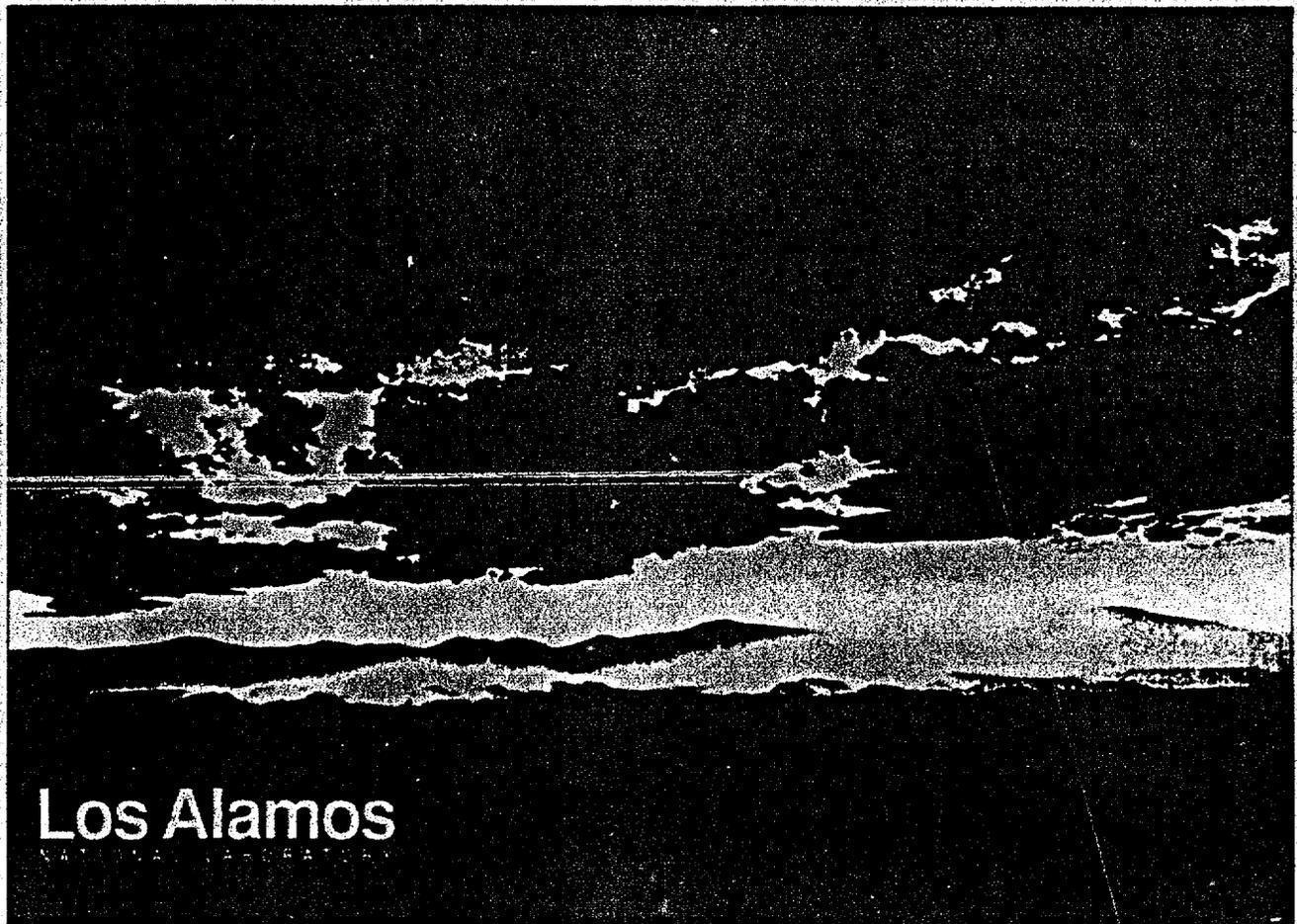
Cy w/o att.:

Susan Klein, IS-11, MS J521  
CRM-4, MS A150

*Yucca Mountain  
Site Characterization Project*

*Monthly Activity Report*

*March 1992*



**Los Alamos**  
NATIONAL LABORATORY

Photograph by Chris J. Lindberg

*Attachment to TWS-EES-13-05-92-032*

This document has not received formal technical or policy review by Los Alamos National Laboratory or by the Yucca Mountain Site Characterization Project. Data presented in this report represent work progress and are not intended for release from the US Department of Energy.

This work was supported by the Yucca Mountain Site Characterization Project Office as part of the Civilian Radioactive Waste Management Program. This Project is managed by the US Department of Energy, Yucca Mountain Site Characterization Project.

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**LOS ALAMOS NATIONAL LABORATORY**  
**YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT**

**Monthly Activity Report**  
**March 1992**

**WBS 1.2.1 Systems**

**Objective**                    The objective of this task is to integrate systems with the Geologic Repository Program, to describe the Yucca Mountain Site Characterization Project Mined Geologic Disposal System, and to evaluate the performance of the natural, engineered barrier, and total systems for meeting regulatory standards.

**Technical Data (WBS 1.2.1.3.5)**

**Activities and Accomplishments**            Staff attended a workshop on 26 March on the status of the Technical Data Base and the parameters for the Technical Data Catalog.

Staff submitted the Parameter Normalization List to principal investigators for review; they will submit additions or deletions to the list.

Submitted data from tasks 1.2.3.4.1.2.2, 1.2.3.4.1.4.1, and 1.2.3.4.1.4.2 to the Automated Technical Data Tracking System (ATDT).

**Planned Activities**                    Submit data from B. Crowe, B. Carlos, and C. Harrington to the ATDT.

Submit input to G. Heitland on the Parameter Normalization List.

Work on parameter screens for the Technical Database.

Work with P. Adams of Sandia National Laboratory (SNL) to create tables for data to be submitted to the Site Engineering Property Database.

**Caisson Experiment (WBS 1.2.1.4.6)**

**Activities and Accomplishments**            The limonite was ground and will be shipped to Los Alamos early in April. (The particle size fraction was finer than desired.)

The Wedron 510 silica sand was delivered to Los Alamos on 30 March.

A draft standard operating procedure (SOP) was completed and is in review.

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*Continued on next page*

March 1992

**Planned Activities**

Travel to SNL to discuss the lower-boundary condition with SNL staff.

Prepare the caisson for filling with sand.

Revise SOP as indicated by reviewers.

Write paper for special issue of *Radioactive Waste Management*.

**Publications**

E. P. Springer and M. D. Siegel

*An Integrated Intermediate-Scale Caisson Experiment to Validate Models of Fluid Flow and Contaminant Transport in the Unsaturated Zone*

Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle - Special issue on the Yucca Mountain Project*

In preparation.

**Performance Assessment Computational Support (WBS 1.2.1.4.7)**

**Activities and  
Accomplishments**

No activity to report.

---

## WBS 1.2.3.1 Site Management and Integration

### Site Management (WBS 1.2.3.1.1)

**Objective** The objective of this task is to manage and integrate site characterization activities.

**Activities and Accomplishments** A poster, "Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, NV," was presented at the Waste Management '92 Symposium 4 March.

NWTRB support staff was briefed on Los Alamos YMP Site Characterization Work on 20 March.

Project orientation on site characterization was presented on 13 March.

Planning began for a DOE/OCRWM team-building visit to Los Alamos.

**Publications** J. A. Canepa  
*Strategy for Testing the Applicability and Validity of Radionuclide Transport Models for Yucca Mountain, Nevada*  
Conference Paper, *Migration '91, Jerez de la Frontera, Spain, 14-18 October 1991*  
In revision.

A. M. Simmons and J. A. Canepa  
*Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, Nevada*  
Conference Paper, *Waste Management '92 Symposium, 2-6 March 1992*  
In preparation.

### Surface-Based Test Management and Integration (WBS 1.2.3.1.1.)

**Objective** The goal of this investigation is to provide coordination for Los Alamos surface-based test planning package development.

**Activities and Accomplishments** No significant accomplishments this month.

---

## WBS 1.2.3.1 Site Management and Integration

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**Activities and Accomplishments** A poster, "Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, NV," was presented at the Waste Management '92 Symposium 4 March.

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In preparation.

### Surface-Based Test Management and Integration (WBS 1.2.3.1.1.)

**Objective** The goal of this investigation is to provide coordination for Los Alamos surface-based test planning package development.

**Activities and Accomplishments** No significant accomplishments this month.

---

## WBS 1.2.3.2.1.1.1 Mineralogy, Petrology, and Rock Chemistry of Transport Pathways

<b>Objective</b>	The purpose of this activity is to define the important mineralogic and geochemical variables along fracture and rock-matrix transport pathways at Yucca Mountain, in support of performance assessment and to evaluate the impact of repository construction on natural waste-transport barriers.
<b>Activities and Accomplishments</b>	<p>All staff trained to several revised quality and detailed technical procedures. All staff have attended required Los Alamos YMP orientation training class.</p> <p>The journal article on manganese minerals (milestone 3123), "Manganese Oxide Minerals in a Fractured Silicic Tuff at Yucca Mountain, Nevada," by B. Carlos, S. Chipera, D. Bish, and S. Craven was submitted for internal technical review.</p> <p>R. Luce of the NWTRB technical staff discussed mineralogy-petrology studies with staff members.</p> <p>The new INEL microdiffractometer arrived and assembly was begun.</p>
<b>Planned Activities</b>	Work for the next few months includes the following: (1) continued analysis of Mn-oxide fracture fillings in the Crater Flat and Paintbrush tuffs to determine their distribution and factors controlling that distribution; (2) internal review of the paper on Mn-oxides; and (3) continued analysis of calcites to understand transport and precipitation mechanisms.
<b>Milestone Progress</b>	<p>3120 29 May 1992 <i>Calcite in the Upper Paintbrush Tuff</i> 40% complete.</p> <p>3123 2 March 1992 <i>Mn Fracture Minerals at Yucca Mountain</i> Undergoing extensive revision.</p> <p>3130 17 August 1992 <i>Fracture Mineralogy of the Paintbrush Tuff</i></p> <p>3137 30 September 1992 <i>Mineralogy of Calico Hills for Adit Development</i> 85% complete.</p>
<b>Publications</b>	<p>D. E. Broxton <i>Chemical Changes Associated with Zeolitization on the Tuffaceous Beds of Calico Hills at Yucca Mountain, Nevada</i> Conference paper, <i>Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium</i>, July 1992 Approved by YMPO.</p>

---

Continued on next page

B. Carlos, D. Bish, S. Chipera, and S. Craven  
*Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff*  
Journal article, *Chemical Geology*  
Undergoing extensive revision.

G. D. Guthrie, D. L. Bish, and B. T. Mossman  
*Quantitative Analysis of Zeolite-Bearing Dusts Using the Rietveld Method*  
Journal article, Submitted to *Science*

D. Vaniman, D. Bish, D. Broxton, B. Carlos, S. Chipera, and S. Levy  
*Mineralogy as a Factor in Radioactive Waste Transport Through Pyroclastic Rocks at Yucca Mountain, Nevada*  
Journal article, *Journal of Geophysical Research*  
Draft complete; may be revised for a different journal.

---

March 1992

## WBS 1.2.3.2.1.1.2 Mineralogic and Geochemical Alteration

<b>Objective</b>	The objective of this task is to characterize past and present natural alteration processes that have affected the potential geologic repository and to predict future effects of natural and repository-induced alteration.
<b>Activities and Accomplishments</b>	<p>G. WoldeGabriel performed K/Ar analysis on prepared samples at Case Western Reserve University. His activities included repeat analyses of zeolite samples, along with some zeolite-clay pairs for comparison, and analyses of alunite-bearing samples collected in the Calico Hills by B. Simonds, USGS.</p> <p>D. Vaniman processed root samples from Trench 14 in a low-temperature asher to obtain mineral residues; some ashed samples were x-rayed.</p> <p>S. Levy and B. Rundberg, along with B. Levich (DOE) and C. VanderGraff (AECL), examined outcrop sites of the Topopah Spring at Busted Butte for fractured blocks suitable for use in laboratory studies. S. Levy mapped the deepened portion of Trench 14 with E. Taylor (USGS) and collected additional samples for analysis; she also revisited sample collection sites at SE Yucca Mountain for a more detailed study of possible hydrothermally altered rocks exposed at the surface.</p> <p>D. Bish attended an NRC-DOE technical exchange on repository thermal effects in Albuquerque.</p> <p>New samples were ground up to provide material for long-term heating experiments. Software for the mass spectrometer and thermogravimetric analyzer was updated; QA documentation was submitted.</p>
<b>Planned Activities</b>	Characterization of new materials for hydrothermal experiments will continue, as will ongoing analysis of Trench 14 and other samples. D. Vaniman and S. Levy will attend a climate workshop at the USGS in Denver at which Vaniman will give a short presentation.
<b>Problem Areas</b>	None
<b>Milestone Progress</b>	<p>3138 30 October 1992 <i>Chemical Transport in Zeolitic Alteration</i></p> <p>3141 31 March 1992 <i>Laminated Zone in Trench 14</i></p> <p>3142 3 April 1992 <i>K/Ar Dating of Clays and Zeolites</i> Research continuing; new draft in preparation.</p> <p>3143 15 January 1992 <i>Experimental Dehydration of Volcanic Glasses</i> Interim draft complete.</p>

Continued on next page

**Publications**

G. WoldeGabriel, et. al.

*Preliminary Assessment of Clinoptilolite K/AR Results from Yucca Mountain, Nevada: a Potential High-Level Radioactive Waste Repository Site*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

S. Levy and C. Naeser

*Bedrock Breccias Along Fault Zones near Yucca Mountain, Nevada*

Chapter in USGS Bulletin on Yucca Mountain studies  
In USGS editorial review.

D. Vaniman, D. Bish, and S. Chipera

*Dehydration and Rehydration of a Tuff Vitrophyre*

Journal article, *Journal of Geophysical Research*  
Interim draft complete.

D. Vaniman, et. al

*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

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March 1992

### **WBS 1.2.3.2.1.2 Stability of Minerals and Gases**

**Objective**

The objective of this activity is to produce a model for past and future mineral alteration in Yucca Mountain. The model is intended to explain the natural mineral evolution resulting from the transformation of metastable mineral assemblages to more stable assemblages and the effects of a repository emplacement.

**Activities and Accomplishments**

This activity has been deferred.

---

### WBS 1.2.3.2.5 Postclosure Tectonics

**Objective**

The objective of these volcanism studies is to determine the hazards of future volcanic activities with respect to siting a high-level radioactive waste repository at Yucca Mountain.

**Activities and Accomplishments**

A comment by Wells, Crowe, and McFadden on the paper by Turrin *et al.*, "<sup>40</sup>Ar/<sup>39</sup>Ar Age of the Lathrop Wells Volcanic Center, Yucca Mountain, Nevada," has been accepted by *Science* for publication. The comment summarizes alternative interpretations of the radiometric ages for the Lathrop Wells Center.

An additional phase of trenching was completed at the Lathrop Wells Volcanic Center and the "A" cone of the Cima Volcanic Center. Five trenches were dug in the pyroclastic surge unit, northwest of the Lathrop Wells cone. The exposures were described for soil, petrology, and tephra studies, and samples were collected. A fourth trench was excavated in eolian and tephra deposits above the buried lava flow, north of the main cone; this section was also described for soil studies, and samples were collected. Four soil pits were excavated in the tephra-fall sheet, directly west of the main cone; these pits were sampled for petrology studies, but there was insufficient time to describe the soils and tephra sections. The pits will be re-excavated and described in the next trenching phase. A total of 29 soil pits have been excavated at the Lathrop Wells Volcanic Center.

A poster session that summarized the progress of volcanism studies for the Yucca Mountain Site Characterization Project was presented at the Waste Management '92 Conference in Tucson, Arizona in March.

Paleomagnetic data have been obtained and analyzed for the Q1<sub>1</sub>, Q1<sub>2</sub>, and buried lava flow at the Lathrop Wells Volcanic Center.

An internal audit of the volcanism program began; it will be completed during the first week of April.

Five samples were collected from surface clinker for the Q1<sub>1</sub> lava flow south of the main cone. They will be used for <sup>3</sup>He cosmogenic dating of the lava flow. A sample was also collected for dating using the U-Th disequilibrium method.

Geologic mapping and sampling for petrological studies continued for the 3.7 Ma centers in Crater Flat. We found that the geometry of the major vent zones for these units are different from the younger basalt centers: the vents are elongate (north-south) along fissures marked by accumulations of vent scoria and local sites of lava that was ponded in vent craters. Extrusive lava flows from these centers are of aa type and have sheet-like distributions. The flows tend to be relatively thin (3-5 meters). These flow features are consistent with higher magma effusion rates when compared with the flow features of the younger basalt centers.

Isotope-dilution data were examined for Rb and Nd for units of the Lathrop Wells volcanic center. The data strongly support the theory that the individual units were formed by different degrees of partial melting and represent temporally and spatially distinct magmas, which is consistent with a polycyclic classification of the center. We have begun to model geochemical constraints of melt processes to evaluate the geochemical variations. We are comparing the Lathrop Wells geochemical data set with geochemical data from established monogenetic volcanic centers.

*Continued on next page*

March 1992

We are interested in developing some alternative methods to predict the probability of magmatic disruption. At this time we are considering two possibilities: using models of deterministically chaotic systems and nonlinear forecasting. (Although forecasting may be of limited value considering the small number of past volcanic events in the Yucca Mountain region, it may be useful for predicting events in the Lunar Crater and Cima volcanic fields.)

Work continued on the issue resolution report for volcanism; we are writing introductory sections on the history of volcanism in the Yucca Mountain region.

#### Planned Activities

Four talks on volcanism studies will be presented at the April High-Level Waste Conference in Las Vegas in April. (See section on publications.)

A talk on the effects of volcanism on the Yucca Mountain Project will be presented at Arizona State University in April.

We will meet with the Performance Assessment Group and the M&O to discuss volcanism studies.

#### Milestone Progress

3174

8 January 1992

*Effects of Magmatic Disruption on the Repository* (Study Plan 8.3.1.8.1.2, R0)  
First draft complete.

3071

September 1992, expected completion April 1992

*Status of Geochronology Studies at the Lathrop Wells Volcanic Center*

3129

10 July 1992, expected completion April 1992

*Geochemistry of Lathrop Wells Eruptive Sequences*

3034

30 September 1992

*Report on Magma System Dynamics*

3035

30 September 1992, expected completion April 1992

*Effects of Strombolian Eruption*

3109

30 September 1992

*Report of Subsurface Effects*

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Continued on next page

3111  
30 September 1992  
*Preliminary Geologic Mapping of Volcanic Centers*

3164  
30 September 1992  
*Progress Report on Thermoluminescence*

**Publications**

B. M. Crowe, *et al.*  
Issue Resolution Report  
In preparation.

B. M. Crowe, *et al.*  
*Lathrop Wells Volcanic Center: Status of Field and Geological Studies*  
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992  
Approved by YMPO.

B. M. Crowe, *et al.*  
*Recurrence Models of Volcanic Events: Applications to Volcanic Risk Assessment*  
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992  
Approved by YMPO.

F. V. Perry and B. M. Crowe  
*Geochemical Evidence for Waning Magnetism and Polycyclic Volcanism at Crater Flat, Nevada*  
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992  
Approved by YMPO.

G. A. Valentine, B. M. Crowe, and F. V. Perry  
*Physical Processes and Effects of Magnetism in the Yucca Mountain Region*  
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992  
Approved by YMPO.

S. G. Wells, *et al.*  
*Multiple Eruptive Events at Small Volume Basaltic Centers: Evidence From the Cima and Crater Flat Volcanic Fields*  
Journal article  
In preparation.

March 1992

## WBS 1.2.3.3.1.2.2 Water-Movement Tracer Tests

<b>Objective</b>	The objective of the water movement tracer tests is to obtain measurements of chlorine isotope distributions to help quantify the percolation of precipitation in the unsaturated zone.
<b>Activities and Accomplishments</b>	<p>Work this month focussed on collection of soil samples, taking advantage of sampling opportunities provided by soil-trenching activities of other site-characterization studies in Midway Valley. J. Fabryka-Martin collected 4 soil profiles, consisting of 77 bulk samples, to depths of 3 m, which will be analyzed for <math>^{36}\text{Cl}/\text{Cl}</math> to estimate present-day infiltration rates. An additional 81 samples from depths corresponding to those of the bulk samples were analyzed for moisture content, and 16 additional deep-soil samples from 8 other soil pits will be input to a database on the spatial variability of the pre-bomb meteoric <math>^{36}\text{Cl}/\text{Cl}</math> ratio.</p> <p>Collection of ream-bit cuttings from four additional neutron-access boreholes (being drilled for the USGS study, "Characterization of Unsaturated-Zone Infiltration") was completed. J. Fabryka-Martin continued to support the test planning package and job package development for UZ-16.</p> <p>Two additional water samples from the Yucca Mountain area (JF-3 and UE-29 UZ-N91) were received from the USGS; they will be analyzed for <math>\text{Cl}/\text{Br}</math> and <math>^{36}\text{Cl}/\text{Cl}</math>.</p> <p>The subcontractor, Hydro Geo Chem, began processing the 5 USGS water samples and 12 ream-bit cutting samples from N54 and N55 for <math>^{36}\text{Cl}</math> analysis.</p> <p>The subcontractor focussed on defining precision and bias in the determination of chloride and bromide and revising the draft DP for ion chromatographic analysis accordingly.</p> <p>Detailed procedure LANL-INC-DP-96, R0, "Measurement of Bulk Density of Soil Samples," was distributed.</p>
<b>Planned Activities</b>	Complete additional DPs; process cuttings samples from neutron-access boreholes; process USGS water samples; collect soil samples from Yucca Mountain area.
<b>Milestone Progress</b>	3191 <i>Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples</i> 30 September 1992

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### WBS 1.2.3.3.1.2.5 Diffusion Tests in the ESF

**Objective** The objective of this task is to determine *in situ* the extent to which the nonsorbing tracers diffuse into the water-filled pores of the Topopah Spring welded unit.

**Activities and Accomplishments** No significant activity in this study.

**Milestone Progress** No level II milestones are planned this fiscal year.

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March 1992

### WBS 1.2.3.3.1.3.1 Site Saturated Zone Ground-Water Flow System (Reactive Tracer Testing)

**Objective** Experiments will be conducted at the C-Well complex (bores UE25 C#1, UE25 C#2, and UE25 C#3) and other wells in the vicinity of Yucca Mountain using reactive tracers to characterize retardation and transport properties at a larger scale than currently used in laboratory experiments.

**Activities and Accomplishments**

**Software Certification.** The requirements and design phases of the SORBEQ application have been completed, and the final review of the implementation phase will take place when software that SORBEQ accesses is certified.

The requirements review of the FEHMN application was completed, and the review comments are being addressed.

The final iteration of the review of the cdftools application (tools for using the netCDF software more easily) is in process.

Work continued on the GZSOLVE and genplot (general-purpose plotting routine using DISSPLA graphics software) applications; however, no new baselines have been completed.

**Lithium Bromide Studies.** Error statistics have been compiled for the analyses of all dissolved species being measured by ion chromatography. A significant amount of adjustment was required to bring the errors down to acceptable levels as specified by the ion chromatography DP.

**Planned Activities**

Continue the effort to bring the computer codes FRACNET, FEHMN, GZSOLVE, and SORBEQ and other software into compliance with the SQAP. This consists of compiling existing documentation on these codes and writing new material required by the SQAP where necessary.

Begin batch sorption experiments using lithium bromide.

Continue developing techniques for measuring the concentration of polystyrene microspheres in solution.

**Problem Areas** None

**Publications**

W. L. Polzer, W. L., M. G. Rao, H. R. Fuentes, and R. J. Beckman  
*Thermodynamically Derived Relationships Between the Modified Langmuir Isotherm and Experimental Parameters*  
Journal article, *Environmental Science and Technology*  
Undergoing revision.

B. A. Robinson  
*FRACNET-Fracture Network Model for Water Flow and Solute Transport*  
LA-series report  
In preparation.

Continued on next page

B. A. Robinson  
*SORBEQ-A One-Dimensional Model for Simulating Column Transport Experiments*  
LA-series report  
In preparation.

B. A. Robinson  
Journal article  
*A Strategy for Validating a Conceptual Model for Radionuclide Migration in the Saturated Zone Beneath Yucca Mountain Radioactive Waste Management Journal special YMP Issue*

W. E. Polzer, E. H. Essington  
Journal article  
*The Use of Selectivity Coefficients to Estimate Modified Langmuir Isotherm Parameters as a Function of Experimental Conditions*  
*Radioactive Waste Management Journal Special YMP Issue*

**Milestone Progress**

3188  
16 January 1992  
*Documentation for SORBEQ*

3194  
1 April 1992  
*Batch Sorption Experiments with Lithium*

T112  
22 June 1992  
*Final Documentation for FEHMN*

3196  
27 July 1992  
*FRACNET Documentation*

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March 1992

### WBS 1.2.3.4.1.1 Groundwater Chemistry Model

#### Objective

The goal of this investigation is to provide conceptual and mathematical models of the groundwater chemistry at Yucca Mountain. These models will explain the present groundwater composition in relation to interactions of minerals and groundwater and will be used to predict groundwater compositions as a result of anticipated and unanticipated environments.

#### Activities and Accomplishments

The Groundwater Chemistry Model Study Plan, R0, is currently in project review.

Two papers to be presented at the 7<sup>th</sup> Water-Rock Interactions Symposium in Park City, Utah, in July were approved by YMPO. "Water-rock interactions and the pH stability of ground waters from Yucca Mountain, Nevada" by M. Ebinger discusses compositional analyses of water samples from the tuff aquifer at Yucca Mountain and carbonate water from UE-25p#1 that were used in a modeling study of pH stability. He found that mineral dissolution and precipitation tended to produce smaller changes in pH than when no minerals were allowed to form during the simulations. "Precipitation of calcite, dolomite, sepiolite, and silica from evaporated carbonate and tuffaceous waters of southern Nevada" by D. Vaniman, M. Ebinger, D. Bish, and S. Chipera discusses modeling results, which were consistent with observations made on fracture material derived from Yucca Mountain.

Modeling evaporation of different Yucca Mountain waters and waters from the surrounding area continued.

QA Activities. No additional progress to report on the IMOU between LLNL and Los Alamos. IMOU is in review in Las Vegas.

#### Planned Activities

Track Study Plan 8.3.1.3.1.1 during YMO review.

USGS collaboration will continue. Dissolved gas compositions (e.g., fugacities of CO<sub>2</sub>g and O<sub>2</sub>g) from existing and new water-table wells will be used to determine Eh conditions independently of Pt electrode measurements. The gas-composition data will also be used in further pH buffering capacity modeling and for refined models of the overall groundwater chemistry.

Continue support of QA efforts. Continue tracking IMOU mentioned above.

#### Problem Areas

None

#### Milestones Progress

3006

31 May 1992

*Eh and pH Buffering Capacity*

3415

30 September 1992

Letter Report: *Most Active Groundwater Chemistry*

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*Continued on next page*

**Publications**

M. Ebinger  
*Water-Rock Interactions and the pH Stability of Ground waters from Yucca Mountain, Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

D. Vaniman, D. Bish, M. Ebinger, S. Chipera  
*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

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March 1992

## WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 Batch Sorption Studies and Sorption Models

### Objective

The objective of this task is to provide sorption coefficients for elements of interest to predict radionuclide movements from the repository to the accessible environment.

### Activities and Accomplishments

P. Rogers replaced A. Meijer as principal investigator for the sorption task. Appropriate QA paperwork, equipment transfers, and responsibility transfer for laboratory space have been completed.

P. Rogers and L. Triay participated in the technical audit of the sorption task held 17 March.

An important priority of the new PI will be to improve communication and integration between the sorption and dynamic transfer tasks. To this end, an extensive series of experiments to measure the batch sorption coefficients of neptunium under varying conditions was planned jointly with I. Triay of WBS 1.2.3.4.1.4. These experiments will begin when the new sorption staff member, K. Kung, begins work in June. K. Birdsell has also begun a series of calculations to test the applicability of the minimum  $K_d$  approach under various flow scenarios. Improved interaction with this task will provide valuable information on the validity of this approach for broad classes of radionuclides.

Over 80 x-ray diffraction (XRD) quantitative analyses, for samples used in experiments to determine the effect of particle size on sorption, were received from D. Bish and S. Chipera. The analyses provide important information for interpreting the results of those experiments because the analyses show that significant compositional changes were caused by the extensive grinding and washing of the samples, which must be corrected before final data interpretation. The precise content of hematite in these samples is important for comparing the results of neptunium batch sorption with column experiments carried out by the dynamic transport task. D. Bish has agreed to try to improve the precision of hematite analysis in two samples that currently are yielding results of  $1 \pm 1\%$  hematite.

Research at the atomic-force microscope (AFM) has been redirected to emphasize experiments that are technologically feasible at this time. Previous work targeted obtaining atomic-resolution AFM scans of hematite; however, researchers from Stanford, Berkeley, and Switzerland have indicated that they have not been successful in obtaining atomic-resolution scans of hematite, presumably because of the strong electrostatic field due to Fe(III). These researchers also report problems similar to those we have encountered in preparing smooth surfaces on hematite and have suggested one promising alternative method for surface preparation, which we will try. We are currently looking into significant alterations of the experimental conditions under which we could scan hematite samples to determine if improved resolution is possible as obtaining high-resolution scans of hematite is a prerequisite to studying sorption behavior of this mineral.

### Milestone Progress

3009

20 February 1992

*Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff*

3212

30 September 1992

*Progress Report on Single Mineral Experiments*

Continued on next page

March 1992

**Publications**

A. Meijer

*A Strategy for the Derivation and Use of Sorption Coefficients in Performance Assessment Calculations for the Yucca Mountain Site*

Conference proceedings, *Proceedings of the DOE/Yucca Mountain Site Characterization Project Radionuclide Adsorption Workshop at Los Alamos National Laboratory September 11-12, 1990.*

In preparation.

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March 1992

## WBS 1.2.3.4.1.2.2 Biological Sorption and Transport

### Objective

The purpose of this research is to determine whether microbial activity can influence the movement of plutonium in tuff. Because fluids are used extensively in the exploration of locations for a nuclear repository, those micro-organisms capable of utilizing drilling fluids as growth substrates are of special interest.

### Activities and Accomplishments

Work continued on the characterization of the siderophore(s) produced by micro-organism 11c. Specifically, a bioassay of the siderophore, using ethylenediamine di(o-hydroxyphenyl) acetic acid (EDDA) is being performed.

A review of the chelation chemistry of mineral dissolution literature was completed.

Work continued on writing Milestones 3080, Report on Chelation, and 3092, Report on Colloidal Agglomeration.

### Planned Activities

Continue plutonium  $K_d$  experiments.

Continue colloidal agglomeration experiments.

### Problem Areas

None

### Milestone Progress

3080

30 September 1992  
*Report on Chelation*  
In preparation.

3092

30 September 1992  
*Report on Colloidal Agglomeration*  
In preparation.

3176

30 September 1992  
*Procedure for Determination of Formation Constants*  
In progress.

3177

30 September 1992  
*Procedure for Determination of Effects on Colloidal Agglomeration*  
In preparation.

### Publications

L. R. Hersman, D. E. Hobart, and T. W. Newton  
*Preliminary Evidence of Siderophore/Plutonium Complexation*  
Journal article, *Journal of Applied and Environmental Microbiology*  
Resubmitted.

### WBS 1.2.3.4.1.3 Radionuclide Retardation by Precipitation Processes

**Objective** The objective of the solubility determination task is to determine the solubilities and speciation of important waste elements under conditions characteristic of the repository and along flow paths from the repository into the accessible environment.

**Activities and Accomplishments** The solubility task was audited on 17-18 March; no deficiencies were noted.

We continued to revise the study plan, which should be complete by 15 August.

D. Morris participated in the Database Workshop on 26 March in Los Alamos.

Milestone 3010, "Report on Measured Solubilities of Pu, Am, and Np in J-13 Groundwater from Oversaturation Conditions," has been revised and will be submitted to YMPO for review.

**Speciation Studies.** Experimental work on the PAS system continues to focus on the Pu(IV) carbonate systems. Specifically, we continue to map-out speciation boundaries as a function of both pH and total carbonate (i.e. combined bicarbonate and carbonate anion) concentrations. We have extended our spectral range by repeating scans done previously with coumarin 480 laser (range 475 to 499 nm) with coumarin 500 dye (490 to 534 nm). A carbonate peak in this spectral region makes interpretations from this range possible only for dilute (bi)carbonate concentrations (<30 mM). Furthermore, we have obtained data at pH = 8.6 to 8.9 with  $[\text{NaHCO}_3] = 0.4 \text{ M}$  for a range of Pu(IV) concentrations from 500 to 25 nM, and the peak position does appear to change with concentration, with the lower energy peak(s) gaining importance at lower concentrations. This change underlines the importance of being able to probe at low-actinide concentration. Finally, we have noted a time-dependent effect on the spectra of dilute Pu(IV) samples, with more defined spectra appearing after the sample has been sitting for at least several days. This kinetic effect is as yet not understood, but it may be caused by an equilibration effect similar to that measured by the LBL team from oversaturation.

We took delivery of the data acquisition system and software for the wavelength calibration / Raman / emission spectrometer this month. This commercial-grade hardware/software may save one man-year of effort in software development and quality assurance time. The entire system should be in operation in two months.

An experiment was conducted on the Pu(IV) EDTA complexation to observe speciation changes in the pH range of 7 to 10. Preliminary analysis indicates there are probably 3 species present in this pH region; however, additional studies must be performed to unequivocally identify the species present.

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Synthesis on model complexes continued, and line-width measurements made on Pu(VI) and Am(VI) carbonate complexes indicate that ligand substitution follows an associative pathway for uranium through americium. Data reduction on <sup>13</sup>C NMR on the 242-Pu(VI) carbonate system suggested that a few more experiments are warranted to deduce the intimate exchange mechanism. These results will be written up as a milestone report and will be submitted to the *Journal of the American Chemical Society*. The letter report on model complex studies is being converted to LA-series report format.

**Solubility Studies.** The solubility determinations for Np, Pu, and Am in UE-25p#1 water continue. The Np undersaturation experiment at pH 8.5 was started during the past reporting period. Exactly 24 hours before stopping the oversaturation experiment, a fresh sample of UE-25 water at 60°C was saturated with a CO<sub>2</sub>/Ar mixture, and the sample from the oversaturation experiment was centrifuged to isolate the Np solids. Small portions of the solids were retained for structural analysis, and the remaining portion was taken up in the CO<sub>2</sub>-saturated solution. Samples from this experiment have now been taken at intervals of 3 hours, 1 day, and 6 days. Similar undersaturation experiments for Np at pH 6 and 7 will begin this month.

A revision to Detailed Technical Procedure "X-ray Powder Diffraction by the Debye-Scherrer Method" (TWS-LBL-DP-03, R1), has been completed and forwarded to Los Alamos for technical and quality assurance reviews.

**Planned Activities**

Efforts in all above mentioned areas will continue.

Solubility task staff will attend the 203rd National Meeting of the American Chemical Society, 5-10 April in San Francisco.

**Problem Areas**

None

**Milestone Progress**

3031

30 September 1992

*Plutonium(IV) and Plutonium(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies*

On schedule.

3329

30 September 1992

*Report on Neptunium, Plutonium, and Americium Solubility Experiments in UE-25p#1 Water from Oversaturation.*

On schedule.

3330

*Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy*

Early completion anticipated.

Letter Report

*Spectroscopic Studies of the Hydrolysis of UCl<sub>4</sub>, Spectral Effects of Ligand Exchange*

In preparation.

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*Continued on next page*

L. E. Hersman, P. D. Palmer, and D. E. Hobart,  
*Preliminary Evidence of a Siderophore/Plutonium Complex*  
Journal article, *Journal of Applied and Environmental Microbiology*  
Undergoing revision.

H. Nitsche, R. C. Gatti, E. M. Standifer, S. C. Lee, A. Miller, T. Prussin,  
R. S. Deinhammer, H. Maurer, K. Becraft, S. Leung, and S. A. Carpenter  
*Measured Solubilities and Speciations of Neptunium, Plutonium, and Americium in a  
Typical Groundwater (J-13) from the Yucca Mountain Region*  
LA-series report  
In preparation.

C. D. Tait, D. E. Morris, J. M. Berg and W. H. Woodruff  
*Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy*  
In preparation.

C. D. Tait, D. E. Morris, S. A. Ekberg, P. D. Palmer, and J. M. Berg  
*Plutonium Carbonate Speciation Changes with pH*  
Conference abstract, *American Chemical Society National Meeting Program*, April 1992  
In YMPO review.

Report  
*Molecular Models for Actinide Speciation*  
Submitted 5/30/91.  
Internal technical review completed.

H. Nitsche  
*The Importance of Transuranium Solids in Solubility Studies for Nuclear Waste Repositories*  
Conference paper, *European Materials Society Meeting Program*  
Approved by YMPO.

D. L. Clark, D. E. Hobart, P. D. Palmer, J. C. Sullivan, and B. E. Stout  
*Carbon-13 NMR Characterization of Plutonyl(VI) Aqueous Carbonate Complexes*  
Journal article, *Journal of the American Chemical Society*  
In preparation.

D. E. Hobart, D. L. Clark, P. D. Palmer, J. C. Sullivan, and B. E. Stout  
*Carbon-13 NMR Characterization of Americyl(VI) Aqueous Carbonate Complexes*  
Journal article, *Inorganic Chemistry*  
In preparation.

D. L. Clark, C. D. Tait, D. E. Morris, D. E. Hobart, S. A. Ekberg, and P. D. Palmer  
*Plutonium(IV) and Plutonium(VI) Carbonate Speciation Studies by NMR and PAS  
Spectroscopies*  
LA-series report  
In preparation.

D. E. Morris and D. L. Clark  
*Spectroscopic Studies of the Hydrolysis of UCl<sub>3</sub>, Spectral Effects of Ligand Exchange*  
LA-series report.  
In preparation.

March 1992

#### WBS 1.2.3.4.1.4 Radionuclide Retardation by Dispersive, Diffusive, and Advective Processes

##### Objective

The objectives of this task are to determine the rate of radionuclide movement along the potential flow paths to the accessible environment and to examine the effect of diffusion, adsorption, dispersion, anion exclusion, sorption kinetics, and colloid movements in the flow geometries and hydrologic conditions expected to exist along the flow path to the accessible environment in the scenarios used for performance assessment.

##### Activities and Accomplishments

Staff participated in a one-week audit of the dynamic transport and diffusion studies.

I. Triay and A. Mitchell arranged for dynamic transport and diffusion staff to discuss their transport studies with R. Luce of the NWTRB geochemistry staff.

Staff prepared a budget document stating the impact of level funding for fiscal year 1993 as well the long-range impact of delaying work planned for FY93.

I. Triay participated in a technical data workshop.

M. Ott briefed visitors at the Los Alamos exhibit at the March 1992 YMP open house.

Continued Neptunium (Np) transport work using crushed-tuff columns made from tuffs G4-1530.3 and G4-275. To study Np transport, we must obtain sharp breakthroughs for tritium elutions. Np is expected to sorb to trace minerals in the tuff, and this will tend to broaden the elution curves; consequently, we must ensure that physical dispersion is not responsible for the broadening.

The columns described in Table 1 below have been used for our transport studies.

Table 1

Fig. No.	Column #	Flow Rate (ml/hr)	Length (mm)	Diameter (mm)	Dry/Wet Weight (g)
1	G4-1530.3A	0.3	254	9.5	17.8/26.9
2	G4-1530.3B	0.3	254	9.5	17.9/27.1
3	G4-1530.3C	3.0	254	9.5	17.8/26.9
4	G4-1530.3E	3.0	1000	4.72	16.7/28.7
5	G4-1530.3F	3.0	1000	4.72	16.7/28.7
6	G4-275A	0.3	254	9.5	24.64/32.03
7	G4-275B	0.3	254	9.5	24.5/32.31

Figures 1-7 show the cumulative activity of tritiated water eluted through the columns (A/A<sub>t</sub>) vs the cumulative volume eluted. All columns except G4-1530.3F were injected with 5 ml of tritiated water; an injection loop of 0.5 ml was used for column G4-1530.3F. We are in the process of optimizing all possible parameters (including packing techniques) to minimize elution broadening.

Continued on next page

Fig. 1 HTO elution through G4-1530.3A

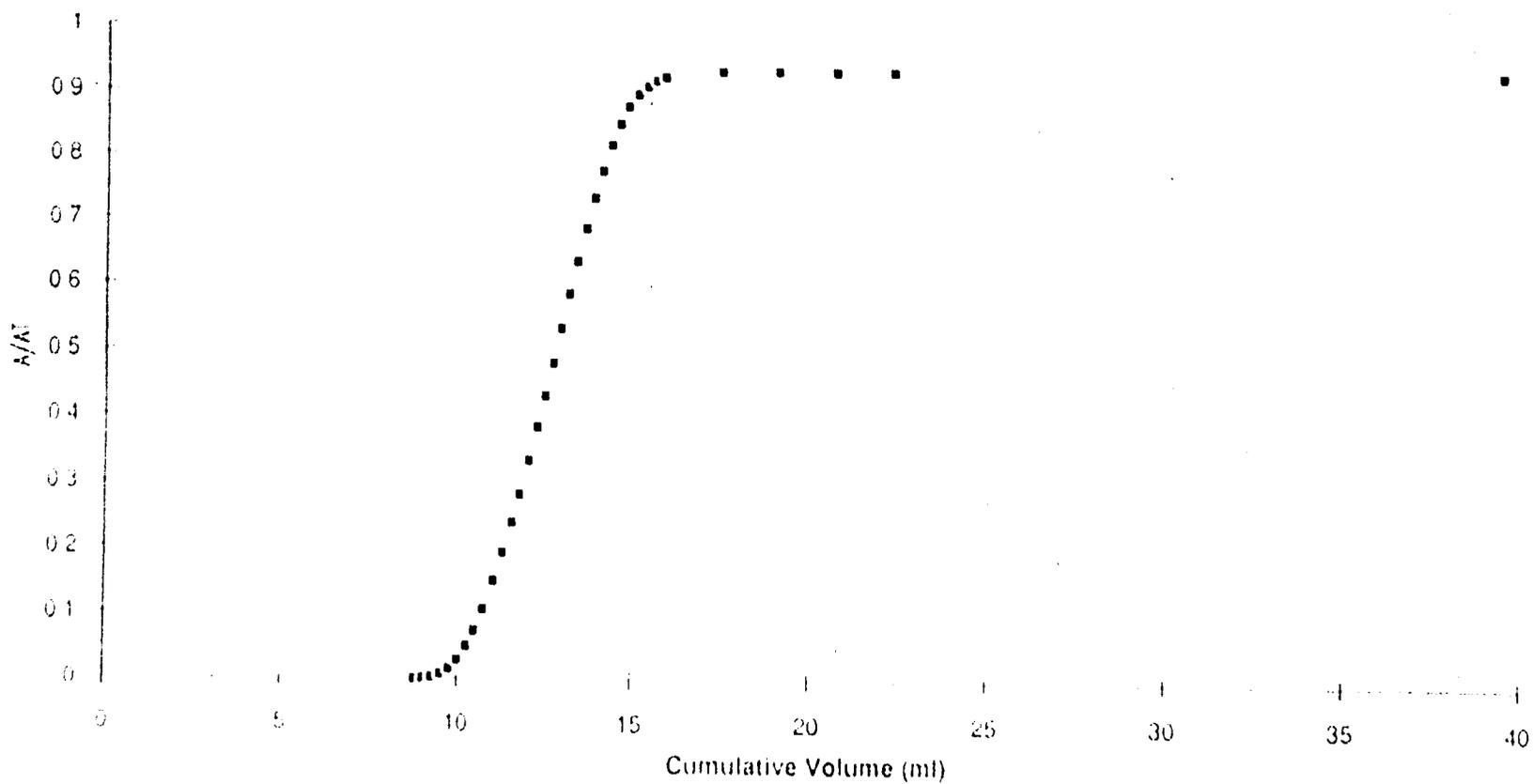


Fig. 2 HTO elution through G4-1530.3B

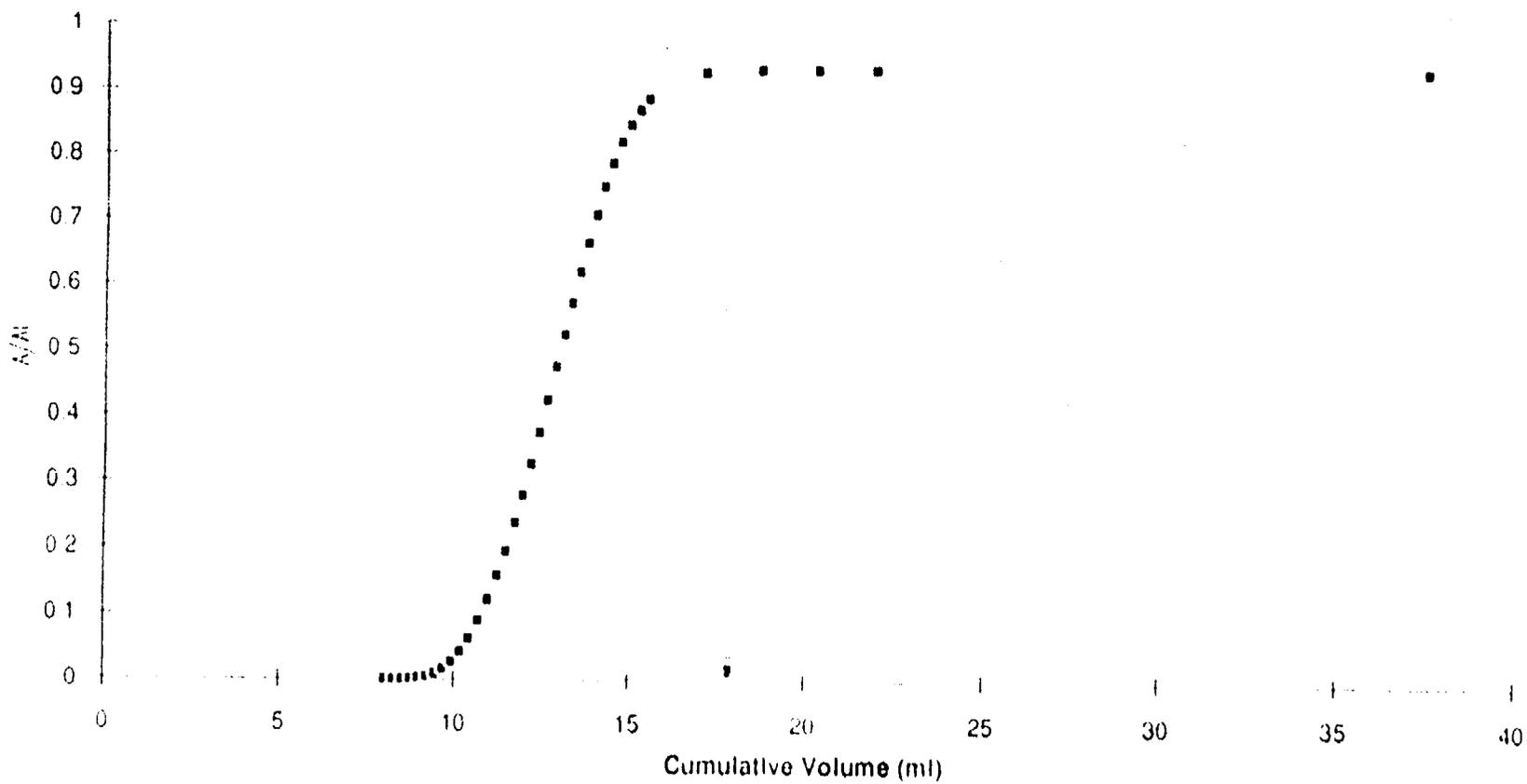


Fig. 3 HTO elution through G4-1530.3C

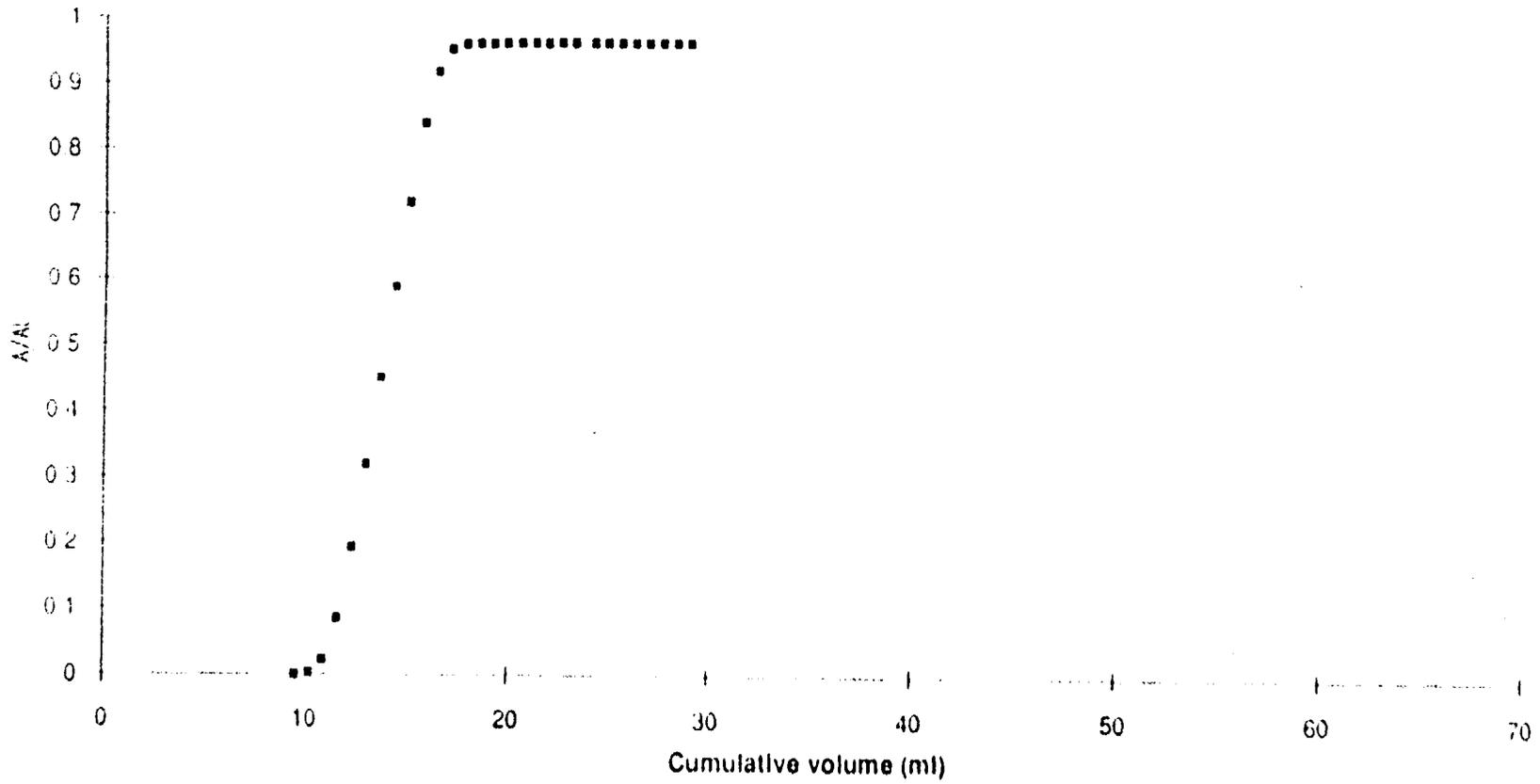


Fig. 4 HTO elution through G4-1530.3E

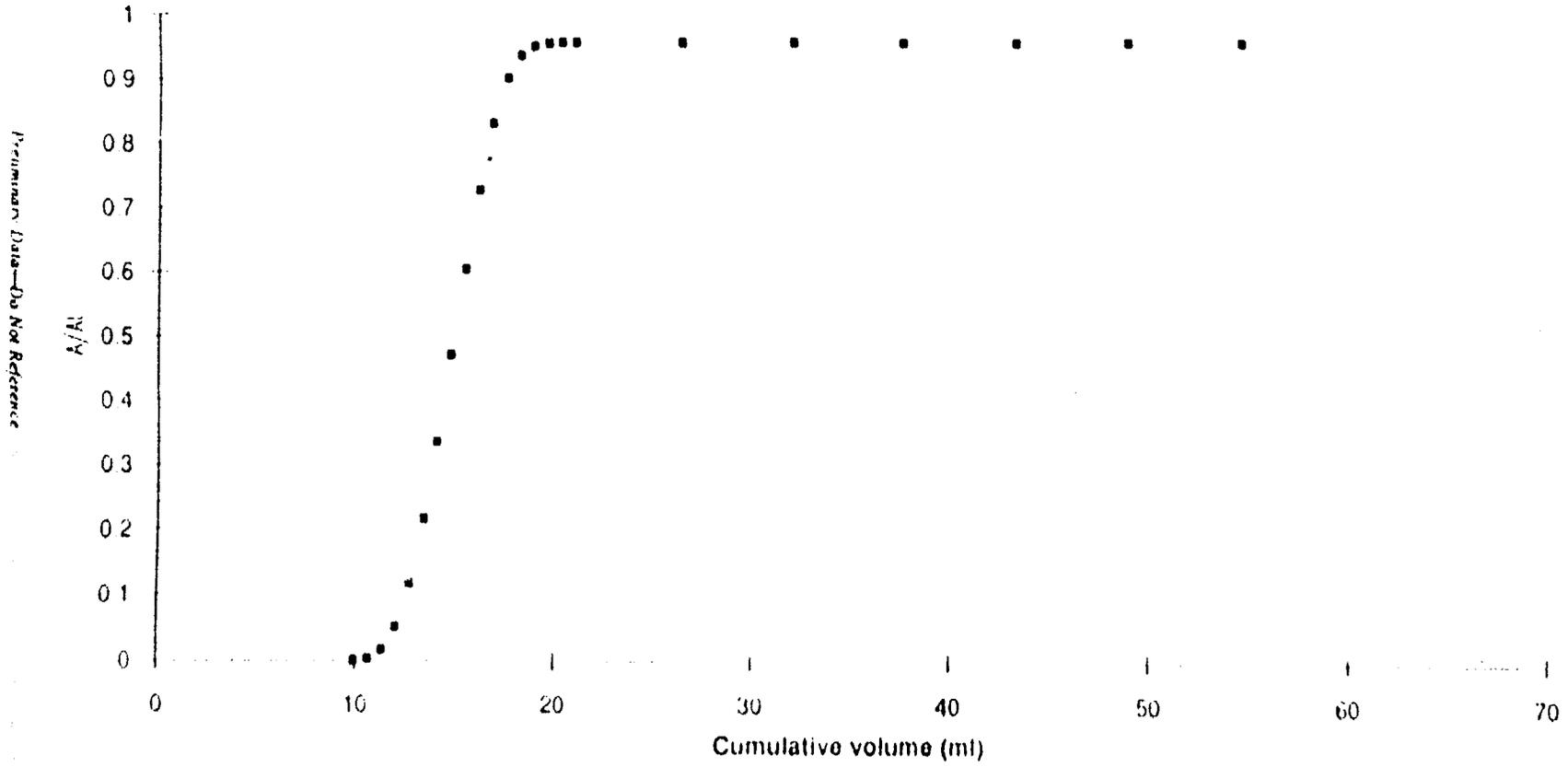


Fig. 5 HTO elution through G4-1530.3F

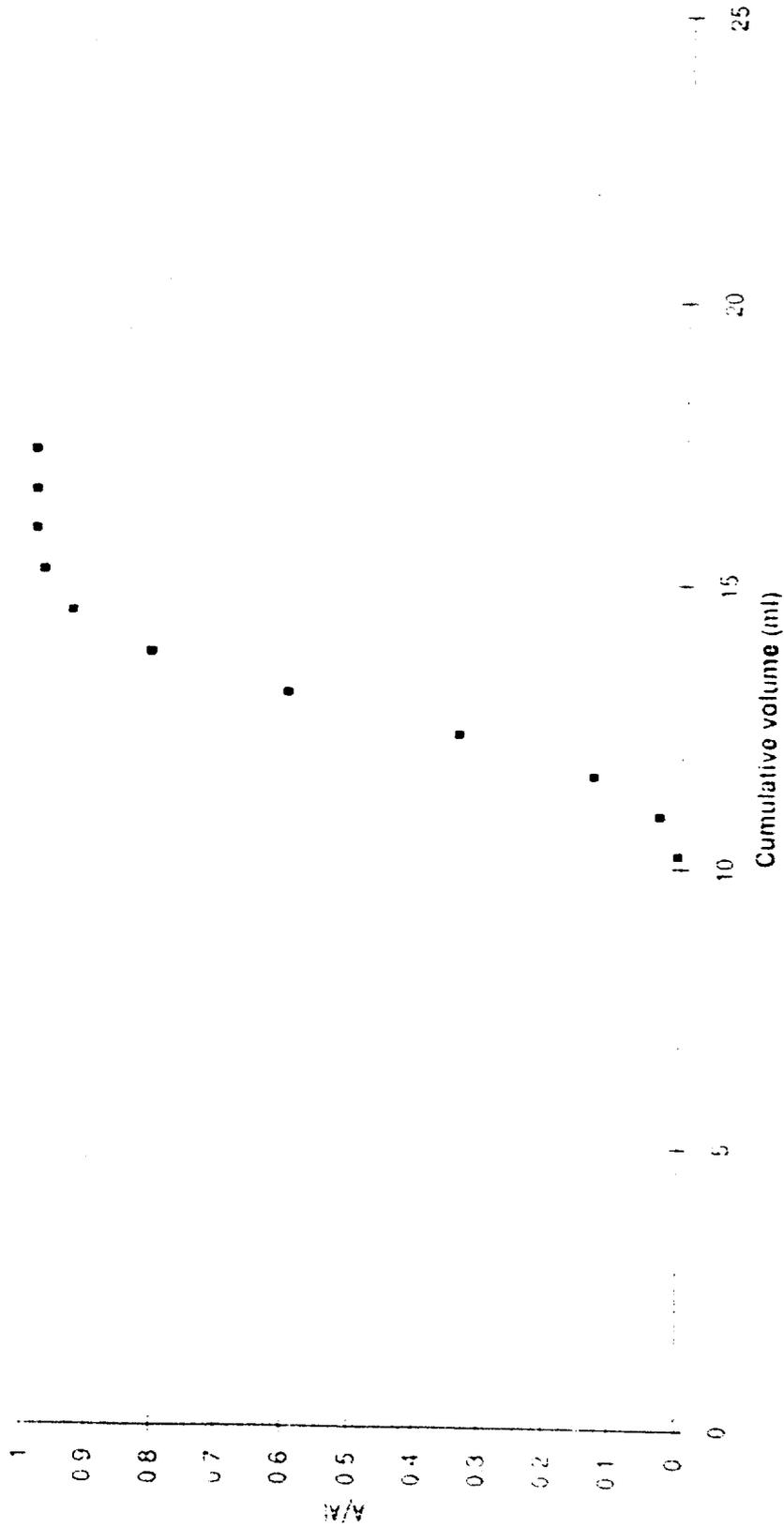
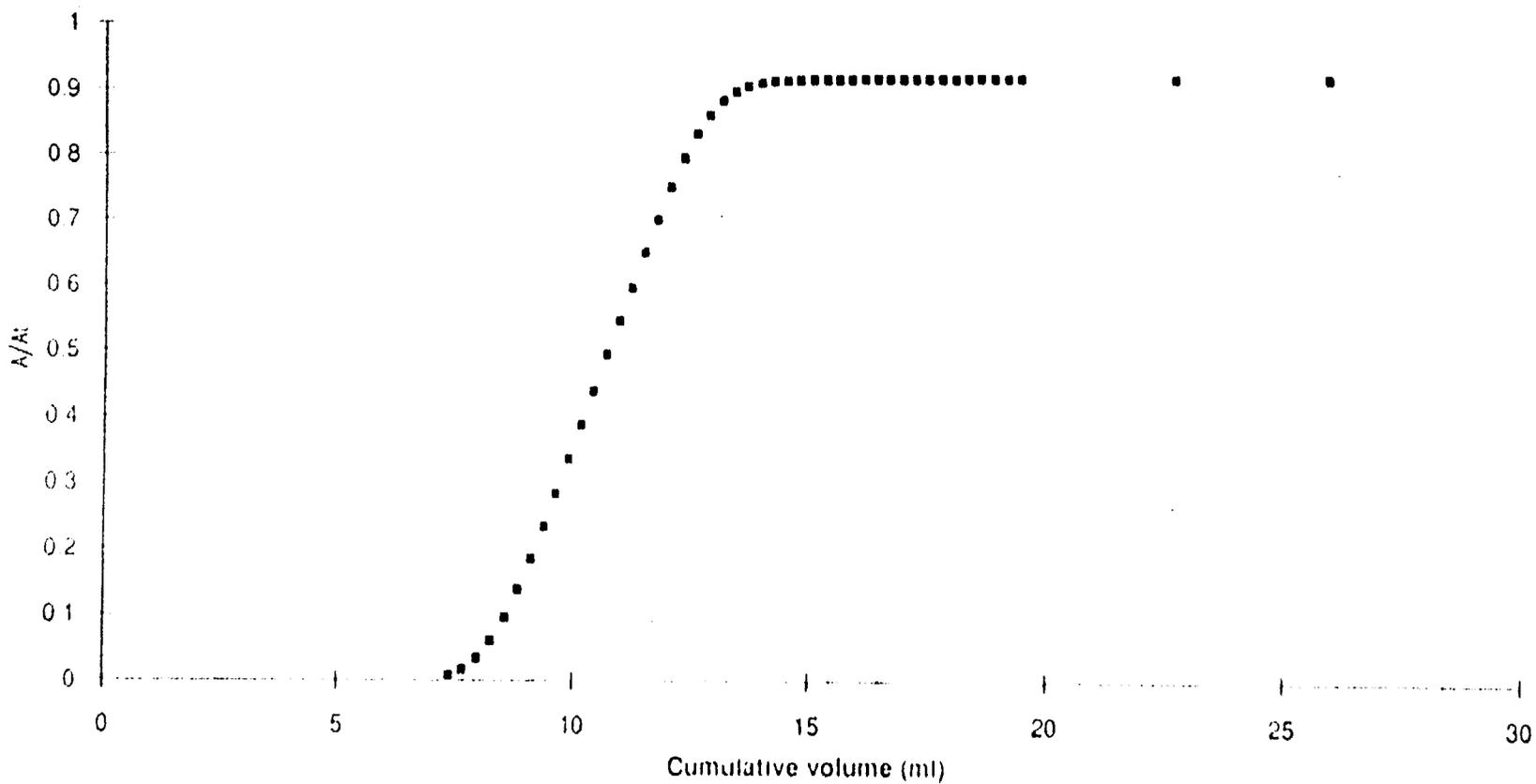
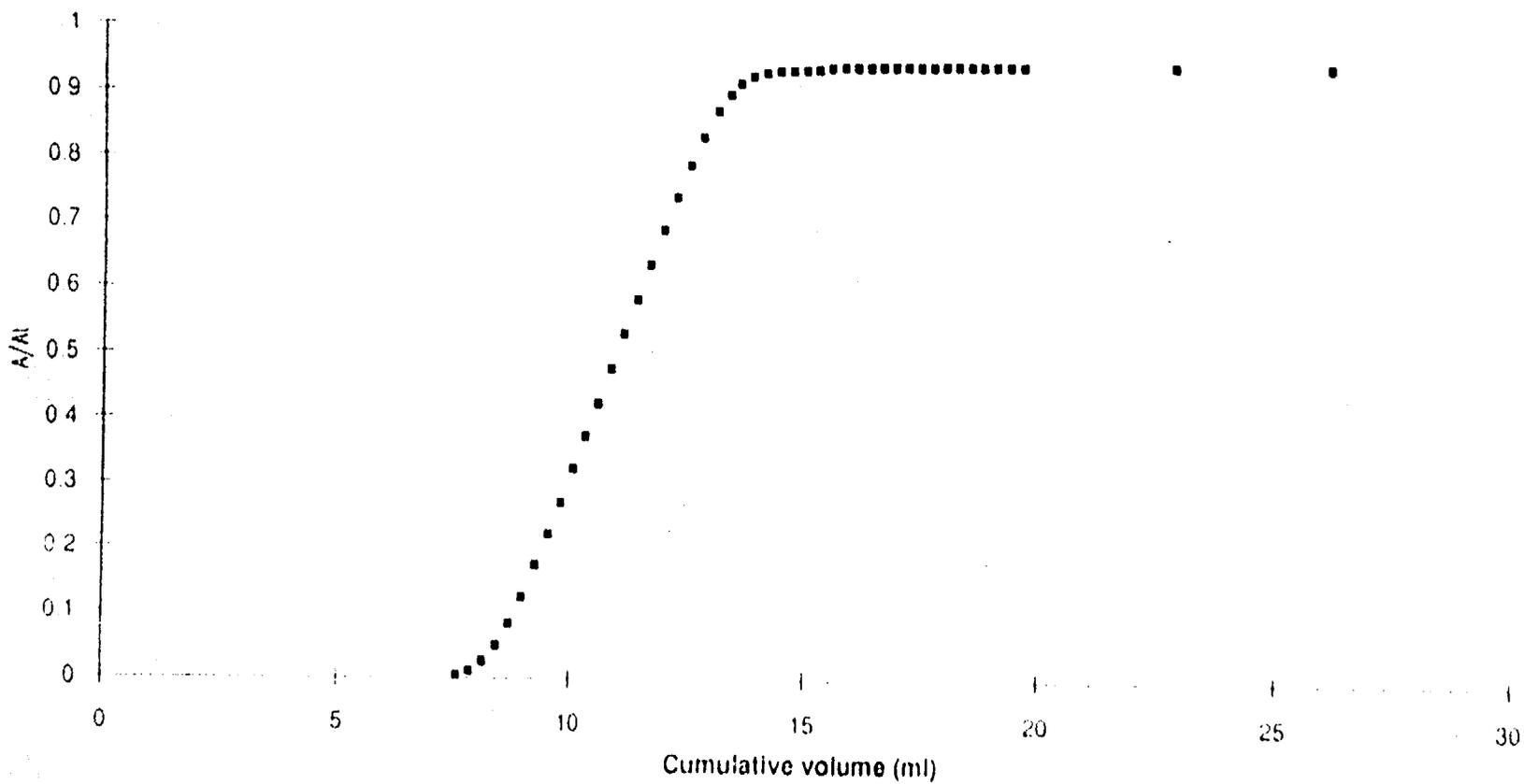


Fig. 6 HTO elution through G4-275A



Preparation Data Not Reference

Fig. 7 HTO elution through G4-275B



Interim Data - (1) Not Reference

March 1992

**Planned Activities**

Continue work described above.

**Milestone Progress**

3040

30 September 1992

*Kinetics of Sorption on Columns of Pure Minerals*

3044

31 August 1992

*Letter Report on Assessment of Available Techniques for Unsaturated Column Transport Experiments*

In preparation.

3027

31 March 1992

*Report on Sorption by Batch and Column Techniques*

**Publications**

I. R. Triay

*Radionuclide Migration in Tuff under Diffusive Conditions*

Conference Paper, *Proceedings of the Migration '91, Jerez de la Frontera, Spain,*

*14-18 October 1991*

In preparation.

I. R. Triay, A. J. Mitchell, and M. A. Ott

*Radionuclide Migration Studies for Validating Sorption Data—Past, Present, and Future*

Conference paper, *Proceedings of the DOE/Yucca Mountain Site Characterization Project*

*Radionuclide Adsorption Workshop* at Los Alamos National Laboratory September 11-12,

1990.

Submitted to YMPO.

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## WBS 1.2.3.4.1.5.1 Retardation Sensitivity Analysis

<b>Objective</b>	The objectives of this task are to construct a geochemical/geophysical model of Yucca Mountain and to use this model to examine the physical and chemical controls on radionuclide transport along flow paths to the assessable environment.
<b>Activities and Accomplishments</b>	<p><b>Physical/Chemical Processes Affecting Transport.</b> G. Zyvoloski and G. Valentine attended a joint DOE/NRC meeting in Albuquerque, NM, on 18 March. The focus of the meeting was modeling of heat and mass transfer in the unsaturated zone.</p> <p>A paper entitled "Three-Dimensional Simulations of Radionuclide Transport at Yucca Mountain" by K. Birdsell, K. Eggert, and B. Travis for the <i>Special Issue of Radioactive Waste Management and the Nuclear Fuel Cycle on the Yucca Mountain Project</i> was sent to YMPO for policy review.</p> <p>Editorial changes to Milestone R746, "Sensitivity Analysis of Integrated Radionuclide Transport Based on a Three-Dimensional Geochemical/Geophysical Model," by K. Birdsell, K. Campbell, K. Eggert, and B. Travis were completed. This report will be included in the "Proceedings of the Radionuclide Adsorption Workshop at Los Alamos National Laboratory September, 1990."</p> <p><b>QA and Programmatic.</b> Certification of TRACRN continued. TRACRN review committee comments on the Models and Methods Specification were addressed. Prologues were written for the include files, which were modified when memory management was added. The design phase will be resubmitted upon completion of these changes.</p> <p>Verification of TRACRN continued. The verification runs were written up in both the verification and validation plan and report.</p> <p>Staff participated in the DOE/SAIC YMP audit on 17-20 March. The audit team reviewed software QA and notebooks, and both were rated satisfactory.</p> <p>K. Birdsell attended the meeting on the status of the Software Quality Assurance Plan.</p> <p>K. Eggert, G. Zyvoloski, and K. Birdsell discussed this task with R. Luce, a member of the NWTRB.</p> <p>Corrective actions were completed for DR-LANL-0188.</p>
<b>Planned Activities</b>	Staff will attend the Los Alamos YMP project orientation class.
<b>Milestone Progress</b>	<p>3052</p> <p>30 March 1992</p> <p><i>Baseline Documentation for TRACRN</i></p>
<b>Publications</b>	<p>K. Birdsell, K. Eggert, and B. Travis</p> <p><i>Three-Dimensional Simulations of Radionuclide Transport at Yucca Mountain</i></p> <p>Journal article, Special issue of <i>Radioactive Waste Management and The Nuclear Fuel Cycle</i></p> <p>Submitted to YMPO.</p>

March 1992

## WBS 1.2.3.4.1.5.2 Demonstration of Applicability of Laboratory Data

<b>Objective</b>	The purpose of this study is to design and conduct experiments to evaluate the applicability of laboratory data and to test models used in the Radionuclide Transport Program to determine far field radionuclide transport. Both intermediate- and field-scale experiments and natural analogues will be assessed for their potential to provide the required data.
<b>Activities and Accomplishments</b>	<p>A presentation was made on 4 March in Las Vegas by N. Cook and J. Wang of Lawrence Berkeley Laboratory (LBL) on the potential of Rainier Mesa, particularly N and P Tunnels, as an analogue for Yucca Mountain. This effort was completed by LBL under this task. Cook and Wang pointed out many similarities and differences between Rainier Mesa and Yucca Mountain. They submitted a report for review.</p> <p>A Hydrology Integration Task Force (HITF) telecon was held 4 March to discuss the proposed joint meeting with the Geochemistry Integration Team. A joint telecon, with limited participation, was held 13 March, and the group decided to pursue fast flow paths at an upcoming joint meeting. An agenda of the meeting was to be completed.</p> <p>E. Springer participated in two Integrated Test Evaluation (ITE) meetings. The first meeting was held in Las Vegas on 12-13 March; the development of criteria and test categories was discussed. The second meeting was held 19 March at Sandia National Laboratory; its topic was the development of criteria for the site-suitability column to distinguish tests.</p>
<b>Planned Activities</b>	<p>Continue to develop study plan.</p> <p>Travel to LBL to discuss field test design, schedule and resources for this effort. This will have to be entered into PACS. Travel to Berkeley to brief YMPO personnel on the status of this task.</p> <p>Review LBL N and P Tunnels report. Attend ITE meetings.</p>
<b>Problem Areas</b>	None
<b>Milestone Progress</b>	No FY91 milestones.
<b>Publications</b>	<p>E. P. Springer <i>The Use of Anthropogenic Analogues in Site Characterization of Low-Level Radioactive Waste Sites</i> Conference Paper, <i>Proceedings of the 13<sup>th</sup> Annual DOE Low-Level Waste Management Conference, Atlanta, Georgia, 19-21 November 1991</i> In preparation.</p> <p>C. Woloshun <i>A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada</i> LA-series report Received YMPO approval on 29 October 1991. Accession numbers for references are being obtained.</p>

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Continued on next page

## WBS 1.2.5 Regulatory and Institutional

**Objective** The purpose of this task is to coordinate the regulatory and institutional Project requirements within the Los Alamos programmatic structure. The focus of this coordination effort is on the integration of the technical work within the regulatory and institutional framework.

**Management and Integration** Significant effort was made to put forth changes to the SCP Baseline. In particular, the rock-varnish work to support volcanism, erosion, and neotectonic studies was identified discretely. PACs changes were initiated. Work began to evaluate rock-varnish data in support of the erosion issue resolution.

**Study Plans** **Water Movement Test, R1 (8.3.1.2.2.2).** R1 has been approved by DOE but not by NRC. A revision incorporating NRC and State of Nevada comments was submitted to the YMPO on 17 October 1991.

**Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5).** A revision incorporating DOE/HQ and Project Office comments was submitted to Dr. Dobson in June 1991.

**Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7).** In February 1990 DOE/HQ issued this study plan as a controlled document; it was then sent to the NRC for comments. In January 1992 we were requested by DOE to revise NRC comments. The revision is in progress.

**Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1).** In March 1991 this study plan was submitted to the project office for review .

**Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1).** In August 1990 the NRC approved the study plan. In October 1991 we were asked to revise the study plan; in January 1992 we submitted revised comments to T. Bjerstedt.

**History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2).** The Project Office approved the study plan in December 1991 and submitted it to the NRC in January 1992 for comments.

**Natural Analogue Hydrothermal System in Tuff (8.3.1.3.3.1).** This is an out-year activity.

**Kinetics and Thermodynamics of Mineral Evolution and Conceptual Model of Mineral Evolution, R0 (8.3.1.3.3.2; 8.3.1.3.3.3).** A comment resolution meeting for DOE/HQ and Project Office comments was held in March 1990; revision on this activity has been deferred because funds have not been allocated.

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*Continued on next page*

March 1992

**Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3).** A revision is in progress.

**Biological Sorption and Transport, R1 (8.3.1.3.4.2).** Revisions incorporating DOE/HQ and Project Office comments were submitted in May 1991. Additional revised text were submitted in August 1991.

**Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2).** In November 1990 the project office submitted comments to Los Alamos to revise; that revision is in progress.

**Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1).** A comment resolution meeting for DOE/HQ and Project Office comments was held in August 1990; revisions are in progress and are expected to be completed by April 1992. **Diffusion, R0 (8.3.1.3.6.2).** A comment resolution meeting for DOE/HQ and Project Office comments was held in August 1990; revisions are in progress and are expected to be completed by April 1992.

**Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1).** A revision incorporating DOE/HQ and Project Office comments was submitted in June 1991. In October additional comments were received from SAIC, P. Cloke. The comments have been addressed and were submitted to the P. Cloke in March 1992.

**Demonstration of the Applicability of Laboratory Data to Repository Transport Calculations, R0 (8.3.1.3.7.2).** This study plan is in preparation.

**Gaseous Radiation Trans Calcites and Measures, (8.3.1.3.8.1).** Funds have not been allocated.

**Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1).** This study plan was approved by the Project Office in September 1990 and by the NRC in October 1991.

**Physical Processes of Magmatism and the Effects on the Repository, R0 (8.3.1.8.1.2).** In preparation, expected target date is May 1992.

**Characterization of Volcanic Features, R0 (8.3.1.8.5.1).** Accepted by NRC in September 1990.

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## WBS 1.2.6 Exploratory Studies Facility

<b>Objective</b>	These Exploratory Studies Facility (ESF) tasks address the issues and information needs associated with the ES-based characterization of Yucca Mountain to determine the suitability of permanently isolating high-level nuclear waste from biosphere in a geologic repository.
<b>Activities and Accomplishments</b>	Initiated work on developing Tracers, Fluids, and Materials (TFM) management program consistent with plan issued by the Project (YM 91-23) prepared by Los Alamos. Supported ED&D in developing briefing material for Prototype Test Facility. Developed and addressed methodology to manage TFM. Reviewed APQs to ascertain best approach to capture TFM to be used at the Yucca Mountain. Continue to participate in Test Integration (TIG) meetings and SMF meetings. Prepare briefings for weekly ESF management meeting. Started activities to develop ESF-based sample requirements for laboratory tests. Started developing test information for tests to be performed in north-portal area. Developed a comprehensive list of "To Be Determined" (TRD) items in Appendix B of the ESF Design Requirements Document for the project office.
<b>Planned Activities</b>	<p>Implement strategy to gather TFM information from participants.</p> <p>Continue to develop definitive design related information for tests to be performed in the launch chamber.</p> <p>Continue to support integration meetings such as ESF design, TIG, SMF surface-based testing and its interface with ESF testing.</p> <p>Continue to replan Los Alamos effort.</p> <p>Develop interfaces for testing and the ESF design.</p> <p>Revise and update PSAR as required.</p> <p>Prepare Title II Test Planning Packages.</p> <p>Develop new networks for ESF testing.</p> <p>Meet with CRWMS/M&amp;O regarding the Integrated Data System for the ESF.</p> <p>Participated in ESF replanning meetings, RSED guided TIG meetings, surface-based drilling and testing meetings, and Field Operations Center weekly meetings.</p>
<b>Problem Areas</b>	None
<b>Milestone Progress</b>	None

March 1992

#### WBS 1.2.6.8.4 Integrated Data System

**Objective**

The integrated data system (IDS) supports the Exploratory Studies Facility (ESF) test program by providing a central facility to automatically measure and control aspects of the ESF tests. The primary purposes of the IDS are to assist the principal investigators (PI's) in acquiring high-quality test data in a uniform, controlled fashion and to transfer those data to the PI's organizations for data management and analysis.

**Activities and Accomplishments**

This activity has been deferred.

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## WBS 1.2.9.1.2.4 Technical Software Management

### Objective

The purpose of this activity is to manage the development, implementation, and use of all software employed on activities that will support a license application; to manage the configurations of all software and computational data; and to provide tools and procedures that support these activities. Technical software management continued to perform the quality assurance, configuration management, and engineering tasks that are required by the Los Alamos Software Quality Assurance Plan for the Yucca Mountain Project.

### Activities and Accomplishments

Software configuration management (SCM) staff continued to perform the quality assurance, configuration management, and engineering tasks that are required by the Los Alamos Software Quality Assurance Plan (SQAP).

G. Cort participated in an all-day meeting called by the QALP on 9 March to determine how to modify the software quality assurance program in light of the recent budget cuts. After a review of the existing SQAP with respect to DOE Order 1330.1c and the most recent (draft) version of the QARD, the group agreed that no substantive changes should be made to the existing SQAP.

SCM was audited by DOE from 17-19 March, and no findings were recorded. The auditor and NRC observer expressed concerns about the viability of the SQAP after the existing software quality assurance team leaves the Project (because of budget cuts) on 1 May.

G. Cort conducted two Laboratory-wide training sessions in software configuration management.

The DOCCEN application continued in prototype development. The design is almost complete and should be implemented soon.

The command-line parser, which will enable developers to easily define legal command lines for their applications and obtain information from the Unix command line, is almost complete. Little progress was made on this tool this month because of other more pressing tasks.

Prototype development continues for a set of reuse components for the SCM effort, File-List Utilities, which will allow us to automate many tasks.

Support of the software review process continued in the form of inspections and review committee participation. Support of the SCM effort continued.

G. Cort, S. Donahue, and D. Hines produced a draft R1 version of the SQAP and its procedures. The documents have been submitted for review.

Four SIRs were submitted to address some minor problems with the INTERFACE\_TABLES application. The necessary changes have been incorporated into the application, which has been submitted for review.

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*Continued on next page*

March 1992

SCM processed four baseline submissions, storing the submitted material in the certification environment, generating the attendant SCM documentation, performing physical and functional configuration audits on each, and generating software review packets to support Configuration Control Board (CCB) review of each. SCM sanctioned twenty-nine software applications, of which ten had submitted baselines that were certified and stored in the Computer Program Library. The remainder were system or acquired commercial software applications for which there were no baselines. Two CCB meetings were held at which five reviews were approved and one SCM Variance Authorization was issued.

**Planned Activities**

**Configuration Management:**

- Continued management of submitted baselines and change requests.

**Software Engineering:**

- Continued work on the object-oriented design of the command line parser
- Continued support of the schedule update effort for project control section
- Continued support of the SCM effort
- Continued technical support of the software review process.

**Problem Areas**

None

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#### **WBS 1.2.9.1.4 Records Management**

**Objective**

The objective of this task is to manage records and documents related to the licensing of a geologic repository for the disposal of high-level radioactive waste by developing, implementing, and maintaining a comprehensive, automated, and integrated information management system.

**Activities and Accomplishments**

Stop Work Order, SWP-LA-07, against LANL-YMP-QP-17.3, R1, Section 6.10, was lifted 4 March. Records held in the RPC because the stop work order will be submitted to the CRF by 15 April. K. West and L. Sanders attended a records coordinators' conference hosted by DOE in Las Vegas, NV, on 4-5 March.

The Records Processing Center rejected 10 records and accepted 62 records in March.

---

March 1992

### WBS 1.2.9.3 Quality Assurance

<b>Objective</b>	The Quality Assurance (QA) Program supports Los Alamos Yucca Mountain Site Characterization Project participants and ensures that their efforts provide data and evidence admissible for the repository-licensing process.
<b>Activities and Accomplishments</b>	<p><b>Software.</b> One software Configuration Control Board (CCB) meeting was held. Efforts to process change requests continue.</p> <p><b>Grading Reports.</b> Los Alamos has 33 approved grading reports. A revised grading report was accepted; one additional revised report is in review at the Project Office.</p> <p><b>Records/Document Control.</b> Three detailed technical procedures (DP-66, DP 96, and DP 605) and quality administrative procedures QP 16.3, R1 (Deficiency Reports) and QP 3.23, R0 (Preparation and Review of Technical Information Products and Study Plans) were issued.</p> <p><b>Training.</b> The March indoctrination class was attended by 17 YMP personnel.</p> <p><b>Program Development.</b> Fifteen quality administrative procedures (QPs) are in various stages of revision. A traveler identifying specific due dates is now used to streamline the QP process.</p> <p><b>Deficiencies.</b> Actions to close CARs YMP-92-002 and 003 were accepted and verified by the Project Office. Stop work order SWO-07 (against QP 17.3, Records Management) was lifted. Internal surveys SR-92-004 and SR-92-005 were conducted to determine the status of stop work orders SWO-03 and SWO-02, respectively. Stop work order SWO-02 (Subcontractor Personnel Qualification) was subsequently lifted.</p> <p><b>Audits.</b> The audit report for EES-1 activities (LANL-AR-92-001) was approved and issued. Internal audits of EES-13/Las Vegas (LANL-AR-92-02), and subcontractors University of New Mexico (LANL-AR-92-03), Ohio State University (LANL-AR-92-04), and University of California at Riverside (LANL-AR-92-05) are in process. The audit report for criterion 18 (LANL-AR-91-16) was approved and issued.</p> <p>DOE conducted external audit YMP-92-012 of Los Alamos technical activities (criteria 3, 5, 6, 17, 19, 20). No CARs were issued. An internal survey, LANL-SR-92-001, was conducted to verify that no further actions were needed to resolve a deficiency corrected during the audit. The audit team complimented investigators on their implementation of the notebook procedure and software quality assurance program.</p>
<b>Planned Activities</b>	QP revisions will continue and three 1991 survey reports will be completed. The 1991 quality assurance status report will be sent out for Laboratory editorial review. An indoctrination class will be offered in April. The audits of EES-13/Las Vegas and associated subcontractor activities (LANL-AR-92-02,3,4) will be completed.
<b>Problem Areas</b>	The current software quality assurance plan is being examined. Modifications will be determined by budget constraints.

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*Continued on next page*

**Publications**

S. L. Bolivar

*The Los Alamos National Laboratory Yucca Mountain Site Characterization Project Quality Program,*

A Progress Report for January 1, 1990 - December 31, 1991.

In internal review.

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APPENDIX

ATTACHMENTS AND LEVEL III MILESTONE REPORTS



# Lawrence Berkeley Laboratory

1 Cyclotron Road Berkeley, California 94720

(415) 486-4000 • FTS 451-4000

(510) 486-6509 • FTS 451-6509  
Mailstop 70A-1150  
Telefax (510) 486-5799 • FTS 451-5799

WBS 1.2.3.1.3.1  
QA: N/A  
TWS-LBL-03-92-01

March 3, 1992

Dr. David E. Hobart  
Los Alamos National Laboratory  
Mail Stop G-739  
Los Alamos, New Mexico 87545  
FAX: FTS 855-4624

RE: Letter Report for February 1992

Dear Dave:

During the reporting period, we continued working on the project "Determination of Solubilities and Complexation of Waste Radionuclides Pertinent to Disposal at Yucca Mountain."

Figures 1, 2, and 3, the latest approach-to-equilibrium plots for Np, Pu, and Am/Nd, respectively, are enclosed. Figure 1 shows that the neptunium solubility experiments have reached steady-state. We are unsure why the last two assays in the pH 7 experiment show the changes in concentration, but we are looking into possible causes. Until an answer is found, this experiment will continue and, more assays will be taken. UV/VIS absorption spectrophotometry studies of the neptunium experiments have been performed to determine the solution species, and the results are being worked up now. We will begin the undersaturation experiments soon. We will start with neptunium at pH 6, then with pH 8.5 because these oversaturation experiments have already reached steady-state for some time.

*Preliminary Data—Do Not Reference*

Dr. David E. Hobart

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3/3/92

Figure 2 shows that the three plutonium solubility experiments have also reached steady-state. We are preparing to perform oxidation state separations for the determination of plutonium species present. After this, undersaturation experiments with the plutonium solids will begin.

Figure 3 shows that the Am/Nd solubility experiments require much more work. The low americium solubility in UE2Sp#1 at 60° C leads to assays with very low count rates. Neptunium and plutonium samples usually have enough activity that results can be obtained with relatively short counting times. The rather irregular approach-to-equilibrium plots for the americium experiments are probably caused by the relative concentration inaccuracy due to too short counting times and the non-consideration of the low-level counter background. To avoid extra long counting times for the gamma pulse height analysis of each sample, we tried to use alpha liquid scintillation counting because of its high efficiency. We found, however, that this method will not work for the following reason: Am/Nd has a very low solubility in UE2Sp#1, while  $^{237}\text{Np}$ , the daughter of  $^{241}\text{Am}$ , has a rather high solubility relative to Am/Nd. Even though the daughter impurity is very small in the initial stock solution, we have enriched the Am/Nd/UE2Sp#1 solution with  $^{237}\text{Np}$  to a significant degree with regard to gross alpha activity. Liquid scintillation counting does not have the resolution to distinguish between these alphas, and is, therefore, unsuitable for this situation. We must now perform low-level gamma pulse height analysis of all Am/Nd samples, which necessitates the use of very long counting times as well as periodic background counts.

The problems that we experienced with the new hardware for our personal computer multichannel analyzers have been corrected, and low level gamma pulse height analysis of Am/Nd assays has begun, including the assays from the second filtration experiment.

Dr. David E. Hobart

Page 3

3/3/92

Regarding our QA effort, we completed a detailed technical procedure (draft) titled "Operating and Calibrating the Mettler H6T Analytical Balance," TWS-LBL-DP-14, R0. We have included our draft for technical and quality assurance reviews. Would you please designate a technical reviewer for the procedure. Terry Morgan will perform the quality assurance review, and he may suggest a technical reviewer as well. We are continuing work on the draft detailed technical procedure, "Concentration Determination of Soluble Radionuclides From Data Provided by the Low Energy Gamma Counting System," TWS-LBL-DP-01, R0.

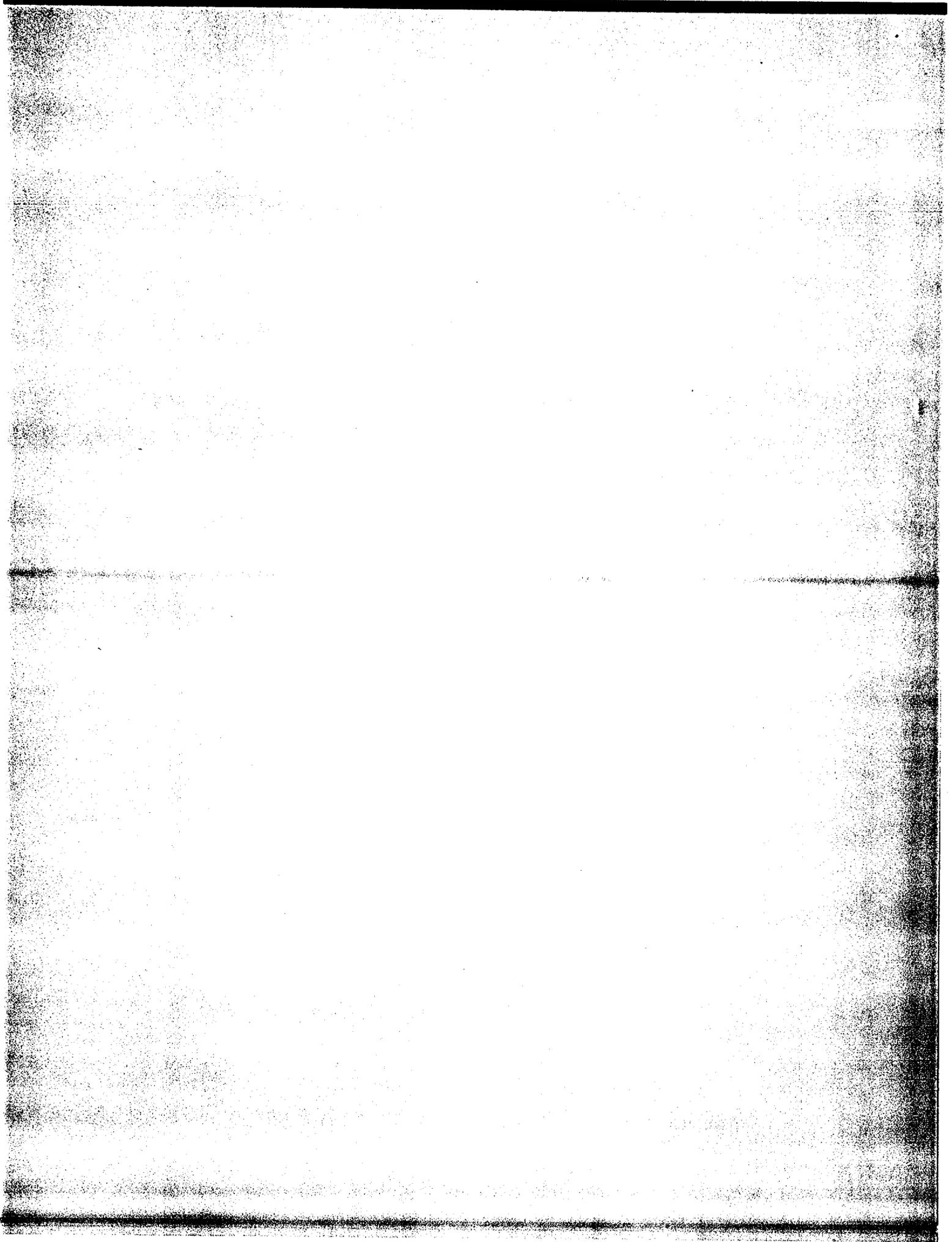
If you have any questions, please call me.

Best regards,



Heino Nitsche, Ph.D.  
Principal Investigator  
Actinide and Radiochemistry  
Earth Sciences Division

cc: Dr. David E. Morris



APPROACH TO EQUILIBRIUM OF  $^{237}\text{Np}$  IN UE25-p#1 WATER  
at 60° C and pH's 6, 7, and 8.5

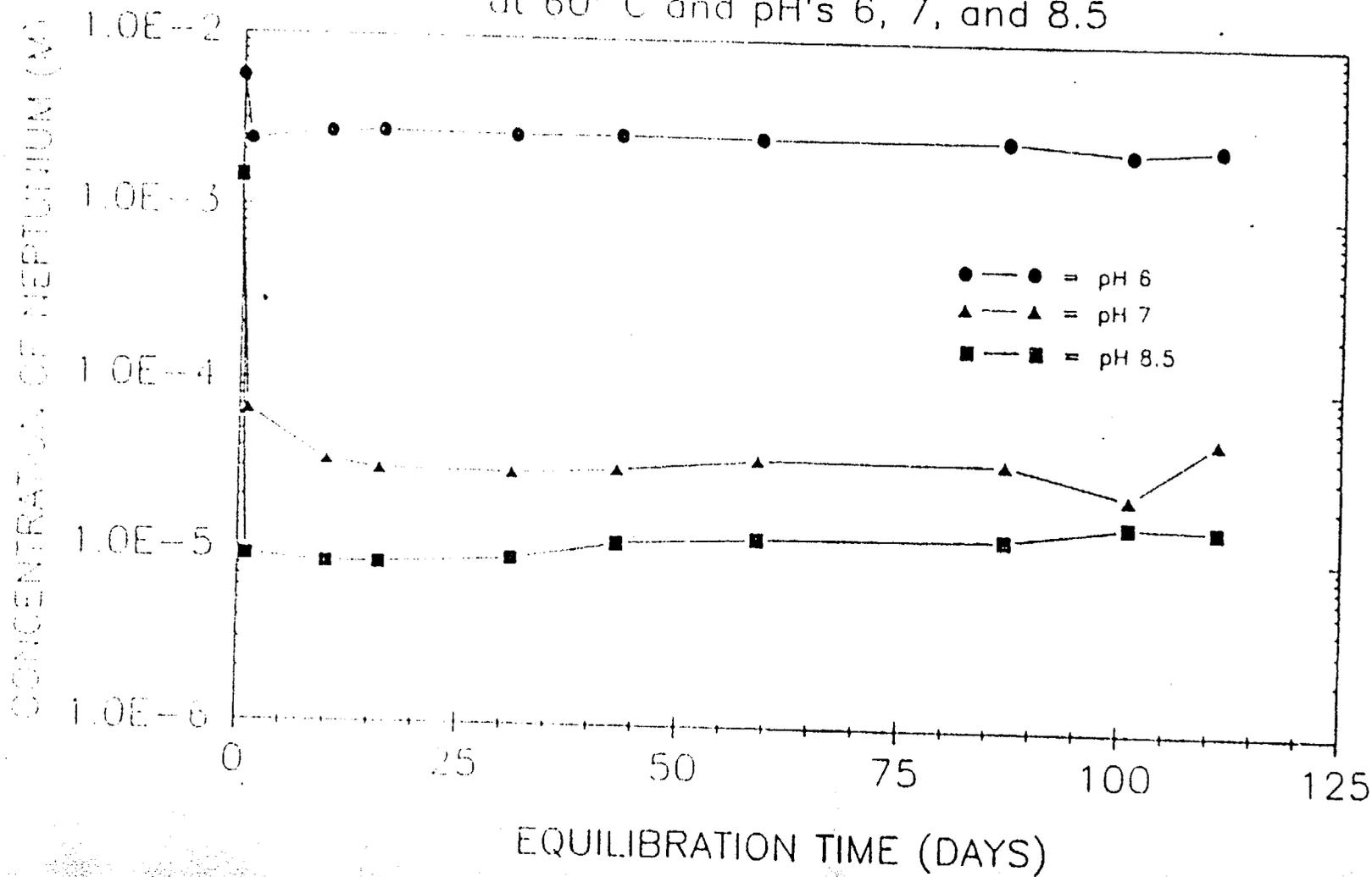
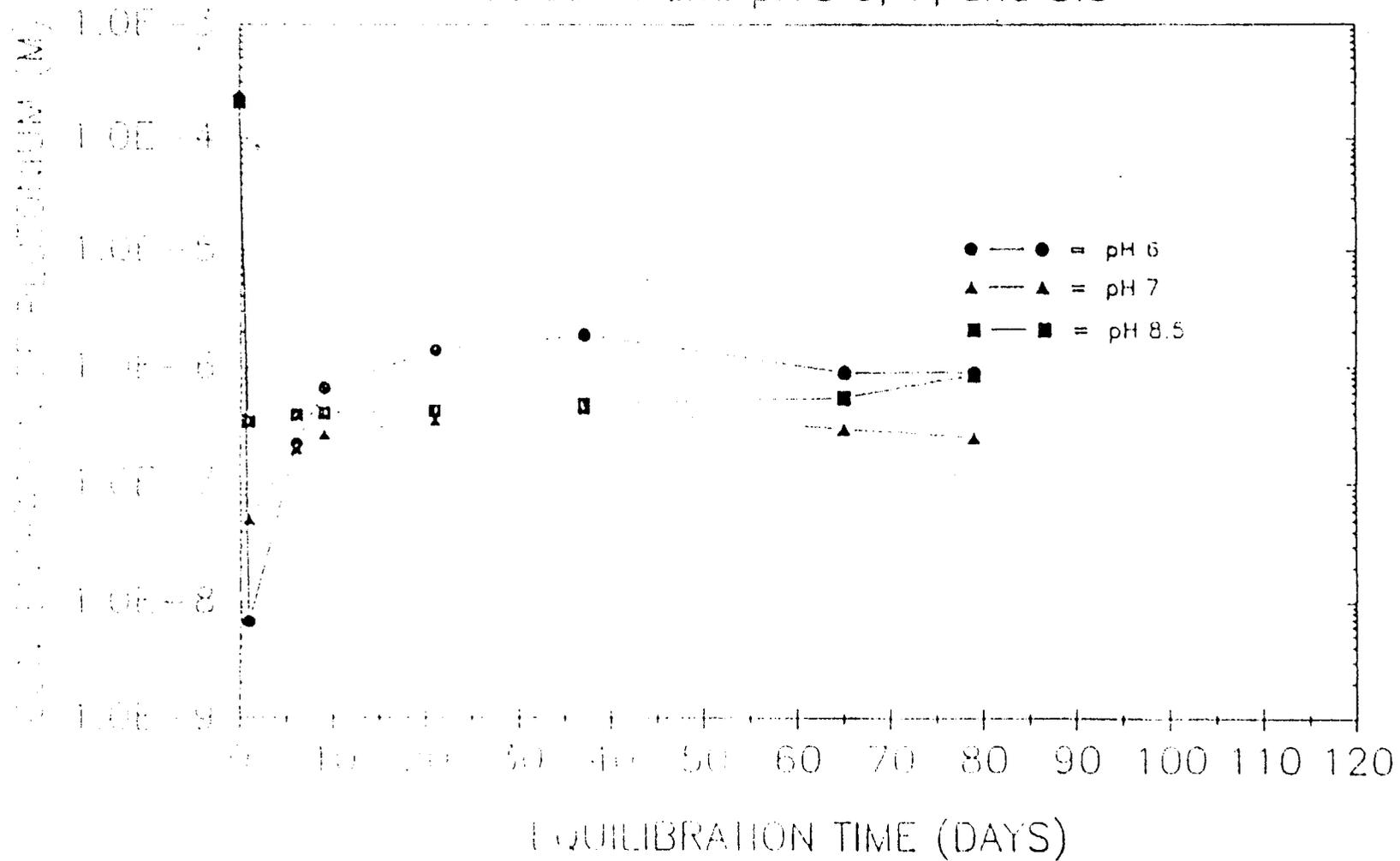


Figure 1

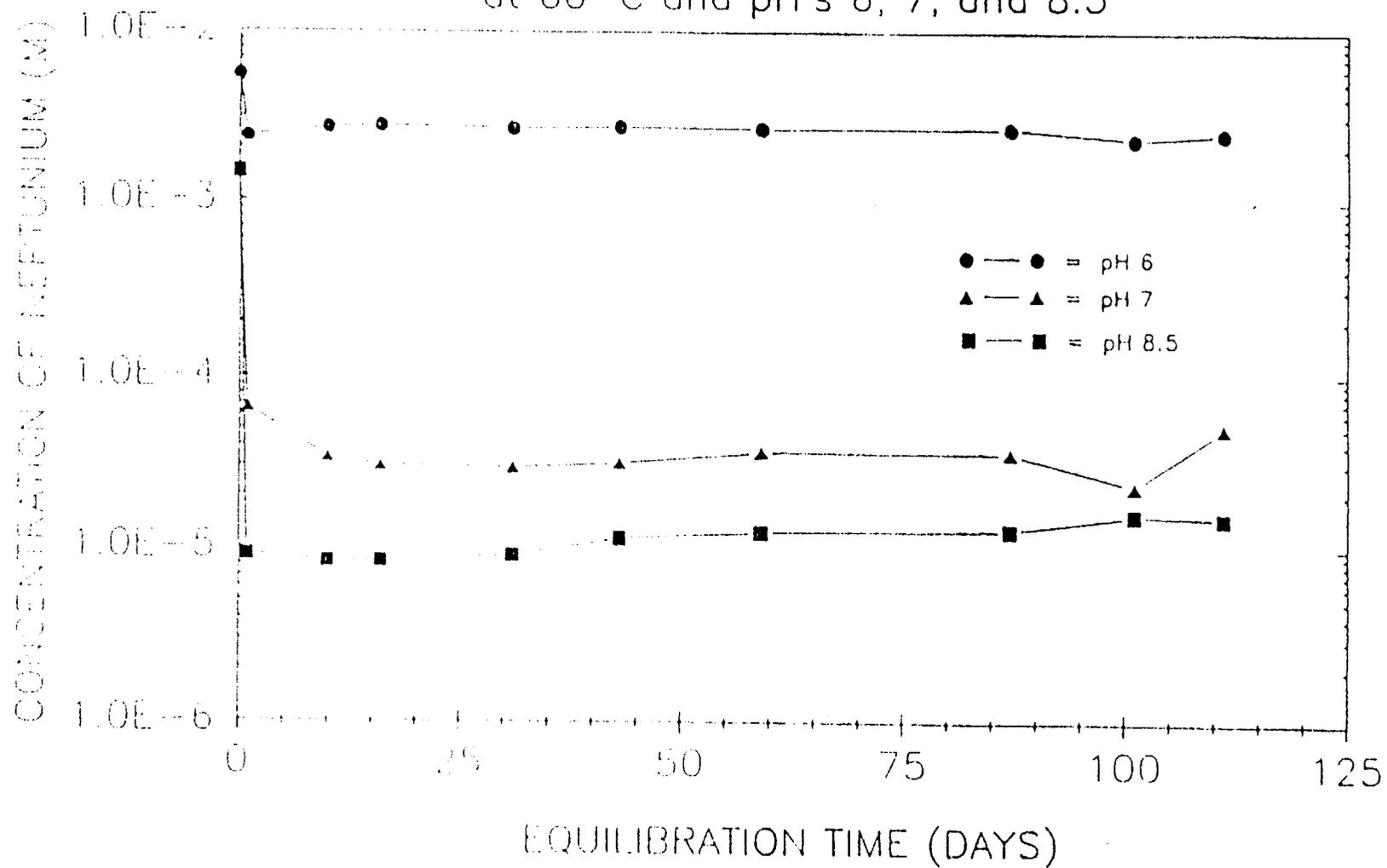
APPROACH TO EQUILIBRIUM OF  $^{239}\text{Pu}$  IN UE25-p#1 WATER  
at 60° C and pH's 6, 7, and 8.5



PJAEQUE6.GRA  
24 FEBRUARY 1992

Figure 2

APPROACH TO EQUILIBRIUM OF  $^{237}\text{Np}$  IN UE25-p#1 WATER  
at 60° C and pH's 6, 7, and 8.5



NPAEQUE6 GRA  
24 FEBRUARY 1991

Figure 3



Carl P. Gertz  
580-01-336  
April 8, 1992  
Page 2

cy w/encl.

Central Files THRU

Executive Office, M/S 555

C. E. Hampton, DOE/NV, M/S 505  
W. J. White, DOE/NV, M/S 505  
M. B. Blanchard, DOE/YMP, M/S 523  
U. S. Clanton, DOE/YMP, M/S 523  
M. O. Cloninger, DOE/YMP, M/S 523  
W. R. Dixon, DOE/YMP, M/S 523  
J. R. Dyer, DOE/YMP, M/S 523  
B. D. Hutchinson, DOE/YMP, M/S 523  
V. F. Ioril, DOE/YMP, M/S 523  
E. H. Petrie, DOE/YMP, M/S 523  
W. B. Simecka, DOE/YMP, M/S 523  
W. A. Wilson, DOE/YMP, M/S 717  
P. Prestholt, NRC/Las Vegas, NV  
R. C. Furtek, REECo, M/S 235  
B. R. Gardella, REECo, M/S 408  
W. J. Glasser, REECo, M/S 408  
J. L. Henze, REECo, M/S 751  
R. B. Land, REECo, M/S 585  
T. M. Leonard, REECo, M/S 408  
K. L. Limon, REECo, M/S 408  
C. J. Mason, REECo, M/S 751  
S. O. Straub, REECo, M/S 408  
J. R. Trujillo, REECo, M/S 590  
R. A. Adams, SAIC, M/S 517  
M. Brodeur, SAIC, M/S 517/T-23  
R. D. Hutton, SAIC, M/S 517  
S. C. Smith, SAIC, M/S 517/T-10  
J. W. Teak, SAIC, M/S 517  
J. E. Therien, SAIC, M/S 517  
R. S. Saunders, W, M/S 517/T-24

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

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)

MARCH 1992 - STATUS REPORT

**SITE (1.2.3)**

**WBS 1.2.3.5**

Task: LM-300 Drill Rig and Pipe Handling System

The LM-300 drill rig and pipe handling system is presently rigged up at the Area 25 Subdock on display for groups touring the Yucca Mountain area. The rig is tentatively scheduled to be put into operation on the UZ-16 drillhole in early April 1992.

Received a Subcontract Release Statement from Lang Exploratory Drilling for the performance testing of the LM-300 and pipe handling system. Final payment was processed, the total Subcontract amount is \$122,835.37.

Task: Capital Equipment to support Drilling Programs

Procurement of the air processing and metering system, awarded to Perry Equipment Corporation (PECO), is in progress. A meeting was held at the PECO location to resolve issues associated with back pressure valves. Delivery is now scheduled for April 20, 1992.

The Mobile All-Terrain Drill Rig will be awarded in early April with delivery scheduled for May 1, 1992. Procurement is also in process for conveyor belts and two filter units to support the drilling program.

Task: USGS Hydrological Research Facility (HRF) Holes (Job Package 91-6)

All work in support of HRF holes has been completed.

Task: Neutron Access Holes (Job Package 91-9)

Completed UZ-N36, UZ-N17 and UZ-N15; presently coring at 51 feet on UZ-N16.

Task: JF-3 Water Monitoring Well (Job Package 92-1)

Completed 36-hour pump test on March 5, 1992. Removed the 1.5-inch tubing and USGS transducer from the well, removal of the test pump is scheduled April 6, 1992.

Task: Reclamation Trial Sites

Regraded fourth and fifth (final) sites.

Task: NRG-1 (Job Package 92-2)

Initiated site preparation activities to include clearing, grubbing and topsoil removal. Cut and fill is 90 percent complete; experienced four days of delay waiting for a Field Change Notice.

Excavated, shored, and closed all 5 original soil pits in access road centerline. Excavation and study of the remaining 27 pits is in progress with one-half excavated.

Task: UZ-16 Drilling (Job Package 92-4)

Mobilized equipment, removed and stockpiled topsoil, completed cut and fill for drill pad.

Task: Midway Valley Trenching (Job Package 92-5)

Excavated and shored 20 pits and trenches.

Task: Drill Site Cleanup

Removed construction and drilling debris from identified drill pads.

**EXPLORATORY STUDIES (1.2.6)**

WBS 1.2.6.1

Task: Exploratory Studies Facility (ESF)

Continued to provide constructability support to activities to begin Tunnel Boring Machine (TBM) operations and ESF Title II design. Distributed Request for Proposal (RFP) 1-DH-92 for the Technical Support and Underground Excavation for the ESF to prospective offerors on March 30, 1992. Copies were concurrently provided to DOE/NV for review and forwarding to DOE HQ. The RFP will not be closed until approval is obtained. A Pre-proposal conference is scheduled for April 29, 1992.

Prepared Requests for Matrix Support Services as required for upcoming site investigations job packages.

**FIELD OPERATIONS (1.2.7.4)**

Task: Administrative & Maintenance Support

Continued support to W. A. Wilson, Yucca Mountain Site Manager, to include: process purchase requisitions for Field Operations Center (FOC) Site Office requirements; provide support services to participants and maintenance to TMP utilized facilities, equipment and roads in Area 25; and provide logistical and support services to management contractor.

Provided support for the Yucca Mountain Site Office open house and public tours. Nine tours were held during this period with 375 people attending. Support included but was not limited to: arrangements for buses; registration of guests; coordination of lunches/beverages, medical service, furniture, mechanical service; and grading of access road. Continued preparations for upcoming tours.

Task: Deactivate Well VH-1

Completed site cleanup and deactivation. Performed technical inspection on leased water tanks prior to return.

Task: Class III Sanitary Landfill

Continued preparation of Title II design and surveying activities.

**PROJECT MANAGEMENT (1.2.9)**

WBS 1.2.9.1

Task: Management and Administrative Support

Continued coordination and staffing of YMP displays at meetings, exhibits, and conferences; staffed and supported the Public Reading Room of the Research and Study Center; and participated in transfer of DOE property to University of Nevada, Reno.

Distributed project-wide Programmatic Review Statusing System User Guide.

Task: Site Characterization Plan (SCP) Distribution

Distributed 12 SCP sets during this period.

Task: Hazardous Materials Coordination

Continued review and resolution of comments received on draft of the Materials Reporting and Handling Plan, Revision 3; prepared material safety data sheets; and continued developing new maps for proposed locations of Satellite Accumulation Areas.

Task: Long Range Planning (LRP)

Continued support of LRP, Planning and Control System, Independent Cost Estimate Review, Fiscal Year 1994 Work Authorization System budget exercise, and Performance Measurement Baseline activities; completed cost estimates and schedules as requested for Prototype Testing Facility at Busted Butte in Area 25, Building 4015 desert landscaping, UZ-16 mobilization and demobilization.

WBS 1.2.9.3

Task: Quality Assurance (QA)

Continued review, comment, and approval of various REECo implementing procedures, standard operating procedures, and purchase requisitions. Continued work revising existing quality procedures and replacing documents with management control (MC) procedures. Issued three MC procedures, one procedure cancellation and seven interim change notices to the Controlled Document Center for distribution. Conducted five orientation sessions on MC procedures issued since January 15, 1992.

Conducted internal audit REECo-003-92 (Operations Equipment Department); scheduled internal audits REECo-004-92 (YMP Control Department) and REECo-005-92 (Information Management Department) for April. Issued audit reports REECo-001-92 (YMP Drilling) and REECo-002-92 (Construction Department) without any findings.

Performed a mock surveillance of the Batch and Shaker Plant in Area i to assess their readiness to perform quality work.

General

REECo has no reportable Level I or Level II milestone activities at this time.

I-327334 *JA*



# Reynolds Electrical & Engineering Co., Inc.

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

DISTRIBUTION MADE  
ACCORDING TO MAIL  
DISTRIBUTION LIST

IN REPLY REFER TO  
580-01-400

WBS 1.2.9.1  
QA: N/A

May 14, 1992

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

## YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP) STATUS REPORT

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

If further information is required, please contact Sandra L. Hughes at 794-7192.

*R.F. Pritchett*

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

RFP:SLH:mab

Enclosure  
Status Report (3 pages)

cy: See page 2

*Rehkop  
Wilson  
Brodsky  
S. Jones  
Waters  
Hucker - RW-ZZ  
Gertz - WJ  
See Dist. List*

*5/18/92*

Mar 18 10 05 AM '92

REECO

AN ELECTRIC COMPANY

ENCLOSURE *48*

Carl P. Gertz  
580-01-400  
May 14, 1992  
Page 2

cy w/encl.

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L. M. Smith, DOE/NV, M/S 505  
M. B. Blanchard, DOE/YMP, M/S 523  
U. S. Clanton, DOE/YMP, M/S 523  
M. O. Cloninger, DOE/YMP, M/S 523  
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W. B. Simecka, DOE/YMP, M/S 523  
W. A. Wilson, DOE/YMP, M/S 717  
P. Prestholt, NRC/Las Vegas, NV  
R. C. Furtek, REECo, M/S 235  
B. R. Gardella, REECo, M/S 408  
W. J. Glasser, REECo, M/S 408  
J. L. Henze, REECo, M/S 751  
R. B. Land, REECo, M/S 585  
T. M. Leonard, REECo, M/S 408  
K. L. Limon, REECo, M/S 408  
C. J. Mason, REECo, M/S 751  
S. O. Straub, REECo, M/S 408  
J. R. Trujillo, REECo, M/S 590  
R. A. Adams, SAIC, M/S 517  
M. Brodeur, SAIC, M/S 517/T-23  
R. D. Hutton, SAIC, M/S 517  
S. C. Smith, SAIC, M/S 517/T-10  
J. W. Teak, SAIC, M/S 517  
J. E. Therien, SAIC, M/S 517  
R. S. Saunders, W, M/S 517/T-24



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

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)

APRIL 1992 - STATUS REPORT

SITE (1.2.3)

WBS 1.2.3.5

Task: LM-300 Drill Rig and Pipe Handling System

The LM-300 drill rig, pipe handling system and related drilling equipment are presently rigged up on UZ-16 drill pad awaiting completion of Job Package 92-3 and the necessary permits.

Task: Capital Equipment to Support Drilling Programs

Modification of the air processing and metering system being manufactured by Perry Equipment Corporation (PECO) was required to change the air cooler heat exchanger hydraulic fan motor to an electric motor. The pre-shipment inspection is scheduled at PECO in Mineral Wells, Texas, for May 1, 1992. Tentative shipping date is May 5, 1992.

The Mobile All-Terrain Drill Rig was awarded with delivery scheduled for May 1, 1992.

Task: Neutron Access Holes (Job Package 91-9)

UZ-N16, UZ-N38 and UZ-N64 were completed. Presently coring at 190 feet on UZ-N27.

Task: JF-3 Water Monitoring Well (Job Package 92-1)

The test pump has been removed and the two monitoring strings have been installed. The Joy 1 drill rig and related equipment were returned to the Area 25 Subdock. The 7-foot by 7-foot concrete pad around the well casing should be complete on May 1, 1992. Cleanup, recontouring, fence removal, retrieval of discharge pipe and replacement of water main servicing MX sumps was accomplished.

Task: NRG-1 (Job Package 92-2)

Finished cut and fill, plating with select fill, and setting of concrete traffic barriers. RSN Survey and QC accepted the work. Finished excavating test pits and moved shoring for geologists.

Task: UZ-16 Site Preparation/Road (Job Package 92-4)

Performed drainage enhancements per Field Change Request 92-072. RSN Survey and QC accepted the work.

Task: Midway Valley Trenching (Job Package 92-5)

Limited activity. Moved shoring for geologists.

**EXPLORATORY STUDIES (1.2.6)**

WBS 1.2.6.1

Task: Exploratory Studies Facility (ESF)

The Pre-proposal conference was held on April 29, 1992, for the Request for Proposal 1-DH-92, for the Technical Support & Underground Excavation for the Exploratory Studies Facility. The minutes are being prepared and a copy, along with the attendance roster, will go to potential proposers and YMP participants who attended the conference.

Prepared Requests for Matrix Support Services as required for upcoming site investigations job packages.

**FIELD OPERATIONS (1.2.7.4)**

Task: Administrative & Maintenance Support

Continued support to W. A. Wilson, Yucca Mountain Site Manager, to include: processing of purchase requisitions for the Field Operations Center (FOC) Site Office requirements; providing support services to participants and maintenance on YMP utilized facilities, equipment and roads in Area 25; and providing logistical and support services to management contractor.

Provided support for the Yucca Mountain Site Office open house and public tours. Support included but was not limited to: arrangements for buses, registration of guests, coordination of lunches/beverages, medical service, furniture, mechanical service and grading of access road. Continued preparations for upcoming tours.

**PROJECT MANAGEMENT (1.2.9)**

WBS 1.2.9.1

Task: Management and Administrative Support

Continued coordination and staffing of YMP displays at meetings, exhibits and conferences; staffed and supported the Public Reading Room of the Research and Study Center.

Created two new displays for the International High Level Radioactive Waste Conference (IHLRWC). One dealt with the advanced air drilling system developed to characterize the unsaturated zone at Yucca Mountain. The second dealt with the advanced mining technology to be employed in the construction of the Exploratory Studies Facility. Staffed the YMP Technical Display at the IHLRWC at the Mirage Hotel.

Assisted with the Yucca Mountain tours on April 23 and 28.

Staffed the Yucca Mountain Display at the 1992 Earth Day activities at Sunset Park.



Task: Site Characterization Plan (SCP) Distribution

Distributed five SCP sets during this period.

Task: Hazardous Materials Coordination

The Hazardous Materials Coordinator completed incorporating comments made on the preliminary draft of Revision 3 of the Materials Reporting and Handling Plan, and commenced final draft; submitted Request for Authorization to use Regulated Materials per AP 6.13 to the Project Office; attended a meeting with the Waste Management Department, SAIC, the Project Office, and the Alternate Hazardous Materials Coordinator regarding setting up a contract to remove petroleum stained soil from the Drilling Subdock.

Task: Long Range Planning (LRP)

Continued support of LRP, Planning and Control System, Independent Cost Estimate Review, Fiscal Year 2001 budget exercise, and Performance Measurement Baseline activities. Completed cost estimates and schedules as requested.

WBS 1.2.9.3

Task: Quality Assurance (QA)

Continued review, comment and approval of various REECO implementing procedures, standard operating procedures and purchase requisitions. Continued work revising existing quality procedures and replacing documents with management control (MC) procedures. Issued four MC procedures, seven procedure cancellations and five interim change notices to the Controlled Document Center for distribution. Conducted five orientation sessions on MC procedures issued since January 15, 1992.

Conducted internal audit REECO-005-92 (YMP Information Management) and scheduled internal audit REECO-006-92 (YMP Division Office) for May. Issued audit report REECO-005-92 (YMP Information Management) without any findings or deficiencies.

Conducted Surveillance No. SR-005-92 and issued the Surveillance Report to the Human Resources Department with no findings identified.

Conducted audit REECO-004-92 and issued the audit report to the Control Department which resulted in Corrective Action Report (CAR) CA-92-001 being issued to the YMP Division Office and two minor deficiencies being identified and corrected during the course of the audit. Furthermore, assisted the YMP Division in developing a response to the CAR in order to resolve several training issues.

General

REECO has no reportable Level I or Level II milestone activities at this time.

APR 14 1992

WBS: 1.2.9  
QA: NA

Carl P. Gertz, Project Manager  
Yucca Mountain Site Characterization  
Project Office  
U. S. Department of Energy  
Nevada Operations Office  
101 Convention Center Drive  
Phase 2, Suite 200  
Las Vegas, Nevada 89193-8518

Attention: V. F. Iorii

Dear Carl:

Subject: March 1992 Monthly Highlights and Status Report

Enclosed is the Monthly Highlights and Status Report for the month of March 1992. If you have any questions, please call Fran Cheek-Martin at FTS 844-7810.

Sincerely,

*SE Shampton for*

Thomas E. Blejwas, Manager  
YMP Management Project Department  
Department 6302

FCM:6318:jd  
Enclosure

*Iorii*  
*Plant*  
*Cloung*  
*Gertz*  
*Stucker - ew22*  
*Lyman*  
*Simicka*  
*Grubsky*  
*Johnson - w/o*  
*4/20/92*

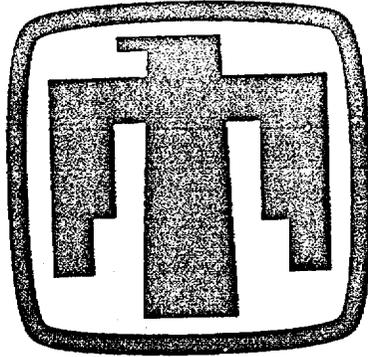
APR 20 2 57 PM '92

ENCLOSURE

APR 14 1992

Copy to:

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YMPO J. Robson  
YMPO W. B. Simecka  
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NRC P. T. Prestholt  
SAIC M. Brodeur  
TESS S. J. Bodnar (2)  
TESS E. M. Fortsch (2)  
TESS R. K. St. Clair (2)  
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ORNL R. B. Pope  
CCS S. O'Connor  
6300 D. E. Miller  
6302 T. E. Blejwas  
6312 F. W. Bingham  
6313 L. S. Costin  
6316 R. P. Sandoval  
6316 J. W. Teak, SAIC  
6318 S. E. Sharpton  
6318 F. Cheek-Martin  
6318 B. J. Mathis  
6319 R. E. Richards  
7111 J. S. Phillips  
6310 Library  
6318 31/12911/1.3/NQ  
6318 YMP CRF



**Sandia National Laboratories**

**U.S. DEPARTMENT OF ENERGY**

**YUCCA  
MOUNTAIN**

**YUCCA  
MOUNTAIN  
PROJECT**

**Yucca Mountain  
Site Characterization Project**

**MONTHLY HIGHLIGHTS  
AND STATUS REPORT**

**March 1992**

MARCH 1992



#### 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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## 1.2.1 SYSTEMS

The objective of the Systems element is to provide the focal point for the Yucca Mountain Site Characterization Project (YMP) activities concerned with the integrated perspective of the entire radioactive waste disposal system. The Systems element is comprised of four individual tasks: Systems Management and Integration (1.2.1.1), Systems Engineering (1.2.1.2), Technical Data Base Management (1.2.1.3), and Total System Performance Assessment (1.2.1.4).

### 1.2.1.1 MANAGEMENT AND INTEGRATION

#### Significant Meetings Attended

Sandia National Laboratories (SNL) hosted a meeting for the Integrated Test Evaluation (ITE) Task Force subcommittee meeting with Science Applications International Corporation (SAIC), Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), and the U.S. Geological Survey (USGS).

#### Status Report on Ongoing Activities

Two dry runs were made for the scheduled April 7 and 8, 1992 Technical Review Board Meetings to present results of the Total System Performance Assessment (TSPA). Work continues on the Performance Assessment roadmap.

### 1.2.1.2.1 SYSTEM REQUIREMENTS AND DESCRIPTION

No activity to report this period.

### 1.2.1.2.2 SYSTEM STUDIES

No activity to report this period.

### 1.2.1.2.4 SYSTEMS ENGINEERING IMPLEMENTATION

No activity to report this period.

### 1.2.1.2.5 CONFIGURATION MANAGEMENT PLANS AND PROCEDURES CONTROL

#### Status Report on Ongoing Activities

Internal Memo of Understanding (IMOU) 330029, Rev. 0, Track Identifier C, was approved by all parties. This IMOU describes activity related to the development of grading.



1.2.1.2.6 YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)  
SUPPORT TO THE MANAGEMENT SYSTEMS IMPROVEMENT  
STRATEGY (MSIS)

No activity to report this period.

1.2.1.3.1 SITE AND ENGINEERING PROPERTIES DATA BASE (SEPDB)

Significant Meetings Attended

P. Adams of the Site and Engineering Properties Data Base (SEPDB) staff met with L. Lopez and several LANL Principal Investigators (PIs) at Los Alamos, NM on February 18, 1992 to discuss the design of new tables for absorption and dynamic transport data.

Status Report on Ongoing Activities

The SEPDB staff continued its effort to enter, verify, and prepare return packages for all data submitted prior to FY91 that either has not yet been entered into the data base or has not had records completed.

Major Activities Upcoming Next Three Months

Data entry for outstanding data submittals and the investigation of the merger of the SEPDB and GENISES data bases will continue.

Other Items to Report

The following product was issued:

SEP0107 - Drill hole mineralogy and surface sample mineralogy for Activity 8.3.1.5.2.1.5 was sent to C. Johnson, M&O, of Las Vegas, NV.

1.2.1.3.2 INTERACTIVE GRAPHICS INFORMATION SYSTEM (TGIS)

Status Report on Ongoing Activities

The new version of ARC/INFO, a graphics software package, is now loaded and available to anyone on the network with a Sun workstation. Further development is required before printing, plotting and other features are available. The menu system developed for the last version is compatible with the new version.

Efforts to use the Lynx geologic modeling software continue.

The following CALMA jobs have been completed:

<u>Job</u>	<u>Requestor</u>	<u>Description</u>	<u>Status/Comments</u>
381	C. Rautman	T/M contours	Complete
384	R. Barnard	Hydro section	Complete



### Major Activities Upcoming Next Three Months

A solid model of thermal/mechanical units, including the drifts, will be developed. A presentation of the models will be prepared for the International High Level Radioactive Waste Management (IHLRWM) conference in April.

Additional files will be obtained from the Project Graphic Information System (GIS) as needed to display contours at a higher resolution. Files that contain graphics to display symbols that match the maps produced at the GIS will also be obtained.

The following CALMA jobs are in progress:

<u>Job</u>	<u>Requestor</u>	<u>Description</u>	<u>Status/Comments</u>
385	W. F. Chambers	FEM of Yucca Mtn. cross-section	Continuing
386	H. A. Dockery	Drill holes/section	Continuing

Video graphics and animation techniques will be developed.

### 1.2.1.3.3 REFERENCE INFORMATION BASE (RIB)

#### Status Report on Ongoing Activities

A Project Change Request (CR) was submitted for Change Control Board (CCB) action. The CR requests the addition of five new items to the Reference Information Base (RIB).

### Major Activities Upcoming Next Three Months

Additional CRs will be prepared and submitted.

### 1.2.1.3.4 TECHNICAL DATA BASE MANAGEMENT COMPUTER SUPPORT

#### Status Report on Ongoing Activities

Staff continued to load PC-NFS, a communication software package, on personal computers (PCs), to install communications boards, and to set up network files to render all PCs operational on the local area network (LAN).

Contractors completed modifications to the computer room that provide additional power outlets and emergency shutoff switches.

TGV software, which connects DEC systems via the Transmission Connection Protocol/Internal Protocol, was installed on the VAX3600 (IGIS) system, so that the system is now accessible directly from LAN workstations.

The Excabyte/Legato backup system is ready for use.

### Major Activities Upcoming Next Three Months

The LAN setups for PCs will be completed. Staff will also begin setting up machines for automatic backups on the Excabyte/Legato system. The board on the optical disk drive will be replaced and the electrical connections to all equipment in the computer facility will be mapped and reconfigured as needed to power down in an efficient manner.

Routine backups and system maintenance on all machines will be performed.



### 1.2.1.3.5 TECHNICAL DATA BASE INPUT

No activity to report this period.

### 1.2.1.4.1 TOTAL SYSTEM PERFORMANCE ASSESSMENT

#### Status Report on Ongoing Activities

SAND91-7034, "Numerical Studies of Rock Flow in Yucca Mountain," by B. Ross, S. Amter, and N. Lu, has been printed and distributed.

SAND92-7032J, "Predicted Gas-Phase Movement of Carbon-14 From a Radioactive Waste Repository," by B. Ross, S. Amter, and N. Lu, is in technical review. This paper will be submitted to Science.

SAND92-7033A, "A Coupled Model of Gas Flow and Heat Transport in Porous Media," by B. Ross, N. Lu, and S. Amter, is in internal technical review. This abstract will be submitted to the American Geophysical Union Spring Meeting in Montreal, Quebec, Canada on May 12 through 15, 1992.

The Total-System Performance Assessment (TSPA) report (SAND91-2795) underwent extensive revision before being submitted for internal technical review. Information from this report will be presented at a Nuclear Regulatory Commission (NRC) technical interchange on air and vapor transport and to the National Academy of Science in mid-March 1992, and to the Nuclear Waste Technical Review Board (NWTRB) at the IHRWM Conference, and at an interchange with the SKB (Sweden's high-level waste organization), all in early April 1992. The TSPA report has been submitted to the YMPO for review.

The artwork for the report on scenario selection for basaltic igneous activity, SAND91-1653, is essentially complete. The artist has been very successful in capturing the details of many elements of each scenario. The addition is expected to render the document invaluable for visualizing and constructing numerical and analytical models related to basaltic igneous activity.

The SAND report on scenario selection for nominal flow is still in rough-draft form. A. Flint of the U.S. Geological Survey (USGS) has agreed to co-author the document. Upon completion of his review and incorporation of the resulting comments, the report will be submitted for internal technical review. The event tree for nominal flow is also currently in revision.

The Total-System Simulator platform, Wingz, is being modified to a low parallel processing on four SPARC stations. This WBS element was unfunded until January 1992; therefore, many of the activities originally planned for this element are currently being reviewed and rescheduled.

### 1.2.1.4.3.1 POSTCLOSURE REPOSITORY DESIGN ANALYSIS

#### Significant Meetings Attended

E. Ryder attended a participants meeting on the systems implications of thermal loading in Las Vegas, NV on March 20, 1992. The meeting focused on establishing an appropriate implementation strategy for a study that would address the systems implications of various approaches to repository thermal loading (e.g., a hot versus a cold repository). A follow-up meeting has been tentatively scheduled for April 14, 1992.

### Status Report on Ongoing Activities

SAND91-1493, "Equivalent Energy Density Concept: A Preliminary Reexamination of a Technique for Equating Thermal Loads," by E. Ryder, has been sent to the Project Office for policy review. SAND91-1493 documents the results of a study that addresses the thermal design problem of bounding-induced thermomechanical responses over expected ranges of waste stream characteristics (age and burnup). Results are presented for baseline thermal loadings of 57 and 80 kW/acre [based on the layout described in the Site Characterization Plan-Conceptual Design Report (SCP-CDR)] in both the near- and far-fields.

Support for the Management and Operations (M&O) study on the feasibility of using an in-drift emplacement scenario for the potential repository continued during this reporting period. To date, this support has been in the form of highly idealized thermal analyses, waste stream projections, and assistance in defining future study directions.

## 1.2.1.4.3.2 PRECLOSURE RADIOLOGICAL SAFETY ANALYSES

### Significant Meetings Attended

On March 24, 1992, SNL staff hosted a meeting in Albuquerque, NM for the Items Important to Waste Isolation (IITWI) Process Review Team. The SNL presentation showed that the methodology developed is being implemented on unconsolidated surficial deposits.

## 1.2.1.4.3.4 SEAL PERFORMANCE REQUIREMENTS AND ANALYSES

### Status Report on Ongoing Activities

Analyses continued on seismic evaluation of sealing components. This work involves (1) definition of the equivalent static and dynamic loads, (2) evaluation of dynamic amplification as a function of frequency, (3) Universal Distinct Element Code (UDEEC) analyses of rigid sealing components, and (4) pseudostatic analysis to establish critical angle of incidence and peak loads. A second analysis developing performance goals for grouted fractured rock continued. This analysis was extended to include different environments in which fractures may be grouted.

## 1.2.1.4.4.1 PRE-WASTE-EMPLACEMENT GROUND-WATER TRAVEL TIME

### Major Accomplishments

SAND87-2380, "Statistical Analysis of Yucca Mountain Hydrologic Data," by B. M. Rutherford, I. J. Hall, R. G. Easterling, R. R. Peters, and E. A. Klavetter, completed all review processes, was published, and is now available for distribution.

### Significant Meetings Attended

Staff attended the NRC/DOE Technical Interchange Meeting on Air and Vapor Transport at Yucca Mountain. The meeting was held at the Sheraton in Albuquerque, NM.

Staff hosted S. Borg (YMP) and R. Luce (NWTRB) on a tour of the SNL Yucca Mountain Project on March 19, 1992.

### Status Report on Ongoing Activities

SAND92-0461, "Pre-Waste-Emplacement Ground-Water Travel Time Sensitivity and Uncertainty Analyses for Yucca Mountain," by P. Kaplan, completed internal SNL technical review and is currently in management review.

Preparation has begun on a presentation titled "Uncertainty and Sensitivity Results of Pre-Waste-Emplacement Ground-Water Travel Time" for the International High-Level Radioactive Waste Management Conference to be held in Las Vegas, NV in April 1992.

A new, as yet unnamed, two-dimensional steady-state flow model has been developed. Preliminary results indicate that predictions of the flow field at Yucca Mountain may be extremely sensitive to assumptions about boundary conditions. Data were taken from outcrop studies at Yucca Mountain to support further two-dimensional analyses of the sensitivity of performance parameters to boundary conditions. The initial interpretation of the data set suggests that the current hydrostratigraphic models may need further revision.

Work on a document titled "The Probabilistic Basis for Pre-Waste-Emplacement Ground-Water Travel Time Performance Assessment" was begun.

#### 1.2.1.4.6 DEVELOPMENT AND VALIDATION OF FLOW AND TRANSPORT MODELS

##### Major Accomplishments

All accomplishments have been included in the status report on ongoing activities for the sake of brevity and completeness.

##### Status Report on Ongoing Activities

##### Unsaturated flow through single fractures

Experiments are continuing to complete the systematic study of full-field instability in unsaturated fractures as instigated by redistribution following an infiltration event. Preliminary results were presented in SAND91-1985C "Gravity-Driven Fingering in Unsaturated Fractures," by M. J. Nicholl and R. J. Glass, written for presentation at the IHLRWM conference in April 1992. Eight experiments were conducted this month varying the volume of water in the infiltration slug and the angle of the fracture with respect to vertical. Also, the IHLRWM conference presentation was prepared.

##### Fracture matrix interaction

Presentation of SAND91-2030C "Wetted Region Structure in Horizontal Fractures," by R. J. Glass and D. L. Norton, was prepared for the IHLRWM conference in April 1992. In the paper, small-scale processes that influence wetted structure within the plane of a horizontal fracture as the fracture wets or drains through the matrix are investigated. This approach integrates both aperture-scale modeling and physical experimentation. Several types of aperture-scale models have been defined and implemented. A series of physical experimental systems that allow measurement of wetted-region structure as a function of system parameters and water pressure head in analog fractures also have been designed. In the preliminary proof-of-concept experiment, hysteresis is clearly evident in the measured saturation/pressure relation, as is the process of air entrapment, which causes a reduction in the connected areas between blocks and the wetted region available for flow in the plane of the fracture. A percolation threshold where the system is quickly spanned, allowing fluid conduction in the fracture plane, is observed that is analogous to that found in the aperture-scale models. A fractal wetted and entrapped-region structure is suggested by both experiment and modeling. This structure implies that flow tortuosity for both flow in the fracture and for interblock fluid transfer is a scale-dependent function of pressure head.

##### Gravity-driven fingering in porous media

R. J. Glass gave an invited presentation to students and faculty at the Department of Hydrology of the University of Arizona on gravity-driven fingering in porous media and fractures.

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

The presentation entitled "Field Research Program for Unsaturated Flow and Transport Experimentation," to be given at the IHLRWM conference in Las Vegas, NV, was prepared. This presentation outlines the approach, scope, and activities related to the field research program for the development and validation of flow and transport models.

This research program will challenge the current understanding of the scaling of effective media properties through the collection of large suites of gas permeability data that span a range of scales. Such measurements will be made quickly and inexpensively, both in the laboratory and in the field, using an instrument termed the gas permeameter. The key to making accurate measurements is establishing a good seal between the rock surface and the permeameter nozzle. On smooth surfaces, as with core samples or rock slabs, a good seal is easy to make, but on an outcrop, sealing is not a trivial matter. In an effort to make a better seal, tests have been run using a seal molded out of caulking putty rather than the standard sealing materials, such as closed-cell foam or silicon rubber stoppers. In recent field tests, the caulking putty has shown to provide a very good seal, even in relatively loosely bedded deposits.

Contact has been made with a Tulsa, OK firm that manufactures gas permeameters for use in the petroleum industry. Such a unit is more portable than the current permeameter. It is constructed of electronic components that reduce errors in reading the measurement and the unit is equipped with a data-logger.

Experiments to develop scaling laws for saturated and unsaturated systems containing micro-layering and cross-bedding heterogeneities, as found in all the alluvial sediments at and around Yucca Mountain and in the bedded tuffs units within Yucca Mountain, are under development.

Three preliminary experiments were run to further develop the automated flow and transport data acquisition system.

#### Development of experimental capabilities

Preparation was made for the presentation entitled, "X-ray and Visible Light Transmission as Two-Dimensional, Full-Field Moisture-Sensing Techniques," to be given at the IHLRWM Conference in Las Vegas, NV. Work also continued on compiling this work into a journal article for submission to Water Resources Research.

#### Caisson experiment

Collaboration with LANL YMP staff (E. Springer) in an intermediate-scale (caisson) flow and transport validation experiment continued. Approximately 75 tons of Wedron 510 sand was delivered to LANL during March to be used to fill the caisson. A mixed sand-limonite (cryptocrystalline and crystalline goethite) is being prepared for placement at an intermediate depth within the caisson. Migration of reactive tracers (Ni) through this layer should be measurably retarded and provide a basis for validation of transport codes. Approximately 600 pounds of limonite have been ground at the New Mexico Bureau of Mines for the sorbent layer.

Initial Ni sorption studies indicate that the Ni sorption by sand in 0.01M NaCl solutions is strongly dependent on the pH. In addition, it has been observed that the pH of the sand suspensions is not stable and drifts during measurement, probably due to equilibration with atmospheric CO<sub>2</sub>. The final pH, however, is higher than that expected for pure silica sand. In order to better understand the range of pH likely to be encountered in the caisson experiment at LANL, the pH of several batch systems containing sand in 0.01 M NaCl in equilibrium with atmospheric CO<sub>2</sub> were investigated. The first experiment was conducted with raw (untreated) sand at a solid:solution ratio of 1:2. The solution pH changed from 5.47 to 6.04 upon addition of the sand, and stabilized at 7.20 sometime within the first 5.5 hr of mixing. In the second experiment, the sand was first acid-washed to remove any carbonate coatings that could contribute to the observed anomalously high pH. The final pH of this sand in equilibrium with atmospheric CO<sub>2</sub> was approximately 5.0, suggesting that the Wedron 510 sand contains trace amounts of calcite. Experiments and calculations designed to predict the change in pH of solutions percolating through the sand in the caisson due to calcite dissolution and equilibration with atmospheric CO<sub>2</sub> have been initiated.

Scoping iodide sorption experiments in batch systems containing 0.01M NaCl and limonite and/or sand were carried out during March. Anomalous results (negative K<sub>d</sub> values) at low total iodide concentrations were encountered and have led to a modification of the analytical technique (substitution of a single-junction reference electrode for the double junction electrode) for the next round of experiments.

### Scoping sorption studies

A low-flow Ar purge system has been assembled and documented. This system will provide the ability to purge the headspace of the batch-experiment containers during pH measurements, maintaining CO<sub>2</sub>-free conditions. Reagent-container headspace can also be purged. Documentation for the system, including a Pressure-Safety Data Package and a Technical Procedure (TP), was prepared.

Portions of drafts of two papers for the special issue of Radioactive Waste Management and Nuclear Fuel Cycle on the Yucca Mountain Project were prepared during March.

### General

A laboratory tour was given to Nuclear Waste Technology Review Board (NWTRB) staff member B. Luce and U.S. Department of Energy/Yucca Mountain Project Office (DOE/YMPO) staff member S. Borg.

### Major Activities Upcoming Next Three Months

Relative to the gas permeability studies, purchase of a commercial permeameter and automation of data collection for tests performed on rock slabs in the laboratory are planned. Further activities include refinement of rock seal nozzles for use with thin slabs to provide better control of flow geometry and hence permeability estimates.

Detailed studies of sorption of B, I, and Ni by mixtures of sand and goethite and by materials (samplers and plastic laboratory ware) to be used in caisson or in supporting laboratory studies will continue. Scoping experiments on Li sorption for the caisson experiment will be initiated.

Design calculations for the caisson experiment will continue, and the caisson will be filled and instrumented.

The surface potentiometric titration of sand, goethite, and zeolite will begin.

Two papers for the special issue of Radioactive Waste Management and Nuclear Fuel Cycle on the Yucca Mountain Project will be completed.

## 1.2.1.4.7 SUPPORTING CALCULATIONS FOR POSTCLOSURE PERFORMANCE ANALYSES

### Status Report on Ongoing Activities

The documents describing the performance assessment plan for the Exploratory Studies Facility (ESF) Title II design support will be completed. The plan described in the document will be developed and implemented.

The calculations to estimate the effects on repository performance of surficial water use in the controlled zone but outside the repository (ESF PA Analysis No. 12) have been initiated. The Problem Definition Memo (PDM), describing these calculations PDM 72-32, has been written. The ESF DR Appendix I will be revised to include the results of ESF PA Analysis No. 12.

SAND91-0792, "Estimation of the Impact of Water Movement from Sewage and Settling Ponds Near a Potential High-Level Radioactive Waste Repository at Yucca Mountain, NV," has been published.

Preliminary efforts for a model validation exercise in collaboration with WBS 1.2.1.4.6 have been initiated. Preliminary calculations are being performed and a PDM describing calculations to be made in conjunction with the caisson sand experiments is being written.



#### 1.2.1.4.8 PERFORMANCE CONFIRMATION

No activity to report this period

#### 1.2.1.4.9 CODE DEVELOPMENT AND VERIFICATION

##### Status Report on Ongoing Activities

##### Code Development (Subactivity 1.6.2.1.2)

Evaluation of the modified version of JACQ3D on a two-dimensional infiltration problem was completed. Results of the study were documented in an internal memo. In summary, for a problem involving infiltration into a rectangular domain composed of heterogeneous material with a uniform initial pressure head, JACQ performed well given a moderately dry initial pressure head (-7.34m). However, for a case with much lower initial pressure head (-100m), the CPU requirements became prohibitive and the run was stopped prematurely. Thus, if the code is to be used on very dry problems, a more robust scheme for solving nonlinear equations is needed.

One- and two-dimensional benchmarking problems proposed to evaluate the applicability of COYOTEII to flow problems were completed and were documented in an internal memo.

A proposal was submitted to investigate vapor flow through fractured material at Yucca Mountain. The study would consider the effects of barometric pumping, the "Bernoulli effect," and diurnal fluctuations on moisture transport.

##### Software QA (No SCP activity)

LLUVIA2D and NORIASP were both installed on the Sparc9. They were each successful in solving test cases. The installation report is currently being written for NORIA. NORIASP also was put under informal control of the Source Code Control System (SCCS) as a preliminary test case to resolve the differences between version and release numbers of codes in the SCCS and those in the LRC. SNL staff were involved in preparations of the internal software surveillance that was held during this month.

Staff worked on identifying the computer needs of the new SNL project center that will be formed as result of restructuring in April. A white paper on software quality assurance needs of the new center was also developed.

### 1.2.3 SITE INVESTIGATIONS

The objective of the Site Investigation element is to determine repository site suitability in terms of DOE siting guidelines (10 CFR 960), Nuclear Regulatory Commission (NRC) criteria (10 CFR 60), and Environmental Protection Agency (EPA) standards (40 CFR 191).

#### 1.2.3.1 SITE MANAGEMENT AND INTEGRATION

##### Major Accomplishments

M. Siegel served as a member of the Yucca Mountain Geochemistry Integration Team (GIT) during the first half of FY92. As a team member, he participated in the monthly teleconferences and quarterly meetings. The December quarterly meeting was held in Las Vegas, NV on December 4 and 5, 1991. The focus of the meeting was to define the interfaces between geochemistry and performance assessment. Siegel gave a presentation entitled "The Roles of Complex Mechanistic Process Models and Total System Models in Performance Assessment and Sensitivity Analysis." The talk described the adequacy of the representation of geochemical processes performance assessment models with respect to sensitivity analysis. Siegel suggested that the gap between performance assessment and geochemistry can be bridged by development of geochemical scenarios for sensitivity analysis, by using an inverse problem approach, by formulating numerical criteria to assess the validity of approximations used in transport calculations, and by the enlightened use of complex geochemical transport models, such as the LEHGC code. A set of recommendations for improved coordination between geochemical activities and performance assessment was formulated based on the discussions held at the meeting and will be presented to C. Gertz.

##### Significant Meetings Attended

M. Siegel participated in the March teleconference of the GIT. Final revisions to a letter report describing the December Quarterly Meeting of the GIT and plans for the Spring Quarterly Meeting (joint with the Hydrology Integration Team) were discussed.

The Sample Overview Committee (SOC) met on March 3, 1992 to consider a number of specimen removal requests from various PIs for existing core and for preservation of new core from drill holes UE-25 and UZ-16, anticipated to start drilling in April. The requests for existing core were approved. Requests for core from UZ-16 were approved for a priori preservation of the designated intervals; however, distribution of these preserved core samples will not occur until after other PIs have had the opportunity to view the core and to request critical samples that might otherwise be destroyed in non-critical uses.

The SOC did not take up issues of drill hole prioritization and sequencing as anticipated. Presumably, consideration of these topics will be rescheduled.

#### 1.2.3.2.2.1 SYSTEMATIC ACQUISITION OF SITE-SPECIFIC SUBSURFACE INFORMATION

##### Significant Meetings Attended

PIs from the Systematic Drilling Program (SCP Activity 8.3.1.4.3.1.1) and the Surface Facilities Exploration Program for Soil and Rock Properties (SCP Activity 8.3.1.14.2) met in Las Vegas, NV on March 18, 1992 with YMPO personnel and staff from SAIC to discuss the feasibility of combining efforts on one or more drill holes. The Soil and Rock Properties Program requires a deep drill hole to identify the exact depth of the transition from the north ramp to the ESF. The Systematic Drilling (SD) Program requires a somewhat deeper hole, in approximately the same location, to support identification of stratigraphic unit contacts and sampling for numerous testing activities. Combining these efforts in an as-yet unnamed drill hole would reduce duplication of effort and cost, while



providing both groups with needed geologic information and physical samples. No irreconcilable differences in requirements were identified, and the Pls will proceed to work out details through input to the Test Planning Package. Drilling may not require use of the LM300 drill rig; the potential for using a smaller rig may accelerate the scheduled start of this joint hole.

#### Status Report on Ongoing Activities

The revised draft of the Study Plan for this study was essentially completed during the month, and responses to all comments from the Project Office and DOE/HQ have been prepared. An integrated package of comments, responses, and text will be compiled and sent to the Project Office early in April. (SCP Activity 8.3.1.4.3.1)

A new vertical transect of tuffs from Yucca Mountain was collected in late February and early March in cooperation with personnel from the USGS. The transect is important in that the location sampled encompasses an expanded interval of nonwelded tuffs between the Topopah Spring and Tiva Canyon Members. This interval is believed to be very significant with respect to infiltration and redistribution of downward percolating water above the repository horizon. Hydrologic testing of the roughly 150 samples is in progress. Additional outcrop sampling activities to refine estimates of horizontal correlation structure in this important nonwelded interval were under way at the end of March.

Hydrologic testing of a set of 82 samples of existing core and cuttings from the Sample Management Facility has been largely completed at the USGS Hydrologic Research Facility. Evaluation and geostatistical analysis of these test results will begin during April. (SCP Activity 8.3.1.4.3.1.1 and 8.3.1.2.2.3.1)

#### Major Activities Upcoming Next Three Months

An integrated package on this Study Plan will be compiled and sent to the Project Office in early April. Comment resolution for the Study Plan for this activity continues. Formal acceptance of the revised philosophy regarding testing to be conducted by the study versus coordination of testing to be conducted by others will clear the way for Nuclear Regulatory Commission (NRC) review of this document, which is required before the drilling of the joint Systematic Drilling Program/Surface Facilities Exploration/Soil and Rock Properties drill hole can commence under this study. (SCP Activity 8.3.1.4.3.1.1)

#### Issues/Potential Problems Needing Resolution and Potential Impacts

Acceptance of the resolution to comments on the Study Plan will need to be a Project priority. Delay would postpone NRC approval of the Study Plan and impact the schedule for drilling the first SD drill hole. Numerous other testing activities also depend upon samples from the SD drilling program. Project and/or HQ action may be required to facilitate final resolution of any remaining issues.

### 1.2.3.2.2.2.2 THREE-DIMENSIONAL ROCK CHARACTERISTICS MODELS

#### Status Report on Ongoing Activities

Development activities using the Lynx Geotechnical Modeling System are continuing, although slowly. A software upgrade from Lynx Geosystems has been received and installed successfully. A major upgrade under the beta-test site agreement will be forthcoming later this year. Down-hole deviation survey data from existing drill holes has been loaded successfully, and major unit contacts from these holes are being prepared for input. Digital geophysical log data has been requested from the USGS, but receipt of this information has been delayed. (SCP Activity 8.3.1.4.3.2.1)

#### Major Activities Upcoming Next Three Months

Modeling activities using the Lynx Geotechnical Modeling System will continue. USGS personnel will visit SNL during April; information from surface stratigraphic studies will be incorporated into the Lynx system. (SCP Activity 8.3.1.4.3.2.1)

#### 1.2.3.2.7.1.1 LABORATORY THERMAL PROPERTIES

##### Status Report on Ongoing Activities

Experiments to investigate dehydration anomalies observed in welded tuff at temperatures above 160°C have been initiated. (SCP Activity 8.3.1.15.1.1.1)

Calibration of instrumentation and verification of testing prerequisites for thermal conductivity scoping studies continues. (SCP Activity 8.3.1.15.1.1.3)

##### Major Activities Upcoming Next Three Months

The scoping study on the effects of saturation on thermal conductivity will begin in April. (SCP Activity 8.3.1.15.1.1.3)

A quality assurance (QA) audit of Holometrix is planned for late April.

##### Other Items to Report

A seminar on the use of the new Environmental Scanning Electron Microscope (ESEM) at the University of New Mexico was attended by C. Chocas (SNL) and J. Connolly (UNM) on March 12, 1992.

#### 1.2.3.2.7.1.2 LABORATORY THERMAL EXPANSION TESTING

##### Status Report on Ongoing Activities

SAND88-1581, "Linear-Thermal-Expansion Data for Tuffs from the Unsaturated Zone at Yucca Mountain, Nevada," is being prepared for management review. (SCP Activity 8.3.1.15.1.2.1)

Investigations to stabilize the drift in the linear variable dilatometer transformer (LVDT) output during soak times continue. (SCP Activity 8.3.1.15.1.2.1)

##### Major Activities Upcoming Next Three Months

Once the accuracy and reproducibility of test data is established and the relevant procedures approved, a scoping study on the effects of sample size on thermal expansion will be initiated. (SCP Activity 8.3.1.15.1.2.1)

#### 1.2.3.2.7.1.3 LABORATORY DETERMINATION OF MECHANICAL PROPERTIES OF INTACT ROCK

##### Status Report on Ongoing Activities

A study involving high-temperature experiments at creep and low strain rate conditions is being conducted at New England Research, Inc. (NERI). The data from a series of six experiments run at a nominal axial strain rate of  $10^{-9} \text{ s}^{-1}$  are being analyzed and a SAND report presenting the data is being

drafted. In addition, the heater is being fabricated and the calibrations being run in preparation for beginning a series of six creep experiments in April. (SCP Activity 8.3.1.15.1.3.2)

R. Price (SNL) is a member of the American Society for Testing and Materials/Institute for Standards Research (ASTM/ISR) Steering Committee for the Interlaboratory Testing Program for Rock Properties. The testing portion of Phase I has been completed, with a total of nine government, private, and academic laboratories participating. The committee is now in the process of writing and revising the report of the data from Phase I and is planning the testing for Phase II. R. Price has revised the Phase II protocols for the participating labs. (No SCP Activity)

SAND92-0223A, "The Influence of Strain Rate and Sample Inhomogeneity on the Moduli and Strength of Topopah Spring Member Tuff," by R. Price (SNL), R. Martin, P. Boyd, and J. Noel (NER), was accepted for presentation at the American Geophysical Union (AGU) Spring 1992 meeting. (SCP Activity 8.3.1.15.1.3.2)

#### Major Activities Upcoming Next Three Months

A series of six constant stress (creep) experiments will be initiated in April. The samples of TSw2 will be tested at a pore pressure of 4.5 MPa, a confining pressure of 5 MPa, and a constant differential stress of 80 MPa. Initially, the experiments will be performed at room temperature and then at 250°C. Each test will each take about four months to complete. (SCP Activity 8.3.1.15.1.3.2)

The logbook covering a series of six experiments run at a nominal axial strain rate of  $10^{-9} \text{ s}^{-1}$  will be submitted to the Data Records Management System (DRMS) and a data report presenting the data from these tests will be drafted and begin the review process in the next six weeks. (SCP Activity 8.3.1.15.1.3.2)

A report presenting the data from and the analysis of experiments performed to study the attenuation and modulus dispersion in tuff will begin the review process in April. (SCP Activity 8.3.1.15.1.3.2)

A report presenting the results of a scoping and procedure study in the collection of bulk properties data will begin the review process in the next two months. These data support the analysis of the mechanical property data. (SCP Activity 8.3.1.15.1.3.2)

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

#### Status Report on Ongoing Activities

On March 18 and 19, 1992, S. Brown (SNL) and R. Price (SNL) met with Dr. B. Amadei at the University of Colorado to discuss fracture mechanical properties. The discussions were centered around experiments performed in direct shear and whether there is a direct relation between fractal dimension and the amount of surface shear (or damage). The meetings resulted in some preliminary conclusions and ideas for future work to investigate these issues. Additional discussions among the participants are anticipated in the future. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

To determine the variability of the roughness and the degree of mismatch of the surfaces of natural joints, the topography of seventeen natural joints from the various rock types (including tuff) have been profiled. These data are being analyzed to quantify the roughness of each surface, its scaling (size-dependent) properties, and the degree of mismatch between the two opposing surfaces. A simple mathematical model of rough fractures has been developed based on these data. Using this simple model, a computer code is being developed for simulation of the frictional shear strength of rock joints. Simulations using this code will allow some physical insight into empirically derived



relationships commonly used in engineering geology for design of structures in rock. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

An informal status report has been written that details the results of experiments being performed in rotary shear. These tests are designed to investigate the effects of different stress paths on the frictional behavior of artificially produced (i.e., relatively smooth) fractures. Following shear deformation on a fracture, the subsequent behavior is highly dependent on whether the fracture remains "primed" (i.e., the normal stress is not relieved) or not. This testing will continue for the next several months. (SCP Activity 8.3.1.15.1.4.2)

#### Major Activities Upcoming Next Three Months

A journal article summarizing the topography data collected on 17 natural joints and the analysis of the data using the simple mathematical model will be written and submitted. (SCP Activities 8.3.1.15.1.4.1 and 8.3.1.15.1.4.2)

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

#### Status Report on Ongoing Activities

Comments have been received on Study Plan 8.3.17.3.3.2 (Select or develop empirical models for ground motion from underground nuclear explosions) and responses have been initiated.

#### Major Activities Upcoming Next Three Months

Responses to comments on Study Plan 8.3.17.3.3.2 (Select or develop empirical models for ground motion from underground nuclear explosions) will be completed and transmitted to the Project Office.

### 1.2.3.2.8.4.2 LOCATION AND REGENCY OF FAULTING NEAR PROSPECTIVE SURFACE FACILITIES

#### Major Accomplishments

Excavation of soil pits began within Midway Valley to the east of Exile Hills.

#### Significant Meetings Attended

Results of survival mapping were presented during a poster session at the West Management '92 Conference in Tucson, AZ on March 4, 1992.

#### Status Report on Ongoing Activities

Work is proceeding on a report for the USGS on Trench A/BR-3, which was excavated last summer in Midway Valley.

#### Major Activities Upcoming Next Three Months

Excavation will continue of soil pit area trenches in Midway Valley.



### 1.2.3.6.2.1.6 FUTURE REGIONAL CLIMATE/ENVIRONMENTS

#### Status Report on Ongoing Activities

Planning was completed for a multiyear regional climate run for the western U.S. with the model driven by the output from a Community Climate Model (CCM) simulation at finer resolution (T42, 2.8 degrees latitude by 2.8 degrees longitude). This run is part of Phase II validation analysis of the coupled GCM-MM4 modeling system at the National Center for Atmospheric Research (NCAR). These present climate simulations are scheduled to be started very soon.

The management review of the paper summarizing the results of the Phase I validation analysis has been completed.

The NCAR contract has been revised as part of the response to Deviation Reports (DRs) 92-02 and 92-03. These DRs are officially closed out.

#### Major Activities Upcoming Next Three Months

The review of the Phase I report, "Toward the Simulation of Possible Future Climate Scenarios Over the Southern Great Basin," will be completed.

A multiyear regional climate run for the Western U.S., using boundary conditions provided by CCM1 at finer resolution (T420), will be completed.

The software evaluation reports for computer codes associated with the regional climate modeling will be completed.



## 1.2.4 REPOSITORY INVESTIGATIONS

The objectives of the Repository element are to design a repository compatible with the host rock that meets the engineered barrier performance objectives of 10 CFR 60 and 40 CFR 191; to develop the required instrumentation and equipment for the repository; to obtain the necessary geoenvironmental data through laboratory and field tests; and to identify repository operation, closure, and decommissioning requirements.

### 1.2.4.1.1 REPOSITORY MANAGEMENT AND INTEGRATION

#### Significant Meetings Attended

A technical exchange was held with staff from the Canadian Underground Research Laboratory. Fielding of a large mining test was discussed along with instrumentation problems and in situ stress measurement techniques. SNL staff benefited greatly from the interchange. A letter report on the interchange was forwarded to DOE/HQ.

#### Major Activities Upcoming Next Three Months

Significant staff and management effort will be required to support the upcoming revision of the Planning and Control System (PACS) (Mission 2001) and to support the Independent Cost Estimate (ICE) Team audit.

#### Other Items to Report

Two meetings between the M&O repository design staff and SNL staff have been scheduled for April. The agendas for these meetings include discussions of previous design efforts managed by SNL and other repository design issues that need to be resolved during advanced conceptual design (ACD).

### 1.2.4.2.1.1.1 EXCAVATION INVESTIGATIONS

No activity to report this period.

### 1.2.4.2.1.1.2 IN SITU THERMOMECHANICAL PROPERTIES

#### Significant Meetings Attended

L. Costin, J. Pott, and D. Holcomb attended a joint SNL/AECL Rock Mechanics meeting on March 11 and 12, 1992 in Pinawa, Manitoba, Canada.

#### Status Report on Ongoing Activities

Background material is being researched as a first step in the design of test instrumentation that will operate in the hot thermal environment proposed for the in situ thermomechanical experiments. (SCP Activity 8.3.1.15.1.6)



### 1.2.4.2.1.1.3 IN SITU MECHANICAL PROPERTIES

No activity to report this month

### 1.2.4.2.1.1.4 IN SITU DESIGN VERIFICATION

#### Status Report on Ongoing Activities

Comments on Study Plan 8.3.1.15.1.8, In Situ Design Verification, are being reviewed and resolved.

### 1.2.4.2.1.2 ROCK MASS ANALYSIS

#### Status Report on Ongoing Activities

Work on Design Investigation Memo (DIM) 260, "Rock Mass Property Assessment-I, Fracture Analysis," continued. For thermal/mechanical units down to and including the Calico Hills nonwelded unit, spacing and orientation of fractures have been determined and analyzed. Using this and other information, rock quality designations (RQDs) for each unit were developed. The work is now documented in draft SAND92-0449, "Fracture Analysis and RQD Estimation for the Yucca Mountain Site Characterization Project," by M. Lin and M. Hardy (Agapito & Associates) and S. Bauer (SNL). The report is currently in peer review.

Work on DIM 261, "Rock Mass Property Assessment-II, Rock Mass Modulus, Strength, Etc.," continued. For thermal/mechanical units down to and including the Calico Hills nonwelded unit, rock mass mechanical properties such as moduli, strengths, etc. have been determined using the output from DIM 260, intact rock properties, and empirical methods. The work is being documented in SAND92-0450, "Rock Mass Mechanical Property Estimations for the Yucca Mountain Site Characterization Project," by M. Lin and M. Hardy (Agapito & Associates) and S. Bauer (SNL). A draft of the report is being prepared.

Work continued on analyses of the heated room experiment in support of the ESF design effort. The analysis work has been slowed in order to complete software QA requirements.

Work continued on a series of laboratory experiments with results intended for use in evaluating and validating the joint models. The initial experiments use a stack of plates of Lexan with a centrally located hole. The plates are being loaded perpendicular to the stacking and displacements are tracked and measured using Moire grid techniques. Preliminary experiments have been completed and analysis of the results is forthcoming. Experimental results to be used as input to analyses being performed in WBS 124231 have been completed.

#### Major Activities Upcoming Next Three Months

SAND91-1982C, "Fault Stress Analysis for the Yucca Mountain Site Characterization Project," by S. Bauer (SNL) and M. Hardy, R. Goodrich, and M. Lin (Agapito & Associates) will be presented at the American Nuclear Society IHLRWM Conference meeting in April 1992. (SCP Activity 8.3.2.4.1.4)

Preliminary results from DIMs 260 and 261 were presented to interested parties from the DOE, Management and Operations (M&O), and Exploratory Studies Facility (ESF) design group on March 18, 1992 in Las Vegas, NV.

### 1.2.4.2.3.1 CERTIFICATION OF DESIGN METHODS

#### Status Report on Ongoing Activities

An important component of the Project involves the development of constitutive models capable of analyzing the responses of jointed rock masses, which is a representative geologic feature of the potential waste repository site at Yucca Mountain, NV. Current compliant joint models represent state-of-the-art analysis capabilities. These models were incorporated into computationally efficient computer codes providing a unique capability of simulation of large-scale field problems. Efforts to improve both the capability and efficiency of the models and codes is ongoing.

Work has continued on a series of numerical analysis of a series of laboratory experiments being performed (WBS 124212). The analyses are intended to help evaluate and validate the joint models. Pretest analyses of the layered model have been completed and the results are currently being studied and evaluated. The work is being summarized in a paper for the International Society for Rock Mechanics (ISRM) Regional Conference, "Fractured and Jointed Rock Masses," to be held in early summer.

Work continued at SNL and Geo Logic Inc. to continue preliminary work to develop a linked boundary element-finite element computer model for analyzing thermomechanical problems associated with design and performance of a potential nuclear waste repository. During this reporting period, efforts have concentrated on combining the boundary element computer program developed previously for calculating the thermally induced displacements and stresses with an existing boundary element method for elastostatics to solve general thermoelasticity problems. The combined boundary element method, when integrated into the finite element program, JAC, to form a hybrid program, will satisfy both the thermal and mechanical boundary conditions at the interfaces between the finite element domain and the boundary element domain.

SAND87-1305, "JAC-3D, A Three-Dimensional Finite Element Computer Program for the Non-Linear Quasi-Static Response of Solids with the Conjugate Gradient Method," by J. Biffle (SNL, 1425), completed management review and is being readied for Project Office review.

### 1.2.4.2.3.2 DESIGN ANALYSIS

#### Status Report on Ongoing Activities

Work on Problem Definition Memo (PDM) 75-25, "New 3-D Far-Field Repository Thermomechanical Calculations," continued. The analyses are intended to determine the temperatures, stresses, and strains expected in the vicinity of ESF openings that may become part of the repository. The "new repository design" is being used in the analysis, with thermal loadings of 57 and 80 kW/acre. The work was reviewed by E. Ryder and S. Bauer; preliminary results were presented to the ESF design team on March 18, 1992.

### 1.2.4.6.1 SEAL DESIGN AND DESIGN REQUIREMENTS

No activity to report this period.

### 1.2.4.6.2 SEALING TESTING

#### Status Report on Ongoing Activities

Work continued in the development of the field test definitions report. The efforts concentrated on defining the surface backfill and seepage control tests, defining hydrologics and geophysical techniques to characterize rock, and completion of a draft of the report.

## 1.2.5 REGULATORY AND INSTITUTIONAL

The objective of the Regulatory and Institutional element is to (1) conduct all activities involving licensing, environmental compliance, communication, and liaison with the State of Nevada, affected Indian tribes, and the public and (2) administer the grants mandated by the Nuclear Waste Policy Act (NWPA) of 1982.

### 1.2.5.1 MANAGEMENT AND INTEGRATION

#### Status Report on Ongoing Activities

R. Orzel represented SNL on the public tour conducted at Yucca Mountain on March 28, 1992. These tours are conducted monthly as part of the DOE public outreach program. A representative from each of the YMP participants is requested to staff the exhibits at the Field Operations Center (FOC) and answer questions that the public might have about the displays.

#### 1.2.5.2.1 NRC and NWTRB INTERACTION SUPPORT

##### Significant Meetings Attended

Staff attended the NWTRB meeting in Arlington, VA on March 10 and 11, 1992 and the NRC meeting in Albuquerque, NM on March 17 and 18, 1992.

##### Status Report on Ongoing Activities

Work is underway to provide required support for the April meetings with the NWTRB, the Advisory Committee on Nuclear Waste (ACNW), and the NRC.

##### Major Activities Upcoming Next Three Months

SNL staff will support and attend the following meetings:

April 6 - 8	NWTRB Meeting in Dallas, TX
April 23 and 24	ACNW Meeting in Bethesda, MD
April 28 and 29	NRC Meeting in Albuquerque, NM
May 11	NWTRB Meeting in Hanford, WA
May 13	NWTRB Meeting in Idaho Falls, ID
May 19	NRC Meeting in Rockville, MD
May 26 and 27	ACNW Meeting in Bethesda, MD
May 27	NRC Meeting in Rockville, MD
May 27	ACNW Meeting in Bethesda, MD
May 28 and 29	ACNW Meeting in Bethesda, MD
June 3	NRC Meeting in Rockville, MD
June 25 and 26	ACNW Meeting in Hanford, WA

#### 1.2.5.2.2 SITE CHARACTERIZATION PROGRAM

No activity to report for this period.

#### 1.2.5.2.3 REGULATORY REVIEW

No activity to report for this period.



### 1.2.5.2.5 STUDY PLAN COORDINATION

#### Major Accomplishments

Study Plan 8.3.1.2.2.2, "Water Movement Test," written by LANL staff, was reviewed by M. Siegel in response to a Project Office request. Comments were submitted to YMPO on March 27, 1992. (No SCP Activity)

#### Major Activities Upcoming Next Three Months

Study Plan 8.3.1.4.3.1.1, "Systematic Acquisition of Site-Specific Subsurface Information - Systematic Drilling Program," by C. A. Rautman, has been reviewed by other Project participants, YMPO, and HQ personnel. The review comments were received on October 3, 1990 and will be responded to within the next two months. (SCP Activity 8.3.1.4.3.1.1)

### 1.2.5.2.6 SEMI-ANNUAL PROGRESS REPORTS

#### Status Report on Ongoing Activities

A meeting was held on March 20, 1992 to begin the preparation of the Semi-Annual Progress Report.

#### Major Activities Upcoming Next Three Months

The Semi-Annual Progress Report for October 1, 1991 through March 31, 1992 will be prepared and submitted to the Project Office by April 6, 1992.



## 1.2.6 EXPLORATORY SHAFT INVESTIGATIONS

The objective of the Exploratory Shaft element is to develop, design, construct, operate, maintain, and decommission the exploratory shafts required for site characterization and to plan and implement the in situ testing program.

### 1.2.6.1.1 EXPLORATORY SHAFT MANAGEMENT, PLANNING, AND TECHNICAL ASSESSMENT

Preliminary discussions were held with the LANL Test Coordinators regarding sampling needs and consolidating the sampling efforts.

A review of the SNL laboratory and field test program was performed to determine which, if any, tests SNL should field during the construction of the North Ramp TBM Launch chamber. Sample collection for laboratory tests was the only activity identified as being applicable to this early construction activity.

## 1.2.9 PROJECT MANAGEMENT

The objective of the Project Management element is to schedule, budget, perform, control, coordinate, and report Project management, Project control, and quality assurance work. This includes identifying and defining interfaces among Project elements and integrating those elements.

### 1.2.9.1.1 MANAGEMENT

#### Significant Meetings Attended

Staff attended the first meeting of the YMP Information Resources Management Council in Las Vegas, NV on March 25, 1992.

#### Status Report on Ongoing Activities

Work continued on updating the property database. Staff was trained in requirements regarding property procured with Nuclear Waste Funds.

Management of production of technical reports has transitioned to new staff.

All IHRWM conference papers have been submitted as record packages to the local records center (LRC).

#### Major Activities Upcoming Next Three Months

Technical publication staff will meet with Project Office Central Records Facility (CRF) staff in April to discuss Records Information System (RIS) problems and receive training.

The close out of the DOE/YMP Property Audit will be conducted and audit observations will be addressed. An information bulletin detailing requirements for use and disposal of property acquired with Nuclear Waste Funds will be written and distributed to all SNL staff supporting the YMP.

### 1.2.9.1.4 RECORDS MANAGEMENT

#### Major Accomplishments

The SNL Local Records Center was awarded the YMP Records and Document Control Quality Service Recognition Award for the fourth quarter of 1991. This award recognizes superior achievement, process improvements, and customer service.

#### Significant Meetings Attended

Records staff attended the YMP Records Coordinators Meeting in Las Vegas, NV on March 4 and 5, 1992. Records staff also attended the Association of Record Managers and Administrators (ARMA) Spring Conference in Albuquerque, NM on March 19, 1992. Technical and Management Support Services (T&MSS) records staff conducted a one-day workshop in Albuquerque, NM for Records Management staff on the use of the Records Information System (RIS) and records indexing methodologies.

#### Status Report on Ongoing Activities

Record source training was provided to SNL YMP staff. Development of supplemental modules for the on-the-job (OJT) program for LRC staff continued. Sorting of backlog records related to the Site Characterization Project (SCP) was initiated. Indexing of photos for the Nevada Test Site (NTS) Photos Database continued.



### Major Activities Upcoming Next Three Months

QAIPs 17-1 and 17-3 will be issued.

## 1.2.9.1.5 YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP) SUPPORT FOR THE TRAINING MISSION

### Status Report on Ongoing Activities

The new training program, Training for Optimal Performance by Staff (TOPS), was presented to and approved by the Technical Project Officer (TPO).

A textbook for use in an Interdisciplinary Technical Training general geology course has been identified and a sample copy is being obtained. An instructor has also been identified.

A preliminary matrix has been developed as the first step of implementing the Job Effectiveness Training (JET) component of TOPS.

The Computational and Visualization Environment (CaVE) users' survey has been completed and the results are being compiled. These results will be analyzed and training will be developed and implemented based on same.

### Major Activities Upcoming Next Three Months

Several staff will be attending "Using Video's Power in Training" course on April 1 through 3, 1992 at the Sony Institute in California.

Training staff F. Cheek-Martin and A. Hotchkiss will attend the Project Office's "Train the Trainer" five-day class in Las Vegas, NV on April 20 through 24, 1992.

Staff will participate in the Training Coordinators meeting, which is currently expected to be held in Washington, DC in May.

A revised proposal for the development and implementation of JET will be prepared and presented to the TPO in mid-May.

## 1.2.9.2 PROJECT CONTROL

### Significant Meetings Attended

The YMP Project Control Steering Committee (PCSC) met in Albuquerque, NM on March 20, 1992. Discussions were held on the upcoming ICE Team visits from DOE/HO and the Mission 2001 effort planned by the M&O.

### Status Report on Ongoing Activities

Actual cost and network status reports were sent to YMPO. The clean up on PACs data bases continued.

The PACS video is still under development. Additional filming is scheduled for early May. Progress on the film has been slower than originally expected because of delays in obtaining computer equipment needed for the animation segments.

Work is continuing on the QADEFs data base software, with completion and installation in the production mode being planned for the first or second week in April.



A process to use FTP software to transfer text files from the YMP VAX computers to the AIMS computers has been developed and documented for use by AIMS users.

A utility menu was developed on the Administrative Information Management System (AIMS) computer to allow AIMS users to communicate using the UNIX mail facility on the AIMS computer.

#### Major Activities Upcoming Next Three Months

Replanning for FY93 - FY01 is expected to start on April 6, 1992.

The PACs video will be completed, previewed and presented.

Information packages will be assembled for the ICE Team visit. The PACS workstation software will be installed permitting electronic transmittal of PACS data to Las Vegas, NV.

The YMP PCSC will meet in Albuquerque, NM on April 24, 1992 to discuss the progress of the ICE Team visits and the Mission 2001 effort.

### 1.2.9.3 QUALITY ASSURANCE PROGRAM

#### Status Report on Ongoing Activities

The QA audits of NER and Holometrix were rescheduled from February 1992 to the last week of April 1992. The revised schedule was required to allow participation of key personnel from both facilities and the required SNL technical specialists deemed crucial for a performance-based assessment of quality-affecting activities.

Quality Assurance Implementing Procedures (QAIPs) 16-1 (Corrective Action) and 18-1 (Quality Assurance Audits) are in management review. QAIPs 15-1 (Nonconformance Control and Reporting), 17-3 (Processing YMP Records), and 1-5 (Work Agreements) are in preliminary draft review. DOP 17-1 (Records Management System), revised and retitled as QAIP 17-1, "Preparing and Submitting YMP Records," is also in draft review.

The SNL NWRT QA Department submitted a response to a Corrective Action Report (CAR), YMP 92-021, that was issued as a result of YMP Audit 92-09 conducted in February 1992. Additionally, the proposed actions were completed and objective evidence thereof submitted to the Yucca Mountain QA Division.

#### Major Activities Upcoming Next Three Months

QA program changes dictated by the SNL restructuring will continue to be identified and implemented.

The review of SNL QAIPs for improvement and simplification will continue.

Activity will continue on the development of a new computer-based QA matrix.

An internal surveillance of software code development (specific to WBS 1.2.1.4.9 activities) is scheduled.

The SNL internal audit tentatively scheduled for late May or early June 1992 will focus on the implementation of QA controls applicable to ongoing significant technical activity.

#### Other Items to Report

Work was completed within the SNL NWRT QA organization to identify the impact of the transition to a revised work breakdown structure (WBS) system.

J. V. Voigt (MACTEC) is scheduled to present a poster session at the April 1992 IHLRWM conference.

## APPENDIX A: TECHNICAL DATA BASE INPUT

### 1. CANDIDATE DATA FOR THE TECHNICAL DATA BASE

<u>Participant</u>	<u>Description of Data</u>
SNL	"Uniaxial and Triaxial Compression Test Series on Calico Hills Tuff," SAND82-1314, R. H. Price.
SNL	"Uniaxial and Triaxial Compression Test Series on Topopah Spring Tuff," SAND82-1723, R. H. Price.
SNL	"Uniaxial Compression Test Series on Topopah Spring Tuff from USW GU-2, Yucca Mountain, Southern Nevada," SAND83-1646, R. H. Price.
SNL	"Preliminary Characterization of the Petrologic, Bulk, and Mechanical Properties of a Lithophysal Zone Within the Topopah Spring Member of the Paintbrush Tuff," SAND84-0860, R. H. Price.

### 2. DATA FORMALLY SUBMITTED TO THE TECHNICAL DATA BASE

<u>Participant</u>	<u>Description of Data</u>	<u>SNL Data Auth. No.</u>
USGS	"Strontium Isotopes in Carbonate Deposits at Crater Flat, Nevada," from the High Level Radioactive Waste Management Proceedings of the Second International Conference.	Not applicable
USGS	"Assessing the Natural Performance of Felsic Tuffs using the Rb-Sr and Sm-Nd Systems--A Study of the Altered Zone in the Topopah Spring Member, Paintbrush Tuff, Yucca Mountain, Nevada," from the Materials Research Society Symposium Proceedings.	Not applicable
USGS	"Distribution of Rubidium, Strontium and Zirconium in Tuff From Two Deep Coreholes at Yucca Mountain, Nevada," from the High Level Radioactive Waste Management Proceedings of the Second International Conference.	Not applicable

### 3. DATA FORMALLY ENTERED INTO THE TECHNICAL DATA BASE

<u>Participant</u>	<u>Description of Data</u>	<u>SNL Data Auth. No.</u>
USGS	Drill hole mineralogy data	DA0045
USGS	Drill hole and surface sample mineralogy data, Surface sample location and description	DA0068
USGS	Surface sample mineralogy data	DA0126
USGS	Drill hole mineralogy data	DA0128
LLNL	Solubility of radionuclide data	DA0155 and DA0159
LLNL	Drill hole mineralogy data	DA0156
USGS	Surface sample mineralogy data	DA0162



## APPENDIX B: REFERENCE INFORMATION BASE

### 1. REFERENCE INFORMATION BASE (RIB) CHANGE REQUESTS SUBMITTED\*

<u>RIBCR</u>	<u>Subject</u>	<u>Participant</u>	<u>Status</u>
None.			

### 2. INFORMATION BEING PROCESSED AS RIB CHANGE DEVELOPMENT FILES FOR CONSIDERATION AS INPUT TO THE RIB\*

<u>RIBCR</u>	<u>Subject</u>	<u>Status</u>
CR57	Calcite-Silica Vein Deposits	Submitted to CCB
CR58	Volcanic Features	Review
CR60	Spent Fuel Vertical Emplacement	Cancelled
CR61	Spent Fuel Horizontal Emplacement	Cancelled
CR62	Geomorphic Processes	Cancelled
CR63	Estimated Water Usage	Review Complete
CR64	Physiographic Divisions	Cancelled
CR65	Tectonic Geomorphology	Cancelled
CR66	Mechanical Excavation	Cancelled
CR67	Thermal/Mechanical Cross Sections	Submitted to CCB
CR68	Existing Roads	Cancelled
CR70	Hydrogeologic Zones	Submitted to CCB
CR71	Potential Transportation Routes	Review Complete
CR72	Material Specifications - Surface	Cancelled
CR75	Regional Seismic History	Submitted to CCB
CR76	UNE Seismicity	Submitted to CCB
CR77	Rock Mass and Q Ratings	Cancelled
CR80	Water Application Movement	Under Development
CR81	Thermal/Mechanical Surfaces	Review
CR82	Topographic Maps	Review Complete

### 3. INFORMATION ENTERED INTO THE RIB

None.

\*Candidate information is identified by RIB Change Requests, which are prepared in accordance with Revision 0 of Yucca Mountain Project Administrative Procedure AP-5.3Q, "Information Flow Into the Reference Information Base," which is implemented at SNL as Department Operating Procedure (DOP) DOP 3-8.



United States Department of the Interior

I-327329 *819*

AMERICA

GEOLOGICAL SURVEY  
BOX 25046 M.S. 455  
DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

IN REPLY REFER TO:

May 11, 1992

WBS: 1.2.9.1.1

CA: N/A

Carl P. Gertz, Project Manager  
Yucca Mountain 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 March, 1992

Dear Carl:

Enclosed is the USGS detailed monthly status report for March, 1992. If you have any questions or comments, please contact Raye Ritchey at FTS 776-0517.

Sincerely,

*Raye E. Ritchey*

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

Attachment

MAY 18 10 32 AM '92

*Gertz  
Simecka  
Dyer  
Dyer  
Lorui  
Broderick  
S. Jones  
Hilckler  
Wallace* ) *RW-22*

*5/18/92* *Gertz*

ENCLOSURE

cc: D. Appel, USGS/Denver  
T. Blejwas, SNL/Albuquerque  
R. Bullock, RSN/Las Vegas  
D. Campbell, USBR/Denver  
R. Craig, USGS/Las Vegas  
W. Dudley, USGS/Denver  
D. Gillies, USGS/Denver  
R. Herbst, LANL/Los Alamos  
V. Iorii, DOE/Las Vegas  
W. Clark, LLNL/Livermore  
R. Pritchett, REECo/Las Vegas  
R. Ritchey, USGS/Denver  
E. Roseboom, USGS/Reston  
J. Shaler, SAIC/Golden  
N. Trask, USGS/Reston  
YMP-USGS Local Records Center 1.1.02

LRH/RER/mt  
059204

Department of the Interior  
United States Geological Survey  
YUCCA MOUNTAIN PROJECT  
Monthly Highlights and Status Report  
MARCH 1992

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
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
ALARA	.....	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
AMD	.....	Administrative Management Section
ANS	.....	American Nuclear Society
ANSI	.....	American National Standards Institute
ANSTO	.....	Australian Nuclear Science and Technical Organization
AO	.....	Administrative Officer
AP	.....	Administrative Procedure
APO	.....	Administrative Procedure Quality
ARR	.....	Area Recommendation Report
ARS	.....	Automated Records System
ASA	.....	American Statistical Association
ASME	.....	American Society of Mechanical Engineers
ASOC	.....	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 for work performed
BCWS	budgeted cost for 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
BOA	Branch of Quality Assurance
BRC	below regulatory concern
BRG	Branch of Central Regional Geology
BSP	balanced cross section modeling program
BSR	Bi-annual Status Report
BWIP	Basalt Waste Isolation Project
C/SCR	Cost and Schedule Change Report
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 Document 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 shaft
ESF	Exploratory Studies Facility
ESF/DRD	Exploratory Shaft Facility Design Requirements Document
ESQAT	Earth Science Quality Assurance Team
ESR	electron spin resonance
ESSE	Early Site Suitability Evaluation
ESTC	Exploratory Shaft Test Coordination
ESTP	Exploratory Shaft Test Plan
ESTP-C	Exploratory Shaft 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
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
FOI	Federal Quality Institute
FR	Federal Register
FRD	Functional Requirement Document
FRHP	Fractured Rock Hydrology Program
FSN	Fenix and Scisson, Nevada
FSU	Florida State University
FTE	full-time equivalent
FWP	field work proposal
FY	fiscal year
G&A	Goodson and Associates
GAO	Government Accounting Office
GAP	Geostatistical Analysis Package
GC	gas chromatograph
GCM	Global Climate Model
GCP	Geochronological Procedure
GD	Geologic Division
GEOEAS	Geostatistical Environmental Software
GET	General Employee Training

GETT	grants equal to taxes
GID	Ground Water Site Investigation
GIS	Geologic Information System
GIS	Graphic Information System
GIT	Geochemistry Integration Team
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
H&N	Holmes and Narver
HIP	Hydrologic Investigations Program (formerly NHP)
HITF	Hydrology Integration Task Force
HLRW	high-level radioactive waste
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
ICLAM	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
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 simulator
LRC	Local Records Center
LRE	latest revised estimate
LRGS	Local Read-Out Ground Station
LRP	long-range planning
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
MADS	Meteorological Alert Distribution System
MCL	Maximum Contaminant Level
MEDA	Meteorological Data Acquisition Network
MFC	mass flow controller
MGDS	Mined Geologic Disposal System
MIC	Management Information Center
MISIS	Micro Integrated Storm Information System
MLT	materials testing laboratory
MMDS	Martin Marietta Data Systems
MODFE	Modular Finite Element
MOT	Management Overview Team
MOU	Memorandum of Understanding
MPBA	multipurpose borehole activity
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	main testing 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
NHP	Nuclear Hydrology Program (now HIP)
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
NOO	Nevada Operations Office
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
NWOL	National Water Quality Laboratory
NWTRB	Nuclear Waste Technical Review Board
OBS	organization breakdown structure
OCRWM	Office of Civilian Radioactive Waste Management
OF	Open file
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
OWOSU	Ocala Water Quality Services Unit
P&S	planning and scheduling
PA	performance assessment
PAC	planning and control
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
PBQ&D	Parson, Brinkerhoff, Quade, and Douglas
PBS	pyramid beam splitter
PC	personal computer
PCBI	Prototype Controlled Blasting Investigation
PCCB	Program Change Control Board
PCM	pivoting camera mount
PCSB	Program 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
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
PRC	Project Records Center

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
ORA	Quality Related Activities
ORB	Quality Review Board
QVC	Quality Verification Check
QWL	quality of work life
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
ROPG	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	study activities
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
SCM	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 simulator
SOA	Software Quality Assurance
SOAP	Software Quality Assurance Plan
SRD	system requirements and description
SRG	strike rail goniometer
SRM	standard reference material
SRP	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
TPT	Testing Prioritization Task
TOM	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
UNE	Underground Nuclear Explosion
UNLV	University of Nevada at 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. Department of the Interior 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
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
WIT	Working Integration Team
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
WPDRD	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
YM	Yucca Mountain

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

## 1.2.1 SYSTEMS

### OBJECTIVE

To integrate systems with the Geologic Repository Program and to describe the YMP Mined Geologic Disposal System (MGDS); and to evaluate the performance of the natural, engineered barrier, and total systems for meeting regulatory standards.

#### WBS 1.2.1.3 Technical Data Base Management

### OBJECTIVE

To manage, maintain, and accumulate technical data and information produced by site characterization, design development, and performance assessment activities for the Project.

#### WBS 1.2.1.3.5 Technical Data Base Input

Principal Investigator - L. Hayes

### OBJECTIVE

To provide the hardware, software, personnel, and procedures needed to provide data to the technical base.

#### ACTIVITIES AND ACCOMPLISHMENTS

The Participant Data Archives (PDA) accepted 22 technical data information forms covering SCP activities 8.3.1.2.2.3.1, 8.3.1.5.2.1.3, 8.3.1.5.2.1.5, 8.3.1.17.4.7.2, and one for WBS 1.2.5.4.8 under the Environmental Monitoring Plan.

The PDA has acquired all missing developocorder films from the earthquake center. An audit and inventory was conducted at the Security Archives storage facility to complete the revamping of the developocorder data base.

#### WBS 1.2.1.4 Performance Assessment

### OBJECTIVE

To conduct investigations and develop mathematical models examining the performance of the MGDS in the preclosure and postclosure phases; to verify, validate, benchmark, and document codes for assessing the performance of the overall waste isolation system; and to analyze the performance of the total system and subsystems.

#### WBS 1.2.1.4.4 Site Performance Assessment

### OBJECTIVE

To integrate physical process submodels and data into computational models for prediction of performance of the site (including uncertainties); and assess whether the site will meet requirements for ground-water travel time in 10 CFR 60.113(a) (2). (SCP Sections 8.2.2 and 8.3.5)

#### WBS 1.2.1.4.4.2 Favorable and Adverse Conditions

Principal Investigator - A. Flint

### OBJECTIVE

To assess site performance characteristics under the favorable and adverse conditions listed in 10 CFR 60.122; and assess engineered barrier system (EBS) performance characteristics under the potentially adverse conditions in 10 CFR 60.122, which refers to impacts on EBS performance. (SCP Section 8.3.5.17)

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GPA006 Test new neutron calibration in 1-D model

Moisture retention curves are currently being developed on many samples representing all of the lithologic units present in USW UZN-55. The data will be used for input into the 1-D model. Additional rock properties are still underway. Several of the N-55 core are being oven dried at temperatures ranging from 200 C - 800 C to determine the appropriate temperature to remove all hydrogen from the rock matrix. Preliminary results suggest that this will improve the neutron probe calibration. All core from N-55 will be dried at high temperature to determine the final calibration to use for the model.

#### 3GPA002 Develop analytical solution to model imbibition

The computer program using the analytical solution for determining sorptivity via inverse modeling was run utilizing the measured sorptivity on the Shardy Base horizontal transect samples and the composite transect samples. Some success was achieved, but it was apparent that additional work is necessary to predict the high and the low permeabilities. Moisture retention curves were run on Shardy Base and composite samples, and will be used for model validation of Brooks and Corey functions.

#### 3GPA007 Sensitivity analysis model mesh size to 1-D infiltration

This activity has begun by considering appropriate mesh sizes according to model specifications, along with the finalization of the neutron calibration for validation input.

### Quality Assurance

### Planning and Operations

### Variations

## WBS 1.2.1.4.6 Development and Validation of Flow and Transport Models

Principal Investigator - A. Flint

### OBJECTIVE

To develop and validate the calculational models that (1) are used primarily in assessments of performance for the resolution of Issues 1.1, 1.2, 1.3, 1.6, 1.8, and 1.9; (2) describe fluid flow or the transport of energy/or radionuclides; and (3) are not used exclusively in the resolution of a single issue; and to follow applicable quality-assurance procedures.

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GVF001 Prepare for core heating experiment

Particle density measurements using the pycnometer and imbibition measurements have been completed on all samples. An additional high temperature oven was obtained and calibrated for use with these samples. Statistical analyses have been run to divide the samples into groups for processing at different temperatures. All preparations for the experiment are complete.

#### 3GVF002 Heating experiment lab analyses

Preparation of core and initial measurements are complete and the necessary equipment has

been obtained and calibrated to begin the heating experiment.

**3GVF005 Develop method for thermal conduct and heat capacity**

The thermal probe design has been completed and tested in prototype experiments. An experimental protocol has been developed and tested for determining thermal conductivity and heat capacity of rock cores as a function of water content. Data logger programs and wiring panels have been constructed for a system to measure properties on six rock cores simultaneously. Construction and calibration of a set of thermal probes is in progress. A computer program for reading data logger files and computing thermal properties was completed. The program permits interactive data interpretation and analysis.

**3GVF009 Continue development of 3-D borehole imbibition model**

A 3-D mesh has been constructed and coded for use with TOUGH. Preliminary simulations are unable to reproduce neutron readings; simulated imbibition rates are much smaller than observed in the experimental data. Further model development is awaiting the analysis of laboratory sorptivity data which has just been completed. The MTL core data has not yet been received for model input, and the imbibition data will be used as data for analysis in 3GVF010 (Analysis of MTL core data for model input) for the time being.

**3GVF014 Prepare technical report, horizontal variability of Shardy Base transect**

Analysis of data from the Shardy Base horizontal transect has been completed. Measured properties include: bulk density, porosity, saturated hydraulic conductivity, and sorptivity. Water characteristic curves have also been measured. This activity has been expanded to include an intensive 2-D sampling grid which is being used to investigate vertical and horizontal trends in bulk and hydraulic properties. Approximately 300 1-inch core specimens were collected in a series of 26 vertical transects arranged across a horizontal transect approximately 3500 ft. long. The determination of properties is in progress. The results of this investigation will be presented at the Fourth International Geostatistics Congress in September, 1992. This information will be used to supplement and finalize the draft of the technical report, and is not expected to create any delays at this time.

**3GVF015 Finalize geostatistical software and text**

Chapter 3 of the textbook has been completed and work on chapter 4 is in progress. The geostatistics package has been completed. A computer programmer has been hired to perform diagnostic tests and to prepare a version of the software for user testing. The user's manual is being written now. Test copies of the software will be distributed in May. Delays in the actual finish of this activity will not impact any other activities, because the computer package is finished and currently being used for prototype analysis.

Quality Assurance

Planning and Operations

Variations

**3GVF015 Finalize geostatistical software and text**

Delays in this activity will not impact any other activities. The actual finish date will probably be delayed until mid-summer.

## WBS 1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses

Principal Investigator - A. Flint

### OBJECTIVE

To provide documentation and results of calculations used in analyses of postclosure performance that support design efforts, contribute to the resolution of Issue 1.3, and indirectly support activities carried out under other performance assessment WBS elements.

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GPC002 Develop method to determine moisture retention-CX-2

A welded core sample, 1.5 inches in diameter, was initially saturated and then evaporated to attain various water contents. Water potential was determined using the CX-2 at each water content to develop a moisture retention curve. A Brooks and Corey model was successfully fit to the data. A sample cup was fabricated that has a smaller inside diameter enabling the utilization of the many 1-inch core plugs collected from transects. The cup also has an O-ring to see if there is any reduction in water loss from the instrument that may improve the accuracy. Additional core samples are being prepared for moisture retention and an experimental procedure is being developed to see if the particle size of rock chunks has an influence on the measured water potential.

##### 3GPC004 Finish measurement on transect core, preliminary data analysis

Imbibition and moisture retention were completed on the composite transect samples. All remaining core from the UZ-6 transect are undergoing imbibition experiments. Data has been organized into a dataset for submittal to the LRC.

#### Quality Assurance

##### 3GPC001 Develop calibration procedure, test CX-2

Development of the calibration procedure is being revised based on new information on the CX-2.

#### Planning and Operations

#### Variances

## 1.2.3 SITE

### OBJECTIVE

To characterize Yucca Mountain and vicinity to identify and technically qualify a possible site for the construction and operation of a mined geologic repository for high-level radioactive waste.

### WBS 1.2.3.1 Management and Integration

Principal Investigator - L. Hayes

### OBJECTIVE

To manage and integrate the work performed within the site WBS elements.

### M&I - Branch 0G3192B1

Summary Account Manager - L. Ducret

### ACTIVITIES AND ACCOMPLISHMENTS

R. Craig attended Prototype Management Team meetings on March 6, 13, 20, and 27; Exploratory Studies Facility (ESF) meetings on March 6 and 20; UZ-16 Task Force meetings on March 5 and 19; the YMPB staff meeting in Denver on March 16; a SOC meeting at the SMF March 3; a Tracer Injection System meeting March 17; and a meeting at the FOC with USBR personnel regarding soils, on March 4.

R. Craig provided overviews of Yucca Mountain geology and hydrology programs as part of the public open house tour on March 28.

R. Craig reviewed the 50% Phase 1A ESF design as part of the Management Review on March 2.

### M&I - Geologic Studies Program 0G3192G1

Summary Account Manager - J. Stuckless

### ACTIVITIES AND ACCOMPLISHMENTS

J. Stuckless continued work on MOAs with the Geologic Division with most time being spent on transfer of seismic network from GD to the University of Nevada, Reno.

J. Stuckless continued work on the start up of GSP. C. Menges and W. Simonds were added to the staff.

J. Stuckless presented a report on Trench 14 at the Waste Management 92 symposium poster session.

### M&I OA Implementation GSP 0G3192G2

Summary Account Manager - J. Stuckless

### ACTIVITIES AND ACCOMPLISHMENTS

The following preliminary draft technical procedures were prepared or changed as requested:

GCP-14, R2	Extraction and Recovery of H <sub>2</sub> O From Calcite-Hosted Inclusion Fluids
GP-39, R0	Geophotogrammetric Mapping of Trench Walls - Field Work
HP-114, R1	Estimating Streamflow Discharge
HP-126, R1	Extraction of Residual Water from Tuff Samples by Vacuum Distillation
HP-169, R1	Determination of Peak Discharge by the Slope-Area Method
HP-221T, R0	Monitoring the Well Water Level or Fluid Pressure Response to

- HP-222T, R0    Underground Nuclear Explosions or Earthquakes  
Using a Small Draft Packer and Transducer to Measure Field  
Pressure in Wells
- HP-229, R1    Determination of Water Content and Physical Properties for Laboratory  
Rock Samples
- HP-236T, R0    Installation and Operation of PVC Straddle Packer String in Unsaturated  
Zone Boreholes for Gas and Water Vapor Sampling
- HP-237T, R0    Methods for Sealing Unsaturated Zone Borehole Core Samples to Preserve  
Moisture Content

Final drafts of the following technical procedures were prepared and returned to the HIP for signatures:

- HP-221T, R0    Monitoring the Well Water Level or Fluid Pressure Response to  
Underground Nuclear Explosions or Earthquakes
- HP-222T, R0    Using a Small Draft Packer and Transducer to Measure Fluid Pressure in  
Wells
- HP-169, R1    Determination of Peak Discharge by the Slope-Area Method

Within a two week period GP-39, R0, Geophotogrammetric Mapping for Trench Walls-Field Work, was prepared, processed through QA and technical reviews and submitted for controlled distribution in time for investigator J. Coe (GSP) to meet his field work deadline.

A change request to modify the SCPB as a result of a need to move the seismic profiling task from Study 8.3.1.17.4.3 to 8.3.1.4.2.1 was completed.

A job package for SCP activity 8.3.1.5.2.1.5 was revised and approval was coordinated with the chief of the Nevada operation program and the YMPO.

The GSP was assisted with responses to and/or remedial/investigative actions for CAR-91-03, CAR 91-05, CAR-91-07, CAR-92-05, NCR-90-37, NCR-91-26, NCR-91-31, NCR-91-36, NCR-91-44, NCR-92-02, NCR-92-17, AND NCR-92-19. The GSP was also assisted in following up on overdue reading assignments and document transmittal notices (DTNs), in gathering raw data for manuscript record packages, as well as completing TDIFs. A QA records package for Study Plan 8.3.1.17.4.3 was transmitted to the LRC.

The GSP continued to be represented on a committee to revise procurement control and control of purchased materials, equipment and services. Data bases utilized by the GSP were reviewed and suggestions made to create a single relational data base.

Several meetings and planning sessions to transfer the operation of the Southern Great Basin Seismic Network from the Branch of Geologic Risk Assessment to the University of Nevada, Reno were attended.

Eleven technical data information forms were prepared for SCP activity 8.3.1.5.2.1.5 and submitted to the technical data coordinator. Seven of the TDIFs were for data acquisition, two were for selected data, and two were for developed data.

Records packages were prepared and submitted to the LRC for two approved Memoranda of Agreements, "Borehole Geophysical Surveys at Yucca Mountain" and "Facilities and Services, Branch of Isotope Geology". Distribution was provided for the Isotope Geology memorandum.

J. Whitney was assisted with the preparation of viewgraphs for his presentation at the EPRI Workshop on Earthquakes and Tectonics held March 4-6 in Washington, D.C.

The TPO office was assisted with the investigative and remedial actions for USGS-NCR-91-14 on missing qualification documents for study plans. Fifteen GSP study plan files were examined for records compliance. A study plan records package checklist was prepared and submitted to the TPO QA advisor to assist in planning further actions.

Configuration Control Committee (CCC) meetings were attended in Denver (March 5 and 17). Assistance was provided to numerous technical contacts for software in Menlo Park on March 25-27. P. Nelson was assisted with completing the QMP-3.03 attachments for software.

The technical procedure status list was updated and forwarded to the YMP-USGS QA office.

A review of configuration management change request and change directive for eight affected document notices (ADNs) was made. Final responses for the ADNs were returned to DOE/YMP.

M&I - Hydrology Program Management and Administration 0G3192H1  
Summary Account Manager - D. Gillies

ACTIVITIES AND ACCOMPLISHMENTS

All 60 USGS and LBL summary account schedules were statused as of the end of February using schedule-status and progress information provided by each summary account manager.

A draft USGS management agreement for conduct of the YMP environmental program water-resources monitoring project was reviewed by all parties concerned. Minor revisions to the agreement resulted from the review.

D. Appel and D. Gillies met with staff of the USGS Nevada District on March 20 to discuss management of the water resources monitoring project and future plans for expansion of the Yucca Mountain surface-water gaging network. Nevada District staff presented a first-cut budget for FY 93 that would allow for significant expansion of the network.

D. Gillies participated in the March 23 DOE-Environmental Program mid-year financial/progress review for the water resources monitoring project being conducted by the USGS Nevada District.

D. Gillies synthesized historical cost information for selected hydrology program planning and scheduling accounts (SCP studies) in preparation for a meeting with the DOE-HQ Independent Cost Estimating team. At the meeting on March 31, Gillies traced the evolution of Hydrology Program multi-year cost estimates from the 1989 "bottoms-up" exercise conducted for the FY 1991 WAS, to the FY 1992 PACS.

M&I OA Implementation, Hydrology 0G3192H2  
Summary Account Manager - W. Causseaux

ACTIVITIES AND ACCOMPLISHMENTS

S. Frans is currently processing 45 hydrologic procedures and scientific notebook plans.

Seven approved technical procedure packages and five approved scientific notebook plan packages were submitted to SAIC by S. Frans.

W. Causseaux met with G. Patterson, S. Boucher, and W. Rodman to discuss final changes in HP-

222T and HP-222 prior to submittal for review and approval.

W. Causseaux and J. Woolverton met with A. Flint and J. Ziemba to discuss the adequacy of YMP-USGS interfaces with REECO in using QA controls for the sample collection that is acceptable to HIP.

J. LaMonaca submitted the draft of QMP-3.04, R4 to the QA office on March 26 for retyping and preparation for QMP-5.03 Management review.

The HIP reviews of QMP-3.15, R0 were completed by W. Causseaux, R. Luckey, J. Woolverton and G. Severson and submitted to the YMPB on March 17.

W. Causseaux met with T. Chaney to discuss proposed changes in the draft revision of QMP-4.01, with specific reference to include management controls in the management procedure for procurement. The need for comment resolution for the draft of QMP-3.15, R0 was also discussed.

N. Karas (SAIC/Golden) met with W. Causseaux to discuss the status of YMP-USGS QMPs and TPs that are in process or review by the HIP. Of particular interest was the continuing improvement in timeliness and adequacy of technical review and comment resolution records packages.

W. Causseaux met with D. Porter (SAIC/Golden) to finalize comment resolution for the HIP reviews of QMP-3.15, R0. Issuance of this management procedure is important to the YMPB technical staffs to facilitate implementation of the YMPO QA grading process within the USGS-YMP.

J. LaMonaca initiated NCRs 92-13 and 92-14 pertaining to YMPB publications not complying with various requirements of QMP-3.04.

D. Appel met with W. Causseaux and J. Woolverton to finalize the HIP proposed disposition for USGS-CAR-92-04 regarding QA deficiencies for Study Plan Activity 8.3.1.2.2.6.1 Gaseous Phase Circulation.

W. Causseaux met with A. Whiteside to review the final YMPB proposed disposition for NCR-91-31 regarding deficiencies in instrument calibration services provided by approved vendors.

W. Causseaux and S. Frans met with J. Millsap of the YMPB administrative staff to review procurement document records packages prior to submittal to the LRC. Causseaux also talked with T. Mendez-Vigo about strategy previously used to complete the records packages.

D. Appel, W. Causseaux, and other HIP and YMPB personnel attended a meeting on March 3 to discuss the YMPO Audit-92-13 scheduled for six HIP study plan activities during the period April 1-10. The purpose of the meeting was to finalize operational strategy and evaluate readiness for the audit.

W. Causseaux visited the Las Vegas subdistrict office to discuss preparations for YMPO audit-92-13 with M. Pabst and the technical staff of the surface-water runoff study.

W. Causseaux visited the HIP Hydrologic Research Facility at the NTS to participate in USGS Audit-92-04 and to serve as HIP liaison for QA and management.

W. Causseaux met with L. Hayes in Las Vegas to apprise him of the status of USGS Audit-92-04

that was in progress at the Hydrologic Research Facility at the NTS. Hayes and Causseaux met with J. Ziembra and M. Mustard at the YMPB office in Las Vegas to receive a progress report on USGS Audit-92-02.

HIP QA, management, and technical personnel attended the "How To Be Audited" session presented by the YMP-USGS QA office on March 24 as part of the YMP-USGS preparations for the YMPO Audit 92-13.

W. Causseaux and J. Woolverton met with T. Chaney to discuss strategy for the YMPO Audit-92-13 of HIP activities and the Hydrologic Research Facility at the NTS.

D. Appel met with W. Causseaux and J. Woolverton to finalize the HIP proposed disposition for USGS-CAR-92-03 regarding the need for management agreements between HIP and non-USGS organizations.

J. LaMonaca met with L. Ducret and T. Chaney to discuss the proposed changes by the Branch to QMP-3.04, R4.

J. LaMonaca and S. Frans attended classroom training on "How to be Audited", instructed by W. Rodman.

S. Frans and J. LaMonaca attended a meeting concerning QMP-3.07, R4 held by W. Rodman.

J. LaMonaca met with M. Murray (SAIC/Golden) to discuss new QMP-17.01 requirements on record package submittal.

Seven published GSP abstract packages, three published HIP abstract packages, and three complete HIP publication packages were submitted to the LRC by J. LaMonaca.

Computer Operation & Data Management, Hydrology 0G3192H3  
Summary Account Manager - C. Washington

### ACTIVITIES AND ACCOMPLISHMENTS

#### NOVELL File Server

An SMTP Gateway has been installed to address the need of a centralized E-mail delivery point. Most of HIP personnel receives E-mail on three different computers. Beginning April 6, 1992, E-mail from all of HIP's computer systems will be routed to the Novell E-mail Package. Mail will be received and can be sent from only one attach point.

#### Telecommunication link to Parfet Building

The T-1 link, to speed up transmission from the Parfet Building to Building 53, was installed on March 27.

The T-1 Remote Bridges, according to purchasing, will be ordered on April 6, 1992. The delivery date will be approximately May 1, 1992. When the bridges are received, the Parfet LAN will be taken down for approximately four hours for installation and testing. All concerned will be notified through Novell's E-mail.

#### Telecommunication link (56Kbs), Area 25, NTS

The computer operations unit installed Ethernet cards and attached all of the PCs at the HRF to the LAN. All of the staff present were instructed in the use of same.

SAIC/Las Vegas has not installed the Class 'C' address; therefore, no more PCs can be added to the HRF's LAN.

The FOC will be networked by SAIC/Las Vegas. At the present, a date has not been set.

Scientific Reports and Project Documents, Hydrology 0G3192H4  
Summary Account Manager - T. Brady

#### ACTIVITIES AND ACCOMPLISHMENTS

HIP is currently processing 83 YMP-HIP scientific publications, 57 YMP-GSP scientific publications, eight YMP-LBL scientific publications, and 15 abstracts.

The HIP review of the following reports and abstracts was completed by T. Brady: "Seismic reflection profiling across Tertiary extensional structures in the eastern Amargosa Desert, southern Nevada, basin and range province, USA", by T. Brocher and M. Carr; "Does localized recharge occur within the ground water flow system of Yucca Mountain, Nevada?", by J. Czarnecki; "A hint of recharge at Franklin Lake playa, Inyo County, California", by J. Czarnecki, D. Ronen, M. Margaritz, and L. Kroitoru; "Application of imbibition experiments to the evaluation of measurement scale in welded and nonwelded tuff", by A. Flint, L. Flint and K. Richards; "Isotopic studies of fracture coatings at Yucca Mountain", by B. Marshall, J. Whelan, Z. Peterman, K. Futa, S. Mahan, and J. Stuckless; "Strontium isotopic composition of the Ash Meadows ground-water systems, southern Nevada", by Z. Peterman, J. Stuckless, S. Mahan, B. Marshall, E. Gutentag, and J. Downey; abstract, "Results from 1991 wildcat wells near Yucca Mountain, Nevada", by A. Harris, J. Repetski, J. Clayton, J. Grow, M. Carr, and T. Daws; abstract, "Soil water transport in the unsaturated zone at Organ Pipe Cactus National Monument, southern Arizona; chloride, bome  $^{36}\text{Cl}$ , and stable isotope approaches", by B. Liu, S. Hoines, and F. Phillips; and abstract, "Constraints on extensional fault geometries in eastern Railroad Valley, Nevada, based on seismic reflection and gravity data", by J. Grow, H. Blank, Jr., C. Potter, and J. Miller.

The HIP review of study plan 8.3.1.5.2.1, R2 - Characterization of the Yucca Mountain Quaternary Regional Hydrology, was completed by T. Brady and the final HIP version was transmitted to YMPO on March 31.

Study Plan 8.3.1.2.3.2 - Saturated-zone hydrochemistry, by W. Steinkampf was approved by DOE on March 11.

A change request to the SCPB was completed by HIP for SP-8.3.1.2.3.1 - Site Saturated-Zone Ground-Water Flow for the addition of a new well in the c-hole complex, and transmitted to YMPO March 31.

The HIP review of other participant study plan 8.3.1.2.2.2, was completed and forwarded to the Project Office on March 18.

The HIP review of other participant study plan 8.3.1.15.1.4, was completed and forwarded to the Project Office on March 20.

The HIP author responses to YMPO review comments on draft SP-8.3.1.2.3.3 - Site Saturated-Zone Hydrologic System Synthesis and Modeling were completed by E. Ervin and the proposed revised text was transmitted to YMPO reviewers by S. Keller (SAIC/Golden) on March 31.

The HIP author responses to YMPO review comments of draft SP-8.3.1.5.2.2- Effects of Future

Climate on Hydrology were completed by J. Downey and K. Kolm and the proposed revised text was transmitted to YMPO reviewers by S. Keller on March 16.

Technical Data Base Management, Hydrology 0G3192H5  
Summary Account Manager - N. Stuthmann

ACTIVITIES AND ACCOMPLISHMENTS

Routine jobs were performed throughout the month, including the retrieval of the QW data from the WRD National Water Laboratory, entering these data into the HIP NWIS data base and the cleanup of the Satellite Transmission of data (SATIN) maintenance logs and directories. Backup of the NWIS data base was performed and the backup tape sent to the Local Records Center for storage in their fire proof vault.

N. Stuthmann, B. Kerans and D. Burkhardt attended a meeting with EG&G concerning their progress in the development of a GIS data base. Kerans and Stuthmann also had a meeting with A. Flint to learn more about the various type of data he is collecting. Flint gave a very good review of his activities. Now the data management unit must see that the necessary data can be stored either in the present NWIS-I data base or the new version presently being written.

Much of B. Kerans time this month has been spent in setting up and learning about the operation of the data general workstation. This also includes the use of the Ingress data package.

W. Oatfield has completed a memo to be sent to Nevada concerning the question Nevada had on past data in the Amdahl WATSTORE system. He has also prepared a first draft on establishing unique identification of field sites.

WBS 1.2.3.2 Geology  
Principal Investigator - J. Stuckless

OBJECTIVE

To conduct geologic investigations to evaluate the suitability of the surface and subsurface environment for siting a nuclear waste repository.

WBS 1.2.3.2.2 Rock Characteristics

OBJECTIVE

To describe present and expected rock characteristics of the Yucca Mountain site and to develop a three-dimensional model of rock characteristics. (SCP Section 8.3.1.4)

WBS 1.2.3.2.2.1 Geologic Framework of the Yucca Mountain Site

OBJECTIVE

To conduct field studies, including surface and subsurface geophysical surveys and geologic mapping on the surface and in the exploratory shaft facility to characterize the geologic framework of the Yucca Mountain site. (SCP Investigation 8.3.1.4.2)

WBS 1.2.3.2.1.1 Vertical and Lateral Distribution of Stratigraphic Units within the Site Area  
Principal Investigator - R. Spengler

OBJECTIVE

To determine the vertical and lateral variability and emplacement history of stratigraphic units and lithostratigraphic subunits within the Yucca Mountain site area. (SCP Study 8.3.1.4.2.1)

SCP 8.3.1.4.2.1.1 Surface and subsurface stratigraphic studies of the host rock and surrounding units  
0G3221A2

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU002A Geochemical isotopic sampling and analysis, phase 1

Z. Peterman spent two days in the YMP core library in Nevada with R. Spengler sampling cuttings from JF-3 and core from J-13. Samples will be used to further establish the isotope data base on different stratigraphic units and to compare 87/76 Sr ratios obtained from the rocks with 87/86 ratios obtained from waters collected within the same stratigraphic units.

3GGU010A Compilation of existing boreholes, lithologic logs (WT)

The start on this activity has been deferred again due to the section chief's involvement in detailed budget planning and in responding to DOE and M&O concerns on the Independent Cost Estimate (ICE). While the formal process to fill a vacancy in the rock characteristics section continues, a new subcontractor employee has been added and dedicated to rock characteristics activities. Orientation and training activities have begun. There is no milestone impact at this time.

Quality Assurance

3GGU002A Geochemical isotopic sampling and analysis, phase 1

B. Marshall attended two software configuration control committee meetings and completed document review of QMP-3.07.

J. Paces continued calibration of a spike according to GCP-22, starting a second set of calibration standards. Status is still pending.

J. Paces initiated software review (as per QMP-3.03, R3) of a critical program used in U-series data collection by alpha-spectrometry (program name is UTH.FOR, CID #GDD0020.02). The program had to be transferred from the old Nuclear Data Systems operating platform to the new PC-based system following catastrophic failure of the old computer. Alpha-spectrometric data collection has been suspended until all control configuration documentation has been submitted to the software control coordinator.

S. Mahan met Sr isotopic calibration date of SRM 987 on March 4.

Planning and Operations

3GGU002A Geochemical isotopic sampling and analysis, phase 1

B. Marshall recalibrated the printer processor on the energy-dispersive XRF instrument in order to fix a minor problem which became apparent when analyzing low-Rb samples.

J. Paces continued review of an outside manuscript (submitted to *Geochimica et Cosmochimica Acta*) on actinide element mobility in fractures at the Canadian radioactive

waste repository site.

#### Variances

3GGU12AA Write criteria letters G-5

The criteria package has not been started.

Cause: Scheduling of drillhole G-5 has slipped to FY93.

Impact: There may be indeterminate impact, but the slippage of the drilling schedule should provide necessary flexibility.

Corrective action: the criteria letter will be written when schedule specifics are available.

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

C. Hunter attended the Water Resources Division short course "Isotope Hydrology" at the National Training Center in Denver. Purpose of the training was to enhance interaction of the petrographic group in rock characteristics with the isotope support group, with particular attention to the possible use of Sr stratigraphy in description of variation of rock units at Yucca Mountain. B. Marshall, K. Futa, and S. Mahan from the isotope support group also attended the week-long course, which included reading assignments, homework problems and a course critique. (160 hours)

SCP 8.3.1.4.2.1.2 Surface-based geophysical surveys 0G3221B2

Summary Account Manager - C. Hunter

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GGU221 Complete report gravity/magnetics Fortymile Wash

Compilation and technical review of previously acquired gravity and magnetic data from Fortymile Wash is complete. A report providing these detailed data along five profiles across Fortymile Wash just east of Yucca Mountain has been submitted for technical review. (See Ponce and others, 1992.) The report is primarily a data release, but concludes that no significant vertical offset of geologic units occurs directly under the Wash. A gravity anomaly of approximately 2 Mgal, however, is associated with the Paintbrush Fault just west of Fortymile Wash, suggesting that the gravity method could provide an effective means to better define the location of known or suspected faults and to locate completely unknown faults, especially those concealed by alluvium.

Manuscript submitted for technical review:

Ponce, D.A., Kohn, S.B., and Waddell, S., 1992, Gravity and magnetic data of Fortymile Wash, Nevada Test Site, Nevada: U.S. Geological Survey Open-File Report 92-xxx, 36p. [DOE]

3GTQ005J Write seismic contract

This task is 90% complete. The Request for Proposal documents have been revised in response to the contract section concerns, but delays in contract administration continue. The announcement of the forthcoming request for proposals has been published, but vendor response is still stymied by incomplete processing in the contract section office. The rock characteristics section office continues to work with the contract administrator to complete the RFP work. Concerns relative to the RFP from DOE resulting in 66 comments on the original proposal have been answered, with responses approved by L. Hayes (Chief, YMPB) and submitted to DOE.

3GGU222 Submit status of regional geophysical for review

Compilation of previously collected data continues under this review of regional geophysics.

The review will be used to refine the planning and selection of procedures and collection parameters for acquisition of future geophysical data.

Chapter authors of the proposed USGS bulletin "Status of regional geophysical studies at Yucca Mountain and vicinity, Nevada and California" have been contacted to answer review comments and to submit revised chapters to H. Oliver, with a May 1, 1992, deadline.

#### 3GGU250 Collect and reduce magnetics/gravity in Yucca Wash

This activity to collect magnetic and gravity data in investigations to support interpretation of the seismic lines to be run in Yucca Wash is awaiting approval of the study plan by the NRC. Planning for fieldwork has begun, but there is no allowable start for fieldwork until the MOA is approved. The signed MOA has now received Reston approval. Data from this activity will be used to target the location for proposed corehole USW G-5 and will also provide constraints on the interpretation of regional variation in the stratigraphic relationships at Yucca Mountain. There is no milestone impact at this time.

#### Quality Assurance

##### 3GGU220 QA Documentation of software

Activity to complete QA documentation of data reduction software for gravity and magnetic studies continues, with nine programs earmarked for QA appraisal. These nine programs have been evaluated by the CCC, which determined the necessary documentation required. Documents for two of these programs have been submitted.

#### Planning and Operations

##### 3GGF223 Study plan approval

The study plan for this activity, included under approval of the 8.3.1.4.2.1 "Vertical and Lateral Distribution of Stratigraphic Units within the Site Area" study plan, has complete resolution of review comments and was submitted to DOE for verification of revisions and final approval in February 1992. The verification review is awaiting final signature, record center submission, and release to the NRC.

#### Variances

Several of the activities in this account are behind schedule, largely due to delay in approval of the governing study plan.

##### 3GGU220 QA documentation

QA activities for software are underway. There should be no impact, and corrective action will involve completion of documents required by the configuration committee.

##### 3GTQ005J Write seismic contract

The contract for seismic lines is incomplete.

**Cause:** Delay in the seismic contract stems from DOE and support contractor technical concerns, delays in the contract office, and lag in approval of the SCP baseline rewrites, which influence approval of the study plan.

**Impact:** Failure to run seismic lines will interfere with the process to locate proposed drillhole G-5.

**Corrective action:** SCPB rewrites have been submitted to DOE. Delays in the contract administration group have been addressed, and the progress of the contract documents continues to be monitored and assisted. Responses to the DOE technical concerns have been completed, approved by the TPO, and submitted. The responses will be included in the revised request for proposals.

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

The Memoranda of Agreement for seismic reflection studies and for gravity and magnetic work were completed by the section chief and principal investigators. The seismic reflection MOA has been signed and funds approved. During this reporting period, the MOA for gravity and magnetic studies was signed in Reston.

The manuscript "Seismic reflection profiling across Tertiary extensional structures in the eastern Amargosa Desert, southern Nevada Basin and Range Province, United States," by T. Brocher *et al.*, has received approval of the Director and was sent to DOE approximately March 15 and to the Geological Society of America for publication. The QA data record packages have been submitted to the local record center. Reviews of the paper have been received with very favorable comments; significant time has been spent on revision of the paper.

### SCP 8.3.1.4.2.1.3 Borehole geophysical surveys 0G3221C7

Summary Account Manager - P. Nelson

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GGU332 Evaluate logs from G-2

The evaluation of commercially available downhole electrical logging methods in comparison tests between Dresser-Atlas and Schlumberger in logging runs in USW G-2 continues as the main focus of effort during the reporting period. This evaluation and formulation of recommendations is 80% complete and will include consideration of a variety of logs and different models of logging tools for acquisition of each log type, including older model tools to facilitate comparisons to logging runs made in Yucca Mountain holes in the early 1980s. This evaluation and the resulting recommendations for choice of borehole geophysical logging methods will be released as an Open-File Report (P. Nelson, co-authored with R. Schimschal) tentatively entitled "Assessment of geophysical logs from borehole USW G-2, with recommendations for future logging at Yucca Mountain, Nevada." Anticipated date of submission of the report for review is next month.

P. Nelson met with R. Olson (RSN) to review assessment of the Dresser/Schlumberger procedures and to discuss related geophysical logging QA topics.

##### 3GGU393 Compute algorithms to density and resistivity logs

There was no activity during the reporting period. Per the recently completed Memorandum of Agreement, this activity has been deferred to the third quarter. There is no milestone impact at this time.

##### 3GGU364 Write procedure for magnetometer logging

There was no activity during the reporting period. Per the recently completed Memorandum of Agreement, this activity has been deferred to the third quarter. There is no milestone impact at this time.

#### Quality Assurance

##### 3GGU332 Evaluate logs from G-2

P. Nelson attended software QA training.

#### Planning and Operations

#### Variations

Work Performed but not in Direct Support of the Scheduled Tasks

The Memorandum of Agreement for borehole geophysical studies was completed during the last reporting period by the section chief and principal investigator. The MOA has now been approved by Reston and returned with all necessary signatures.

Discussions with C. Wittwer (LBL) arising from the February unsaturated zone modeling workshop concern preparation of geophysical data for inclusion in the 3-D unsaturated zone/geologic model. Although this work is scheduled by the MOA for later in the year, it has begun at the request of the modeling group. Efforts by P. Nelson include replay of existing data to display at a scale of 1" = 100'.

A paper entitled "Physical properties of ash-flow tuff from Yucca Mountain, Nevada" by P. Nelson and L. Anderson has been accepted for publication by the *Journal of Geophysical Research*. This work is a culmination of FY91 efforts. During this reporting period, the galley proofs were received, corrected and resubmitted to the journal.

WBS 1.3.3.2.2.1.2 Structural Features within the Site Area

Principal Investigator - R. Spengler

OBJECTIVE

To determine the frequency, distribution, characteristics, and relative chronology of structural features within the Yucca Mountain site area. (SCP Study 8.3.1.4.2.2)

SCP 8.3.1.4.2.2.1 Geologic mapping of zonal features in the Paintbrush Tuff 0G3221G2

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF182A Analysis of samples

K. Futa continued high-precision Sr isotopic analyses of outcrop samples (from the volcanic section in the southern portion of Yucca Mountain) which are assumed never to have been positioned below the water table. These analyses are being compared to completed 87/86 Sr ratios from core samples collected below the Topopah Spring member to assess the amount of Sr modification caused by hydrothermal alteration.

3GGF184A Structural analysis of exposed fault zones

A. Braun and assistant R. Linden continued mapping and measurement of fault characterization parameters along and within the Ghost Dance Fault on Yucca Mountain. Work in this period took place in the area south of Whale Back Ridge. The work utilizes the rectilinear grid laid out and reported earlier, which will allow collection of numerous types of information on a consistent foundation grid. These efforts will characterize a large number of parameters along the fault which will be integrated into the geologic model. On this trip, twelve 200' x 200' "areas" from the foundation grid were mapped and fracture data recorded, giving a total of 22 mapped "areas" that have been completed in the field to date.

F. Singer continued preparation of preliminary illustrations using SURFER software to create two- and three-dimensional views of specific lithologic intervals. J. Nelson has had greater involvement with this effort and will continue to support these graphical presentation and modeling activities.

F. Singer continued compilation of a data base comprised of stratigraphic information for incorporation into Sandia National Laboratory's LYNX geotechnical modeling system. To this end, collaborative efforts are underway with workers at Sandia and at the Colorado School of Mines to develop appropriate modeling capabilities, with regard to facilities available elsewhere in the program.

3GGF124 Reconnaissance of study area

This work will conduct detailed investigations of stratigraphically and structurally complex terrains at a scale of 1:12,000. Preparation for detailed mapping in the area north and west of Prow Pass is underway, and field operations will begin shortly. Some of this effort will be carried out in conjunction with the tectonics section.

R. Spengler and C. Hunter visited outcrops in the basal Tiva Canyon/uppermost Topopah Springs in northeastern Crater Flat where a well-exposed roll-over flexure was discovered.

3GGF160 Revise technical procedure on analysis of volcanic rocks

The planned start of this task was delayed while the formal process continues to fill a vacancy in the rock characteristics section. A subcontractor employee (R. Dickerson) who will be dedicated to the mapping effort has been brought on board; training and orientation are partially completed, and initial site visits will occur next month.

Quality Assurance

3GGF182A Analysis of samples

B. Marshall attended two software CCC meetings.

B. Marshall completed document review of QMP-3.07.

J. Paces continued calibration of a spike according to GCP-22, starting a second set of calibration standards. Status is still pending.

J. Paces initiated software review (as per OMP-3.03, R3) of a critical program used in U-series data collection by alpha-spectrometry (program name is UTH.FOR, CID #GDD0020.02). The program had to be transferred from the old Nuclear Data Systems operating platform to the new PC-based system following catastrophic failure of the old computer. Alpha-spectrometric data collection has been suspended until all control configuration documentation has been submitted to the software control coordinator.

S. Mahan met Sr isotopic calibration date of SRM 987 on March 4.

Planning and Operations

3GGF182A Analysis of samples

B. Marshall recalibrated the pulse processor on the energy-dispersive XRF instrument in order to fix a minor problem which became apparent when analyzing low-Rb samples.

B. Marshall, K. Futa, and S. Mahan completed a week-long short course on Isotope Hydrology. Training included reading assignments, homework problems and a course critique.

J. Paces continued review of an outside manuscript (submitted to *Geochimica et Cosmochimica Acta*) on actinide element mobility in fractures at the Canadian radioactive waste repository site.

### Variances

3GGF160 Revise technical procedure on analysis of volcanic rocks  
Delay in this activity is described above. There should be no impact, and corrective action is in place.

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

R. Spengler devoted 36 hours to preparation of detailed budget summaries and administrative planning in response to requests for further details on out-year budgets and to preparation for the Independent Cost Estimate (ICE) interactions.

C. Hunter received two hours of audit training.

### SCP 9314222 Surface-fracture network studies 0G3221H2

Summary Account Manager - M. Fahy

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GGF160A Revise TPs, grid design, RC gauge development  
Revision of the data notebook technical procedure is 85% complete.

3GGF159A Design fracture data base; software OA

The ORACLE data base management software has arrived. Training has begun on use of this program, which is a sophisticated relational data base manager able to accept a full range of data files, from flat files through DXF AUTOCAD files.

The basic geotechnical data base structure is complete. This data base design reflects evaluation of appropriate and useful parameters for inclusion in the data base following coordination of needs from the surface fracture network, underground mapping, and surface soil and rock characterization activities. Many data base formats were used previously. All of these geotechnical activities (managed under USBR as part of the rock characteristics section) will now be able to use a single consistent data base. ORACLE and AUTOCAD links will be possible.

3GGF100 Map and analyze fractures in Tiva Canyon Member

AUTOCAD DXF files for faults, breccias and other structural features were obtained from EG&G. Generation of preliminary contoured stereoplots and pole plots are 15% complete. This work generates lower-hemisphere stereonet projections from the structural data, which are then converted to the DXF format. The priority is on quality-affecting data. The topographic DXF files can be read in but they currently lack elevations. Training continues on AUTOCAD ver11.

3GGF152A Fracture data logia

A field meeting with C. Throckmorton was held to review selected outcrops for the uncleared outcrop study and the acquisition of quality-affecting data. (Other site types include "photogeologic" and cleared "pavement".) This review accommodates suggestions derived from the verification activity. The field meeting and further review addresses issues of data and technique verification, confirming early preexisting measurements at these sites. Some sites will have replication of previous data collecting work, meeting an obligation written in the SCP for verification.

### Quality Assurance

Planning and Operations

3GGF160A Revise TPs, grid design, RC gauge development

A meeting with PI and USGS OA staff resulted in the decision to proceed with a USBR TP for data collection and analysis in lieu of revision to GP-12.

Variances

3GGF160A Revise TPs, grid design, RC gauge development

The completed revision was submitted to the USBR OA group, but necessary changes have not been determined. No impact is anticipated.

SCP 8.3.1.4.2.3 Borehole evaluation of faults and fractures OG322112

Summary Account Manager - J. Wright

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU006F Edit, review existing data; data log-in

C. Barton's G-4 data have been obtained. Assembly of file compilation has begun on G-4 and G-2, with current emphasis on G-2.

Borehole fracture data files have been acquired from P. Nelson for 57 boreholes at Yucca Mountain. These files are in LOTUS format and are being converted to dBASE files as ASCII flat files.

3GGU07AF Preparation of specifications for data collection

The specification document for collection of fracture data is in preparation. These specifications will describe appropriate techniques for collection of fracture data using borehole television and the televiwer method.

Quality Assurance

Planning and Operations

Variances

3GGU07AF Preparation of specifications for data collection

Specifications are incomplete.

Impact: there should be no significant impact due to rescheduling of the G-5 drillhole.

Corrective action: work is underway to complete these specifications. Technical procedures used at Savannah River have been obtained as model specifications.

SCP 8.3.1.4.2.4 Geologic mapping of the exploratory shaft and drifts OG322112

Summary Account Manager - S. Beason

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF022B Upgrade computer equipment

S. Beason and J. Coe met with representatives of DEC/VAX about upgrades to the MicroVax II which presently drives the Kern DSR-11 analytical plotter.

Quality Assurance

### Planning and Operations

#### 3GGF006B Excavate test pit

A draft of the criteria letter for deepening of the Fran Ridge Pits has been completed. S. Beason met with R. Oliver and N. Elkins (LANL) regarding opening of the job package and test planning package for pit deepening and pavement clearing around the pits.

### Variances

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

S. Beason continued preparation of job description and RPA for hiring an analytical photogrammetrist.

S. Beason and others (see listing under Study 8.3.1.14.2.2) participated in a field workshop sponsored by the rock characteristics section to discuss the effectiveness and positioning of drillholes along the proposed alignments of the north and south ramp declines.

#### SCP 8.3.1.4.2.2.5 Seismic tomography/vertical seismic profiling 0B3221A2

Summary Account Manager - E. Majer

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GGF030B Validate interpretational codes ANI90 and BEAM87

The ANI90 program was modified and enhanced to include a more flexible user interface to allow a visual representation of the input model. Further enhancements were installed to allow cross section display of any arbitrary alignment through the model volume.

##### 3GGF035M Report: progress VSP

Discussions continued with T. Brocher and with on-site workers at Yucca Mountain regarding cooperative arrangements to perform VSP in conjunction with the seismic line planned for mid-1992. These discussions focused on selection of a possible site (or sites) at which to carry out VSP to interpret and validate the seismic reflection to be done at Yucca Mountain. Candidate holes included H-3, P-1, or one of the C-complex holes. Consultation with J. McDaniels (REECo) during this reporting period suggests that one of the C-complex holes will be most suitable for shooting VSP. Both the H-3 and P-1 wells are instrumented for hydrologic studies.

#### Quality Assurance

#### Planning and Operations

#### Variances

### WBS 1.2.3.2.3 Erosion

#### OBJECTIVE

To identify the site-specific geomorphic parameters and data that are needed to satisfy the design and performance issues and to ensure that the 200-meter disqualifying condition is not exceeded. (SCP Section 8.3.1.6)

WBS 1.2.3.3.1 Present Location and Rates of Surface Erosion  
Principal Investigator - J. Whitney

OBJECTIVE

To identify the erosional processes in the Yucca Mountain area during the Quaternary; quantify the rates of the different processes and assess their relative importance; and identify the specific locations of past erosion. (SCP Investigation 8.3.1.6.1)

SCP 8.3.1.6.1.1 Development of geomorphic map of Yucca Mountain OG3231A2  
Summary Account Manager - J. Coe

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GER001A Scoping study -- photogrammetric analysis

J. Coe, J. Whitney, and P. Glancy field checked the photogrammetric map of erosion and deposition on Jake's Point and determined that the photogrammetrically measured volumes are correct within machine measurement error. The first phase of the scoping study is considered successful. Glancy believes that the method will also be useful for SCP activity 8.3.1.2.1.2.2 (debris flow hazards).

3GER002A Write report on erosion rate for existing data

J. Whitney and C. Harrington prepared a revised annotated outline for the DOE topical report on erosion. Data from this report will be used for the report in this activity.

Quality Assurance

J. Whitney prepared data and procedures for a DOE/M&O meeting to qualify old data collected before the present QA program was implemented. Whitney spent one day with the SAIC/M&O team to discuss the procedures to be used to qualify "old" data.

Planning and Operations

Variations

WBS 1.2.3.2.5 Postclosure Tectonics

OBJECTIVE

To supply data on the probability and effects of tectonic initiating events that may alter existing conditions at Yucca Mountain and adversely affect repository performance. (SCP Section 8.3.1.8)

WBS 1.2.3.2.5.3 Changes in Hydrology Due to Tectonic Events

OBJECTIVE

To assess or analyze the possibility that tectonic events could cause changes in existing hydrologic conditions at the Yucca Mountain site. (SCP Investigation 8.3.1.8.3)

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

Principal Investigator - J. Whitney

OBJECTIVE

To analyze and assess the probability that tectonic initiating events could result in significant changes in the elevation of the water table or potentiometric surface, changes in the hydraulic gradient, the creation of discharge points in the controlled area, or the creation of perched aquifers in the controlled area. (SCP Study 8.3.1.8.3.2)

SCP 8.3.1.8.3.2.5 Effects of faulting on water-table elevation OG3253A2

Summary Account Manager - C. Fr

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

C. Fridrich completed the following report (milestone 3GTW021M, Report: large hydraulic gradient) and submitted it for USGS review: "A geologic hypothesis for the large hydraulic gradient under Yucca Mountain, Nevada" by C. Fridrich, W. Dudley, Jr., and J. Stuckless.

Quality Assurance

Planning and Operations

Variations

WBS 1.2.3.2.5.5 Information Required by the Analysis and Assessment Investigations of the Tectonics Program

OBJECTIVE

To collect field data called for by analysis and assessment activities in other tectonics investigations to support analyses of volcanic, igneous intrusion, and folding processes. (SCP Investigation 8.3.1.8.5)

WBS 1.2.3.2.5.5.2 Characterization of Igneous Intrusive Features

Principal Investigator - J. Sass

OBJECTIVE

To gather data concerning the presence of thermal anomalies in the area and data on the geochemical and physical effects of intrusions on the surrounding rock. (SCP Study 8.3.1.8.5.2)

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 OG3255B2

Summary Account Manager - J. Sass

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Work was performed to select contractors for calibration of fragile equipment. Ongoing calibration of laboratory and field equipment was also accomplished.

Quality Assurance

Planning and Operations

Variances

WBS 1.2.3.2.6 Surface Characteristics

OBJECTIVE

To collect information on surface characteristics to determine location and design of repository surface facilities. (SCP Section 8.3.1.14)

WBS 1.2.3.2.6.2 Soil and Rock Properties of Potential Locations of Surface Facilities

OBJECTIVE

To characterize the soil and rock at and near the surface to provide design issues with the necessary geotechnical information to help locate the surface facilities, conduct foundation design analyses, evaluate soil-structure interactions, and evaluate potentially unstable slopes; and provide design issues with hydraulic-related soil information for evaluating erosion potential and infiltration-runoff characteristics. (SCP Investigation 8.3.1.14.2)

WBS 1.2.3.2.6.2.2 Surface Facilities Laboratory Tests and Material Property Measurements

Principal Investigator - M. McKeown

OBJECTIVE

To conduct laboratory tests and material property measurements on representative samples of soil and rock. (SCP Study 8.3.1.14.2.2)

SCP 8.3.1.14.2.2 Laboratory test and material property measurements

Summary Account Manager - M. McKeown

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GSR006 Materials testing

Laboratory investigations under this activity will test a range of soil and rock properties. These parameters will be used in the design of foundations for surface facilities.

3GSR007 Design data submittal of north ramp

The first design data submittal to RSN was made March 16. QA Level 1 soil and rock properties (engineering data) are reviewed as acquired and submitted to RSN for use in the design process for surface facilities.

3GSR016 Draft report on engineering geophysics

Planning is underway in preparation for USBR doing the borehole engineering geophysics specifically required for the soil/rock investigations. These include density and caliper logs of drillholes and a check shot of NRG-1. Planning is also underway for a grounding-mat design survey.

Quality Assurance

### Planning and Operations

#### 3GSR005 Field exploration-mapping, drilling, excavation

All necessary planning documentation was completed this month. Soils investigations began on March 2. Approximately 50 percent of the excavation of planned test pits and in-place testing is complete. This activity provides samples for laboratory testing. Reconnaissance of areas to be mapped is also underway.

### Variances

The organizations responsible for design of the test planning package did not finalize the design. The failure to complete the test planning package on schedule required revising the start date of field exploration to March 1992. The resultant slippage of dependent activities includes an indeterminate impact on Title II design. Specific impacts and corrective action can not be determined due to uncertainty in the TPP status.

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

The final report on site selection for six alternative North Portal alignments was reviewed and transmitted.

M. McKeown attended a part of the rock characteristics workshop held to examine effectiveness of planned drill holes along proposed ramp alignments.

A valuable result of the meeting was realization that the design process for the tunnel boring machine (TBM) requires description of the range of geologic ground conditions likely to be encountered but did not require description of the extent of (bad) ground conditions. On this basis, tentative drill site locations were negotiated with respect to position relative to inferred or known structures, to rig access, and to location relative to the still undetermined final location of the ramp alignment.

Participants at the drillhole effectiveness workshop, held March 4, at the Yucca Mountain site, included S. Beason (USBR), D. Campbell (USBR), R. Craig (USGS), M. Fahy (USBR), C. Friedman (USGS), C. Hunter (USGS), R. Linden (SAIC), M. McKeown (USBR), R. Spangler (USGS), J. Wesling (Geomatrix), and D. Williams (DOE).

### WBS 1.2.3.2.8 Preclosure Tectonics

#### OBJECTIVE

To develop an understanding of and to characterize the tectonic events and processes that could impact proposed repository structures, systems, or components considered to be important to safety through the operational phase and that could affect the design and operation of certain structures, systems, and components required for exercising the retrieval option. (SCP Section 8.3.1.17)

### WBS 1.2.3.2.8.4 Preclosure Tectonics Data Collection and Analysis

#### OBJECTIVE

To provide data and analyses required by other investigations including the assessments of fault displacement and vibratory ground motion that could affect repository design or performance. (SCP Investigation 8.3.1.17.4)

WBS 1232841 Historical and Current Seismicity  
Principal Investigator - K. Shedlock

OBJECTIVE

To compile information on reported and instrumentally recorded earthquakes that characterize the earthquake potential near Yucca Mountain and to attempt to purge explosion and triggered earthquakes related to weapons testing from existing catalogs of instrumentally determined earthquakes. (SCP Study 8.3.1.17.4.1)

SCP 8.3.1.17.4.1.2 Monitor current seismicity 0G3284HB  
Summary Account Manager - K. Shedlock

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

The installation of the seismic network upgrade has been put on hold until the seismic network has been completely transferred to the University of Nevada seismology lab (UNRSL).

3GSM114A Complete transition--sign MOA

A meeting was held on March 13 and final terms of the transition plan to transfer the seismic network to UNRSL were agreed upon by UNR and the USGS. On the basis of this revised transition plan and revised budget allocations, a new MOA for USGS participation was halted.

K. Shedlock attended meetings to finalize the BGRA-UNRSL transition plan and BGRA-YMPB MOA. D. Overturf and J. Gomberg prepared informational documents.

D. Overturf and J. Gomberg met with J. Brune and W. Nicks to discuss the technical aspects of the SGBSN transfer to UNRSL.

3GSM157A Continue testing lab/field equipment

Testing telemetry nodes with multiple data acquisition systems continue; data generated in Dallas is sent to Golden via satellite. Remote command and control (from Golden to Dallas) capabilities are being developed and tested.

3GSM160A Monitor 1992 seismicity

Seismic monitoring of the SGBSN continued uninterrupted in March.

The seismic network's computer captured 64 local earthquakes for the month of March, 1992, down from 99 for February. All but one had  $M_L < 3.0$ . Nineteen (19) chemical explosions, and one probable blast, all in the Bullfrog Hills of southwestern Nevada, and two probable blasts in the Dry Lakes area NE of Las Vegas were located from SGBSN digital data in March. There was one NTS nuclear detonation, at Silent Canyon Caldera, March 26, 1992, 16:30 UTC. Low-coda-frequency aftershocks were plentiful for this test, and are continuing at a very diminished rate to this time (4/02/92). No Yucca Mountain, Nevada, earthquakes were detected in March. For a five-day period, approximately March 18-23, one of the two A-to-D converters on the seismic computer was malfunctioning (amplitude of all output channels was about 10% of correct level); this may have reduced the triggering sensitivity, although small chemical explosions at the Bond gold mine were detected throughout that period.

March's seismicity includes a concentration of earthquakes at a point in the Las Vegas

valley, scattered activity in southern NTS, possibly associated with the Rock Valley left-lateral fault system, the tail end of a particularly intense (for the region) swarm at Suncline Ridge in central NTS, isolated earthquakes at Timber Mountain, at central and northern Sarcobatus Flat, at southern Bare Mountain, several earthquakes at southeast Pahranaagat Shear Zone south and southwest of Alamo, Nevada, a few at Grapevine Mountains, Nevada and California, one in the Seaman Range, one in the Hiko Range (southeast of Hiko, Nevada), one in the Amargosa Desert, Nevada-California border area, one in northern Death Valley, California, and a few earthquakes elsewhere in the SGB. The largest SGB earthquake for March,  $M_L$  3.0, occurred in the Reveille Range, Nevada, on March 1, 1992, 05:54:10 UTC. Its first-motion data are consistent with oblique reverse slip-strike on northwest trending nodal planes (mechanisms not shown, constrain is not good).

3GSM154A Test communications - receiving nodes/field  
Processing software development continues.

The first draft of refraction technology equipment documentation was reviewed by SGBSN staff and returned for revision.

3GSM022A Prepare FY91 earthquake catalog  
The 1987-89 Seismicity Catalog is being reviewed at DOE; the 1990 Seismicity Catalog is at the printers; and the 1991 Seismicity Catalog is in internal USGS review.

#### Quality Assurance

#### Planning and Operations

#### Variances

### WBS 1.2.3.2.8.4.2 Location and Recency of Faulting Near Prospective Surface Facilities Principal Investigator - J. Whitney

#### OBJECTIVE

To identify appropriate trench locations to investigate the possible occurrence of late Quaternary surface faulting in the vicinity of planned critical surface facilities; and using surface and trench mapping, locate sites without evidence of significant late Quaternary faulting. (SCP Study 8.3.1.17.4.2)

#### SCP 8.3.1.17.4.2.1 Identify appropriate trench locations in Midway Valley 0G32S4IB Summary Account Manager - F. Swan

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GFP001 Excavate and log soil pits

Excavations of soil pits were completed during the week of March 16. The study and logging of the soil pits began on March 23 and will continue into April. A conference poster entitled, "Recent characterization activities of Midway Valley as a potential surface facility site" was presented in early March at "Waste Management '92" in Tucson, Arizona.

#### Quality Assurance

#### Planning and Operations

Variances

SCP 8.3.1.17.4.2.2 Conduct exploratory trenching in Midway Valley 0032841B  
Summary Account Manager - F Swan

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFP013 Write report on trench ABR-B

The report on Trench ABR-B is being revised after Geomatrix and Sandia technical reviews.

Quality Assurance

Planning and Operations

Variances

WBS 1.2.3.2.8.4.3 Quaternary Faulting within 100 km of Yucca Mountain  
Principal Investigator - J. Whitney

OBJECTIVE

To identify Quaternary faults within 100 km of Yucca Mountain and to characterize those faults capable of future earthquakes with magnitude such that associated ground shaking could impact design or affect performance of the waste facility. (SCP Study 8.3.1.17.4.3)

SCP 8.3.1.17.4.3.2 Evaluate Quaternary faults within 100 km of Yucca Mountain 003284K2  
Summary Account Manager - L. Anderson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTO008B Review and synthesize existing work

Work continues on compiling existing work. Development and input into Quaternary fault and reference data base continues.

3GTO001B Draft technical procedure - aerial photo

Technical review is being conducted.

Quality Assurance

Planning and Operations

3GTO006B Complete study plan 8.3.1.17.4.3

Study Plan 8.3.1.17.4.3.2 was completed and forwarded to DOE for review and approval.

Variances

WBS 1.2.3.2.8.4.4 Quaternary Faulting within Northeast-Trending Fault Zones  
Principal Investigator - J. Whitney

OBJECTIVE

To evaluate the potential for ground motion resulting from future movement on Quaternary left-lateral strike-slip faults located east and south of the site area. (SCP Study 8.3.1.17.4.4)

SCP 8.3.1.17.4.4.1 Evaluate the Rock Valley fault system. OG328402  
Summary Account Manager - D. O'Leary

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Available air photographs, base maps, satellite imagery were examined and selected for ordering. D. O'Leary began to acquire relevant published information on tectonics of the Southern Great Basin that will be used in this activity.

Quality Assurance

D. O'Leary received QA indoctrination and training in Denver during mid-March.

Planning and Operations

Variances

WBS 1.2.3.2.8.4.5 Detachment Faults  
Principal Investigator - J. Whitney

OBJECTIVE

To provide information pertaining to the distribution, displacement rate, and age of detachment faults proximal to Yucca Mountain; and determine whether they represent a significant earthquake source or conceal a significant earthquake source at depth. (SCP Study 8.3.1.17.4.5)

SCP 8.3.1.17.4.5.1 Evaluate the significance of the Miocene-Paleozoic contact in the Calico Hills area to detachment faulting within the site area. OG328452  
Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTD007B Complete geologic map of Calico Hills

Delay of completion of geologic map of Calico Hills is anticipated because the scientist for this project did not report for duty until March 8. Also, final approval of the study plan is not anticipated until May.

Quality Assurance

Planning and Operations

Final revisions to Study Plan 8.3.1.17.4.5 were made based on the comment resolution meeting in February. The revised study plan has been sent back to DOE for final approval and submittal to DOE. J. Hoisch (Northern Arizona University) completed QA training and indoctrination in March.

Variances

WBS 1.2.3.2.8.4.6 Quaternary Faulting within the Site Area  
Principal Investigator - J. Whitney

**OBJECTIVE**

To evaluate the age and recurrence interval of Quaternary faulting and to analyze the probability of future faulting; to determine which faults moved during the Quaternary; and to assess fault probability on the basis of rates of faulting during the Quaternary. (SCP Study 8.3.1.17.4.6)

SCP 8.3.1.17.4.6.1 Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain  
0G3284C?

Summary Account Manager - J. Whitney

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

3GPF08A Complete field mapping -- strip map Yucca Mountain fault zone  
Field mapping and data collection on the Pagany and Sever Wash faults was initiated in March.

Quality Assurance

Planning and Operations

3GPF07A Hire project staff  
The hiring of project staff is complete

Variances

SCP 8.3.1.17.4.6.2 Evaluate age and recurrence of movement on suspected and known Quaternary faults  
0G3284D?

Summary Account Manager - J. Whitney

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

3GPF11A Complete report -- trench logs Windy Wash  
Work was not begun on the Windy Wash trench report because the principal author has been asked to write the technical section of the DOE topical report on erosion.

Quality Assurance

Planning and Operations

3GPF30A Hire project staff  
The hiring of project staff is complete. Plans also include hiring a summer field assistant in May. Contract arrangements also completed with the Nevada Bureau of Mines and Geology for activity 3GPF17A, the relogging of Trench 8 on the Solitario Canyon fault. NBMG geologist began QA training and indoctrination in March.

Variances

WBS 1.2.3.2.8.4.12 Tectonic Models and Synthesis

Principal Investigator - J. Whitney

OBJECTIVE

To synthesize data relevant to tectonics; and to develop a model or range of models that establishes the causal relationship between application of tectonic forces and formation of structures observed at Yucca Mountain and vicinity; link observed rates of formation of those structures with regional rates of crustal strain; forecast changes in tectonic setting and the manner in which those changes will affect both the regional crustal strain rate and tectonic stability in the Yucca Mountain region; and estimate the effect of those changes on rate and nature of crustal strain at Yucca Mountain and vicinity and the future rate of tectonic processes at Yucca Mountain. (SCP Study 8.3.1.17.4.12)

SCP 8.3.1.17.4.12.1 Evaluate tectonic processes and tectonic stability at the site. 0G3284A1

Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTE07JA Integration of tectonic data

A contract for the revision of a 1:250,000 scale map of the geology of the Death Valley region was written.

Quality Assurance

Planning and Operations

3GTE06JA Order thematic map -- 1:100,000

A draft contract and sole source justification was written for thematic mapper imagery. The contract is now being reviewed.

3GTE001K Draft study plan and USGS review

The study plan for this activity will be delayed until later this fiscal year because the MOA for this work states that the study plan will be completed in the fourth quarter of this fiscal year.

Variances

WBS 1.2.3.3 Hydrology

Principal Investigator - D. Appel

OBJECTIVE

To conduct hydrologic investigations to evaluate the suitability of the surface and subsurface environment for siting a nuclear waste repository.

WBS 1.2.3.3.1 Geohydrology

OBJECTIVE

To provide information about geohydrologic characteristics, processes, and conditions, both favorable and potentially adverse, to support resolution of the performance and design issues through the development of a credible geohydrologic model of Yucca Mountain and vicinity. (SCP Section 8.3.1.2)

WBS 1.2.3.1.1 Description of the Regional Hydrologic System

OBJECTIVE

To develop a conceptual model of the regional hydrologic system to assist in assessing the site's suitability to contain and isolate waste. (SCP Investigation 8.3.1.2.1)

WBS 1.2.3.1.1.1 Precipitation and Meteorological Monitoring for Regional Hydrology

Principal Investigator - A. Flint

OBJECTIVE

To characterize the area surrounding Yucca Mountain in terms of precipitation and other meteorological data and their relationship to surface runoff and infiltration; and to provide input into rainfall-runoff model development for the Fortymile Wash drainage basin. (SCP Study 8.3.1.2.1.1)

SCP 8.3.1.2.1.1.1 Precipitation and meteorological monitoring 0G331E2

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GMM02A Monitor stations and tipping-bucket gauges FY92

Work continued to maintain and retrieve data from each weather station and each tipping bucket rain gauge. Data from the stations with radio telemetry are downloaded daily during precipitation events.

3GMM03A Calibrate tipping-bucket rain gauges

The sixth and last Sierra-Misco 1mm rain gauge was calibrated using the laboratory procedure HP-179, R1. Work began to calibrate Qualimetries 0.1mm snow gauges. These will be sequentially brought in from the field locations and recalibrated using HP-180 laboratory calibration procedures.

3GMM05A Acquire regional meteorological data-FY92

Regional precipitation and evaporation data for southern Nevada and southern California were acquired from various sources. Historical files for all reporting stations in Nevada and California were requested and received from the Western Region Climate Center (WRCC) station. The establishment of a BPO with the WRCC has been requested in order to obtain complete historical precipitation records for regional locations. To date, only current data for most locations of interest have been received. Pea-sized hail was observed near Yucca Mountain while golf ball-sized hail fell in Las Vegas. Also, a tornado was filmed as it touched down in SW Las Vegas. Little damage was done, however.

3GMM07A Monitor collection gauge network-FY92

March was an extremely wet month, one of the wettest on record in southern Nevada. Five major storm systems moved through the region. The rainfall amounts were variable around Yucca Mountain depending on location and elevation. All five appeared to be the result of a split in the jet stream causing low pressure centers to develop off the coast of southern California. This type of storm track is the most likely to produce the heaviest precipitation in the southern Nevada region. Preliminary analysis showed that nearly 3 inches fell over portions of Yucca Mountain. According to the Elliott Storm Types of North America, these are known as Type C storms. The storm of March 30 was the most significant in terms of severe weather.

3GMM10A Analysis of station data-FY91

Although no progress has been made this month, no impacts should occur.

3GMM15A Prepare criteria letter

A criteria letter may not be required if the USGS does not need NTS support to accomplish the installation of the raingages. The installation method is currently being developed and should be complete in a few weeks. Environmental surveys still need to be completed for the proposed site. A letter will be drafted which will provide a map with the locations of the rain gages marked.

3GMM23A Collect NTS lightning data-FY92

The storm of March 30 produced widespread lightning throughout southern Nevada. The data were collected and archived for future study in relation to precipitation patterns. Lightning was observed near Yucca Mountain and in Jackass Flats.

3GMM034 Analysis of regional data-FY91

Although no progress has been made this month, no impacts should occur as a result.

3GMM060 Design optical lightning detection network

This program is currently on hold while the manufacturer continues developmental work on the instrument. No impacts should result from this delay.

3GMM070 Collect GOES data-FY92

Collection and archiving of 3-hourly GOES satellite data continued. These images contributed significantly to the tracking of the synoptic-scale storm systems which affected Yucca Mountain during the month.

3GMM080 Analysis of Yucca Mountain precipitation data-FY91

Although no progress has been made this month, no impacts should occur as a result.

3GMM100 Monitor daily weather patterns-FY92

Daily synoptic-scale weather patterns were archived and studied. Each day's patterns were typed according to Elliott's Weather Types of North America. There are six specific types.

Quality Assurance

3GMM066 Graded QA and other QA requirements

An internal audit of the meteorology program was conducted. No major findings were documented. All records were in order and well organized.

Planning and Operations

Variances

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated seven hours were spent on the following:

D. Ambos prepared a position description for a meteorological instrumentation and data manager.

D. Ambos supported other projects as follows: sat on the drill rig at N-17; retrieved precipitation samples for the geochemical program from N-2 and N-46; and logged N-36 as part of the neutron meter calibration scheme.

## WBS 1.2.3.3.1.2 Runoff and Streamflow

Principal Investigator - D. Beck

### OBJECTIVE

To collect basic data on surface-water runoff at, and peripheral to, Yucca Mountain and its hydrologic flow system; to use the streamflow data to describe the runoff characteristics of the area and assess the response of runoff to precipitation; to assess the potential for flood hazards and related fluvial-debris hazards to the Yucca Mountain Project; and to provide basic data and interpretations of surface-water runoff to investigations that evaluate the amounts and processes of infiltration and ground-water recharge at Yucca Mountain and surrounding areas. (SCP Study 8.3.1.2.1.2)

### SCP 8.3.1.2.1.2.1 Surface-water runoff monitoring 0G3311E7

Summary Account Manager - T. Kane

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GRS002A Collect FY92 runoff and streamflow data

The month of March saw a continuation of storm fronts moving across Nevada. They increased the yearly rainfall total at the Nevada Test Site, to well above normal. March turned out to be the wettest on record.

Accumulation of rainfall data was collected after each event. The data were compared with surface-water data and provided runoff characteristics for storms which occurred both on and off the Test Site.

Three separate measurements were made on the Amargosa River at Tecopa station 10251300. These measurements range in discharge from 150 to 170 cfs and occurred on March 27 off the Test Site.

The measurements made on the Test Site include a series of four, made at the Unnamed Tributary to Fortymile Wash near Rattlesnake Ridge, Station 10251248. Discharges range between 1.5 to 2.5 cfs. Water samples were taken and a schedule, 1904 and 39A, is presently being processed at the USGS Denver lab. Local runoff from Jackass Flats, Area 25, was measured at Topopah wash at little Skull Mountain, Station 10251260. The measurement was made 30 miles upstream of the gage. A discharge of 1.5 cfs was obtained on March 30, 1992.

##### 3GRS022A Complete FY 83-85 data and prepare report

Records are undergoing review at Carson City. The data report is at Carson City for retyping.

#### Quality Assurance

##### 3GRS027A Complete technical process for streamflow data collection

HPs 100, 117, 166, and 219 are at HIP for review and then submittal to QA office. HP-40, R2; HP-43, R2, and HP-169, R1 were approved March 23. HP-44, R2, and HP-114, R1 are in the signature process.

#### Planning and Operations

##### 3GRS016A Complete installation of two Amargosa gages

The work package with designs and environmental statements is to be resubmitted to the BLM by request. Eagle Mountain is the one remaining site to be constructed under this

heading.

Variations

3GRS022A Complete FY 83-85 data and prepare report

The records and report are on hold due to the office relocation at Carson City, Nevada.  
Impact: Schedule delayed possibly one month.

3GRS016A Complete installation of two Amargosa gages

Eagle Mountain construction is on hold due to inability to receive permits from the BLM (California). This is the final site to be completed under this activity. Contact with the BLM at present is being handled by DOE.

Impact: Schedule delayed; no current estimate of restart.

3GRS027A Complete technical procedures for streamflow data collection

All procedures reside at HIP QA.

Impact: Schedule delayed; estimate additional month to complete.

SCP 8.3.1.2.1.2.2 Transport of debris by severe runoff 0G3311G?

Summary Account Manager - D. Grasso

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRS002B Field reconnaissance of severe runoff features

D. Grasso and P. Glancy conducted reconnaissance in southern Nevada to determine if any debris had moved as a result of severe storms on February 12-13 and most recently on March 26-27 and 30-31. The March storms were especially heavy and produced intense precipitation, hail, and flooding. On March 30 a funnel cloud touched south of Las Vegas and golf ball-size hail pelted the area. Intense precipitation, measured as 2.0 to 2.5 inches in the southern and southwestern Las Vegas valley near Duck Creek and Blue Diamond, occurred during the March 26-27 storm. This heavy rain resulted in severe runoff and flooding in these parts of the valley where the brunt of the storm system was positioned. Streamflow and erosion was particularly heavy along Las Vegas Wash to the east along its major tributaries (e.g. Flamingo Wash, Duck Creek, and others), as well as in places where city streets act as conduits that drain flood waters from the large alluvial fans surrounding the valley. Duck Creek, at Spencer Road, for example, flowed at bank-full capacity and flooded the streets near-by most of the day of March 27 and again following the severe thunderstorm of March 30.

P. Glancy reconnoitered areas of highest runoff following the storms of March 7-8 and 26-27 to look for evidence of heavy debris transport. Along the Amargosa River, he recorded only minor streamflow and no evidence of intense debris transport from the March 26-27 storm.

D. Grasso investigated the middle reaches of Duck Creek in the southern Las Vegas valley to locate evidence of historic flow events. It is thought that such evidence may reveal important information regarding the frequency and magnitude of severe runoff events in southern Nevada.

P. Glancy revisited Copper Canyon mudflow of 1990 with R. Carmen and J. Yount (USGS-GD). They attempted to reach the source of the mudflow, but were unable to because of the long hike and shortness of daylight. They were, however, able to isolate the source area of a specific tributary and discovered ample evidence of a long and complex debris-flow

history in this drainage. This basin would be exceptionally attractive for paleoflood analysis because of the prevalence of datable stratigraphic horizons of tephra and vegetal (organic) materials. The basin will probably be selected as a candidate site for detailed study of debris-flow and transport processes for this activity, as well as for its long paleoflood history for the paleoflood evaluation activity.

P. Glancy visited Jake's Point, an area west of Fortymile Wash and north of Yucca Wash, with J. Whitney and J. Coe. Coe analyzed the volumes of sediment eroded and deposited by severe floods and ensuing debris flows during July 1984. This group presented a poster session at the AGU meeting in San Francisco in December, 1991, regarding the scoping results of this photogrammetric analysis. Prior to the March 21 field visit to Jake's Point, Glancy and Grasso reviewed Coe's analytical techniques in Denver on March 18-19. The field visit verified the quantitative resemblance of Coe's analyses by field checking the dimensions of the erosional and depositional areas against the numerical results obtained by Coe. The preliminary results of this technique are promising. The technique does, however, require large-scale, high-resolution aerial photography before and after a debris-flow event occurs in order to achieve an acceptable degree of quality and accuracy.

#### 3GRS004B Procure and prepare aerial reconnaissance data

D. Grasso contacted FOLD (Federally Owned Landsat Data) distributors regarding the availability and cost of Landsat digital data for geomorphometric activities. Three of the needed data sets (Landsat TM scenes, all dated 3/23/84) are available. Two have been ordered. The third one will be ordered during the first week in April.

#### Quality Assurance

#### Planning and Operations

#### Variations

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

P. Glancy and D. Grasso spent time preparing for an upcoming QA audit (April 1, 1992) for this activity. The timing of this audit impacted field investigations of a recent runoff event in March, and time needed for the monthly PACS and the six-month status report. (24 hours)

### WBS 1.2.3.3.1.3 Regional Ground-Water Flow System

Principal Investigator - J. Czarnecki

#### OBJECTIVE

To define the potentiometric distribution hydraulic properties, and recharge and discharge for the regional ground-water flow system to determine the magnitude and direction of ground-water flow. (SCP Study 8.3.1.2.1.3)

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRG052 Process existing log data Amargosa Desert

S. Keller continued to assemble and process existing log data from mining-company drillholes constructed in the Amargosa Desert.

3GRG054 Prepare report on existing regional water level data

R. Luckey, W. Oatfield, J. Czarnecki, and N. Stuthmann met to discuss Oatfield's potential involvement in finishing this assignment. Per that meeting, Oatfield provided M. Ciesnik with a draft version of a water-level data report with approximately 540 water-level measurements. Ciesnik modified the format of the report text and plates for compatibility with USGS review requirements.

3GRG053 Locate additional piezometers in the Amargosa

J. Czarnecki and C. Savard performed field reconnaissance for additional mining company drillholes constructed in the Funeral Mountains and Greenwater Range. A new access road in the Greenwater Range was visited which provided access to a previously inaccessible drillhole (VC-1). This hole (as well as another nearby hole) had collapsed. An additional drillhole site located on a fan south of Pyramid Peak in the Funeral Mountains was visited, but the drillholes there were either too shallow or collapsed.

3GRG003 Measure water levels in Amargosa Desert

J. Czarnecki and C. Savard measured water levels in nine observation wells in the southern half of the subregional ground-water flow system.

3GRG007 Conduct prototype equipment testing in small diameter wells

C. Savard and J. Czarnecki installed and tested a 1-11/16" diameter jack pump (similar to a windmill-style pump) in a 1,100'-deep piezometer located west of Stateline, Nevada, in the Amargosa Desert. The tripod that had been constructed to lower the 1"-diameter pipe and rod downhole was insufficiently tall to handle the pipe, and was taken to a welding shop in Las Vegas for modification. For the test, 30 ft. of 1"-galvanized pipe and rod were lowered down the piezometer by hand, providing a water column of only 20 ft. above the pump intake. This water column was drained in less than 2 minutes at a pumping rate of about 2 gallons per minute. No drawdown was observed in a shallow piezometer constructed in the same borehole, indicating hydraulic isolation. The well was allowed to recover over night and was repumped with similar results. Future testing will be done with the pump intake placed at least 200 ft below the static water level in the well. The above-ground pumping apparatus (pump jack and motor) was assembled in less than one hour.

Quality Assurance

Planning and Operations

3GRG003A Access permits to measure water-levels in Amargosa Wells

Letters requesting access to well sites in the Amargosa Desert were sent to BLM offices in Las Vegas and Barstow, California. Included were maps showing the sites to be visited.

3GRG007 Prototype equipment testing for small diameter wells

Plans were discussed by J. Czarnecki with personnel from USGS Las Vegas subdistrict office regarding upcoming planned testing of a jack-pump in 2" diameter wells in the Amargosa Desert. Testing is on hold until appropriate permits are in place from the BLM.

3GRG003A Access permits for Amargosa wells

Permit application forms were received from the BLM for access to well sites throughout the Amargosa Desert, but specifically at deep observation wells constructed in mining-company exploration holes. Forms are in the process of being completed for access to these sites and testing the wells located there.

Variances

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 100 hours were spent on the following:

J. Czarnecki submitted a report entitled "Ground-Water Conditions in Amargosa Desert, Nevada-California, 1952-87" (USGS Water Resources Investigations Report 89-4101) to W. Causseaux for qualification of all data contained therein. The report has water-level data that will be needed for regional modeling efforts.

M. Ciesnik participated in a series of pre-audit meetings in preparation for an upcoming DOE audit.

J. Czarnecki prepared a request for personnel action to obtain a contract hydrologic technician to assist the Fortymile Wash study and regional potentiometric levels activity.

M. Ciesnik submitted a technical data information form to the OA office for water levels measured in selected wells in the Amargosa Desert during field trips in 1991.

J. Czarnecki and M. Ciesnik performed routine checks of their QA documents (HPs and OMPs).

J. Czarnecki reviewed a proposed revision to the SCPB for adding drillhole UE-25 c#4 to the c-hole complex.

J. Czarnecki purchased and acquired various equipment for testing a small diameter pump including a shaft pulley, pipe elevators, pipe clamp, and a winch.

M. Ciesnik completed reading assignments pertaining to AP-528Q, OMP-3.03, R3, and OMP-3.07, R4.

M. Ciesnik and J. Czarnecki reviewed plans to perform validation of the computer program PLANE-PC, required by OMP-3.03, R2.

M. Ciesnik performed a technical review of modifications made to HP-96, R0 (Measurement of wind speed using a Met-One Inc. Model 014A Wind Speed Sensor).

J. Czarnecki gave presentations on characterization of the regional ground-water flow system to seven busloads of citizens visiting the Hydrologic Research Facility in area 25 on the Nevada Test Site.

M. Ciesnik and J. Czarnecki attended a QA training course entitled "How to Be Audited"

presented by W. Rodman.

SCP 8312133 Fortymile Wash recharge study 063311C2

Summary Account Manager - C. Savard

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GRG003B Complete report on channel loss

Continued to draft report. Preliminary runs with the Agricultural Research Service model were completed to define the relationship between mean annual streamflow and recharge.

3GRG004B Develop infiltration test procedure

Assisted Nevada District personnel measuring pump discharge during the JF-3 water sampling. Similar techniques with a ten-turn potentiometer will be used to monitor water levels in infiltration tanks. Held brief discussions with L. Hoffman about his future work with artificial recharge studies.

3GRG012B Non-linear analysis of regional streamflow

Prepared supporting material for presentation of a poster supporting the abstract titled 'Looking for chaos in streamflow with discharge-derivative data' which was accepted by the American Geophysical Union for presentation at the Spring 1992 meeting special session 'Predictability of Climatic and Hydrologic Systems: Insights from Nonlinear Dynamics'. The poster will provide information about the underlying nonlinear dynamics of streamflow. Continued correlation integral analysis of Merced River streamflow data for a more complete analysis. The predictability of streamflow is important in the Yucca Mountain area to define ground-water recharge.

3GRG02S Collect FY-92 moisture data

Read rain wedges at UE-25 UZN#85, UE-25 UZN#92, and UE-29 UZN#91. Neutron logged UE-25 UZN#85, UE-25 UZN #92, and UE-29 UZN #91. Made depth to water measurements in UE-29 UZN #91, UE-29 a#1, and UE-29 a#2. The data collection frequency was increased to document an ongoing recharge event.

### Quality Assurance

### Planning and Operations

3GRG001B Complete criteria letter ponding sites

Continued to draft criteria letter.

3GRG006B Complete criteria letter FM and FMN boies

Continued to draft criteria letters.

3GRG010B Continue to site FMN and FM boies

Continued to site possible locations for the FMN and FM holes. Observed discharge from JF-3 water sampling pump operation in Fortymile Wash. Future hole locations can not be located where man has influenced the natural movement of water through the unsaturated zone.

### Variances

3GRG001B Complete criteria letter ponding sites

Ponding sites are not finally located. The infiltration test procedure has not been finalized

and the extent of other DOE contractors involvement is not decided. Infiltration tests at the ponding sites will not be run until neutron logging holes are completed. Additional time is required to complete the draft criteria letters. No impact on major deliverables is expected.

**3GRG003B Complete report on channel loss**

Due to other work commitments and relocation, personnel assigned to complete the report have been unable to finish the report by the scheduled time. Additional time is required to complete the report which is being targeted for a journal.

**3GRG004B Develop infiltration test procedure**

Additional time is needed to develop a workable infiltration test procedure using the large tanks and to define a system to record all the necessary physical parameters for later analysis. No impacts on major deliverables is expected.

**3GRG005B Complete procurement of infiltration test equipment**

When the infiltration test procedure is developed all the equipment necessary can be procured. No impacts on major deliverables is expected.

**3GRG006B Complete criteria letter FM and FMN holes**

Additional time is needed to complete the draft criteria letters. Hole locations need to be sited. The sampling schedule during drilling needs to be defined. No impact on major deliverables is expected.

**3GRG010B Continue to site FMN and FM holes**

FMN locations need to be finalized. A balance between holes used to monitor natural conditions and infiltration experiments needs to be defined. No impacts on major deliverables is expected.

**3GRG012B Non-linear analysis of regional streamflow**

Additional time is required to finish the poster, which is scheduled to be presented on May 14, 1992, at the AGU meeting.

**3GRG109A Procure equipment for air-k tests**

Air permeability tests need to be reevaluated for their help in determining recharge from Fortymile Wash. Experts in the field will be consulted to determine if the costs and effort to obtain air-k data will be useful for Fortymile Wash recharge objectives. Any delay will not impact major deliverables.

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

An estimated 40 hours were spent on the following:

Collected depth to water measurements in the Amargosa Desert for the regional potentiometric level network.

Assisted in testing equipment to be used for ground-water sampling in the regional potentiometric level network.

Participated in the USGS audit of the activity.

Summary Account Manager - J. Czarnecki

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GRG205A Complete report on vertical multilevel sampler, Franklin Lake Playa

Two reports entitled "Does localized recharge occur at a discharge area within the ground-water flow system of Yucca Mountain, Nevada?" and "A Hint of Recharge at Franklin Lake Playa, Inyo County, California" were sent to USGS Headquarters for final approval following D. Appel's review.

3GRG030 Select WT/ET sites

This activity has not started. See 3GRG215A below.

### Quality Assurance

### Planning and Operations

### Variances

3GRG201A Perform prototype tests of ET measurement

No prototype testing was performed. Meetings were held with D. Stannard (USGS/NRP) and R. Luckey to discuss the scope of work and available personnel.

3GRG208A Purchase materials for piezometer nests

A determination of type and quantity of materials to purchase for piezometer nests cannot be made until an evaluation of the number of sites is made. This will be delayed until the chloride profiling method can be evaluated and tested, which may greatly minimize the need for piezometer nests. J. Czarnecki discussed chloride profiling with S. Tyler (DRI, Reno) who provided several papers on the subject.

3GRG030 Select WT/ET sites

See 3GRG208A variance.

3GRG206A Analyze Franklin Lake hydrochemical data

No activity. This activity has been placed on hold until the project chief can be freed to work on it. Results from this effort will feed G006 (Hydrochemistry of Franklin Lake playa).

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

J. Czarnecki presented a poster entitled "Localized recharge at a discharge area within the ground-water flow system of Yucca Mountain, Nevada" at Waste Management '92 in Tucson, Arizona. Czarnecki sent papers on the regional ground-water flow system and Franklin Lake playa to about 12 persons who stopped by the poster.

J. Czarnecki sent a formal request to the U.S. Board of Geographic Names to officially name the unnamed alkali flat located north of Eagle Mountain as Franklin Lake playa. The request was received and a decision is expected in four months.

WBS 1233.1.1.4 Regional Hydrologic System Synthesis and Modeling  
Principal Investigator - J. Czarnecki

OBJECTIVE

To synthesize hydrologic, geologic, hydrochemical, and geophysical data into a model and make a qualitative analysis of how the system is functioning; and to represent quantitative observations of hydrologic data pertaining to the ground-water flow system in a comprehensive flow model. (SCP Study 8.3.1.2.1.4)

SCP 8.3.1.2.1.4.2 Subregional two-dimensional areal hydrologic modeling 0G331112  
Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

3GRM017A Hydrology integration task force participation

J. Czarnecki participated in a meeting of a subset of the Hydrology Integration Task Force and the Geochemistry Integration Task Force to set the agenda for a joint meeting on hydrology and hydrochemistry scheduled for May 27 and 28, 1992.

Variations

3GRM014A Verification problems, MODFE computer program  
There was no further activity; staff have been diverted.

3GRM015A Test finite-element mesh generator

This activity has not started; neither J. Czarnecki or M. Ciesnik have been free to start this activity because of other project commitments.

Work Performed but not in Direct Support of the Scheduled Tasks

J. Czarnecki prepared a Research Grade Evaluation Guide (RGEG) package for peer panel review.

J. Czarnecki attended a seminar by C. Voss (USGS/Hawaii) entitled "Parsimony in modeling."

SCP 8.3.1.2.1.4.4 Regional three-dimensional hydrologic modeling 0G3311K2  
Summary Account Manager - J. Downey

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRM040 Interface GIS with ground-water models

C. Faunt and F. D'Agnesse continued working with D. Williams on testing ARC/INFO and MODFLOW interfaces at CSM's Center for Geoscience Computing. Williams is finalizing efforts on the evaluation of MODFLOW and ARC/INFO interfaces.

Quality Assurance

Planning and Operations

3GRM13A Develop visualization software

C. Faunt discussed a user interface for the Intergraph system with B. Wales (Intergraph

Corporation) that would expedite input and visualization of cross-sectional data in the Intergraph system.

K. Turner requested purchase of IDRISI GIS software which is a PC-based raster software package available for only \$400.00 and can be used as a quick visualization tool.

#### Variances

##### 3GRM08A Calibration of 3-D ground-water flow model

This activity has been temporarily delayed until the study plan for future climate changes is approved. A prototype model will be constructed by J. Downey to test memory requirements and/or code constraints.

#### WBS 1.2.3.3.1.2 Unsaturated Zone Hydrology

##### OBJECTIVE

To develop a model of the unsaturated zone hydrologic system at Yucca Mountain that will assist in assessing the suitability of the site to contain and isolate waste. (SCP Investigation 8.3.1.2.2)

##### WBS 1.2.3.3.1.2.1 Unsaturated Zone Infiltration

Principal Investigator - A. Flint

##### OBJECTIVE

To determine the effective hydraulic conductivity, storage properties, and transport properties pertinent to unsaturated zone infiltration as functions of moisture content or potential; and to determine the present and to estimate the future spatial distribution of infiltration rate over the repository block at Yucca Mountain. (SCP Study 8.3.1.2.2.1)

##### SCP 8.3.1.2.2.1.1 Characterization of hydrologic properties of surficial materials 0G3312Z2

Summary Account Manager - A. Flint

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GUI002A Analyze rock outcrop samples

This activity will be extended to June 29, 1992, to incorporate at least two more transects. Along with the Prow transect described in the February report, an additional transect was conducted this month. This transect collected over 300 samples in the Shardy Base of Tiva Canyon along the west side of Yucca Ridge in Solitario Canyon. To investigate the relationship between vertical and horizontal variability in this seemingly very deterministic lithologic unit, 26 vertical transects of 10-15 samples over the 35 foot thick unit were collected over a 4000 foot distance along the unit to create a 2-D dataset. Core plugs are being prepared on the collected field samples. Laboratory measurements are progressing well on the rest of the transect samples. Moisture retention data on the horizontal transect of the Shardy Base indicate a fairly uniform air entry potential of about 0.5 bars which will be used for modeling purposes. Imbibition experiments on that dataset indicate quite a lot of variability, which corresponds with the variation in porosity shown vertically in the unit. Datasets of all measurements done on samples from six transects have been organized into ASCII files for submission into the LRC and TDIFs have been begun. The extension of this activity will not impact the preparation of the OFR due September 30, 1992.

3GUI004A Compile and analyze existing soils data

This activity is progressing now with the arrival of new personnel. Familiarization of new personnel with existing surficial materials data and field testing equipment has begun, along with introduction of field topographic locations that correspond with infiltration-runoff surficial units and associated soils.

3GUI005 Test borehole logging tools in new neutron hole

This activity will be extended to July 1, 1992, to coincide with 3GUI005A, install and check geophysical instruments. The new van has not been received yet.

Quality Assurance

3GUI023A Graded QA and other QA requirements

Implementation of all QA requirements was performed as needed.

Planning and Operations

3GUI025A Procure SPARC station for GIS program

The SPARC station has not been processed through purchasing yet because of delays in the allocation of capital equipment funds.

3GUI026A Continue procurement of geophysical logging van

The geophysical logging van is still expected to arrive soon. The extension of this activity will not impact programmatic schedules. The geophysical logging of all neutron logs is scheduled to take six months after which there is a nine month lag to prepare technical procedures before site characterization borehole logging begins.

Variances

3GUI002A Analyze existing outcrop samples

As explained in the technical activity discussion, this activity has been expanded to include additional transects which will extend the planned finish date to June 29, 1992. This will not impact the planned finish date of 3GUI020A, preparation of OFR for outcrop samples.

3GUI005 Test borehole logging tools in new neutron hole

This activity has been extended to coincide with 3GUI005A, install and check geophysical instruments. Rather than check the old geophysical tools in the new boreholes, then recheck the new tools, the two activities will be concurrent to install the new tools as soon as the new logging van arrives and then check the new tools in the field. The van is expected within four weeks and thus the planned finish of these two activities should not be impacted.

3GUI025A Procure SPARC station for GIS program

This activity has been unavoidably delayed due to the procurement and budgeting process. The actual finish date is currently unknown. There is a three month lag for set up of this system before the next activity to utilize the system begins (3GUI007A, analyze the spatial variability of soil physical properties, six months). This suggests that there will be no impact on programmatic scheduling.

3GUI026A Continue procurement of geophysical logging van

The arrival of the geophysical logging van is imminent, and the delay of this activity should not impact 3GUI005A which allows for three months to install the instruments and field test them in the new boreholes.

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GUI302 Initiate small scale deterministic model

A preliminary analysis of 1-D and 2-D simulation of transient unsaturated flow using the modified version of the VS2DT finite difference algorithm was completed by J. Hevesi, and a comparison of simulation results using VS2DT with results obtained using the TOUGH finite difference algorithm was initiated. The comparison is being made to investigate the importance of including transpiration as a boundary condition and as a sink term in the governing equation for internal nodes within the root zone. Initial results have indicated that including transpiration for an overall ET boundary condition may provide improvements for unsaturated flow simulation and an application of the inverse solution method for investigating material properties and structure within alluvial deposits. Efforts are continuing to more accurately define the ET boundary condition in terms of rooting depth as a function of time and space, root density as a function of depth, time, and space, limiting pressure potentials, and surface resistance factors. The ET subroutine is also being modified to include potential evapotranspiration as a function of meteorological parameters and a solar radiation model in order to account for both seasonal and diurnal effects on the upper boundary condition. For the initial simulations, total daily potential ET was estimated according to evaporation data available from the class A evaporation pan in Jackass Flats. The 90 day flow simulation for the 954 node finite difference mesh required approximately 4 minutes of run-time on a 386/33 machine when using a time step of one day. This is 50 to 100 times faster than flow simulations for the same model using the TOUGH code on the PRIME. A reduction in run-time will be an important advantage in the continuing effort of inverse modeling and also for Monte Carlo simulations.

#### 3GUI311 Initiate analysis of moisture profiles

Analysis of moisture profiles for selected boreholes in Pagany Wash and Fortymile Wash, and also for the newly installed boreholes, was continued by L. Flint, A. Flint, C. Savard, and J. Hevesi as additional data were collected. The boreholes were logged at an increased frequency because of the much higher than average magnitude and frequency of precipitation that occurred for January, February and March. The series of moisture profiles obtained indicated the downward movement of a well defined wetting front to a depth of approximately 2 meters for the newly installed boreholes and for the boreholes in Pagany wash, while the two boreholes in Fortymile Wash, N-92 and N-91, indicated a greater volume of infiltrated water to a depth of 4 to 5 meters. These profiles will be useful as a means of model validation for the small scale deterministic modeling activity, as well as for inverse modeling, specifically in terms of the upper surface layer and the ET boundary condition, because relatively accurate measurements of precipitation depths were made at each borehole site using a storage gage. Logging of the selected boreholes at weekly intervals will continue in order to measure changes in moisture profiles due to evapotranspiration. This work will be valuable in understanding both hydrologic processes and material properties within the upper 2 meters of surficial materials.

#### 3GUI315 Prepare technical paper small scale model

An outline and abstract have been completed for the first report in a series of technical papers describing the analysis of flow simulation results for an application of the inverse solution method. These predict natural infiltration based on possible future climatic conditions, evaluate net infiltration at specific sites using mass balance calculations, perform

sensitivity analyses to evaluate the relative influence of various meteorological, hydrological, and geological parameters, and validate various conceptual models of natural infiltration. The first report will specifically describe the results of the inverse solution method for estimating the field-scale hydrologic and material properties of alluvium deposits in Pagany Wash.

**3GUI321 Install and calibrate automated evaporation pan**

Installation of an automated class A evaporation pan at a field site in Jackass Flats was completed. Modifications made by J. Klenke to the refill reservoir, delivery line, float valve, stilling well, and data collection system will improve the accuracy of measurements. Modifications made by Klenke and J. Gonzales to the instrument shelter, delivery line system, and protective fencing have improved the quality and reliability of the automated system. The instrument station includes a tipping bucket rain gage, totalizing anemometer, and thermistors for measuring water and air temperature. Additional meteorological data, including relative humidity, wind speed, and wind direction, can be obtained from a nearby weather station.

**3GUI324 Initiate tritium sampling program**

Samples were selected from USW-UZN-55 LEXAN samples for tritium analyses. It was agreed to send these samples to USGS Geochemistry in Denver as soon as they are packaged at the Sample Management Facility.

**3GUI368 Procure instrumentation for ET**

No progress was made on this activity during March due to a lack of manpower. This delay does not result in a variance at this time.

**3GUI377 Field calibration of neutron-moisture meters**

Field calibration of the neutron-moisture meters using core samples available from the newly installed neutron access boreholes continued as additional data was collected. A preliminary calibration equation developed by A. Flint and J. Klenke indicated an improvement in calibration accuracy relative to previous calibrations. The improved calibration is possible because of the continuous coring procedure that was implemented for the installation of the new boreholes. N-55 samples are currently being dried at temperature ranges of 200-800° C. Some locations in the borehole indicate a large storage of water at 105° C compared to higher temperatures. Preliminary data suggests that removing all the water from the samples will improve the calibration equation.

**3GUI381 Log neutron access boreholes FY92**

Selected boreholes were logged with increased frequency during March because of the increase in precipitation that occurred during this period. Regular logging of all neutron boreholes was scheduled for the first week of April.

**3GUI385 Drill new neutron access holes**

Installation of boreholes N-17, N-15, and N-16 in Pagany Wash was completed despite a significant amount of down-time due to adverse weather conditions. Installation of boreholes N-27, N-64, and N-38 should proceed on schedule.

**3GUI387 Continue locating new neutron holes**

A total of eight new neutron access boreholes have been successfully installed during FY92. The locations for the final three boreholes to be installed in FY92 have been finalized and approved. The installation of these boreholes should proceed on schedule. Locations of 12 additional boreholes were requested by DOE for FY92 budgeting purposes.

3GUI388 Procure and calibrate sensors for borehole monitoring

No progress was made on this activity during March due to a lack of manpower. This delay does not result in a variance at this time.

3GUI389 Calibration and testing of cross-hole gamma probe

No progress was made on this activity during March due to a lack of manpower. This delay does not result in a variance at this time.

3GUI396 Testing and calibration of prototype TDR

Laboratory testing and calibration of the prototype TDR was completed. Field site testing and calibration is continuing at a location in Jackass Flats. Modifications to the data logger program are also in progress.

3GUI404 Installation of TDR network

Potential field locations for the TDR network have been selected. Installation of the network has been delayed pending procurement of instrumentation (see activity 3GUI409, Graded QA and other QA requirements). This delay does not result in a variance at this time.

#### Quality Assurance

3GUI409 Graded QA and other QA requirements

Implementation of all QA requirements were performed as needed.

#### Planning and Operations

3GUI405 Procure CSI TDR

The problem causing a delay in procurement was identified and corrected. Partial procurement has been completed, and procurement of the remaining materials should now proceed on schedule. The delay does not result in a variance at this time.

#### Variances

SCP 631.2.2.1.3 Evaluation of artificial infiltration 0G331222

Summary Account Manager - A. Flint

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUI606 Prototype infiltrometer field testing

L. Hoffman, a new Foothill Engineering contract employee, began work March 17 and has since made some progress on this activity. Background information has been assimilated and studied and he has become familiarized with the equipment and various field sites. New information regarding calculated solutions for well permeameters has recently been acquired, has been read and will be assessed as to its applicability. A GUELPH Permeameter was loaned to B. Glass with Sandia National Laboratory. Glass is running a comparison of two field infiltrometers.

3GUI616A Develop prototype ponding study

The arrival of only one of the two anticipated personnel has resulted in no further progress on this activity for this month. So far there is no indication, due to the float in this activity, that this will result in programmatic delays.

### 3GUI630 Determine field locations infiltration sites

Field locations for ponding, LPRS and SPRS sites, were chosen this month and sent to DOE for FY93 budgeting purposes. Numbers of sites were reduced to 12 ponding sites, and six each of the rainfall simulation sites. This should represent the various infiltration-runoff units over the mountain. The locations indicated to DOE were not specific and with the assistance of the new employee, work in the artificial infiltration activity this coming month will involve flagging the sites in order to begin the job package for drilling at these plots.

### Quality Assurance

#### 3GUI695 Graded QA and other QA requirements

Implementation of all QA requirements was performed as needed.

### Planning and Operations

### Variations

## WBS 1.2.3.3.1.2.3 Percolation in the Unsaturated Zone - Surface Based Study

Principal Investigator - J. Rousseau

### OBJECTIVE

To determine the present *in situ* hydrologic properties of the unsaturated zone hydrogeologic units and structural features; to determine the present vertical and lateral variation of percolation flux through the hydrogeologic units and structural features; to investigate the relationships between present flux and past climatic conditions; and to determine the effective hydraulic conductivity, storage properties, and transport properties as functions of moisture content or potential. (SCP Study 8.3.1.2.2.3)

### SCP 8.3.1.2.2.3.1 Matrix hydrologic-properties testing 0G3312U2

Summary Account Manager - A. Flint

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GUP009A Construct and test low-flow permeameter

The design and engineering of this device has been completed. Components that have been requisitioned, but not yet received, include a precision-rate controlled, high pressure syringe pump and a high-resolution pressure transducer with a range of several thousand psi. Construction will begin when all components are received.

#### 3GUP010A Develop and test imbibition procedure

This task was completed as scheduled. Two new imbibition procedures were developed and tested - one at the HRF and the other at Oregon State University (OSU). The HRF procedure utilized a saturated capillary matting in a plexiglas box kept wet by a constant head water supply system. Dry cores were weighed and then placed with the flat face down on the capillary matting. The cores were allowed to freely imbibe water, and the rate of imbibition was measured by reweighing the cores periodically. The OSU system works by suspending the samples from small load cells to obtain a continuous weight as water was imbibed from below. The OSU method allows for continuous collection of datapoints which gives information on filling of secondary pores and will provide datasets for verification of moisture retention methodology and modeling of functional relationships. The HRF system only provides enough data to calculate sorptivity but can run more than 50 samples

simultaneously.

**3GUP013A Model imbibition to verify lab measurements**

Additional samples have been used to collect imbibition data for inverse modeling to estimate saturated conductivity and functional relationships from sorptivity. Some preliminary attempts were made to evaluate the inverse modeling computer program, but with inconclusive results. This study is still underway. The imbibition method described in 3GUP010A (Develop and test imbibition procedure) is currently being tested using core samples and will provide data to be used in modeling imbibition curves for methodology verification and estimation of functional relationships.

**3GUP16AA Matric potential from tensiometer/transducer**

No progress was made on this activity in March. Additional personnel have recently been hired and additional personnel are expected in May, at which time this activity will be resumed. It is not expected that delays in this activity will impact other activities at this time.

**3GUP17AA Water retention from SPOC analyses**

This activity was scheduled for completion at the end of March. Additional development to determine the feasibility of incorporating simultaneous measurement of multi-step outflow along with hysteretic moisture retention is being conducted with the aid of personnel at OSU. In addition, it is desirable to automate the system for more accuracy and quantity which requires some development at this point. This activity will be extended to be concurrent with 3GUP019A (Water retention pressure plate tests) and will feed directly into the preparation of the OFR 3GUP020A and therefore will not impact any milestone activities.

**3GUP25AA Chilled-mirror psychrometer verification**

This activity was scheduled for completion at the end of March. However, additional verification tests are required due to inconsistencies in the data collected on the supersaturated solutions of various salts. This problem appears to be solved. An additional problem related to the way in which the sample cup sits against the mirror may allow some external leakage of air into the chamber. A redesigned sample cup with an O-ring seal is currently being tested.

**3GUP26AA Transect sample statistics**

Statistical and geostatistical analysis of the physical and hydrologic data collected from the transect samples is continuing. M. McGraw (LBL) and C. Rautman (SNL) are contributing to this activity as part of their respective numerical modeling efforts, in addition to J. Istok (OSU).

**3GUP27AA Permeability of selected transect samples**

Saturated hydraulic conductivities were measured on approximately 70 samples from the composite transect. These samples were assembled to provide representative core plugs from all of the lithologic units in the unsaturated zone at Yucca Mountain. Permeabilities are currently being run on deeper Calico Hills core samples from the GU-3 borehole.

**3GUP028A Imbibition measurements on transect samples**

These measurements are being run on the newly-developed HRF imbibition apparatus described in 3GUP010A (Develop and test imbibition procedure). This activity is proceeding as scheduled.

### 3GUP30AA Neutron core physical property measurements

Additional samples have been selected for intersampling from the LEXAN liners to make additional measurements supplementing the dataset from the can samples. As the neutron probe calibration equation efforts have progressed, it was seen as necessary to remove all of the water from the rock samples by heating to very high temperatures. Experiments have been done on several of the N-55 samples to determine the appropriate temperatures to accomplish this and it was shown that some of the units do maintain quite a bit of stored water when only dried at 105° C. Additional equipment was obtained and calibrated in order to dry all of the N-55 samples at high temperature.

### 3GUP31AA Neutron core gas pycnometry measurements

The gas pycnometer has been used to test the repeatability of measurement made on nonwelded tuff. The systems appears stable and a draft technical procedure has been written. Once the procedure is in place samples will be processed.

### Quality Assurance

#### 3GUP02AA QA procedure, training and calibration FY92

QA training and equipment calibrations were carried out as required. A procedure is in preparation for the gas pycnometer and the chilled-mirror psychrometer procedure is currently being revised based on new information obtained from the CX-2.

### Planning and Operations

### Variances

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

Public tour, March 28. (4 hours)

Tour for visitors from Russia, March 24. (2 hours)

Attended AGU Hydrology Days, Ft. Collins, Colorado, March 31. (8 hours)

#### SCP 8.3.1.2.3.2a Surface-based boreholes studies 0G3312V2

Summary Account Manager - J. Rousseau

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUP053E Develop electronic diagnostic procedure for verification SPECS of electric equipment

Work on this activity was restarted in late March. Approximately four months will be needed to prepare a first draft of the technical procedure for this method. All equipment to continue with development of this procedure is on hand.

3GUP046E Complete development/design of Denver data base

Work on this activity was restarted in March, in conjunction with the planned conversion of the HRF borehole data acquisition system to IDAS in May.

3GUP003E Instrument and monitor HRF boreholes

Monitoring of HRF boreholes continued throughout the month of March.

3GUP021E Construct/test/evaluate multi-station gas sampling apparatus

Construction of the multi-station gas sampling apparatus is essentially complete.

Preliminary testing of the apparatus and supporting software will take place in April.

3GUP059E Complete processing thermistor, pressure transducer, psychrometer technical procedure  
An in-project technical review of the pressure transducer calibration procedure was completed. This technical procedure will be forwarded for QA review and approval during the month of April.

3GUP023E Develop/test/evaluate in-situ pressure transducer recalibration  
No work was done on this activity during the reporting period due to other higher priority commitments.

#### Quality Assurance

3GUP020E Acquire/install mass flow

A QA certification inspection of the vendor/manufacturer of the mass flow calibrator was conducted. Minor deficiencies were noted and are in the process of being corrected. Exact delivery date of the equipment is still unknown at this time. However, delivery is anticipated in early June.

#### Planning and Operations

3GUP014E Acquire/install humidity generator

A two pressure humidity generator has been shipped to the NTS. The unit will be installed in April. Training classes will be given by the product manufacturer on May 21 and 22 at NTS, HRF calibration laboratory.

3GUP040E Acquire, install, evaluate optical disk media

Procurement documents for the optical disk storage media units (WORM drives) were forwarded in February. The delivery date is unknown.

3GUP035E Prepare for instrumentation of UZP-6

Preparations for instrumenting UZ-16 (VSP borehole) [not UZP-6] continued throughout the month of March. A comment resolution meeting to resolve work package issues was held on March 25. A prototype geophone cable mount is being manufactured. The geophone cable mock-up unit was delivered to RSN to support their mount design efforts. Five potential USGS detailees were identified to assist with drilling operations during the months of May, June, July, and August.

3GUP060E Hire and train new staff

All staff actions requiring input at the project level have been completed. Awaiting personnel division action to process hiring requests, PDs, announcements, etc. Two new staff, hired in December, 1991 and February, 1992, have been scheduled for a special training course at Ruska Instruments in Houston, Texas in April. These new-hires have completed GET and QA indoctrination training.

3GUP045E Order additional microwave telemetry

This activity is on hold pending approval of an FCC license application to operate a 10 MHz wide-band transmitter at the NTS. The 10 MHz system is being investigated as a alternative to the 23 GHz microwave telemetry system. License has been applied for.

#### Variances

SCP 831.2.2.3.2b Vertical seismic profiling OG331232

Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP017B VSP lab/physical and computer simulation: 2-D fault method

H. Jaramillo has produced several excellent fault images. Stacking and compositing continues.

The processing of Yucca Mountain physical-model data continues.

Quality Assurance

3GUP030B Develop/write VSP technical procedure: data acquisition

There was no activity during this reporting period due to lack of time and illness.

Planning and Operations

3GUP050B Procure "X" windows computer terminal for VSP

The "X" windows computer terminal was delivered March 6.

3GUP035B Design/test/evaluate/procure geophone mounts

Evaluation of prototype mounting brackets continues. Current design is considered adequate, but a new, better design is being sought.

Variances

3GUP047B Prepare ICN for cross-hole tomographic surveys

This activity has not started due to both illness and unavailability of time. Will try to begin this activity during the month of April.

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 40 hours were spent on the following:

C. Erdemir's thesis is nearing completion.

A. Balch attended Midwestern A&S meeting, Dallas, and presented a paper; attended "Underground Sound" symposium (Golden) and presented a paper.

H. Jaramillo gave a paper at graduate seminar.

SCP 831.2.2.3.2c Integrated Data Acquisition System OG331242

Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP045C Develop criteria optical disk media

Final comparison of suitable alternatives led to a committee decision (J. Baer, R. Getzen, A. Greengard, M. Kurzmack, M. Neil, and J. Rousseau) for a procurement recommendation for a 5-1/4" optical WORM, controller, and communications software. Kurzmack began work on requisition and supporting documents February 14. A requisition for DEC Pathworks, software for communications between ARC-2 and optical disk controller, had not been submitted as of March 23.

### 3GUP025C Integration and test design for software

M. Neil has nearly completed test designs for all phase 1 and phase 2 IDAS software (software completed in task 3GUP013C, Development and module testing software-2, but not 3GUP020C, Development and module testing software-3, or 3GUP023C, Development and module testing software-4). He will be debugging his testing program and associated hardware throughout most of April. A. Greengard and R. Getzen will review his test plan before May 10, will evaluate its performance through early June. A test plan for phase 3 and phase 4 software should be complete by late June. See variances.

### 3GUP013C Development and module testing software-2

Final two modules (Engineering Conversion Subsystem, Interactive Subsystem) in phase 2 software are currently being coded (J. Baer and A. Sims). These subsystems should undergo preliminary debugging and testing about the end of April. Bugs in SNSRDR, MNTSUB, and GPIB driver were corrected in March. Work is currently underway (Baer) to modify MNTTTP and SNSRDR to permit utilization of the new model 182 Keithly Nanovoltmeter. A potential design glitch has been discovered in the way IDAS software tracks the sequence of electronic and mathematical operations associated with each measurement. This glitch can, under rare circumstances, allow inconsistencies between sensor operation and sensor interpretation, as well as QA difficulties in establishing traceability of data. The physical problem can be circumvented procedurally (with some inconvenience and insignificant disruption of data collection). A better solution, which eliminates QA problems, will be designed and tested as part of work elements 3GUP020C and 3GUP051C. See variances.

### Quality Assurance

#### 3GUP049C Write, review, revise IDAS computer procedures

A. Greengard has been making consistent progress in revising these procedures as software/user interface is being changed. At the same time, procedures are being physically combined and realigned to create more useful documents. (See December and January monthly reports.) Working versions of most of the new documents will be available about the end of April.

#### 3GUP060C Write review, revise IDAS instrument procedures

R. Getzen has outlined the new procedures and made some progress in their writing. They should be complete in mid-June; see variances.

#### 3GUP062C Revise IDAS facility procedures, QA reviews

The need for procedures HP-134 and HP-137 has been eliminated by circumstances and realignment of IDAS procedures in December.

#### 3GUP063C Write/review/revise IDAS maintenance procedures

R. Getzen has outlined the new procedures and made some progress in their writing, but many details depend upon field evaluations of IIS and shelter systems (element 3GUP033C) and of IDAS prototype-2 (element 3GUP051C), which will not begin until mid-May. They should be complete in late December, if the shelter is delivered in mid-August.

#### 3GUP067C Revise IDAS software procedures

A. Greengard made considerable progress in revising these procedures in January and February, but needs further input from software engineers, which probably will not be available until June. Estimated completion is June 10, 1992; see variances.

### Planning and Operations

3GUP032C Construct prototype IDAS instrument shelter (IIS)

R/P International Technologies began ordering materials for IIS about March 20 and expects to have the outer shell ready for the first inspection April 22 ± 6 days.

3GUP046C Procure/delivery microwave datacom

The requisition was forwarded to procurement in late February; no problems are expected from ISD or the procurement office. Delivery is expected mid-May.

3GUP035C Procure/deliver microwave datacom

As described in December-January reports, a change from microwave to UHF carrier promises to save money, installation, testing and operational effort, as well as reduce procurement difficulties. This change is only possible because of recent FCC changes in use of 932-941 MHz band, and cannot proceed without FCC approval. Application to FCC, including request for waiver to use point-to-point channel for multi-point communications, were forwarded to FCC on March 3. Prognosis uncertain; see variances.

### Variances

3GUP025C Integration and test design for software

M. Neil was unable to devote the time planned to this activity. Problems causing delay have been mostly eliminated, and he is now making good logical and physical progress, although documentation is behind schedule. This will delay activities 3GUP026C (Integration and test review for software) and 3GUP027C (Integration and test revision of software) and three subsequent activities, probably by three to six weeks. If R. Getzen or A. Greengard can assist him with documentation, some lost time may be recovered.

3GUP013C Development and module testing software-2

The start of activity 3GUP051C (Evaluation of IDAS prototype-2) has been delayed until May 11, and several subsequent activities will be delayed by two to seven weeks.

3GUP060C Write, review revise IDAS procedures

Although work has started on this activity, its completion will be delayed until about June 20, primarily because completion depends upon partial completion of 3GUP051C, which will not begin until mid-May.

3GUP063C Write/review/revise IDAS maintenance procedures

Completion of this activity depends upon evaluation of microwave datacom and IIS systems (3GUP036C and 3GUP033C), which are both significantly behind schedule. The five-month delays in procurement of these major systems were not anticipated. These procedures will probably not reach QA for review until November, so there probably will be significant delays in some FY93 activities.

3GUP067C Revise IDAS software procedures

Because activities 3GUP013C (Development and module testing software-2) and 3GUP025C (Integration and test design for software) are behind schedule, software engineers have been unable to provide A. Greengard with necessary input. Situation should be corrected in May.

3GUP035C Procure/deliver microwave datacom

Last year's attempt at procuring an integrated microwave-modern system, which is not normally available for multi-point configurations like exist here, resulted in a procurement dead-end. The procurement process necessary to obtain a guaranteed system seemed to be a difficult five-to-eight month process (restarting in January). The FCC recently announced

availability of a 932-941MHz band for shared government and commercial data communications, and off-the-shelf equipment for this frequency band seems well-suited, without modification, to the needs of this project. If frequency assignments can be obtained in this band, both time (months) and funds for procurement and intermediate testing, (\$30K - \$60K in communications equipment, and \$60K - \$120K in installation and operating costs) can be saved, but will experience unknown delays in obtaining frequency assignments. Both the NTS frequency coordinator and DOI frequency coordinator are pressing the FCC on behalf of this project. One or two field sites can be operated with the existing equipment, so the major concern is not physical communications with the prototype field sites in early FY93. Delays in developing appropriate procedures for installation, testing, and maintaining communications equipment cause concern.

3GUP061C Review QA, rewrite IDAS instrument procedures  
Start of this activity delayed by delays in completion of 3GUP060C, Write, review revise IDAS procedures (see above). Anticipated long-term impacts are negligible.

SCP 8312232d Air-permeability and gaseous-tracer testing 0G331252  
Summary Account Manager - G. McCain

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GUP003 Complete construction of first support trailer

The USBR has begun construction of the pneumatic control system for the support trailer. The boom system has been redesigned due to problems in supporting the packer system. The USBR has begun final design of the mass flow controllers housing and control panel that will be installed in the support trailer office.

3GUP005D Purchase parts/assembly of 12" packer system #1

The packers for use in the 12.25-inch packer assembly were received. The USBR can now begin manufacturing the interval pipe and also begin assembly work on the packer assembly.

3GUP010 Complete engineering drawings/assembly/test instr, packer

A USBR drafting technician has been assigned to work on the engineering drawings. Drawings for the 8-inch packer assembly are mostly complete and work has begun on the 12.25-inch system.

3GUP014D Expand hydrologic research facility calibration lab

The thermistor calibration system at the HRF was used successfully to calibrate the air permeability testing 10K ohm thermistors. The pressure transducers are presently being tested to determine if they should be operated in current mode or voltage mode. This must be determined before any adaptations to the present system are considered.

3GUP015D Technical procedure/pressure transducer calibration

The pressure transducers are being tested to determine if they are to be operated in current mode or voltage mode.

### Quality Assurance

### Planning and Operations

3GUP001 Purchase mass-flow control calibration system

Sierra Instruments was selected to provide a mass flow calibration system to be installed at

the HRF. Purchase of the first of two parts of the system is awaiting QA approval. Paper work for the second part (two bell provers) will be submitted upon QA approval of Sierra Instruments.

**3GUP011 Preview/develop crosshole, single hole air injection**

A meeting between the PI and management to discuss the possibility of bringing on additional staff to adapt 3-D hydraulic methods to pneumatic testing was held. The general opinion, supported by all, was that a request for support should be made to the USGS research program to determine if the expertise is available.

**3GUP020 Purchase all measurement and DAS equipment**

A pressure transducer order was received. These pressure transducers will be used in monitoring intervals. Two lap-top computers for use in field testing were ordered.

**Variations**

**3GUP001 Purchase mass-flow control calibration system**

This purchase was delayed by uncertainties in funding and QA certification of the selected supplier. All obstacles have been dealt with and the planned finish is April 30, 1992.

**3GUP003 Complete construction of first support trailer**

Due to staff shortages the USBR is behind schedule. Additional staff has been made available and the new planned finish is June 30, 1992.

**3GUP005D Purchase parts/assembly of 12" packer system #1**

The USBR Purchasing department required considerably longer than anticipated to purchase the 12.25-inch packers. The packers have been received and the new planned finish is June 30, 1992.

**3GUP023 Graded QA and other QA requirements**

This activity is on hold until policy regarding the graded QA system is implemented. The new planned finish date is September 30, 1992.

**WBS 1.2.3.1.2.4 Percolation in the Unsaturated Zone - ESF Study**

Principal Investigator - B. Lewis

**OBJECTIVE**

To conduct hydrologic tests in the ESF to supplement and complement the surface-based hydrologic information needed to characterize the Yucca Mountain site; to provide phenomenological information for analyzing fluid flow and the potential for radionuclide transport through unsaturated fractured tuff; and to provide information about water flow through unsaturated fractured tuffs. (SCP Study 8.3.1.2.2.4)

**SCP 8.3.1.2.2.4.1a Prototype testing of intact fractures OG3312N2**

Summary Account Manager - G. Severson

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GUS023J Journal paper, moire bench-mark and calibration**

The technical reviews of the draft entitled, "Implementation and Use of an Automated Projection Moire Experimental Set-Up" have been completed. Comment resolution remains to be addressed.

3GUS006A Continued moire projection; method development

Work continues to progress using image digitization and processing to look at moire fringes. Work with phase measuring interferometry (PMI), stereoviewing, and the transform analyses for replicating topographical surfaces (fast-Fourier transform (FFT) analysis and cosine transforms) continue to be studied.

The high-resolution video imaging board has been installed. Work has started using the hardware and software for data collection and presentation. The monitor for viewing real-time data does not have enough resolution to fully display the data collected. Several monitors are still being investigated for this use.

3GUS012J Complete journal paper-Moire automation

The technical reviews are complete and this draft entitled, "Projection Moire as a Tool for the Automated Determinations of Surface Topography" was returned to the HIP reports section and will be sent to Dr. Cardenas for comment resolution.

3GUS013J Complete journal paper; FFT Moire

Work on this draft continues.

3GUS014J Complete journal paper; Stereo viewing moire

Work on this draft continues.

3GUS004A Write open file report; intact fracture sampling

A draft has been started on this report.

3GUS014A Complete design fabricate low-pressure vessel

Previous drawings and notes regarding the vessel are being reviewed. Possible ways of funding the materials necessary are being considered.

Quality Assurance

Planning and Operations

Variances

3GUS007A Write technical procedure; moire calibration

There was no progress in March. A draft was started on this procedure. However, the methods developed since this activity was placed in the FY91 and FY92 PACS preclude the use of the original calibration during the set up of the equipment. Traceable, calibrated objects for the technical procedure are being investigated.

3GUS016J Complete design, radial fracture test vessel

This activity has not been started. This activity will be started when more details of the low-pressure vessel are complete.

3GUS001A Select analog site for fracture sampling

This activity has not been started. No funds for continuing and completing the fracture sampling aspects of the intact fracture test during FY92 are available. Approaches to completing this activity will be considered during the fourth quarter of FY92 with the proposed laboratory and field experiments and the funding necessary to complete this activity.

3GUS010A Continued development, axial fracture

This activity has not been started. See comments under activity 3GUS011A.

Work Performed but not in Direct Support of the Scheduled Tasks

Technical review of OMP-3.15, R0 and comment resolution. 5 hours.

Minor maintenance/repairs and clean up of Satec load frame. 3 hours.

SCP 9312242a Prototype infiltration/percolation testing AG331202

Summary Account Manager - F. Thamer

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GUS101B Conduct imbibition experiments on small samples

Finished one imbibition experiment on a core sample. The test started on February 5 and ended on March 9. The sample was welded tuff (diam. = 53 mm, length = 127 mm). This test was designed to study the effect of fracture mineral coating on the water imbibition process. Approximately 10 cubic cm of water were imbibed into the sample through an area of 22 squared cm during 30 days. No other tests were made during this month because three computers, which are used to collect data in the laboratory, malfunctioned during this period.

3GUS002B Conduct ponding test on large block first stage

The ponding test, which was started on October 28, 1991, continues. The water front has moved about 40 to 45 cm in the fractures and 5 to 10 cm in the matrix surrounding the fracture. The water movement in the fractures is not as fast as originally expected. Eight out of the 18 thermocouple psychrometers are showing an increase in water potential (and saturation). The potential level is still detectable with the psychrometers. Therefore, this stage will continue longer than originally expected.

3GUS006B Prepare data report of large block ponding test

Data is being collected, indexed, backed-up, and archived on computer disks. The data include water potentials, electrical resistance, and time-domain reflectometry to estimate water saturation within the block.

3GUS010B Construct equipment for final stage of pond test

Construction on this stage started. A water spraying system is being constructed and tested. The system will allow controlling water pressure and flow rates which will be used to apply constant water pressure or constant flow rates on the large block.

### Quality Assurance

### Planning and Operations

### Variances

3GUS002B Conduct ponding test on large block first stage

The water front in the fracture network of the welded tuff block is not moving as fast as originally expected. The tentative finish date is revised from March 31 to May 31, 1992. It is also anticipated that the second stage of the ponding test (activity 3GUS007) will not last as long as originally expected, which was three months. The second stage may be bypassed and only data from the fractures and the matrix immediately surrounding the fractures will

be collected. A tentative duration of the second stage will be reported next month.

#### 3GUS035B Measure rock sample hydrologic properties

Originally this set of measurements was scheduled to be made at the matrix hydrologic properties laboratory in Nevada. However, the laboratory staff were not able to make the measurements because they were busy conducting other similar tests. This delay will not affect the final finish date since the completion of this activity is linked with the large block ponding experiment which is delayed as described in activity 3GUS002B (Conduct ponding test on large block first stage).

### WBS 1.2.3.3.2.6 Gaseous-Phase Movement in the Unsaturated Zone

Principal Investigator - M. Chornack

#### OBJECTIVE

To describe the pre-waste-emplacment gas-flow field; to identify structural controls on fluid flow; to determine conductive and dispersive properties of the unsaturated zone for gas flow; and to model the transport of water and tracers in the gas phase. (SCP Study 8.3.1.2.2.6)

#### SCP 8.3.1.2.2.6.1 Gaseous-phase circulation study 0G3313W2

Summary Account Manager - M. Chornack

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GGP06A Tabulate and analyze data

Deficiencies in the gaseous-phase circulation study were discovered during an internal USGS audit. As a result of the audit, YMP-USGS-CAR-92-04 was issued on this study. All data collection and analysis activities are suspended pending resolution of the items listed in the corrective action report.

##### 3GGP17A Continue progress report air flow and gas chemistry

Due to the corrective action report, work on this activity is temporarily suspended.

##### 3GGP07A Develop and complete technical procedures

Existing air-flow measurement and gas-sample collection techniques are being evaluated. If needed, additional technical procedures will be completed for this activity when the evaluation is finished. Revisions will be made to existing technical procedures, if necessary.

##### 3GGP19A Conduct and complete technical procedure training

When new personnel are assigned to the gaseous-phase circulation study, technical procedure training will be conducted prior to their performing any work related to this project.

#### Quality Assurance

#### Planning and Operations

#### Variations

##### 3GGP06A Tabulate and analyze data

Temporary suspension of work on this activity.

Cause: USGS audit resulted in corrective action report, YMP-USGS-CAR-92-04, being

issued.

Impact: Level 3 milestones are negatively impacted by this departure from the original schedule.

Corrective Action: Issues raised in the corrective action report are being resolved. Some items listed in the corrective action report have been resolved.

#### 3GGP03A Backlogged data

Preliminary review and compilation of the air-flow data and gaseous-phase chemical data from boreholes UZ-6, UZ-6s, and selected neutron-access boreholes will begin during March.

Cause: Compilation, checking, and submittal of backlogged air-flow and gas-phase chemical data from UZ-6, UZ-6s, and selected neutron-access boreholes has been delayed because of lack of staff.

Impact: Qualification of data and outyear level 3 milestones are negatively impacted, but workarounds are possible.

Corrective Action: Replan schedule and obtain additional staff, in progress.

#### 3GGP002A Collect UZ borehole data

Periodic gas sampling and/or air-flow measuring may be conducted at selected UZ boreholes.

Cause: The need to collect additional UZ borehole data during FY92 is being evaluated.

Impact: Level 3 milestones are negatively impacted by this departure from the original schedule.

Corrective Action: None anticipated at this time.

#### 3GGP04A Chemical analysis of gas samples

Future chemical analysis of gas samples collected from UZ boreholes is dependent upon whether or not additional gas samples are collected.

Cause: The need to collect additional UZ borehole data during FY92 is being evaluated.

Impact: Level 3 milestones are negatively impacted by this departure from the original schedule.

Corrective Action: None anticipated at this time.

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

Participated in USGS audit and resolution of deficiencies reported in YMP-USGS-CAR-92-04.

#### WBS 1.2.3.3.2.7 Unsaturated Zone Hydrochemistry

Principal Investigator - I. Yang

#### OBJECTIVE

To understand the gas transport mechanism, direction, flux, and travel time within the unsaturated zone; to develop and implement methods for extracting pore fluids from the tuff; to provide independent evidence of flow direction, flux, and travel time of water in the unsaturated zone; to determine the extent of the water-rock interaction; and to model geochemical evolution of ground-water in the unsaturated zone. (SCP Study 8.3.1.2.2.7)

Summary Account Manager - I. Yang

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

3GUH006B Prepare UZ1 gas samples for analyses FY92. All UZ1 gas samples collected during the FY92 field trip in January have been processed.

3GUH012 Perform leak and pressure tests on UZP6 packers. The prototype packer was inflated in 12.18" steel pipe in the laboratory. This was tested for water and gas leaks at various pressures. 20 psi was found sufficient to stop water movement past the packer bladder element. 35 psi bladder pressure was sufficient to stop tracer gas movement between the packer bladder element and the steel pipe wall. This was accomplished by injecting the tracer gas, 1 ppm SF<sub>6</sub>, at the top of the packer at 15 psi. The leakmeter was placed at the other end of the packer for leak detection.

3GUH044B Prepare WRI/OFR, on UZ1 data 1984-1991. I. Yang is writing this report. The report consists of an introduction, description of the test hole, method of sampling and analysis, data and interpretations, and conclusions. The introduction section was completed.

3GUH067B Analyze UZ1 gas samples 1992. Filices (15) condensed water vapor samples collected during the FY92 gas sampling field trip are being analyzed in the LKB Quantulus low level liquid scintillation counter in the UZ hydrochemistry laboratory.

No results have yet been received for C<sup>14</sup> or C<sup>13</sup> 12C analyses.

Quality Assurance

3GUH019B Develop technical procedures, portable GC, SFE meter. A technical procedure entitled, "Method for Analysis of a CO<sub>2</sub> Gas Sample Using a Summa Interest SIP 1000 Gas Chromatograph" has been written by J. Ferrase and submitted to the QA office for technical and QA review.

A technical procedure entitled "Method for Analyzing the Concentration of Gases with an Ion Track Instrument, Leakmeter 120" was written and submitted for review.

Planning and Operations

3GUH070B Procure lab chem, labware, and field apparatus. Three CO<sub>2</sub> gas standards and two high pressure regulators have been received. These gas standards will be used to calibrate micro-carbon-dioxide electrodes used in analysis of dissolved CO<sub>2</sub> in water samples.

3GUH037B Procure GC and DAS.

A Chrompac model CP 9000 gas chromatograph and data acquisition system to include thermal conductivity detector, flame ionization detector and electron capture detector has been ordered through REECO.

3GUH036B Procure 10 kw generator for gas sampling support. A capital equipment procurement request was submitted but was returned with instructions to procure through USGS requisition instead of through REECO. A requisition was reyped.

30UH010A Procure "Seamist" fracture-water collector

include aion and select cation analysis capabilities has been ordered through REECO

30UH015A Procure ion chromatograph and DAS

A core storage refrigerator was received

30UH010A Procure refrigerator for core cold storage

Planning and Operations

chromatograph in the UZ hydrochemistry laboratory

J Ferrate trained G Kaitay and P Striffler on the operation of the in-house gas

30UH17A Train staff on analysis technical procedures

Quality Assurance

A Lotus file has been set up and input of chemical analysis results to the file has begun

30UH010A Compile raw data UZ45, 65, and UZP through May 1991

From Core UZ5 - 35 samples

From Core UZ4 - 45 samples

samples

The gas chromatograph was used to determine percent CO<sub>2</sub> concentration, part per million CH<sub>4</sub> (Methane) and part per million SF<sub>6</sub> (Sulfur Hexafluoride) of pore gas from squeeze

30UH009A Analyze/extract core and water, UZ4, 5, 65 boreholes

Technical Activities

ACTIVITIES AND ACCOMPLISHMENTS

Summary Account Manager - I Yang

SCP 8312222 Aqueous-phase chemical investigations 00331222

Prepared scientific notebook plan for sealing core recovered during UZ-16 drilling (10 hours)

Prepared scientific notebook plan for packer use at UZ-16 (16 hours)

hole N-17 (40 hours)

P Striffler traveled to NTS to work as USGS site representative on drilling of neutron access test

Work Performed but not in Direct Support of the Scheduled Tasks

Variations

The degassing rack to be mounted inside the mobile lab is under fabrication.

The mobile lab is still involved in REECO purchasing.

30UH025B Outfit mobile lab with GC, IC, degassing rack

1, 1992

in UZ-16 gas sampling. A string of eight packers for the system will be constructed by June

30UH010 Fabricate UZP6 multi packer string (USBR)

into USGS format and submitted for procurement.

A meeting has been held with Seamist personnel. Requirements for the collection of fracture water in surface-based boreholes were discussed, and they are preparing a proposal.

#### Variations

3GUH14AA Collect core from UZN-27

Cause: Hole has not yet been started.

Impact: None.

Corrective Action: None.

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

Technical procedure HP-194, R0 was revised and updated in September 1991 by author J. Ferarese. This month the author addressed the technical review comments and submitted the HP to the OA office for further processing. (4 hours)

J. Ferarese is conducting an experiment which will examine the use of teflon vials for liquid scintillation counting of carbon-14 samples in the Quantulus LKB liquid scintillation counter. Counting performance will be determined and compared to that of other counters. A first experiment was completed but yielded results which were not expected. A similar study using a different size vial will be conducted and results compared to the initial results. (24 hours)

#### WBS 1.2.3.1.2.8 Fluid Flow in Unsaturated Zone Fractured Rock

Principal Investigator - E. Kwicklis

LBL Principal Investigator - G. Bodvarsson

#### OBJECTIVE

To develop and validate conceptual and numerical models describing gas flow and liquid water and solute movement in unsaturated, fractured rock at the laboratory and sub-REV scales. (SCP Study 8.3.1.2.2.8)

#### SCP 8.3.1.2.2.8.1 Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock 0G3312T

Summary Account Manager - E. Kwicklis

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GUF0021 Revise scoping calculations of percolation test

Major revisions in the organization and technical content have been made in this report as a result of USGS technical review. Major portions of the report have been rewritten, additional figures drafted and additional simulations performed.

3GUF015 Document variable aperture model VSFRAC

Several major sections in the documentation for VSFRAC were completed including those dealing with the governing equations, particle tracking methods and review of important previous work.

3GUF0051 Scoping and bounding calculations-FY92

Steady flow within a network of five 125 micron and four 25 micron fractures was simulated for constant head boundary conditions ranging from 0.0 to -0.25 m of water in order to examine the dependence of pressure head variation and flux distribution within the network to the assigned boundary conditions. It was observed that variance in pressure head within the network increased and flow became more concentrated along specific pathways as

pressure heads imposed at the boundaries deviated from the pressure heads at which the transmissivities for the two fracture sizes were equal. Continuum properties such as permeability were calculated for the network. Future simulations will consider the effects of various matrix materials on the observations made to date.

### Quality Assurance

#### Planning and Operations

3GUF001 Resolve study plan comments (DOE and NRC)

All comments by DOE and its contractors have been resolved to the satisfaction of the reviewers except those made by K. Kersch (SAIC/LV). A meeting will be held with Kersch in early April to discuss his two unresolved comments.

#### Variances

3GUF0021 Revise scoping calculations of percolation test

This activity is behind schedule because revisions are incorporating new work that represents a far more sophisticated understanding and modeling approach than was described in the original report. The revisions thus attempt to reflect advances that have been made in modeling since the report was submitted for review.

3GUF0001 Develop graded QA package

This activity did not begin as scheduled because the investigator responsible for this work is a new hire and has not yet reported for duty.

### SCP 83.1.2.2.8.1 Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock OB3312T2

Summary Account Manager - G. Bodvarsson

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUF002L Complete dual porosity code

The semi-analytical dual-porosity simulator has been used to study vertical infiltration into fractured tuff formations, using characteristic curves for the fractures derived by Pruess et al. (LBL Report 20778, 1988).

3GUF008L Sorptivity/character curve analysis

The new analysis method is being written up in a technical report.

3GUF005L Prepare paper for RWMNFC journal

A draft of a paper entitled "Accuracy and Efficiency of a New Dual-Porosity Simulator for Flow in Unsaturated, Fracture Rock Masses", by R. Zimmerman, G. Bodvarsson and E. Kwicklis has been completed for eventual submission to the journal *Radioactive Waste Management and the Nuclear Fuel Cycle* (Special Issue on Yucca Mountain).

#### Quality Assurance

3GUF006L Prepare paper for 1992 IRLRMN conference

QA materials for the paper entitled "Semi-Analytical Treatment of Fracture/Matrix Flow in a Dual-Porosity Simulator for Unsaturated Fractured Rock Masses", by R. Zimmerman and G. Bodvarsson have been prepared for transmittal to the USGS after publication in the conference proceedings in April.

3GUF007L Continue software QA and all other QA requirements

G. Bodvarsson, E. Klahn, L. Tsao and R. Zimmerman attended a class in records management (OMP-17.01, R5) given on March 25 at LBL by L. Watt (SAIC/Golden), with L. Ducret of the USGS as an observer.

Reading assignments were completed by various staff members.

#### Planning and Operations

#### Variations

### WBS 1.2.3.3.1.2.9 Site Unsaturated Zone Modeling and Synthesis

Principal Investigator - M. Whitfield

LBL Principal Investigator - G. Bodvarsson

#### OBJECTIVE

To develop conceptual and numerical models for the site unsaturated zone hydrogeologic system; to apply the models to predict the system response to changing external and internal conditions; to evaluate the accuracy of the models using stochastic modeling, conventional statistical analyses, and sensitivity analyses; and to integrate data and analyses to synthesize a comprehensive qualitative and quantitative description of the site unsaturated-zone hydrogeologic system under present as well as probable, or possible, future conditions. (SCP Study 83.1.2.2.9)

### SCP 83.1.2.2.9.1 Conceptualization of the unsaturated-zone hydrogeologic system 0G3312C

Summary Account Manager - B. Lewis

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

#### 3GUM05A Construct 2-D cross-section model using TOUGH

LBL modelers are utilizing current USGS geologic and hydrologic data from neutron boreholes in the construction of a 2-D cross-section model using TOUGH. When the model has been completed, it will be used to conduct sensitivity analyses to identify important hydrologic parameters and to begin to investigate grid effects on moisture flow.

#### 3GUM014A Develop alternative conceptual models of UZ

A working set of alternative conceptual models for the UZ hydrogeological system have been identified.

##### Quality Assurance

##### Planning and Operations

#### 3GUM06A Study plan revision and resolution of comments

LBL modelers are responding to the technical review comments for Study Plan 83.1.2.2.9. E. Kwicklis will provide the review of the response prior to transmittal to YMPO for DOE verification.

##### Variations

SCP 8.3.1.2.2.9.2 Selection, development, and testing of hydrologic-modeling computer codes 0B3312D2  
Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM17A Develop alternative conceptual models of UZ

Data on porosity and permeability measurements on small plug samples by A. Flint and others were reviewed.

Quality Assurance

3GUM18A Grading of OA and other OA requirements

G. Bodvarsson and L. Tsao attended a class in records management (OMP-17.01, R5) given on March 25 at LBL by L. Watt (SAIC/Golden), with L. Ducret of the USGS as an observer.

Reading assignments were completed by various staff members.

Planning and Operations

3GUM14A Study plan revision and resolution of comments

Responses to the study plan comments are being prepared.

Variances

SCP 8.3.1.2.2.9.3 Simulation of the hydrogeologic system 0B3312E2  
Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM11B Preparation of paper for ANS conference

Some of the figures included in the ANS paper were designed in color for presentation at the April conference.

3GUM01B Data compilation and analysis

A meeting between R. Spengler and his staff has been scheduled in April in order to use the logging data to refine the current subdivision of the hydrogeological units into sublayers. The main compilation and analysis of the data for the design of the site-scale model has been completed. This completes this task.

3GUM03B Perform preliminary simulation of moisture-flow model

In order to facilitate the check of the 3-dimensional grid, the surface of the site-scale model has been divided into three zones, depending on the types of horizontal connections between the elements. These are (1) regular elements without any contact with fault elements, (2) fault elements connected to another element that may or may not contain a fault, and (3) elements without fault, but connected to a fault element. The connections between the group 1 elements have been checked and the connections between groups 2 and 3 are being verified. Simulations with a 2-D cross section have started in order to assess the effect of the numerical grid by the Ghost Dance Fault.

3GUM07B Evaluate model grid effects

A new regular grid has been developed and is being used to test the feasibility of using the

TOUGH2 simulator and the IBM 6000 RISC machine to solve an unsaturated flow problem with a large number of elements (8000).

3GUM12B Preparation of paper for WMNFC  
Work related to the resolution of the structural discontinuities is being included in the paper.

#### Quality Assurance

3GUM14B Grading of QA and other QA requirements  
G. Bodvarsson and L. Tsao attended a class in records management (OMP-17.01, R5) given on March 25 at LBL by L. Watt (SAIC/Golden), with L. Ducret of the USGS as an observer.

Reading assignments were completed by various staff members.

#### Planning and Operations

3GUM13B Study plan comment resolution and revision  
The responses to the DOE comments are being prepared.

#### Variances

### WBS 1.2.3.3.1.2.10 Prototype Hydrologic Tests that Support Multiple Site Characterization

#### Activities

Principal Investigator - B. Lewis

#### OBJECTIVE

To perform prototype hydrologic tests to minimize costly stand-by times; to develop QA procedures; to determine feasibility of the proposed tests; to train new personnel; to help increase likelihood of success of the tests; and to test new instruments, equipment, and procedures.

#### Prototype Cross-Hole Testing 0G331212

Summary Account Manager - G. LeCain

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUT002 Continue reduction and examination of ALTS Arizona

All ALTS data have been reduced to engineering units. The data are presently being examined to evaluate equipment performance and stability. A possible problem identified from the data is the variability in the pressure transducers. The atmospheric pressure readings show more range than expected.

3GUT003 Continue analysis of ALTS data

The ALTS data are 60% through the final analysis. Analysis shows that the geometry of the tests changes with time and distance. The earlier data show pure radial flow, while the later data show leaky-radial flow and the later data from the monitoring zones show spherical flow.

#### Quality Assurance

#### Planning and Operations

## Variances

### Prototype Tracer Testing 0G3312J2

Summary Account Manager - J. Yang

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GUT011D Procure supplies for monitoring gas tracer at NTS

Two meetings were held in Las Vegas with representatives from USGS, RSN, and REECo, and a final design for the gas tracer monitoring system was approved. The monitoring system will be provided by a contractor selected through competitive bid; REFCo will purchase the system from the approved contractor. All supplies to be provided by USGS are on hand.

#### 3GUT009D Procure lab supplies for gas tracer tests

Improvement to the system design was accomplished by redesigning the connections between the glass column and manifold. The modified column and manifold design were received on March 24. All lab supplies for the gas tracer tests are on hand.

#### 3GUT03DD Prepare WRI report on aqueous tracer tests

The manuscript was sent to the author, A. Lewis-Russ, for checking retyped copy.

#### 3GUT13DD Conduct tracer gas sorption test on stem materials

Work on the tracer gas sorption tests was temporarily delayed while the final design, acquisition, and installation of the gas tracer monitoring system was coordinated and approved by representatives from USGS, RSN, and REECo. Priority was given to completing the details of the monitoring system since its operation will be required at least six months prior to the use of the stemming material.

#### 3GUT01DD Conduct tracer gas sorption tests on tuffs

See "Conduct tracer gas sorption test on stem materials" (3GUT13DD) above.

#### 3GUT012D Test on-line gas tracer monitoring equipment

Testing cannot start until the equipment has been procured and installed. See "Design method for monitoring tracer gas at NTS" (3GUT011D) above. A scientific study plan, entitled "Injection of a Tracer Gas Used for Determining Atmospheric Contamination in a Dry-Drilled Borehole," and a technical procedure, entitled "Method for analyzing the concentration of gasses with an Ion Track Instrument Leakmeter 120," were written in support of this activity.

### Quality Assurance

### Planning and Operations

### Variances

#### 3GUT13DD Conduct tracer gas sorption test on stem materials

Cause: Priority was given to coordinating the final design, acquisition, and installation of the gas tracer monitoring system at NTS. Drilling is scheduled to begin in April; the monitoring system is needed during drilling while the stemming material will not be used until November at the earliest.

Impact: None, since the tests will be completed months before the stemming material is

used in the borehole.

Corrective Action: None; testing will proceed in April and be completed months before the stemming material is used in the boreholes.

Work Performed but not in Direct Support of the Scheduled Tasks  
Attended WRD class "Isotope Hydrology". (40 hours)

Prepared graphs and slides for a presentation by I. Yang at the High-Level Waste Management Conference meeting in Las Vegas, April 12-16. (8 hours)

Prototype Dry Coring of Rubble OG3312L2  
Summary Account Manager - C. Peters

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUT03FF Complete preparation of report on G-Tunnel work

Sections on lab work, chemistry results, introduction, and description of work have been completed. Sections on excavation and effects of blasting are being written. First draft completion expected by mid-May.

3GUT01EE Complete testing effects of core sealing method  
All core weights (86 cores) were measured.

A control piece of Lexan was placed in a cooler to determine if condensation is caused by moist atmospheric air in the liner or the core moisture. This test is ongoing.

3GUT02EE Reduce data for effects of coring methods  
Tabulation of chemical results from the cores progressed.

3GUT004F Develop technical procedures on core sealing  
A scientific notebook plan has been prepared to utilize information gleaned from UZ-16, UZN-27, and NRG-1 to update the draft copy of the technical procedure.

3GUT016F Conduct technical procedures training on core sealing  
Core sealing procedures have been discussed with SMF staff. UZ-16, NRG-1 and UZN-27 will be used as SMF staff training holes.

3GUT03FF Prepare report for effects of core sealing  
An annotated outline was prepared.

3GUT07FF Develop technical procedure on rubble coring  
Prepared outlines for the technical procedures.

Quality Assurance

Planning and Operations

Variations

3GUT03FF Complete preparation of report on G-Tunnel work

Cause: Report not completed. Report draft should be completed by mid-May.

Impact: None.

Corrective Action: None.

Prototype Pore-Water Extraction 0G3312M2  
Summary Account Manager - I. Yang

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GUT026G Complete WRI report

Editing of the text of the report is complete for colleague review. Presently, the figures are being modified for review. It is planned to submit the report for colleague review during the month of April 1992.

The finish has been delayed due to the lapse of, and problems with renewal of, the IPA with the Colorado School of Mines.

##### 3GUT029G Ext/analyze pore water-use high pressure cell, UZ welded

Eight tests were conducted on welded and partially welded tuffs with moisture contents ranging from 5 to 22 percent. The loading method was continuous for some samples and staged for some. Staged versus continuous compression give similar results in strain and water obtained for nonwelded tuffs, but data is incomplete for welded. Additional tests are required.

##### 3GUT020G Procure and construct additional high pressure 1-D cell

Heat treatment of the components caused the material to become too hard to machine to finished specifications. The material has been sent back for solution annealing. The parts will then be finished and heat treated. This additional procedure has delayed the completion of the test cell.

##### 3GUT034G Complete development of compress method extract water

Two comparison tests were run between nonwelded core samples and nonwelded rock chips from nearly the same interval. The chips had an average moisture content of 9.7 percent and produced an average of 15.8 ml of water and 125.5 ml of gas. The similar core averaged a moisture content of 8.6 percent and produced an average of 1.8 ml of water and 90.1 ml of gas.

##### 3GUT018G Procure/develop data acquisition software

Labtech Control displays are being configured and set up to acquire data from the load frame. The data acquisition board requires additional programming before system is operational.

##### 3GUT002G Complete ext/analysis chemistry of pore water, UZ4, 5, 6 and GT

Distillation and oven dried volume of water extracted were added to the data base. Moisture contents and saturation/success values were corrected, using calculated moisture contents based on total volume of water extracted.

Water was extracted from seven UZ cores (6 nonwelded, 1 partially welded) with moisture contents from 4.6 to 14.2 percent using the second generation cell. Results obtained 0-18.3 ml of water per sample (success of 0-44.9 percent) and 58.2-112.8 ml of gas per sample.

##### 3GUT031G Prepare journal paper on 1-D compression

A paper entitled "A Preliminary Study of the Chemistry of Pore Water Extracted from Tuff

by One-dimensional Compression" by C. Peters, J. Higgins, P. Burger and I. Yang was submitted for publication.

3GUT006G Modify high-press cell tech procedure  
Information that varies between the high pressure cell and 1-D compression procedures has been collected from two major cell users.

3GUT027G Submit WRIR triaxial and 1-D methods review and approval  
This report will be submitted for review in mid-April, 1992.

#### Quality Assurance

#### Planning and Operations

#### Variances

3GUT029G Ex/analyze pore water-use high pressure cell, UZ welded  
Cause: One month delay due to the results being inconclusive, additional testing is required.

Impact: None.

Corrective Action: None.

3GUT020G Procure and construct additional high pressure 1-D cell

Cause: Heat treating of material is delayed one month.

Impact: Although the specifications for the heat treatment were identical to the treatment done on the original second generation cell, the material became too hard to machine.

Corrective Action: The material is to be solution annealed, machined to unfinished specifications, heat treated again, and finished to specifications. Assurances were made that no changes to the physical properties would result from this process.

3GUT026G Complete WRI report

Cause: One month delay due to the lapse of the Colorado School of Mines contract from October 1991 to February 26, 1992.

Impact: None.

Corrective Action: None.

3GUT037G Compression of UZP-6 core pore water extraction

Cause: Three month's delay from original schedule caused by the change in the drilling schedule.

Impact: No UZP-6 core; replace activity with UZ-16 core.

Corrective Action: None.

3GUT034G Complete development of pressure method to extract water

Cause: One month delay due to inconclusive results.

Impact: None, the UZ-16 drilling is not likely to start until June, 1992, due to the lack of a tracer permit.

Corrective Action: For the squeezing of rock chips, if technical procedures are not ready, scientific notebook procedures will be used.

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

A second load frame (in Bldg. 56) and its testing room are being cleaned up for use as soon as the second data acquisition system and second high press cell are completed. (24 hours)

Laboratory supplies for one-dimensional tests were ordered including: pH sampling vessels, conductivity calibration set, syringe filters, Nalgene sample bottles, nylon ferrules, tube unions, male connectors, tube adapters, and 3-way stopcocks. Tube adapters and conductivity calibration set have yet to arrive. (4 hours)

### WBS 1.2.3.3.1.3 Saturated Zone Hydrology

#### OBJECTIVE

To develop a model of the saturated zone hydrologic system of Yucca Mountain that will assist in assessing the suitability of the site to contain and isolate waste. (SCP Investigation 8.3.1.2.3)

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

Principal Investigator - R. Luckey

#### OBJECTIVE

To determine the hydrogeologic nature of the Solitario Canyon fault in the saturated zone; to determine the time and spatial variation of the potentiometric surface; to determine the character, magnitude, and causes of water-level fluctuations; to estimate elastic and hydraulic properties; to determine transport properties of the saturated zone; to evaluate the relation between hydraulic properties and fracture characteristics; to characterize chemical and physical properties of the saturated zone that affect radionuclide retardation; and to conduct single-and-multiple well tracer tests using conservative and reactive tracers to determine hydrologic, chemical, and physical properties in the saturated zone. (SCP Study 8.3.1.2.3.1)

### SCP 8.3.1.2.3.1.2 Site potentiometric-level evaluation 0G3313E2

Summary Account Manager - R. Luckey

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GWFO05A Begin 1992 water-level data collection

Three wells are being monitored on a quarterly basis; 15 zones in 15 wells are being monitored on a monthly basis; 21 zones in 13 wells are being monitored on an hourly basis; continuous analog data is being obtained on four zones of two wells (included in count on hourly sites); real-time data is being obtained on nine zones in six wells using satellite data-collection platforms (included in count of hourly sites); the status of the network is being evaluated at the end of each month and recommendations are being made for instruments that should be watched, calibrated, or replaced; and real-time data is being monitored on a daily basis looking for water-level excursions.

Replaced and calibrated transducers at the following wells: UE-25b #1 (lower), USW H-1 (tube 1), and UE-25 WT #13.

Calibrated transducers at the following wells: USW WT-2, USW G-3, USW H-5 (lower) and USW H-6 (lower).

Removed barometer S/N 19236 from well USW H-5 for calibration.

Well UE-25 WT #13 was converted to real-time system

HP-60, R1, Method for monitoring water-level changes using pressure transducers, was transmitted to the QA office for review on March 24

Backlog of data from data-collection platforms, dumped onto diskettes, was prepared for transmittal to Denver.

Packers were placed in the lower zones of USW H-5 and USW H-6 to allow monitoring of formation pressure, as opposed to water level.

C. Savard made a number of water-level measurements in wells UE-29a #1, UE-29a #2 (part of quarterly network) and UE-29 UZN #91 to look for possible effects of recent rainfall and runoff events in the Fortymile Wash area.

**3GWF41AA Continue preparing 1989 water-level data report**

The report "Water levels in continuously measured wells in the Yucca Mountain area, Nevada, 1989" by D. Lobmeyer and R. Luckey has been written and reviewed. No progress was made on this task this month because of one remaining author to other tasks.

**3GWF20AA Continue analysis of water-level trends**

G. O'Brien continues to spend time looking at barometric, earth-tides, and seismically induced water-level fluctuations. He continues to confer with D. Galloway (USGS/California District) on the methodology.

E. Ervin began investigation of long-term water-level trends. If this analysis does not warrant a report of its own, the results will be reported in the revised potentiometric-surface map.

R. Luckey presented response of water-level network to December seismic events at TPO meeting in Las Vegas on March 6.

**3GWF18AA Continue study of accuracy and precision of water-level data**

Work continued on draft report "Precision and accuracy of water-level measurements taken in the Yucca Mountain area, Nevada, 1988-90" by S. Boucher. Most reviewer comments have been resolved and the text is being revised. Little progress was made on this task this month as the author spent most of her time this month participating in or preparing for audits.

**3GWF117A Convert HP-196T (notebook)**

S. Boucher completed a first draft of technical procedure HP-196, "Use of Data Collection Platforms to Collect Water-Level Data" and PI reviewed it and made some suggestions for revision. G. O'Brien completed task of preparing model logbook entries as an attachment to the procedure. Such models should avoid past problems that occurred because of incomplete entries. Little progress was made on this task this month as the author spent most of her time this month participating in or preparing for audits.

**3GWF024A Reduce 1991 periodic water-level measurements**

Manual measurements were worked up for about one-half of the wells.

**3GWF42AA Complete 1990 water-level data report**

Regression analyses were done for all transducer calibrations for 1990 and results were compiled into tables suitable for inclusion in the report. Compilation of transducer histories was nearly completed.

**3GWF006 Convert six sites to DCPs**

Well UE-25 WT #13 was converted to a data collection platform and went online on March

19 with minimal problems.

Well USW WT-2 was in the process of being converted to a data collection platform on March 31. Indications are that it will be online in early April.

**3GWF027 Evaluate quality of 1991 transducer data**

Data has been continuously evaluated through 1991 and plots are available for a more formal evaluation. No other work has been performed on this task.

**3GWF026 Reduce 1991 transducer calibrations**

Transducer calibrations were worked up for about 75 percent of the calibrations done during 1991.

**3GWF116A Replace current software with NWIS**

All continuous water-level monitoring sites will be converted to data collection platforms by late spring. This conversion will make use of National Water Information System (NWIS) software easier. For efficiency, current software will be used on non-DCP sites until they are converted. NWIS software is currently being used to edit data coming from DCP sites.

Quality Assurance

Planning and Operations

**3GWF006 Convert six sites to DCPs**

Twelve trailers, to be used as data collection platform shelters were received from the manufacturer.

**3GWF129A Develop software QA for data reduction**

The technical contact for this software retired in September. G. O'Brien has been designated as the new technical contact for this software but was instructed not to spend time on this activity until the outcome of 3GWF037, Research NWIS software, is known. It is strongly suspected that this task can be better accomplished in the future using NWIS software.

Variations

**3GWF117A Convert HP-196 for satellite platforms**

This is delayed one month because the process is taking much longer than expected. There is no impact, because HP-196T is adequate until HP-196 is approved.

**3GWF006 Convert six sites to DCPs**

This is delayed an additional two months because of the late delivery of trailers and delays in installation. No impact as data is being collected by data loggers during conversion process.

**3GWF18AA Continue study, accuracy/precision, water levels**

This is delayed one month (has been delayed previously). This study, while important, is conducted as time permits and the amount of time available has been seriously underestimated as person working on this study has had to spend much time working with other projects. There is no impact because nothing in the foreseeable future depends on this study. The delay is limited because study is near completion, but further delay is possible.

3GWF20AA Continue analysis of water level trends

This is delayed six months, partially as a result of decision to report this analysis when revised potentiometric map is produced. There is no impact because this analysis is only needed to complete this map.

Work Performed but not in Direct Support of the Scheduled Tasks

S. Boucher gave QA support to various activities preparing for and during audits to address and remedy several potential problems. She also spent time evaluating QA and organizing QA support for eight other groups of activities. She issued, worked on, closed, or helped verify a number of NCRs for other projects. (45 hours)

R. Luckey spent considerable time on tasks related to saturated zone and Quaternary/future regional hydrology tasks. (120 hours)

R. Luckey delivered files and graphs so that the manuscript preparation unit could prepare camera-ready copy for the 1985-88 continuous water-level report. PACS activity for that report was statused as complete several months ago with delivery of the report to DOE for their concurrence. (30 hours)

SCP 8.3.1.2.3.1.3 Analysis of single- and multiple-well hydraulic-stress tests 0G3313F2

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF005D Monitor strain-related pressure response in wells

The six month (October 1991 to March 1992) activity of strain-related monitoring (monitoring for the hydraulic effects of atmospheric loading, earth tides, earthquakes, and UNEs) was 100% completed. (The data will now be analyzed to obtain aquifer characteristics).

3GWF010D Develop scientific notebooks/hydrologic procedures for monitoring hydraulic changes from seismic stress

HP-221T and HP-222T were approved on March 13. This activity is now 100% complete.

3GWF001D Finish intraborehole flow and stress test report

Starting on March 1, G. Patterson's time has been dedicated, almost 100%, to the task of completing the draft of the report. The planned completion date of the report has been moved to July 1, 1992. The completion date is assumed here to be the date of approval by the TPO, preceded by colleague and supervisory reviews, and followed by the simultaneous submittal of the report to the YMPO for concurrence, and to the USGS/WRD regional/headquarters review process for Director's approval.

3GWF002D Reanalyze past c-hole aquifer tests with advanced techniques

A. Geldon has applied a dual-porosity technique to analyze some previously-completed aquifer tests at the c-holes. He has written up his analysis in the form of an internal report. He is considering eventually converting this internal report into a journal article.

Quality Assurance

3GWF011D Develop software QA for analysis programs under the 8.3.1.2.3.1.3 activity

The main code that needs software QA is the well test analysis program. This program is needed to analyze previously completed hydraulic tests at the c-holes. It was determined

that G. McCain of the HIP is also using the program and will be the person primarily responsible for entering it into the software QA system. This activity should be considered 100% completed by the end of March, because it feeds into the successor activity 3GWF012D, "Continue development of software QA for account 8.3.1.2.3.1.3 programs".

#### Planning and Operations

##### Variances

3GWF001D Finish intraborehole flow and stress test report

The author of the report, G. Patterson, had been, until the beginning of March, working on a variety of project tasks, while also trying to finish the report. As a result, completion of the report has been delayed several times. Starting with March 1, the PI has dedicated Patterson's time 100% to finishing the report. There is no anticipated negative impact on other activities as a result of the delay in completion of this report.

SCP 8.3.1.2.3.1.4 Multiple-well interference testing 0G3313G2

Summary Account Manager - M. Umari

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GWF002F Run power and obtain permits for hydraulic tests at the c-holes

A criteria letter has already been written and forwarded to the YMPO to initiate the job package needed to construct the power line. This is all the work that was intended to be accomplished under this activity. The activity now should be considered 100% complete. (Permits needed are to be secured by the YMPO's Project and Operations Control Division).

3GWF003F Purchase additional packers/materials for third 3-zone packer string

The USBR issued all the requisitions for purchase of the additional components to complete this task. This activity now should be considered 100% complete.

3GWF106F Refine and add modules to aquifer test analysis program

The program in its present form is adequate for reanalyzing past c-hole aquifer tests, which is successor activity 3GWF003F. The program is going to be entered into the software QA process (which is part of successor activity 3GWF017F) in its present form. This activity, therefore, now should be considered 100% complete.

3GWF018F Oversee LBL preparation for cross-hole seismic work

A. Geldon had given E. Majer copies of recently prepared hydrogeologic sections for the c-holes (see February 1992 status report) to aid him in the upcoming cross-hole seismic surveying.

USGS completed its part in the preparations to initiate the cross-hole seismic surveys. These included design and construction (the latter through the USBR) of two tripods needed to hoist the seismic tool cables with, arranging for diesel fuel to be delivered to LBL's logging truck during the seismic surveys at the c-holes, and coordinating with LBL on the rental of a generator to be used while conducting the surveys. What is left is to actually conduct the surveys, which is LBL's activity 3GWF03C, "Develop cross-hole seismic profile". The present USGS activity, 3GWF018F, should be considered 100% complete.

**3GWF027F Preliminary numerical/analytical modeling to assist in cross-hole test design**  
During the week of March 2-6, M. Umari, A. Geldon, and G. Patterson attended the class "Fluid Flow and Solute Transport in Fractured Rocks", coordinated by P. Hsieh. The appropriate techniques to be used to interpret results from the upcoming tests, and to do pre-test design simulations, were discussed in the class.

Related activities that had been described under previous monthly reports are: A. Geldon's synthesis of various borehole logs to obtain a composite picture of hydraulically-conductive fracture locations in the c-holes (this indicates locations to place the packers during the cross-hole tests), and Geldon's analysis of previously-completed aquifer tests at the c-holes using dual-porosity techniques (monthly report for activity 8.3.1.2.3.1.3).

This activity will be continued through the successor activity 3GWF028F, "Continue preliminary numerical/analytical modeling to assist in cross-hole test design". The present activity, therefore, now should be considered 100% complete.

**3GWF020F Construct two 3-zone packer strings**

The USBR has completed all major work items for the construction of the two 3-zone packer strings. (The final assembly awaits the return of the 12 packers from Tam International after repairs are completed on them to ensure that they deflate properly). This task now should be considered 100% complete. It leads to activity 3GWF004F, "Complete construction of third 3-zone packer string", starting April 1, 1992.

**3GWF021F Oversea field simulation of cross-hole tests**

This activity encompasses all work related to the U.S. site (Raymond Quarry, near Fresno, California) of the DOE/AECL international project. It is intended that the planned hydraulic and tracer tests planned for the c-holes be prototyped at the Raymond site.

During the week of March 9, three 250-ft. deep boreholes were drilled at the Raymond site. The boreholes were configured in a triangle similar to the c-holes, with a distance of 25 feet between each pair of wells. M. Umari from the USGS was present during the drilling.

During the week of March 30, preliminary hydraulic testing was conducted at the Raymond site using the newly drilled holes. Well (O-O) was pumped, under open-hole conditions, while the pressure drawdown was monitored in two, packer-isolated, zones of each of the other two wells (SE-1, and SW-1). The process was repeated by pumping well SW-1, while observing the pressure drawdown in wells (O-O), and SE-1. The results have not been analyzed yet, but indicate a very good hydraulic connection between the wells. Present from the USGS during the testing were M. Umari and J. Gemmill.

**3GWF024F Develop scientific notebook for cross-hole tests with prototype string**

Discussions were initiated with the OA office on what is needed for initiating this scientific notebook plan.

**Quality Assurance**

**3GWF001F Build discharge pipeline for c-holes tests**

A criteria letter was written by the PI and submitted to the TPO to be forwarded to the YMPO to initiate the job package needed for building the pipeline. This was all the work intended to be accomplished under this activity. This activity, therefore, now should be considered 100% complete.

**Planning and Operations**

### Variances

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

A OA grading report had to be written for activities of the DOE/AECL project. M. Umari prepared the report in cooperation of YMPO's Office of International Programs. It was requested that all activities be exempt from the USGS OA program because the activity does not involve site characterization.

The change request to drill a fourth, inclined, borehole at the c-hole complex was resubmitted. M. Umari worked on this in cooperation with S. Keller (SAIC/Golden).

### SCP 831.231.4 Multiple-well interference testing 0B3313G2

Summary Account Manager - E. Majer

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GWF02C Prepare for cross-hole seismic work

Preparation for the seismic field work at the c-holes continued. In order to increase bandwidth, a new module that matches output impedance has been built. It will match the dynamic load (piezoelectric crystal) to the electronics that drive the cable and crystal.

##### Quality Assurance

##### Planning and Operations

##### Variances

### SCP 831.231.5 Testing of the C-hole sites with conservative tracers 0G3313H2

Summary Account Manager - M. Umari

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GWF161A Preliminary modeling for tracer tests

Work on this activity will continue under the successor activity 3GWF167A, "Continue preliminary modeling for tracer tests". Application of analytical solute transport equation for estimation of tracer volumes will continue under 3GWF167A. The present activity now should be considered 100% complete.

3GWF160A Expand injection permit to full suite of tracers

Indications are that the YMPO's Project and Operations Control Division is in the process of obtaining a class of umbrella permits that can then be used by YMP participants for the various site characterization activities.

##### Quality Assurance

##### Planning and Operations

##### Variances

WBS 1.2.3.3.2 Saturated Zone Hydrochemistry  
Principal Investigator - W. Steinkampf

OBJECTIVE

To describe spatial variations in chemical composition of ground-water; to identify chemical and physical processes that influence ground-water chemistry; to use hydrochemical data to aid in the identification and/or quantification of ground-water travel times; flow paths; fluxes to, from, and within the saturated zone; and climatic conditions during past periods of recharge. (SCP Study 8.3.1.2.3.2)

SCP 8.3.1.2.3.2 Assessment of saturated-zone hydrochemical data availability and needs OG331312  
Summary Account Manager - W. Steinkampf

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWH004 Assess data (extant), phase 1

Located field notebook used to record sample and field data collection at and in the vicinity of the site from late 1980 through mid 1984. The records indicate that most of the samples collected contained drilling fluid and/or other contaminants. Examination of the resultant analytical data confirms this.

USGS Weapons Program geohydrologic support staff in Las Vegas report that checking and site verification of historic USGS hydrochemical data for the NTS and vicinity was started this month. Following checking, entry into a USGS electronic data base will begin.

3GWH024A Develop ion chromatograph methods

There was no action. The chromatograph system was disassembled, packed, and shipped, with attendant reagents, supplies, and supporting equipment, to laboratory space in building 4215 in area 25 of the NTS. The equipment will be installed and performance verified in mid-April. Methods development will begin again in Nevada after installation.

Quality Assurance

3GWH022A Complete study plan comment resolution

Received YMP notification that review-comment resolution has been accepted, and that the verification draft of the study plan (8.3.1.2.3) has been approved by all mandatory reviewers at the project level. Formal YMPO approval will be followed by transmittal to the OCRWM for approval and transmittal to the NRC.

Planning and Operations

Variances

3GWH001 Grade OA for SZ hydrochemical study

The study was graded in a general fashion in May 1991. A revised package, which will address individual activities and work efforts, has not been started because USGS guidance for such grading has not been available. Grading package preparation can/will begin after a guidance or implementation document has been issued. No impact.

G022 Work authorization (non-surface-disturbing)

The early finish date has changed to the end of July 1992 to reflect estimated date of NRC acceptance of Study Plan 8.3.1.2.3.2, R0. This will perhaps delay a sample and data collection effort in the Death Valley region planned for mid to late summer 1992. An additional problem perhaps arises because the M&O contractor is scheduled to assume

responsibility for study-plan handling on April 15. Prior to that date there will be a hiatus in processing. This likely will deleteriously impact the forecast NRC approval date. The possibility of expediting YMP handling of the study plan to enable YMP approval and transmittal before the hiatus is being explored.

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

An estimated 12 hours were spent on the following:

Participated in a meeting of the Work Group for High-level Waste (Sub-committee for Nuclear Waste Management) at the spring meeting of the American Society of Mechanical Engineers in Denver.

Began informal survey within the USGS YMP programs as part of the FY92 management assessment. A summary of OIG efforts for the past year and a brief question list regarding quality assurance were sent to each principal investigator.

Prepared monthly status report.

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

0G3313K2

Summary Account Manager - W. Steinkampf

#### Technical Activities

3GWH014A Develop mobile laboratory

Met with D. Nordstrom (USGS) to discuss his group's experiences in designing and constructing a mobile laboratory. Will examine the lab and discuss subsequent modifications and interactions with suppliers during a visit to Boulder, Colorado, in April.

3GWH008B Examine hydrochemical tool test (lab)

No action. Testing has not taken place.

3GWH008B Examine hydrochemical tool test (field)

No action. Testing has not taken place.

#### Quality Assurance

#### Planning and Operations

3GHW015A Develop downhole data-collection and sample equipment

Cable length needs and anticipated pump usage information transmitted to SKB. Agreed to send specifications and drawings of hydraulic shifting tool planned for incorporation in the system.

#### Variations

3GWH014A Develop mobile laboratory

Lack of study personnel has resulted in this task receiving low priority; impact is minimal. Purchase of this equipment is planned in FY93. Purchase will be either from SKB or an as-yet-unidentified US contractor. This study will draw on the experience of study 8.3.1.2.2.7 in designing a mobile laboratory and selecting a builder/supplier. Additional information will be obtained from USGS National Research Program staff in Boulder, Colorado.

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

An estimated 50 hours were spent on the following:

Collected water samples for selected stable and radioisotope determinations. Samples were

collected near the end of pumping of borehole JF-3, under the aegis of the environmental monitoring program; and from borehole UE-25UZN#91. Samples were processed, as appropriate, at the Hydrologic Research Facility in area 25 for future analyses, then shipped to Lakewood, Colorado.

Contacted J. Gordon (USGS Branch of Quality Assurance) to obtain, for examination, copies of the forms recombined for use in collecting ground-water hydrochemical data and samples. Reviewed the forms for possible inclusion/adaptation in planned sample-collection activities. An electronic version would be most useful for study efforts. It appears that such a version, that is/will be compatible with work stations and to-be-used INGRES, will be available within a year. Contact will be maintained with the Branch for updates in this matter.

Participated in a teleconference/meeting of representatives of the Geochemistry and Hydrology Integration Task Forces. The objective of the joint meeting was to formulate an agenda for the upcoming joint workshop (May 27-29).

Met with L. Hayes, W. Dudley, D. Appel, and R. Luckey on several occasions to discuss perceived coordination problems within the HIP. It was resolved with agreement to produce a summary statement addressing concerns regarding plans for the utilization of extant hydrochemical data.

Participated in the monthly teleconference of the Geochemistry Integration Task Force.

Participated in a meeting of RSN, REECO, and USGS personnel to resolve comments on RSN specifications for drilling of UZ-16. Spoke with D. Wonderly (REECO) to preliminarily apprise him of study plans for sampling of extant WT holes, and construction and sampling of planned WT holes.

SCP 8.3.1.2.3.2.3 Regional hydrochemical characterization 0G3313L2  
Summary Account Manager - W. Steinkampf

Technical Activities

3GWH905 Select sample sites, phase 1

Discussed basis for consideration of sample collection of Death Valley springs with W. Werrell of the National Park Service. Will meet with Werrell in early April to plan preliminary reconnaissance trip through the monument to examine and discuss the general geologic settings, and to visit some of the sites he will propose. Follow-up visits to all sites for detailed reconnaissance will follow.

3GHW910A Collect regional samples, phase 1

Samples for  $^3\text{H}$ ,  $\delta^{13}\text{C}$ ,  $^{14}\text{C}$ , and  $^{36}\text{Cl}$  determinations were collected from boreholes UE25-JF#3 and UE25-UZN#91. The JF#3 samples were collected attendant to work done under the aegis of DOE's environmental monitoring program.

Quality Assurance

Planning and Operations

Variations

WBS 1.2.3.3.3.3 Saturated Zone Hydrologic System Synthesis and Modeling

Principal Investigator - R. Luckey

LBL Principal Investigator - K. Karasaki

OBJECTIVE

To synthesize available data to develop a conceptual model; to make a qualitative analysis of how the system is functioning; to develop and evaluate porous-media and fracture-network methods for simulating ground-water flow and solute transport; and to estimate ground-water flow direction and magnitude for input to ground-water travel time calculations. (SCP Study 8.3.1.2.3.3)

SCP 8.3.1.2.3.3.1 Conceptualization of saturated zone flow models within the boundaries of the accessible environment 0G3313A2

Summary Account Manager - E. Ervin

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GWM005AA Synthesize potentiometric map**

Discussion of the results of the water-level corrections for temperature and density effects continued between E. Ervin and R. Luckey. Little time spent on this activity as the study plan was given priority this month.

**3GWM007AA Develop geologic model of C-holes and site**

A. Geldon has completed analysis of existing data at the UE25c-well complex comprising television and acoustic televiwer logs, in addition to caliper logs, core analyses, tracejector surveys, temperature logs, static tracer tests and heat-pulse surveys into a conceptual geologic model. This conceptual model is ready to be input to a GIS, probably the LYNX system, however; further work is on hold pending purchase, lease or loan of the GIS software. E. Ervin met with K. Turner of the Colorado School of Mines to discuss her testing the LYNX software at the School of Mines GIS facility. She plans to begin trial use of the LYNX software in mid April using the conceptual geologic model developed by Geldon.

Quality Assurance

Planning and Operations

**3GWM002A Revise and resolve (USGS) study plan comments**

E. Ervin has responded to the 115 DOE comments by seven reviewers of Study Plan 8.3.1.2.3.3, Site Saturated Zone Synthesis and Modeling--consisting of 71 minor comments and 44 major comments. The draft recompilation was sent to the reviewers for their concurrence on March 31.

Variances

**3GWM05AA Synthesize potentiometric map**

This activity is delayed two months because of prolonged illness of the principal investigator and unexpected difficulty in interpreting corrected water levels. It will delay milestone 3GW06M by at least two months, possibly more as review process of that milestone will be more difficult than originally anticipated.

**3GWM007AA Develop geologic model of C-holes and site**

The geologic model of the C-holes for the available data is complete, however; development of the site geologic model is on indefinite hold until it is decided which group is performing

the work and more data are available.

Work Performed but not in Direct Support of the Scheduled Tasks

E. Ervin attended a saturated-zone meeting to discuss SZ modeling activities and presented a short overview of how goals of the modeling and how the modeling is structured between the different projects. The meeting was arranged for J. Bredehoeft--who provided a short discussion of his work examining the effect of seismic activity on water levels at Yucca Mountain. (4 hours)

SCP 8.3.1.2.3.3.2 Development of fracture network model 0G3313B2

Summary Account Manager - E. Ervin

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWM01CB Initial mapping of the Crater Flat Tuff

E. Ervin and M. Chornack finished initial fracture mapping in the Crater Flat Tuff, east of Little Skull Mountain and have emplaced permanent markers in all of the fracture-mapping locations.

3GWM015B Revise fracture mapping technical procedure

Technical procedure GP-12, R1--Mapping Fractures on Pavements, Outcrops and Along Traverses, is in the final stages of revision to include more information on the areal fracture-set surveys and the 2 x 2 m grid surveys being done by E. Ervin and M. Chornack. The revised procedure also will include new versions of field forms.

3GWM016B Assist LBL, add outcrop data to fracture model

E. Ervin and K. Karasaki (LBL) are writing a journal outlining current fracture-collection efforts, use of the data in fracture modeling at the UE25c-Hole complex and the status of current fracture modeling at that multiple-well complex.

Quality Assurance

Planning and Operations

3GWM007B Coordinate LBL fracture-network modeling phase I

Ongoing discussions by E. Ervin with M. Umari and A. Geldon about work occurring at the UE25c-hole complex continued. Ervin still plans to see a portion of the cross-hole tomography to be done by E. Major at the multiple-well complex.

Variances

3GWM015B Revise fracture mapping technical procedure

This is delayed two months because of prolonged illness of the principal investigator.

SCP 8.3.1.2.3.3.2 Development of fracture network model 0B3313C2

Summary Account Manager - K. Karasaki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWM04CA Incorporate outcrop data to network model 1

Writing of a report on estimation of the prediction error using spatially correlated data has been initiated. The report will extend and apply a recently developed theory for general stationary random variables to the special case of spatially correlated data.

3GWM06CA Complete rad-waste conference journal article  
More draft sections of the Rad Waste Journal article entitled "Fracture Flow Model in the Saturated Zone at Yucca Mountain," by K. Karasaki and E. Ervin have been written.

3GWM009C Assist USGS/multiple well test design phase 1  
No work was done because the USGS did not request assistance.

3GWM005C Assist USGS prototype multiple well test phase 1  
No work was done because the USGS did not request assistance.

3GWM10CA Assist USGS with first hydraulic test report  
No work was done because the USGS did not request assistance.

3GWM02CA Write report on borehole fracture data bias  
S. Martel has begun writing a journal article on the borehole fracture data bias studies. The article will describe a new approach to interpreting fracture orientation and density data derived from boreholes so that "true" in-situ distributions of such parameters can be estimated with less error.

#### Quality Assurance

3GWM04CA Incorporate outcrop data to network model 1  
K. Karasaki attended a class in records management (OMP-17.01, R5) on March 25 at LBL given by L. Watt (SAIC/Golden) and observed by L. Ducret.

#### Planning and Operations

3GWM04CA Incorporate outcrop data to network model 1  
K. Karasaki gave E. Ervin responses to the review comments on Study Plan 8.3.1.2.3.3. The reviewers needed some clarification on the inversion algorithm and double porosity model. As a result, modifications were made to the study plan.

#### Variances

3GWM06CA Complete rad-waste conference journal article  
This activity has not been completed this month as planned; work is continuing. The new estimated date of completion is April 30, 1992.

### WBS 1.2.3.3.2 Preclosure Hydrology

#### OBJECTIVE

To examine hydrologic conditions, including flooding, availability of water supply, and characteristics within and above the repository horizon; and to determine whether engineering measures that require excessive cost, or technology beyond that which is reasonably available, will be needed during construction or operation of the repository. (SCP Section 8.3.1.16)

#### WBS 1.2.3.3.2.1 Flood Recurrence Intervals and Levels at Potential Locations of Surface Facilities

Principal Investigator - P. Glancy

#### OBJECTIVE

To assess the flood and debris hazards at and near the potential repository surface facilities locations to allow adequate design of facilities to prevent or reduce hazards to an acceptable level. (SCP Study 8.3.1.16.1.1)

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GFR016 Analyze/evaluate FY91 flood data

There was no progress; continued rain in southern Nevada preempted work on this element. Most of the month was spent field checking and measuring runoff caused by these storms.

#### 3GFR002 Collect, analyze, evaluate FY92 flood data

The wet weather of February in southern Nevada continued throughout March. A significant storm on March 7-8 caused renewed runoff in the Las Vegas area and along the lower Amargosa River near Tecopa. Reconnaissance of the basin to Death Valley Junction has occurred. Again some light runoff from the Carson Slough area flowed through Franklin Plaza and downstream past Eagle Mountain. That flow, combined with more local runoff downstream, caused more flow to Death Valley. The magnitude of flow to Death Valley seemed similar to that of February 12-15, 1992. Peak flows were documented. Flooding of the Salt Pan, near Badwater in Death Valley, expanded as a result of the freshwater input. No intense flooding in Death Valley was noted.

An intense storm moved through Las Vegas on March 23-24 and 27. Although flooding occurred in the Las Vegas valley, the storm did not cause flooding or surface streamflow at Yucca Mountain. Similarly, flooding did not occur in Death Valley and runoff in the lower Amargosa River was mild due to the fact that the storms were located in the southwestern part of the Las Vegas valley.

The storms of February and early March caused moderate runoff in the Overton area northeast of Las Vegas. This runoff was documented by P. Glancy and found not to have been of a severe nature.

#### 3GFR018 Reconnaissance of Yucca Mountain to assess debris hazards

P. Glancy visited the Coyote Wash area and other parts of Yucca Mountain with J. Coe and J. Whitney to explore the use of Coe's photogrammetric skills to analyze the characteristics and quantities of debris on the upstream slopes of small drainages that might be mobilized by intensive runoff. Coe believes that these photo-analysis techniques can be used to derive estimates of the magnitude of potential debris hazards (erosion and deposition) if suitable high-resolution, large-scale air photography is available. This strategy will be pursued further.

#### 3GFR004 Map PMF flood-inundation zones at Yucca Mountain

The USBR is continuing work on the delineation of PMF zones. P. Glancy organized a meeting between RSN, DOE, USBR, and USGS staff concerned with PMF flood prediction products. This meeting will take place in Las Vegas in early April to review the status and completeness of the PMF study.

### Quality Assurance

### Planning and Operations

### Variations

WBS 12362 - Climatology and Meteorology

OBJECTIVE

To collect and analyze climatic, paleoclimatic, future climatic, and Quaternary hydrologic data to evaluate the suitability of the site.

WBS 12362 - Climatology

OBJECTIVE

To characterize the present, paleo-regional, local climate, and hydrologic conditions at Yucca Mountain, and to determine the magnitude and likely effects that future changes in climate will have on repository performance.

WBS 12362.1 - Change in Climatic Conditions

OBJECTIVE

To provide a baseline for determining the changes in climate that potentially affect the waste isolation capabilities of the site. (SCP Investigation 8.3.1.5.1)

WBS 12362.1.2 - Paleoclimate Study of Lake, Playa, and Marsh Deposits

Principal Investigator - R. Forester

OBJECTIVE

To establish the nature, timing duration, and amplitude of paleoclimate changes based on paleontologic, stratigraphic-sedimentologic, chemical, and mineralogic analyses of lacustrine sediments in or near southern Nevada; and provide a chronologic frame work for this paleoclimatic information. (SCP Study 8.3.1.5.1.2)

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

0G3621B2

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCL004B Sample outcrop sites

Sediment samples taken by J. Quade during his study of the wetland deposits from the Las Vegas Valley will be made available for study by R. Forester. Those samples, when QA'd, will be processed for calcareous microfossils and resulting material used to make preliminary reconstructions of past limnology and climate. The fossil content of those samples should also provide important information on sites for future outcrop sampling or coring.

3GCL002B Conduct reconnaissance - Las Vegas valley

Availability of samples noted above (3GCL004B) will partially fulfill this activity and of more importance will serve to guide the reconnaissance of the valley deposits.

Quality Assurance

Planning and Operations

Participants in the YMP climate program together with personnel from SAIC organized a climate workshop to be held on April 1.

Variances

3GCL002B Conduct reconnaissance - Las Vegas valley and RGCL001B Hire and train staff  
The final hiring of mapping personnel has been delayed, but is anticipated in the near future. Reconnaissance of the Mountain and of the Valley deposits awaits this personnel action.

WBS 1.2.3.6.2.1.3 Climatic Implications of Terrestrial Paleocology

Principal Investigator - R. Forester

OBJECTIVE

To determine aspects of past vegetation change; and use vegetation records to provide quantitative estimates of changes in climatic variables for the southern Great Basin. (SCP Study 8.3.1.5.1.3)

SCP 8.3.1.5.1.3.1 Analysis of pack rat middens OG3621G2

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCT315M Work Authorization 1.2.3.6.2.1.3

It is believed that the study plan has been signed by DOE, but it is not known if a work authorization is in place.

Quality Assurance

Planning and Operations

Variances

3GCL101 Hire and train staff

P. Wigand has not been hired yet, but the USGS and DRI have initiated the necessary paper work to complete that task in the near future.

WBS 1.2.3.6.2.1.4 Paleoenvironmental History of Yucca Mountain

Principal Investigator - J. Whitney

OBJECTIVE

To evaluate the paleoenvironmental record at Yucca Mountain and surroundings in light of inferred paleoclimate history of the southern Great Basin; to model soil properties in the Yucca Mountain region; to map surficial deposits; and to reconstruct the eolian history of the region.

SCP 8.3.1.5.1.4.2 Surficial deposits mapping of Yucca Mountain area OG3621I2

Summary Account Manager - E. Taylor

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

REFERENCES

3GCH001A Complete transition and hire staff

The position description is complete, justifications are being completed and position should be advertised and filed by the end of March.

SCP 8.3.1.5.1.4.3 Eolian history of the Yucca Mountain region 0G36312

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCH158C Conduct field trip - sand ramps

The need for thermoluminescence dating of material from eolian and hill slope materials has been identified and necessary work to obtain these dates have been initiated.

Quality Assurance

Planning and Operations

Variances

WBS 1.2.3.6.2.2 Effects of Future Climatic Conditions on Hydrologic Characteristics

OBJECTIVE

To determine the relations between climatic conditions and hydrologic characteristics in the vicinity of Yucca Mountain during and since the Quaternary; and to predict future hydrologic response to possible future climatic conditions. (SCP Investigation 8.3.1.5.2)

WBS 1.2.3.6.2.2.1 Quaternary Regional Hydrology

Principal Investigator - J. Stuckless

OBJECTIVE

To investigate the hydraulic characteristics of paleoflood events and to compare them with modern flooding and related geomorphic processes; to determine past infiltration and percolation history at Yucca Mountain through isotopic and chemical analysis of water from the unsaturated zone; to determine past hydrologic conditions in the regional discharge area; to estimate the conditions and rates of infiltration and ground-water recharge during the Quaternary; and to determine the ages, distribution, origin, and paleohydrologic significance of calcite and opaline silica deposits along faults and fractures.

SCP 8.3.1.5.2.1.1 Regional paleoflood evaluation 0G3622A2

Summary Account Manager - D. Grasso

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCH4007A Develop technical procedures

A scientific notebook plan is being prepared to document paleoflood investigations and research techniques. Only minor amounts of work were accomplished in March because of unusually heavy rainfall in southern Nevada. The unplanned arrival of several serious storms required immediate field attention on other Yucca Mountain SCP projects, namely the site flood and debris hazards activity and the transport of debris by severe runoff

ac... severe flooding was mostly restricted to the Las Vegas valley and did not affect the  
ir... area of Yucca Mountain.

### 3GQH008A Geomorphometric analysis of Yucca Mountain and vicinity

D. Grasso worked on technical strategies for conducting geomorphometric analyses of the drainages and alluvial fan systems surrounding Yucca Mountain.

D. Grasso and P. Glancy met with J. Whitney and J. Coe on March 18 and 19 to discuss the use of photogrammetric equipment for geomorphometric analysis activities. This equipment, operated by Coe, is capable of deriving high-resolution, digital landscape data from stereo aerial photographs. Because these high-quality data are lacking for large segments of the study area, this technique may be particularly valuable for geomorphometric analysis of paleoflood sites around Yucca Mountain.

D. Grasso explored the availability of digital terrain data sets, Landsat TM imagery, and aerial photography needed for this phase of the investigation. Two of three preliminary Landsat TM scenes, in digital format, were ordered.

D. Grasso worked on a longitudinal stream profile of the modern-day Amargosa River from upper Fortymile Wash to Badwater in Death Valley, California. The profile, when complete, will show the slope of different reaches of the river system and any breaks in slope that might be related to bedrock barriers or channel adjustments due to changes in past flow regimes. Additional longitudinal profiles will be drawn, of river terraces parallel to the channel, to show the geometry of the river's paleo-floodplain.

### 3GQH003A Reconnoiter Yucca Mountain and vicinity for paleoflood evidence

A visit to the Yucca Mountain area by P. Glancy, J. Coe, and J. Whitney provided a good verbal exchange of ideas on ages of alluvial deposits and the lack of extensive erosion of the area during late-Quaternary time. Whitney showed evidence of long-term landscape stability, but conceded that storm debris transport could have resulted from paleofloods of local severity during the period of landscape stability.

D. Grasso conducted a field reconnaissance of alluvial fans along the west margin of the Las Vegas valley to determine whether these landforms were remnants of past environmental conditions, or if they were still active today. Although flooding in the valley (March 26-27, 30) has shown that the fans are currently active, the presence of very well developed soils, especially in the upper fan (apex) areas, indicate surface stability. Thus, it appears that while the upper parts of the fans may be quite stable, lower (toe) areas may still be developing.

P. Glancy's visit with R. Carmen and J. Yount (USGS-GD) to the source area of the 1990 Copper Canyon mudflow disclosed some valuable evidence of paleofloods and paleo-debris-flow in that drainage. Stratigraphic exposures were discovered that include volcanic-ash deposits, organic debris, and charcoal lens within various stratigraphic units. This should allow the best opportunity discovered thus far for dating these types of deposits. One of the major objectives of this dating will be to see how important the Holocene is in terms of its debris-flow history. Copper Canyon now appears to be a very important site with good potential for development of a debris-flow history based on absolute dates.

### Quality Assurance

### Planning and Operations

3GOH004A Final DOE review and approval of study plan

Following author and reviewer concurrences, the study plan for this SCP activity was sent to DOE for verification and approval.

### Variances

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

An estimated 32 hours were spent on the following:

D. Grasso contacted FOLD distributors regarding the availability and cost of Landsat digital data for geomorphometric activities. Three of the needed data sets (Landsat TM scenes, all dated 3/23/84) are available. Two have been ordered. The third one will be ordered during the first week in April.

D. Grasso and P. Glancy met with J. Whitney and J. Coe to discuss a digital photogrammetric technique for deriving high-resolution digital elevation data from stereo aerial photographs. This technique may be useful for geomorphometric analysis of paleoflood sites in the Yucca Mountain area.

### SCP 8.3.1.5.2.1.3 Evaluation of past discharge areas 0G3622B2

Summary Account Manager - E. Gutentag

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GOH012 Analyze water by NWQL and GSP isotope staff

All samples collected prior to March 1992 have been analyzed for Sr 87/86 isotopes. The playa samples collected in the Fall of 1991 are in the queue for soil chemistry analysis by the Geologic Division, Branch of Geochemistry.

During late March 1992, samples collected California and Nevada will be submitted in early April to NWQL and the GSP isotope lab.

3GOH028 Analyze faunal samples modern springs FY92

R. Forester reports no new work on this activity during March 1992.

3GOH004 Study/analyze results from wet/dry playas

R. Forester reports no new work on the ostracode study of this activity. The Branch of Geochemistry has not sent any results of the playa samples still in their work queue for analysis.

3GOH007 Vegetation mapping phase 1

F. D'Agnesse began testing of remote sensing techniques using the Landsat Thematic Mapper for regional mapping of vegetation. Methods involved red/infrared ratios, to obtain normalized difference vegetation indices, soil-adjusted vegetation indices, and perpendicular vegetation indices. The most suitable methods will be used for vegetation mapping in the regional (3 by 3 degree) area.

3GOH008 Collect faunal samples from past discharge site FY92

On a late March field trip this activity was attended with poor results. A sample collected from Mound Spring in the Pahrump Valley will be analyzed for Sr 87/86 ratio. No faunal material was found at Mound Spring.

3GQH002 Vegetation distribution mapping Amargosa Desert  
K. Turner reports that he needs to correlate transects with road surveys for the Amargosa Desert. He and C. Faunt would like to sample the vegetation when the plants are in full bloom, most likely the second or third week of April. This activity needs to be extended into the growing season.

3GQH009 Prepare faunal samples for analysis  
This activity has been part of the work R. Forester is to perform. He reports that no new work has been performed during March 1992.

3GQH300 Collect/sample ostracodes--surface sediments  
This activity combined with 3GQH305 (Collect/sample ostracodes--Playas in New Mexico and Texas) was to collect and subsample surface sediments for ostracode and other calcareous microfossils from playas in eastern New Mexico and western Texas. This activity was not conducted because of extreme moisture conditions in the area.

3GQH305 Collect/sample ostracodes--Playas in New Mexico and Texas  
This activity has not started because of extreme moisture conditions in the study area.

3GQH306 Conduct analyses--water quality, paleontology, isotopes--New Mexico and Texas  
This activity was to be conducted with 3GQH300 (Collect/sample ostracodes--surface sediments), 3GQH305 (Collect/sample ostracodes--Playas in New Mexico and Texas), and all three activities will be conducted together when climatic conditions permit.

**3GQH005 Conduct field trips modern discharge springs FY92**  
This activity was expanded to test whether ostracodes and other aquatic microorganisms are found living in the aquifer. In early March 1992, the aquatic microorganism collector was tested at well JF-3 which is 0.5 mile south of J-12 in Area 25, NTS. This well was pumping 234 gallons per minute for 36 hours. For 22 hours, 20 gallons per minute was diverted through the aquatic microorganism collector during the time of collection. Although JF-3 was pumping about 10 percent air, which was probably introduced into the aquifer during well development with high pressure compressed air, the undisturbed aquifer may not have been oxygenated. Preliminary analyses of the collection nets in the field indicated that no organisms were present and final analysis of the net contents will be completed in April 1992.

During late March, three springs and one flowing well were collected in the Amargosa Desert area in California and Nevada. These samples will be processed during April.

#### Quality Assurance

#### Planning and Operations

#### Variations

3GQH002 Vegetation distribution mapping Amargosa Desert  
This activity will need to be field checked during the time the desert plants bloom, so that more accurate interpretations can be made. Then the road surveys can be checked against plant transect data. This activity needs to be extended through May.

3GOH30 Collect sample ostracodes--surface sediments. 3GOH35 Collect sample ostracodes--Playas in New Mexico and Texas; and 3GOH36 Conduct analyses--water quality, paleontology, isotopes--New Mexico and Texas

These activities are to be conducted in west Texas and eastern New Mexico playas. It is estimated that these activities will be conducted when weather conditions change. During the winter and spring, most playas in the study area have standing water and thus will not yield meaningful data.

Work Performed but not in Direct Support of the Scheduled Tasks

J. Watson, E. Gutentag spent a total of 120 hours in preparing for OIA audit YMP-92-13 and in closing NCRs from prior work.

SCP 8315214a Analog recharge sites 803622C2

Summary Account Manager - P. McKinley

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GOH13CA Conduct chloride leaching test FY92

The USGS Branch of Geochemistry, who is performing the chemical analysis for the chloride leaching experiment, has completed the first two sets of analysis.

T. Oliver has finished the first and second leach of Stewart tuff. The chloride concentrations decreased with the second leach.

T. Oliver started the first leach of Kawich Creek tuff.

3GOH15CA Complete data report Kawich FY 85-90

P. McKinley talked to E. Maxwell of SERI about their progress in reviewing solar radiation results from the Bird "Clear Sky Model". The National Climatic Data Center (NCDC) has updated data from Ely, Nevada which is being used in the Bird model to estimate several parameters. SERI has the data from NCDC and is verifying the updates. The current estimate from SERI is mid-April before they can provide the information.

P. McKinley completed Kawich Creek at base surface water record for the water year 1989 and 1990.

T. Oliver has completed the software testing for Minitab step-forward regression. D. Burkhardt has agreed to do the verification and validation of Oliver's testing.

3GOH16CA Complete data report Stewart FY 85-90

P. McKinley talked to E. Maxwell of SERI about their progress in reviewing solar radiation results from the Bird "Clear Sky Model". The National Climatic Data Center has updated data from Ely, Nevada which is being used in the Bird model to estimate several parameters. SERI has the data from NCDC and is verifying the updates. The current estimate from SERI is mid-April before they can provide the information.

T. Oliver has completed the software testing for Minitab step-forward regression. D. Burkhardt has agreed to do the verification and validation of Oliver's testing.

3GOH018C Prepare data report on Kawich: FY 91

T. Oliver and P. McKinley completed the final review and entry of the data for Kawich base

soil and air temperatures for 1991.

### 3GQH21CA Development of HRU analog basins

P. McKinley and F. D'Agnesse completed the transfer of basin slope, aspect and elevation data to the Sun.

P. McKinley transferred vegetation units and basin reference points to mvlar for scanning into an Arc data base.

P. McKinley and F. D'Agnesse scanned the Kawich and Stewart vegetation maps into the Sun for future HRU development.

P. McKinley made contact with C. Rich of National Mapping who has agreed to help in the final Arc/Info design of the HRUs. A meeting is scheduled for early April to collate the elevation, slope, aspect and vegetation units.

### Quality Assurance

#### 3GQH012C Collect/reduce hydro data from remote sites FY92

K. Burgess-Kohn, YMP-USGS training coordinator, worked with P. McKinley to insure that relevant QMPs were satisfied for the April field trip.

### Planning and Operations

#### 3GQH012C Collect/reduce hydro data from remote sites FY92

Preparation for the quarterly April field trip for sampling and equipment maintenance was completed. In addition to the regular field work, precipitation distribution in the basins will be investigated in April. This will involve additional sets of snow surveys at various vegetation groups and representative slopes and aspects.

### Variances

#### 3GQH014C Test PRMS model

The activity leader is moving to another job which will impact the start of this activity indefinitely.

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

Software quality assurance training. (2 hours)

Two reading assignments. (1 hour)

Reviewed an extended abstract for G. Leavesley and L. Stannard. (2 hours)

Monthly and semiannual reports. (4 hours)

Preparation and discussions on future climate meeting with DOE. (2 hours)

### SCP 8.3.1.5.2.1.4b Geochemistry of arid-zone infiltration OG3622E?

Summary Account Manager - A. Riggs

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GQH006D Install long-term meteorological monitoring equipment

Worked with Applied Technologies personnel to clear up bugs in their sonic anemometer

software. They eventually fixed the problems.

Completed the electronic integration of the eddy flux and long-term meteorological monitoring equipment. The system will collect and integrate 25 data streams into one file at 10 hertz now.

Finished the design of the long-term meteorology instrumentation shelter and submitted it to Quality Metal Products for construction.

#### 3GOH003C Soil moisture and chemical sampling

Staff met with the New Mexico Institute of Mining and Technology contractor at Organ Pipe Cactus National Monument and discussed the status of the project to date and the future direction. The meeting proved particularly useful by being able to review the geologic development of the deposits in the area. After returning, H. Claassen, E. Taylor, and A. Riggs spent a full day discussing what had been learned and how it could best be applied to further project goals.

Ten samples from Terrace 2 were analyzed for the volume of stones per sample, dry bulk density, the Cl concentration, and gravimetric water content.

A carbonate experiment was initiated to verify that Cl can be measured in carbonate material.

#### 3GOH016D Selection and preliminary mapping of microwatersheds

A number of potential sites were visited and two stream terraces were chosen and their bounds were determined by simple visual techniques.

#### Quality Assurance

##### 3GOH006D Install long-term meteorological monitoring equipment

Sent cup anemometers, hygrometer/thermometers, and barometer to HIF for calibration; initiated requisition for calibration of pyranometer.

Read QMP-3.07, R4 and QMP-17.01, R5.

#### Planning and Operations

#### Variances

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

Attended the paleoclimate workshop. (12 hours)

#### SCP 8.3.1.5.2.1.5 Studies of calcite and opaline silica vein deposits 0G3622D2

Summary Account Manager - J. Whelan

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GOH814A Prepare reports -- drill hole calcite silica

J. Whelan continued efforts to involve E. Roedder in fluid inclusion studies. Arrangements were made for Roedder to tutor myself and D. Vaniman (LANL) in proper sampling and sample preparation, and the measurement of fluid inclusion properties. Whelan prepared a draft of a technical procedure for fluid inclusion studies for comment by Roedder.

Hopefully this work will get underway in April. Whelan initiated the process of vendor QA approval for contracting  $\delta^{18}O$  measurements of opaline silica with the isotope geochemistry lab of P. Knauth at Arizona State University.

J. Whelan and B. Marshall presented "The isotope geochemistry of secondary and pedogenic carbonate from Yucca Mountain" for the Geology Department at the University of Colorado. Whelan continued work on describing fracture mineralogy and petrography of drill core samples from G-4. K. Futa continued evaluation of Sr-Sm-Nd systematics in vein and surficial carbonates. Data indicates that REE content varies considerably in the carbonates. S. Mahan completed Sr analysis of fracture fill samples HD-328, -331, -348, -344, -350, and -322. Mahan continued processing water samples from well JF-3, and samples obtained from C. Peters. Z. Peterman prepared a manuscript for the Water-Rock Interaction Conference entitled "Strontium isotope characterization of the Ash Meadows ground-water system, southern Nevada". Mahan spent one week in southern Nevada collecting soil and water samples for Sr analysis. Whelan made arrangements for a sampling trip to the Bond Gold mine near Beatty.

3GQH803A Analyze isotopes/fossils, Solitario Canyon and Windy Wash

J. Paces continued analysis of the site 199 paleolacustrine spring deposits. Additional data continues to suggest that the deposits formed  $\approx 42$  Ka. Paces initiated analysis of samples of pedogenic carbonate from site 106.

3GQH809A Analyze samples trench 14 original exposures

J. Paces initiated analysis of dissolution residues from trench 14.

#### Quality Assurance

B. Marshall attended two software configuration control committee meetings.

B. Marshall completed document review of QMP-3.07.

J. Paces continued calibration of spike according to GCP-22 starting a second set of calibration standards. The status is still pending. Paces initiated software review (per QMP 3.03, R3) of a critical code used in U-series data collection by alpha-spectrometry (UTH.FOR, CID# GDD0020.02). The program had to be transferred from the old Nuclear Data Systems operating platform to the new PC-based system following catastrophic failure of the old computer. Alpha-spectrometric data collection has been suspended until all configuration control documentation has been submitted to the SCC. S. Mahan met Sr isotopic calibration date of SRM 987 on March 4.

S. Mahan completed QA records management for two manuscripts for the Water-Rock Interaction Conference currently in the system.

#### Planning and Operations

3GQH814A Prepare reports -- drill hole calcite silica

J. Whelan continued efforts to involve E. Roedder in fluid inclusion studies. Arrangements were made for Roedder to tutor myself and D. Vaniman (LANL) in proper sampling and sample preparation, and the measurement of fluid inclusion properties. Whelan prepared a draft of a technical procedure for fluid inclusion studies for comment by Roedder. Hopefully this work will get underway in April. Whelan initiated the process of vendor QA approval for contracting  $\delta^{18}O$  measurements of opaline silica with the isotope geochemistry lab of P. Knauth at Arizona State University.

### Variances

#### 3GOH802A Install/calibrate new mass spectrometers

Delivery of the new Finnigan mass spectrometers for stable and radiogenic isotope measurements has been delayed to April. This delay will impact all milestones related to Sr, Nd, Pb, and stable isotope analyses.

#### 3GOH801A Hiring and training of geologists

The technician position to support stable isotope studies still has not been advertised. This delay will impact all milestones related to stable isotope analyses.

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

J. Whelan attended an SOC meeting at which specimen removal requests for himself and A. Gelson were approved.

B. Marshall recalibrated the pulse-processor on the energy-dispersive XRF instrument in order to fix minor problem which became apparent when analyzing low Rb samples.

B. Marshall, S. Mahan, and K. Futa spent one week in the Isotope Hydrology short course.

J. Paces reviewed a manuscript of B. Marshall et al. for the Water-Rock Interaction Conference.

### WBS 1.2.3.6.2.2.2 Future Regional Hydrology due to Climate Changes

Principal Investigator - J. Stuckless

#### OBJECTIVE

To characterize the impacts of potential future climate changes on the regional and site surface-water system, the site unsaturated zone hydrology, and the regional and site saturated zone hydrology. (SCP Study 8.3.1.5.2.2)

#### SCP 8.3.1.5.2.2.1 Analysis of future surface hydrology due to climate changes 0G3622E

Summary Account Manager - D. Grasso

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

#### Quality Assurance

#### Planning and Operations

##### 3GFH200A Obtain/install micro computer system

Procurement documentation for hardware and software needed for the modeling system was submitted to the USGS district office in Carson City, Nevada, for review and processing in February. At last notice (March 30), J. Lansen, computer section chief in Carson City, noted that the review was complete and that the materials will be forwarded to the regional office in Menlo Park for processing/purchase.

##### 3GFH100A DOE approval of study plan

S. Keller (SAIC/Golden) finalized the draft recompilation of the study plan and forwarded copies to the authors (D. Grasso, J. Downey, and K. Kolm) and DOE reviewers on March 16. At this time, Keller noted that, "when concurrences have been reached with all reviewers, a new recompilation incorporating any necessary changes will be transmitted to

the Project Office for DOE verification review.

### Variances

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

An estimated 58 hours were spent on the following:

D. Grasso conducted interviews of prospective employees to fill the surface-water modeler position (GS-9/11) open for this activity. Someone is lined up for the position and hopefully will be brought on board soon. D. Beck and Grasso met with D. Gillies and D. Appel to discuss this action.

D. Grasso met with J. Coe to discuss the possibility of using photogrammetric equipment currently operated by Coe and J. Whitney to develop high-resolution landscape data sets for surface water modeling at Yucca Mountain. The use of this equipment and techniques developed by Coe could improve delineation of HRUs needed to perform surface-water runoff modeling via the PRMS software supported by the USGS.

D. Grasso attended the annual ASPRS/ACSM national meeting in Albuquerque, New Mexico, to learn more about the various remote sensing, surveying, and mapping techniques used today to classify and derive landscape and watershed parameters. During the meeting, Grasso met with R. Welch and associates (Center for Remote Sensing and Mapping Science) to discuss their digital, automated, photogrammetric techniques for deriving such information as elevation, slope, and aspect from stereo aerial photographs. Their software package, DMS (Desktop Mapping System) is a low cost software package that enables image processing for photogrammetric, remote sensing, and GIS applications using personal computers. Their automated method for deriving digital elevation data from aerial photographs may be especially useful for this activity. Other remote sensing and mapping packages, including PCI, ER Mapper, and ERDAS for Unix workstations, were also evaluated for their possible use in this activity.

#### SCP 5.5.1.5.2.3 Synthesis of effects of possible future recharge due to climate changes on hydrologic characteristics of the Yucca Mountain saturated zone 0G3622G?

Summary Account Manager - J. Downey

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GFH004H Analyze structural geology

Radian Corp. has supplied copies of their advanced contouring package CPS-3, including their fault modeling system FFMS, for use with the Intergraph ERMA software at CSM. This software is urgently needed to complete construction of the 3-D geological framework model of the southern Nevada region.

##### 3GFH003C Conduct literature search for GSIS (Future/Quaternary GW)

C. Faunt continued literature search and review including:

Smith and Lindb (1978), McKinley and others (1990), Ball and Nordstrom (1987), Claassen (1985), White (1979).

##### 3GFH023C Develop recharge/discharge estimates

F. D'Agnese began converting digital soil surveys received from SCS into ARC/INFO coverages which will be used for recharge estimation.

F. D'Agnesse began preliminary testing of remote sensing techniques used for regional mapping of vegetation using Landsat Thematic Mapper data. Methods involved red/infrared ratios, Normalized Difference Vegetation Indices, Soil-Adjusted Vegetation Indices, and Perpendicular Vegetation Indices. The most suitable methods will be used for vegetation mapping in the regional (3 degree by 3 degree) area.

3GFH025C Gather input data to GIS

C. Faunt began compiling a water chemistry coverage of the regional area from existing USGS files and reports.

3GFH005C Analyze hydrogeologic framework

C. Faunt examined rose diagrams of faults that were made to show the distribution of fault orientations.

C. Faunt did some preliminary analysis of the stress data compiled from the literature. Faunt and K. Turner constructed a trend surface for the stress data. This gridded surface can now be input into the GIS to help analyze the faults as to their stress/strain relationships.

Quality Assurance

Planning and Operations

3GFH004H Analyze structural geology

B. Wales (Intergraph Corp) is writing software to automate the process of "attributing" cross-section units.

3GFH025C Establish data documentation procedure for GIS

F. D'Agnesse and C. Faunt attended a meeting with E. Ezra and J. Beckett (EG&G Nevada-Yucca Mountain Project) in Las Vegas to discuss EG&G's methods for development of the YMP GIS technical data base and data documentation conducted by EG&G.

Variances

3GFH021C Construct 3-D hydrogeologic framework model

This activity was not worked on during the month of March. Work on this activity is temporarily delayed until a user defined software code is supplied to the project by B. Wales (Intergraph).

Work Performed but not in Direct Support of the Scheduled Tasks

C. Faunt and F. D'Agnesse prepared for and conducted field work with past discharge (E. Gutentag) in the Pahump/Amargosa Valley area. Field work involved playa, spring and water-well sampling for strontium-ratio, ostracode, and chemical analysis. (Approx. 2 weeks)

C. Faunt, F. D'Agnesse, K. Kolm and K. Turner attended a meeting organized by EOSAT on GIS and remote sensing. (4 hours)

C. Faunt, F. D'Agnesse, K. Turner, and J. Downey attended an informational meeting with J. Bredehoeft to discuss the modeling efforts of the Yucca Mountain Project. (4 hours)

In response to review comments, J. Downey reformulated software code for SNODIF in order to accommodate snow permeability more accurately. (120 hours)

C. Faunt finished editing the Carbonate paper and gave it to K. Kolm and E. Gutentag to review so

that it could be resubmitted to formal review (10 hours)

## 1.2.5 REGULATORY AND INSTITUTIONAL

### OBJECTIVE

To support the Department of Energy (DOE)/HQ in the development of the site-related aspects of compliance with Nuclear Regulatory commission agreements, requirements, and policies, environmental and permitting requirements, and related DOE orders, and the development of site-related regulatory documentation; to plan and conduct environmental field investigations and transportation studies related to environmental compliance, permitting and repository design; to plan and conduct socioeconomic studies to assess the regional socioeconomic action studies; to coordinate Project activities with the community and state and local governments; and to plan and implement a public communication plan.

### WBS 1.2.5.2 Licensing

### OBJECTIVE

To support DOE by providing Project coordination and support of NRC interactions by providing input related to site aspects of proposed NRC regulation changes, and evaluate the impact of the regulation changes on the site activities, strategies, and plans; to support DOE/HQ in the development of site technical position papers by synthesizing site and site performance assessment technical information into Project positions; to develop draft position papers which support these positions; to perform technical evaluation of site data and related reports, technical reports, and conclusions, and draft position papers; to coordinate study plan review; to support the preparation of the semi-annual progress report for site investigations and assessments; and to coordinate and perform technical reviews of the site characterization program.

### WBS 1.2.5.5 Study Plan Coordination

Principal Investigator - L. Hayes

### OBJECTIVE

To coordinate the preparation review and revision of SCP Study Plans.

### ACTIVITIES AND ACCOMPLISHMENTS

The section chief's office completed rewriting of sections of the SCPB to reflect changes in Study Plan 8.3.1.4.2.1.2 to acquire seismic traverses across Yucca Mountain and in Yucca Wash. The suggested rewrites and supporting documents were submitted to DOE on March 23. Also included were responses to DOE and T&MSS concerns on the request for contract proposals. The contract administration office has been advised of appropriate changes to the RFP. The section chief's office also continued efforts with the contract division to ensure timely progress of the proposal.

R. Spengler and C. Hunter met with R. Keefer, R. Craig, D. Williams, R. Crawley, and T. Sullivan on the rewrite of SCPB sections.

Approximately 80 hours were spent on comment resolution on Study Plan 8.3.1.2.3.3, Site Saturated-Zone Hydrologic System Synthesis and Modeling.

D. Grasso approved changes made by S. Keller to the study plan, tables, and figures for 8.3.1.5.2.2.1 and discussed final revision procedures before the recompiled study plan could be submitted for final review. Only minor changes were needed.

D. Grasso approved changes made by S. Keller to the final, recompiled draft of the study plan for

8.3.1.5.2.1.1. Changes made to the tables and figures were also reviewed and approved. Following author and review concurrences, the study plan was submitted to DOE for verification.

The monthly HIP study plan status report was transmitted to W. Causseaux in HIP management.

Study Plan 8.3.1.2.3.1 (Site saturated-zone ground-water flow) - M. Umari and S. Keller finalized the change request to the SCPB for the new C-holes complex well, and transmitted it to the Project Office on March 31 under a TPO letter.

Study Plan 8.3.1.2.3.2 (Saturated-zone hydrochemistry) - A TPO letter notifying the Project Office that the verified study plan of November 27, 1991, can serve as the approval version, was transmitted on March 20.

Study Plan 8.3.1.2.3.3 (Site saturated-zone synthesis and modeling) - The author responses to DOE review comments were completed. A draft study plan and comment tracking table were transmitted to each reviewer and the author for author/reviewer concurrence.

Study Plan 8.3.1.5.2.1, R2 (Quaternary regional hydrology) - Author/reviewer concurrences were concluded on March 19, and HIP review by T. Brady was completed on March 26. The study plan was finalized after final author approval from D. Grasso for Sec. 3.1 (Regional paleoflood evaluation), and was transmitted to the Project Office under a TPO letter.

Study Plan 8.3.1.5.2.2 (Effects of future climate on hydrology) - S. Keller incorporated the completed author responses for Section 3.3 (Future saturated-zone hydrology) from J. Downey and K. Kolm, and transmitted a draft study plan and comment tracking table to each DOE reviewer and the authors for author/reviewer concurrence.

#### WBS 1.2.5.2.6 Semi-Annual Progress Reports

Principal Investigator - L. Hayes

#### OBJECTIVE

To provide support to DOE/HQ for the development and preparation of the Site Characterization Semiannual Progress Reports.

#### ACTIVITIES AND ACCOMPLISHMENTS

D. Appel revised and distributed instructions for preparation of technical investigator input to the semi-annual Site Characterization Progress Report No. 6 for the period October 1991 through March 1992.

Technical Status Reports for site performance assessment, development and validation of flow and transport models, and supporting calculations for postclosure performance analysis covering the period October 1991 through March 1992 were written.

The TSRs for precipitation and meteorological monitoring, hydrologic properties of surficial materials, natural infiltration, artificial infiltration, and matrix hydrologic-properties testing covering the period October 91 - March 92 have been completed and submitted to the USGS for collation.

R. Luckey prepared the six-month technical update report for the site potentiometric-level evaluation project.

The six-month progress reports for conceptualization of SZ flow models and development of

fracture-network model were compiled by E. Ervin for the period of October 1, 1991 to March 31, 1992.

SCP Progress Report 6 for prototype testing of intact fractures was compiled for the period of October 1, 1991 to March 31, 1992.

#### WBS 1.2.5.4 Environment

##### OBJECTIVE

To identify data requirements; to collect required environmental field data; and to prepare topical data reports.

##### WBS 1.2.5.4.8 Water Resources

Principal Investigator - R. La Camera

##### OBJECTIVE

To provide water resources environmental field activity planning documents, field data and analyses, and topical reports describing the results of field data analyses.

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GWR011 Survey monitoring network sites

There was no progress during March. The pumping of well JF-3, water quality sampling, and springflow and water level measurement precluded any additional surveying.

##### 3GWR001 Groundwater levels, springflow monitoring, FY92

Water level measurements were made at 27 network sites and springflow was measured at five network sites. Field sheets were checked and filed into the project data base.

##### 3GWR010 Aquifer Pump Test JF-3

Well JF-3 pumping took place on March 4 and 5. Well JF-3 and well J-12 water levels were continuously monitored and recorded from February 26 to March 12. Pumping discharge of well JF-3 was continuously monitored and recorded during pumping. Some water quality parameters were monitored continuously and periodically recorded manually. Manual water level measurements with an electric tape were made at varying intervals prior to, during, and after pumping. Observations of flow meter and flume gage-height were made and recorded. Four complete water quality samples were collected at 11 hours, 22 hours, and 34 hours after pumping started. Duplicate samples were collected at the 34-hour sampling. The total pumping period was 36 hours. Preliminary test results indicate that the drawdown in well JF-3 was about 1-1/2 feet. No drawdown was detected in well J-12.

##### 3GWR013 Instrument JF-3

The continual water level monitoring system was removed on March 12. The system was removed in anticipation of pump removal on March 16 and 17. Pump removal has been delayed until further notice. A permanent continual monitoring system will be installed once the pump has been removed and permanent tubing installed.

##### 3GWR004 Groundwater quality data collection

Water quality samples were collected at four selected network sites (excluding well JF-3)

from March 24-26. Samples were shipped to the USGS Central Lab in Denver for analysis.

3GWR006 Groundwater monitoring report, second quarter FY92  
Report data that are stored in a data base were reviewed.

#### Quality Assurance

#### Planning and Operations

3GWR014 Capital equipment procurement  
Purchase orders were completed for permanent monitoring equipment for well JF-3.

#### Variances

3GWR011 Survey monitoring network sites  
This activity is delayed due to priority of other activities. The impact on the project is minimal because water levels are measured as depth below measuring point and actual altitudes of water levels can be recalculated after surveying is completed.

#### 3GWR013 Instrument JF-3

Monitoring equipment has been temporarily removed so that the pump can be removed and permanent monitoring tubing can be installed. Pump removal by DOE contractor has been delayed until further notice. In the interim, well J-12 is still in non-pumping status and water levels are being continuously monitored. Problems will occur if well J-12 needs to be pumped before well JF-3 has a permanent monitoring system installed.

#### 3GWR004 Groundwater quality data collection

Although water-quality sample collection was delayed from January, the activity is now underway and biannual sampling in FY92 still will be achieved.

#### 3GWR006 Groundwater monitoring report, second quarter FY92

The progress on this activity is limited due to extended duration of work related to JF-3. Data compilation will intensify in April. The report is still anticipated to be completed, however, by the planned milestone date.

#### 3GWR014 Capital equipment procurement

There is a possibility that a government I-vehicle purchased for water-quality purposes may not arrive by the end of the fiscal year in time to be adequately modified. Short-term impact is minimal as other vehicles can be utilized during the remainder of the year.

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

Reviewed and provided input to HIP on the final draft of a management agreement between USGS-YMP and USGS Nevada District for the water resources monitoring program.

Participated in YMP environmental program mid-year financial review.

Submitted a memo to DOE with recommendations for handling access problems with certain network site, such as wells VH-1 and Army 1.

Provided input to DOE environmental monitoring staff for inclusion into the Annual Site Environmental Report.

## 1.2.9 PROJECT MANAGEMENT

### OBJECTIVE

To provide overall management of the Yucca Mountain Project including: project control, quality assurance, technical integration, and interaction with other OCRWM Program demands on Project management activities.

### WBS 1.2.9.1 Management and Integration

### OBJECTIVE

To provide overall management of the Yucca Mountain Project including: technical integration and interaction with other OCRWM Program elements.

### WBS 1.2.9.1.4 Records Management

Principal Investigator - L. Hayes

### OBJECTIVE

To provide a Yucca Mountain Project Records Management System that will meet the requirements of: DOE-NNWSI, Quality Assurance Plan, DOE-NNWSI/88-9 DOE-OCRWM Records Management Policies and Requirements, DOE/RW-0194; and the Licensing Support System (LSS); and to establish and operate all local records centers.

### ACTIVITIES AND ACCOMPLISHMENTS

OMP-17.01, RS, YMP-USGS Records Management training, was completed for all required personnel. This included seven attendees in Menlo Park and six attendees at Lawrence Berkeley Laboratories. Two new records management training modules were written for the new employee orientation class (75- and 20-minute presentations).

With training complete, all records received are being reviewed for proper use of the QA designation. L. Watt and M. Murray are calling each record source to review the proper QA designation for all questionable designations. Agreement is being reached before any change is made. This has resulted in future records for the record sources being received properly rather than having repeats of the same offense.

Tracking of the various LRC records activities is developed and in process. Reports should be ready by April 30.

L. Watt is reviewing each record received into the LRC which requires correction of any kind before submittal to the CRF. This helps in identifying what type of activities should be tracked. In many instances, a cause has been identified and remedied to prevent repeated problems. With these items submitted properly now, it requires less LRC employee time. This direct work with the record sources and their delegates is beginning to pay off in less follow-up work required of the LRC staff.

Two hundred sixty-three criteria-related "stand-alone" documents and 18 packages were received into the LRC and date stamped. The stand-alone records were quality verification checked and 25 "correction requests" were issued. Nine packages received a "correction request."

Fifteen publication packages were received from J. LaMonaca. Four publication packages were transmitted to the CRF containing one OFR, one WRIR, three LBL reports, two journal articles, and six abstracts, with a total page count of 907. Three cited reference packages containing 40 cited references with a total page count of 907 were also transmitted to the CRF.

The following approved OMP and modifications were distributed:

OMP-3.07, R4	YMP-USGS Review Procedure
OMP-2.02,R5-M2	USGS Personnel Qualification
OMP-2.08,R1-M3	Non-Federal Contractor Personnel Qualification
OMP-3.03,R3-M1	Software Quality Assurance
OMP-4.02,R3-M1	Control of Management Agreements

The following approved technical procedures were issued:

GP-39, R0	Geophotogrammetric Mapping of Trench Walls - Field Work
HP-40, R2	Estimation of Peak-Streamflow Discharge by the Slope-Conveyance Method
HP-43, R2	Installation, Operation, and Examination of Two Types of Non-Recording Rain Gages
HP-169, R1	Determination of Peak-Streamflow Discharge by the Slope-Area Method
HP-220T, R0	Air Flow Monitoring in Deep Saturated Zone Boreholes and in Partially Cased Boreholes
HP-221T, R0	Monitoring the Well Water Level or Fluid Pressure Response to Underground Nuclear Explosions or Earthquakes
HP-222T, R0	Installation of a Small Diameter Packer and Transducer to Measure Fluid Pressure in Wells

ICN-8 to the YMP-USGS Quality Assurance Program Plan was distributed to controlled copy holders.

A rescission notice for the YMP-USGS Software Quality Assurance Plan was issued.

A rescission notice was issued for HP-136, R0 Methods for Handling and Storage of Drill Cuttings and Core from Unsaturated Zone Boreholes at the Unsaturated Zone Testing Laboratory (Test Cell C).

A controlled set of YMP-USGS OMPs, TPs, and the QAPP was issued to the YMPO Document and Records Center.

The 1991 YMP-USGS Controlled Documents Configuration Report has been completed. 112 participants responded. As a result of the configuration report, 20 participants were sent replacement documents and four participants were decontrolled.

Work is continuing on the indexing of and organization of YMP-USBR DTNs into records packages.

Numerous routine document control functions were performed including issuing procedures to new copy holders, distributing replacement documents, sending out follow-up DTNs, transferring controlled documents to new copy holders, sending information copies to various persons/agencies, and transmitting eight DTN record packages to the LRC.

ACTIVITIES AND ACCOMPLISHMENTS

Various routine training functions were performed including distributing individual reading assignments and YMP-USGS orientation video tape assignments; scheduling DOE's general employee training; scheduling GET refresher training exams for Denver area participants; providing management with information regarding the status of participants' instruction assignment completions; distributing first, second, and third reminder notices to participants with overdue reading assignments; supporting instructors providing make-up sessions for software quality assurance and records management training; and submitting record packages to the LRC.

Reading assignments and highlight sheets were prepared and issued for the following procedures:

OMP-3.03, R3	Software Quality Assurance
OMP-3.07, R4	YMP-USGS Review Procedure
OMP-3.07, R4	Highlight Sheet
QAPP-01, R5	ICN No. 8 Quality Assurance Program Plan
AP-5.19Q, R2	ICN No. 1 Interface Control
AP-5.19Q, R2	ICN No. 1 Highlight Sheet
AP-6.3Q, R0	ICN No. 2 Interaction of Participants and Outside Interests with Yucca Mountain Project Sample Management
AP-6.4Q, R1	Procedure for the Submittal, Review, and Approval of Requests for Yucca Mountain Project Geologic Specimens
HP-40, R2	Estimation of Peak-Streamflow Discharge by the Slope-Conveyance Method
HP-43, R2	Installation, Operation, and Examination of Two Types of Non-Recording Rain Gages
HP-169, R1	Determination of Peak Discharge by the Slope-Area Method

Software training was conducted in Denver on March 3, 16 and 24, with P. Covington as trainer. Completed the writing of lesson plans, view graphs, and worksheets for the software unit for YMP-USGS orientation.

The following assistance was provided to GSP management: J. Stuckless, announcing and scheduling participants for an April 16 and 17 Wilderness First Aid Course; R. Forester, preparing for a YMP-USGS Climate Workshop April 1; J. Whitney, providing YMP-USGS orientation, software quality assurance, and records management training for new employees; R. Spengler, requesting GET training for Menlo Park area; Z. Peterman, preparing OMP-2.07, R1, attachment 1 forms for new employees and planning the documentation of vendor training for the new mass spectrometer.

The following assistance was provided to HIP management: D. Appel, preparing an internal memorandum regarding YMP-USGS personnel qualification; M. Whitfield, assisting with training portion of UZ 16/VSP 2 borehole readiness review, P. McKinley, initiating process to modify OMPs 2.02 and 2.08 to allow for waiving of current qualifications requirements for temporary personnel and subsequently prepared waiver letter for personnel involved in implementing HP-165, Method for Measuring Snow Water Content.

Two parts of a major revision of the YMP-USGS orientation were prepared in addition to preparation of text on the technical role, records management, and software quality assurance that was incorporated for a special session.

Reviewed and commented on training portion of draft copy "Working at the Nevada Test Site" for R. Craig. Included information about working at the NTS in March 25 orientation which Craig attended to critique before submittal of final lesson plan for approval of T. Cheney.

WBS 1292 - Project Control  
Principal Investigator - L. Hayes

OBJECTIVE

To provide Project management support in the areas of cost and schedule planning and control; to develop and maintain an integrated project management system; to implement performance measurements; to support the change control system; and to establish WBS.

ACTIVITIES AND ACCOMPLISHMENTS

The SAIC/Golden actual cost distribution, estimated cost distribution, FTE report, and the USGS cost report for February were compiled. The February actual costs and schedule status for the USGS were sent to Las Vegas for input into the PACS system.

S. Reisler chaired the Project Control Procedures Standing Committee meeting.

February status for the USGS schedules was completed and sent to Las Vegas for input into the APECS system. Reports and plots were distributed to the PIs in preparation for next month's statusing.

Minor changes were made to the hydrologic file due to a hold up of some work which was to be accomplished.

Summary plots and milestone listings have been generated for the TPO to be used for meetings in Las Vegas.

Additional schedules and data print outs were sent out for the ICE team to conduct an independent cost analysis for the upcoming years.

A booklet containing geological plots and reports was created for R. Spengler to adjust milestones for DOE requirements.

An existing program was altered to provide technical assistance with variance data retrieval for PACS reporting.

Archived data were retrieved to produce reports needed by R. Ritchey for the ICE review.

WBS 1.2.9.3 Quality Assurance

OBJECTIVE

To establish and implement a Yucca Mountain quality assurance program.

WBS 1.2.9.3.1 Quality Assurance Program Development

Principal Investigator - T. Chancy

OBJECTIVE

To establish and maintain the OA program descriptions.

ACTIVITIES AND ACCOMPLISHMENTS

OMP-17.01, R5, YMP-USGS Records Management, was approved. OMP-3.15, R0, Application of Graded Quality Assurance, was completed and approved. This procedure will be issued and reviewed by the DOE audit early next month and will be implemented in the near future.

The following QMPs were distributed for division review:

- OMP-3.08, R0 Submittal of Prerequisites and Test Information (Prerequisites Review)
- OMP-2.05, R4 Qualification of Audit Personnel
- OMP-18.01, R7 Audits
- OMP-18.02, R3 Surveillances

The following modifications were prepared and approved:

- OMP-4.02,R3-M1 Control of Management Agreements
- OMP-3.03,R3-M1 Software Quality Assurance
- OMP-2.02,R5-M2 USGS Personnel Qualification
- OMP-2.08,R1-M3 Non-Federal Contractor Personnel Qualification

The following draft QMPs were changed as requested and returned to their respective authors:

- OMP-3.04, R4 Technical Review, Approval, and Distribution of YMP-USGS Publications
- OMP-3.07, R4 YMP-USGS Review Procedure
- OMP-3.08, R0 Submittal of Prerequisites and Test Information (Prerequisite Review)
- OMP-3.15, R0 Application of Graded Quality Assurance
- OMP-4.01, R4 Procurement Document Control
- OMP-7.01, R5 Control of Purchased Items and Services
- OMP-7.04, R0 Vendor Evaluation
- OMP-16.03, R3 Trend Analysis
- OMP-18.01, R7 Audits
- OMP-18.02, R3 Surveillances

The QMP master list was updated and forwarded to the YMP-USGS QA office.

The USBR amended their response to Surveillance USGS-92-S01; NCR-92-05 was submitted to the USGS QA office for review and approval.

The USBR OA manager took a trip to the Yucca Mountain site to ensure proper training of USBR personnel performing in-place density testing in support of SCP 8.3.1.14.2.2 on March 3-5. He made a follow-up trip March 15-18 to ensure the effectiveness of USBR-7221 training of USBR personnel.

CAR No. USBR-91-01 was submitted to the USGS QA office in accordance with USBR-QMP-

16.01.

Response to Surveillance Observation USGS-92-S01-OBS1 from Surveillance USGS-92-S01 was accepted by the USGS QA office on March 12.

USBR submitted QA Balance calibration information to the USGS QA office in support of USGS-NCR-91-31.

Surveillance No. USGS-91-S08 was performed by the USGS and facilitated by the USBR QA office on March 20-30.

WBS 12.9.3.2 Quality Assurance - Audits and Surveillances

Principal Investigator - T. Chaney

OBJECTIVE

To verify the QA program through periodic audits and surveillance of Project activities.

ACTIVITIES AND ACCOMPLISHMENTS

Audit Report USGS-92-02 of five USGS-HIP activities was written. The Audit resulted in the initiation of one Corrective Action Report and one Observation.

Audit Report USGS-92-03 of ten USGS-HIP activities was written. The Audit resulted in the issuance of four Audit Finding Reports.

Audit USGS-92-04 of six USGS-HIP activities was researched, planned, and conducted resulting in four Audit Finding Reports. Verification of several NCRs and Audit Findings also were conducted during the Audit.

Vendor Evaluation 92-E07, for Hewlett Packard, was submitted recommending retention on the Approved Vendors List.

Vendor Evaluation 92-E10, for Reynolds Electrical and Engineering Co. was performed in conjunction with OCRWM vendor requalification audit YMP-92-10. A report indicating favorable results will be prepared and submitted.

Surveillance Package 92-S01 was closed and transmitted to the Local Records Center. Surveillance Report 92-S04, for Sierra Instruments, Inc. was submitted. QA concerns were listed on two Observations which require a response. Surveillance Report 92-S05, MKS Instruments, Inc. was submitted recommending inclusion on the Approved Vendors List. Surveillance Plan 92-S06, Ruska Instruments, Inc. was submitted and the surveillance performed with favorable results. Surveillance Plan 92-S08, for the U.S. Bureau of Reclamation, was submitted and the surveillance performed to verify corrective actions for USGS-AFR-9007-01, Rev. 1. A report will be submitted.

Investigative reviews for verification of completed actions were completed for closure of NCRs -91-09, -91-43, 91-44, 92-07, and USGS AFR-9112-04.

OBJECTIVE

To provide quality engineering support to the project through reviews of documentation and assistance with QA training.

ACTIVITIES AND ACCOMPLISHMENTS

Management reviews were performed in accordance with OMP-3.07, R3 (reviews) for draft OMPs: OMP-3.08, R0 (Submittal of Prerequisites and Test Information) and OMP-3.15, R0 (Application of Graded QA); and Modifications for OMP-2.05, R4 (Qualification of Audit Personnel), OMP-18.01, R7 (Audits), and OMP-18.02, R3 (Surveillances). In addition, meetings were held with the QA office and the Chief, YMPB, to discuss the pertinent QA and management requirements for the next draft of OMP-5.05, R3 (scientific notebooks).

Members of the Open Items Committee continued to provide weekly updates to the QA open items coordinator. The Open Items Committee met once during March to discuss the status of various open items. The following open items were addressed during the month:

External Item(s): DOE/YMPO CARs YM-91-74 through YM-91-77 (software requirements); and NRC DNs 1 through 4 (site potentiometric water level evaluations).

Internal Item(s): Audits: AFR 9007-01 R1, 9110-02 (YMP-USGS qualification records), 9112-02 (management agreements), 9115-01 and -02 (USBR procurements and technical procedures); CAR 90-04 (timeliness of corrective actions), CAR 91-03 (unapproved vendors), CAR-91-05 (procurement record packages), CAR 91-06 (management assessments), CAR 91-07 (misinterpretation of OMP requirements), CAR 91-08 (transmittals for individual QA records), CAR 91-09 (misinterpretation of software requirements), CAR 91-10 (misinterpretation of exemptions from procurement QA requirements), CAR 91-11 (scoping activities without documented authorization), CAR 92-03 (management agreements), CAR 92-04 (work authorization for SCP Activity 8.3.1.2.2.6.1), CAR 92-05 (problems with manuscript processing); NCR 90-37 (calibration standards), NCR 91-09 (sampling), NCR 91-14 (qualification records with Study Plans), NCR 91-31 (QA Balance calibrations), NCR 91-37 and 91-38 (report processing problems), NCR 92-02 (SGBSN management agreement), NCR 92-05 (USBR Earth Manual procedures), NCR 92-06 (seismic publications), NCR 92-08 (report processing problem), NCR 92-10 (review of data), NCR 92-13 and 92-14 (report processing problems).

Other miscellaneous actions involved coordinating with YMPB and QA personnel during internal Audit 92-04; coordinating with the Open Items Committee members on planning details for the upcoming DOE/YMPO Audit 92-13; monitoring the status of open and/or overdue training assignments and document transmittal notices; and continuing to update the tracking logs for statusing GSP technical activities and TPO action items.

Several CAR Board meetings addressed associated actions that were discussed involving CAR-90-04 (timeliness of actions), CAR-92-06 (management assessments), CAR-92-03 (management agreements), CAR-91-10 (processing exempt procurements), CAR-91-11 (work authorization) and CAR 92-05 (report processing problems). Also NCR-91-10 (technical procedure boilerplate requirements) was discussed and elevated to CAR-92-06.

Re-evaluation of previous OMP-3.03 classification and documentation requirements was completed on behalf of the Configuration Control Committee (CCC) for software covered by USGS-NCR-92-

02 (Southern Great Basin Seismic Network). The results of this evaluation have been prepared for presentation on April 2, 1992, to the CCC and the technical contact for their concurrence.

Approximately 45 items have been received, reviewed, and/or processed by the SCM coordinator in accordance with OMP-3.03, R3. The Configuration Status Log has been updated and technical contacts have been notified of status of SOA documentation.

An agenda and minutes were prepared for the CCC meetings held on March 5 and 19. CCC Review documentation was completed for each of the CCC reviews conducted at those meetings.

A memorandum and enclosures were prepared for the Chief, YMPB, to transmit the CCC's recommended classification and documentation requirements for OMP-3.03, R2 software to the appropriate technical contacts. Actions related to the issuance of ICN 8 to QAPP-01, R5 were completed. A modification to OMP-3.03, R3 was drafted to conclude resolution of independent verification and validation issues which were remaining from the November 12, 1991 comment resolution of OMP-3.03, R3. Support was provided to the SOA specialist in the production and distribution of two memoranda regarding implementation of OMP-3.03, R3. Notifications have been prepared on behalf of the SOA Specialist to transmit the results of his re-evaluation of certain user manuals. Actions have been initiated to identify data identification requirements for previously released software. All of these actions are pursuant to USGS-CAR-91-09 and are summarized in a supplemental response which was provided on March 27.

A supplemental response was provided to document completion of corrective action associated with DOE CAR YM-91-077.

Two Quality Assurance Grading Reports for the International Program, G1233132a1, Hydrochemical Characterization of the Upper Part of the Saturated Zone (Steinkampf), and G1233131a1, Development of Multiple-Well Hydraulic Test and Field Tracer Test Methods (Umari), were reviewed, approved and submitted to the YMP Quality Review Board for acceptance.

#### WBS 1.2934 Quality Assurance - Quality Overview

Principal Investigator - T. Chaney

#### OBJECTIVE

To provide reviews, analysis, and interpretations of QA requirements and application of QA to technical and scientific disciplines.

#### ACTIVITIES AND ACCOMPLISHMENTS

Prepared daily and weekly status of open items and input to open items data base for trending.

The February Open Items and Trend Analysis Report was written and issued.

Several trend analysis problems were addressed including YMPB report processing problems and untimely open items responses and/or actions. In addition, the chairman of the YMP-USGS 1991 Management Assessment Committee continued with preparation of its report. Draft input was forwarded to the chairman for incorporation into the draft report. Interviews with select management and technical personnel, QA implementation support personnel, and QA personnel will take place in April.



I-326386 *djc*

United States Department of the Interior



GEOLOGICAL SURVEY  
BOX 25046 M.S. *425*  
DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

IN REPLY REFER TO:

April 15, 1992

*Carl*  
*Smucka*  
*Ray*  
*Gene Simmons*  
*Bradley*  
~~\_\_\_\_\_~~  
*Sticker* } *ew-22*  
*Wallace*  
*Gertz* } *Johnson*  
*4/20/92* } *Blanchard* } *w*

WBS: 1.2.9.2  
QA: N/A

APR 20 2 32 PM '92

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

SUBJECT: U.S. Geological Survey Yucca Mountain Project Monthly Summary for March 1992.

Dear Carl:

In compliance with the revised Yucca Mountain Project monthly reporting procedures, following is the YMP USGS input for March, 1992. If you have any questions, please contact Raye Ritchey at FTS 776-0517.

WBS 1.2.1 - SYSTEMS ENGINEERING

The performance assessment modeling project reports that moisture retention curves are being developed on many samples representing all of the lithologic units present in USW UZN-55. The data will be used for input to the 1-D model. Several of the N-55 core are being oven dried at temperatures ranging from 200 C - 800 C to determine the appropriate temperature to remove all hydrogen from the rock matrix. Preliminary results indicate that this will improve the neutron probe calibration. All core from N-55 will be dried at high temperature to determine the final calibration to use for the model.

In support of the development and validation of flow and transport models, thermal probe design has been completed and tested in prototype experiments. An experimental protocol has been developed and tested for determining thermal conductivity and heat capacity of rock cores as a function of water content. Data logger programs and wiring panels have been constructed for a system to measure properties on six rock cores simultaneously. Construction and calibration of a set of thermal probes is in progress. A computer program for reading datalogger files and computing thermal

properties, which permits interactive data interpretation and analysis, was completed. Analysis of data from the Shardy Base horizontal transect has been completed. Measured properties include: bulk density, porosity, saturated hydraulic conductivity, and sorptivity. Water characteristic curves have also been measured. This activity has been expanded to include an intensive 2-D sampling grid which is being used to investigate vertical and horizontal trends in bulk and hydraulic properties. Approximately 300 1" core specimens were collected in a series of 26 vertical transects arranged across a horizontal transect approximately 2500 ft. long.

In support of supporting calculations for postclosure performance analysis, a welded core sample, 1.5 inches in diameter, was initially saturated and then evaporated to attain various water contents. Water potential was determined using the CX-2 at each water content to develop a moisture retention curve. A Brooks and Corey model was successfully fit to the data. Additional core samples are being prepared for moisture retention and an experimental procedure is being developed to see if the particle size of rock chunks has an influence on the measured water potential. Imbibition and moisture retention were completed on the composite transect samples. All remaining core from the UZ-6 transect are undergoing imbibition experiments.

#### WBS 1.2.3 - SITE INVESTIGATIONS

The precipitation and meteorological monitoring project reports that March was one of the wettest months on record in southern Nevada, increasing the yearly rainfall total at the Nevada Test Site to well above normal. Five major storm systems moved through the region. Rainfall amounts were variable around Yucca Mountain depending on location and elevation. All five systems appeared to be the result of a split in the jet stream causing low pressure centers to develop off the coast of southern California. This type of storm track is the most likely to produce heavy precipitation in the southern Nevada region. Preliminary analysis shows that nearly 3 inches fell over portions of Yucca Mountain. The storm of March 30 produced widespread lightning throughout southern Nevada. The data were collected and archived for future study in relation to precipitation patterns. Lightning was observed near Yucca Mountain and in Jackass Flats. Accumulation of rainfall data was collected after each event. The data were compared with surface-water data and provided runoff characteristics for storms which occurred both on and off the Test Site. Three separate measurements were made on the Amargosa River at Tecopa station 10251300, ranging in discharge from 150 to 170 cfs. Measurements made on the Test Site include a series of four, made at the Unnamed Tributary to Fortymile Wash near Rattlesnake Ridge, Station 10251248. Discharges range from 1.5 to 2.5 cfs. Water samples were taken and a schedule, 1904 and 39A, is being processed at the USGS Denver lab. Local runoff from Jackass Flats, Area 25, was measured at Topopah Wash at Little Skull Mountain, Station 10251260. The measurement was made 30 miles upstream of the gage. A discharge of 1.5 cfs was obtained on

March 30.

Staff from the transport of debris by severe runoff studies conducted reconnaissance in southern Nevada to determine if any debris had moved as a result of severe storms in February and March. March storms were particularly heavy and produced intense precipitation, hail, and flooding. On March 30th a funnel cloud touched south of Las Vegas and golf-ball size hail pelted the area. Heavy rain during the March 26-27 storm resulted in severe runoff and flooding in those parts of the valley where the brunt of the storm system was positioned. Streamflow and erosion was particularly heavy along Las Vegas Wash to the east and along its major tributaries, as well as in places where city streets act as conduits that drain flood waters from the large alluvial fans surrounding the valley. Areas of highest runoff were reconnoitered to look for evidence of heavy debris transport. Along the Amargosa River, only minor streamflow and no evidence of intense debris transport were recorded.

In support of studies on regional potentiometric levels and hydrologic properties, field reconnaissance was performed for additional mining company drillholes constructed in the Funeral Mountains and Greenwater Range. Water levels were measured in nine observation wells in the southern half of the subregional groundwater flow system.

Analysis of rock outcrop samples in support of the characterization of hydrologic properties of surficial materials has been extended to incorporate at least two more transects. Along with the Prow transect, an additional transect, collecting over 300 samples in the Shardy Base of Tiva Canyon along the west side of Yucca Ridge in Solitario Canyon, was conducted this month. To investigate the relationship between vertical and horizontal variability in this seemingly very deterministic lithologic unit, 26 vertical transects of 10- samples over the 35 foot thick unit were collected over a 4000 foot distance along the unit to create a 2-D dataset. Moisture retention data on the horizontal transect of the Shardy Base indicate a fairly uniform air entry potential of about 0.5 bars which will be used for modeling purposes. Imbibition experiments on that dataset indicate quite a lot of variability, which corresponds with the variation in porosity shown vertically in the unit.

The natural infiltration project reports that the analysis of moisture profiles for selected boreholes in Pagany Wash and 40-Mile Wash, and also for the newly installed boreholes, continued as additional data were collected. The boreholes were logged at an increased frequency because of the much higher than average magnitude and frequency of precipitation that occurred for January, February and March. The series of moisture profiles obtained indicated that the downward movement of a well defined wetting front to a depth of approximately 2 meters for the newly installed

boreholes and for the boreholes in Pagany Wash, while the two boreholes in 40-Mile Wash, N-92 and N-91, indicated a greater volume of infiltrated water to a depth of 4 to 5 meters. These profiles will be useful as a means of model validation for the small scale deterministic modeling activity, as well as for inverse modeling, specifically in terms of the upper surface layer and the ET boundary condition, because relatively accurate measurements of precipitation depths were made at each borehole site using a storage gage. Logging of the selected boreholes at weekly intervals will continue in order to measure changes in moisture profiles due to evapotranspiration. This work will be valuable in understanding both hydrologic processes and material properties within the upper 2 meters of surficial materials. Installation of boreholes N-17, N-15 and N-16 in Pagany Wash was completed despite a significant amount of downtime due to adverse weather conditions.

In support of matrix hydrologic properties testing, saturated hydraulic conductivities were measured on approximately 70 samples from the composite transect. These samples were assembled to provide representative core plugs from all of the lithologic units in the unsaturated zone at Yucca Mountain. Permeabilities are being run on deeper Calico Hills core samples from the GU-3 borehole. Additional samples have been selected for intersampling from the LEXAN liners to make additional measurements supplementing the dataset from the can samples. As the neutron probe calibration equation efforts have progressed, it was seen as necessary to remove all of the water from the rock samples by heating to very high temperatures and it was shown that some of the units do maintain quite a bit of stored water when dried at only 105 C.

In support of prototype infiltration testing, an imbibition experiment on a welded tuff (diam. = 53mm; length = 127mm) core sample was begun on February 5 and ended on March 9. This test was designed to study the effect of fracture mineral coating on the water imbibition process. Approximately 10 cubic cm of water were imbibed into the sample through an area of 22 squared cm. The ponding test, begun on October 28, 1991, continued. The water front has moved about 40 to 45 cm in the fractures and 5 to 10 cm in the matrix surrounding the fracture. The water movement in the fractures is not as fast as originally expected. Eight out of the eighteen thermocouple psychrometers are showing an increase in water potential (and saturation). The potential level is still detectable with the psychrometers; therefore, this stage will continue longer than originally expected.

To determine scoping and bounding calculations for use in the development of conceptual and numerical models of flow in unsaturated zone fractured rocks, steady flow within a network of five 125 micron and four 25 micron fractures was simulated for constant head boundary conditions ranging from 0.0 to -0.25 m of water in order to examine the dependence of pressure head variation and flux distribution within the network to the assigned boundary

conditions. It was observed that variance in pressure heads within the network increased and flow became more concentrated along specific pathways as pressure heads imposed at the boundaries deviated from the pressure heads at which the transmissivities for the two fracture sizes were equal. Continuum properties such as permeability were calculated for the network. Future simulations will consider the effects of various matrix materials on the observations made to date.

To conceptualize the unsaturated zone hydrogeologic system, LBL modelers are utilizing current USGS geologic and hydrologic data from neutron boreholes in the construction of a 2-D cross section model using TOUGH. When the model is completed, it will be used to conduct sensitivity analyses to identify important hydrologic parameters and to begin to investigate grid effects on moisture flow.

In support of the simulation of the natural hydrologic system, in order to facilitate the check of the 3-dimensional grid, the surface of the site-scale model has been divided into 3 zones, depending on the types of horizontal connections between the elements. These are: 1) regular elements without any contact with fault elements, 2) fault elements connected to another element that may or may not contain a fault, and 3) elements without fault but connected to a fault element. The connections between the group 1 elements have been checked; the connections between group 2 and 3 elements are being verified. Simulations with a 2-D cross section have begun in order to assess the effect of the numerical grid by the Ghost Dance Fault.

Staff from the prototype tracer testing project gave priority to coordinating the final design, acquisition, and installation of the gas tracer monitoring system at the Nevada Test Site. This monitoring system is needed for drilling which is currently scheduled to begin in April.

The prototype pore water extraction project reports that eight tests were conducted on welded and partially welded tuffs with moisture contents ranging from 5 to 22 percent. The loading method was continuous for some samples and staged for some. Staged versus continuous compression gives similar results in strain and water obtained for nonwelded tuffs, but data is incomplete for welded tuff. Comparison tests were run between nonwelded core samples and nonwelded rock chips from nearly the same interval. The chips had an average moisture content of 9.7 percent and produced an average of 15.8 ml of water and 125.5 ml of gas. The similar core averaged a moisture content of 8.6 percent and produced an average of 1.8 ml of water and 90.1 ml of gas.

In support of multiple-well interference testing, it is intended that planned hydraulic and tracer tests planned for the c-holes be prototyped at the Raymond site (Raymond Quarry near Fresno, CA).

Three 250-foot deep boreholes were drilled at the Raymond site. The boreholes were configured in a triangle similar to the c-holes, with a distance of 25 feet between each pair of wells. Preliminary hydraulic testing was conducted using the newly drilled holes. Well (0-0) was pumped, under open-hole conditions, while the pressure drawdown was monitored in two packer-isolated zones of each of the other two wells (SE-1 and SW-1). The process was repeated by pumping well SW-1, while observing the pressure drawdown in wells (0-0) and SE-1. Results have not been analyzed yet, but indicate a very good hydraulic connection between the wells.

To support the hydrochemical characterization of water in the upper saturated zone and regional hydrochemical characterization studies, water samples were collected for stable and radioisotope determinations. Samples were collected near the end of pumping of borehole JF-3, under the aegis of the environmental monitoring program; and from borehole UE-25 UZN #91.

In support of the conceptualization of saturated zone flow modeling activities, analysis was completed of existing data at the UE-25 c-well complex, compiling television and acoustic televiewer logs, caliper logs, core analyses, tracejector surveys, temperature logs, static tracer tests and heat-pulse surveys into a conceptual geologic model. This conceptual model is ready to be input to a GIS, probably the LYNX system; however, further work is on hold pending purchase, lease, or loan of the GIS software.

Staff of the isotope geochemistry support group continued work in support of stratigraphic studies, sampling cuttings from JF-3 and core from J-13, at the YMP core library. Samples will be used to further establish the isotope data base on different stratigraphic units and to compare 87/76 Sr ratios obtained from the rocks with 87/86 Sr ratios obtained from waters collected within the same stratigraphic units.

The surface-based geophysics project reports that compilation and technical review of previously acquired gravity and magnetic data from Fortymile Wash is complete. A report providing these detailed data along five profiles across Fortymile Wash just east of Yucca Mountain has been submitted for technical review. The report is primarily a data release but concludes that no significant vertical offset of geologic units occurs directly under the Wash. A gravity anomaly of approximately 2 Mgal, however, is associated with the Paintbrush Fault just west of Fortymile Wash, suggesting that the gravity method could provide an effective means to better define the location of known or suspected faults and to locate completely unknown faults, especially those concealed by alluvium.

In support of borehole geophysical surveys, the evaluation of commercially available downhole electrical logging methods in comparison tests between Dresser-Atlas and Schlumberger in logging

runs in USW G-2 continued. This evaluation and formulation of recommendations is 80 percent complete and will include consideration of a variety of logs and different models of logging tools for acquisition of each log type, including older model tools to facilitate comparisons to logging runs made in Yucca Mountain holes in the early 1980's.

Staff from the geologic mapping of zonal features project continued high-precision Sr isotopic analyses of outcrop samples (from the volcanic section in the southern portion of Yucca Mountain) which are assumed to never have been positioned below the water table. These analyses are being compared to completed 87/86 Sr ratios from core samples collected below the Topopah Spring member to assess the amount of Sr modification caused by hydrothermal alteration. Mapping and measurement continued of fault characterization parameters along and within the Ghost Dance Fault on Yucca Mountain. Work during this period took place in the area south of Whale Back Ridge. This work utilizes the rectilinear grid laid out and reported earlier, which will allow collection of numerous types of information on a consistent foundation grid. These efforts will characterize a large number of parameters along the fault which will be integrated into the geologic model. Outcrops were visited in the basal Tiva Canyon/uppermost Topopah Springs in northeastern Crater Flat where a well exposed rollover flexure was discovered.

In support of regional paleoflood evaluation studies, staff worked on a longitudinal stream profile of the modern-day Amargosa River from upper Fortymile Wash to Bad Water in Death Valley, California. The profile, when complete, will show the slope of different reaches of the river system and any breaks in slope that might be related to bedrock barriers or channel adjustments due to changes in past flow regimes. Additional longitudinal profiles will be drawn on river terraces parallel to the channel to show the geometry of the river's paleofloodplain. Field reconnaissance was conducted of alluvial fans along the west margin of the Las Vegas valley to determine whether these landforms were remnants of past environmental conditions, or if they are still active today. Although flooding in the valley (March 26-27 and 30) has shown that the fans are currently active, the presence of very well developed soils, especially in the upper fan (apex) areas, indicates surface stability. Thus, it appears that while the upper parts of the fans may be quite stable, the lower (toe) areas may still be developing. A visit to the source area of the 1990 Copper Canyon mudflow disclosed some valuable evidence of paleofloods and paleo-debris-flows in that drainage. Stratigraphic exposures were discovered that include volcanic-ash deposits, organic debris, and charcoal within various stratigraphic units. This should allow the best opportunity discovered thus far for dating these types of deposits. One of the major objectives of this dating will be to see how important the Holocene is in terms of its debris-flow history. Copper Canyon now appears to be a very important site with good

potential for development of a debris-flow history based on absolute dates.

The past discharge project reports that field trips to modern discharge springs have been expanded to test whether ostracodes and other aquatic microorganisms are found living in the aquifer. In early March, the aquatic microorganism collector was tested at well JF-3 which is 0.5 miles south of J-12 in Area 25. This well was pumping 234 gallons per minute for 36 hours. For 22 hours, 20 gallons per minute was diverted through the aquatic microorganism collector during the time of collection. Although JF-3 was pumping about 10 percent air, which was probably introduced into the aquifer during well development with high pressure compressed air, the undisturbed aquifer may not have been oxygenated. Preliminary analyses of the collection nets in the field indicated that no organisms were present and final analysis of the net contents will be completed in April.

To assist in the evaluation of possible future changes in climate, preliminary testing was begun of remote sensing techniques used for regional mapping of vegetation using Landsat Thematic Mapper data. Methods involved red/infrared ratios, normalized difference vegetation indices, soil-adjusted vegetation indices, and perpendicular vegetation indices. The most suitable methods will be used for vegetation mapping in the region (3 degree by 3 degree) area.

The soil and rock properties project reports that the USGS schedule assumed that field and laboratory testing would begin in mid-November, but failure to complete the Test Planning Package and begin North Ramp soils investigations until March may result in slippage of dependent activities including an impact on Title II design. Soils investigations began on March 2. Approximately 50 percent of the excavation of planned test pits and in-place testing is complete. Reconnaissance of areas to be mapped is also underway. The first design data submittal to Raytheon Services Nevada was made March 16. QA/Level 1 soil and rock properties (engineering data) are reviewed as acquired and submitted to RSN for use in the design process for surface facilities.

Staff from the site flood and debris hazards studies report that a significant storm March 7-8 caused renewed runoff in the Las Vegas area and along the lower Amargosa River near Tecopa. Reconnaissances of the Amargosa River in February showed that no flow from the upper basin to Death Valley Junction had occurred. Again, some light runoff from the Carson Slough area flowed through Franklin Plaza and downstream past Eagle Mountain. That flow, combined with more local runoff downstream, caused more flow to Death Valley. The magnitude of flow to Death Valley seemed similar to that of February 12-15. Peak flows were documented. Flooding of the Salt Pan, near Badwater in Death Valley, expanded as a result of the fresh water input. No intense flooding in Death

Valley was noted. An intense storm in Las Vegas on March 23-24 caused flooding in the Las Vegas valley, but did not cause flooding or surface streamflow at Yucca Mountain. Similarly, flooding did not occur in Death Valley and runoff in the lower Amargosa River was mild.

WBS 1.2.5 - REGULATORY & INSTITUTIONAL

In support of water resources assessment studies, well JF-3 pumping took place on March 4-5. Pumping discharge of well JF-3 was continuously monitored and recorded during pumping. Some water quality parameters were continuously monitored and periodically recorded manually. Manual water level measurements were made with an electric tape at varying intervals prior to, during, and after pumping. Observations of flow meter and flume gage-height were made and recorded. Four complete water quality samples were collected at 11 hours, 22 hours, and 34 hours after pumping started. Duplicate samples were collected at the 34-hour sampling. Total pumping period was 36 hours. Preliminary test results indicate that the drawdown in well JF-3 was about 1 1/2 feet. No drawdown was detected in well J-12.

Sincerely,



*for* Larry R. Hayes  
Technical Project Officer  
Yucca Mountain Project  
U.S. Geological Survey

cc: D. Appel, USGS/Denver  
J. Blakey, USGS/CR  
T. Blejwas, SNL/Albuquerque  
M. Brodeur, SAIC/Las Vegas  
R. Bullock, RSN/Las Vegas  
D. Campbell, USBR/Denver  
J. Canepa, LANL/Los Alamos  
T. Chaney, USGS/Denver  
T. Conomos, USGS/WR  
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R. Craig, USGS/Las Vegas  
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R. Dyer, DOE/YMPO/Las Vegas  
L. Ducret, USGS/Denver  
W. Dudley, USGS/Denver  
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J. Weeks, USGS/Denver  
R. Wesson, USGS/  
YMP-USGS Local Records Center File 1.1.02



neutron logging of drillhole N-91 in upper Fortymile Wash were discussed. Water levels in N-91 (detected with a well scander) rose following two precipitation/flood events; however, soil moisture increased in N-91 in only the top 5 meters of the unsaturated zone, well above the saturated zone. This suggests possible movement of water through fractures (or some other mechanism) that could not be detected using neutron logging in N-91.

Staff from the Fortymile Wash recharge study read rain wedges at and neutron logged UE-25 UZN#85, UE-25 UZN#92, and UE-29 UZN#91. Depth to water measurements were made in UE-29 UZN#91, UE-29 a#1 and UE-29 a#2. The data collection frequency was increased to document an ongoing recharge event. While measuring depth to water in UE-29 a#1, water was heard dripping in the casing indicating further support for groundwater recharge from the recent rain and runoff. Runoff observations, precipitation data, neutron logging results, and depth-to-water measurements were discussed with several staff members.

The surface based borehole studies project reports that preparations for instrumenting UZ-16 (VSP borehole) continued. A geophone cable mounting bracket was designed and a prototype built. RSN has been tasked to develop its own version. A meeting was held to discuss requirements and costs for conducting a zero effort, VSP survey of UZ-16 as part of the standard borehole logging program. The start date for drilling UZ-16 is still unknown. Temporary (summer) staff have been hired to assist with well sitting duties. Sensors for the first hydrologic instrumented borehole, probably UZ-14, have been ordered, with delivery scheduled for May. An inventory of bulk materials and supplies for instrumenting USGS and SNL boreholes was forwarded to REECO. Inventory includes pricing information and should be adequate to support REECO budgeting needs. A meeting was held with REECO to assess their interest in fabricating the Downhole Instrument Station Apparatuses (DISAs) and in constructing a cable-spooling rack to support the UZ borehole instrumentation program. Several machine shops in the Denver area were visited to evaluate capabilities and interest in fabricating the DISAs. Mass production of the DISAs needs to get underway within the next few months.

In support of vertical seismic profiling activities, all Yucca Mountain model data has been wave mode separated and deconvolved using both one signature (extracted from the zero offset data) for the whole data and 24 different signatures (one for each shot gather). All the P-mode data were migrated several times (using different parameters) in order to improve the quality of the stacked image. The P-P migration procedure was run for the 24 offsets in the following ways: 1) after deconvolving the whole set of data using one different signature for different offsets; 2) after deconvolving the whole set of data using a single signature coming from the zero offset data; 3) without any deconvolution; 4)

processing flow, as well as the best parameters, for good image achievement. Preliminary results indicate that a good image of the Yucca Mountain Model is able to be generated.

In support of the development of conceptual and numerical models of flow in unsaturated zone fractured rocks, fracture network simulations were completed that examined the variability in pressure head and flux distribution in a network of variably saturated fractures as a function of the boundary pressure head. The most general conclusions to be drawn from the study are that pressure head variability increases as the boundary pressure head deviates from the pressure head at which the permeability-thickness products of the individual fractures are equal (the cross-over pressure head) implying that, in general, pressure head will vary considerably in unsaturated fractured rock, even under steady flow conditions. Furthermore, the locations of specific pathways along which liquid flow is concentrated depends on the boundary pressure head in the rock. In general, flow becomes more concentrated along specific pathways as boundary pressure head deviates more from the cross-over pressure head. Much of the month was spent in analyzing these fracture network simulations and summarizing the work and results in a draft report, "Numerical Investigation of Steady Liquid Water Flow in a Variably Saturated Fracture Network". This report was not planned at the beginning of the year, but the work and results are thought to be significant enough to take precedence over other planned activities.

The prototype tracer testing project reports that the location of equipment and sampling points for injection and monitoring of SF<sub>6</sub> were determined. This temporary injection and monitoring system is similar to the methods employed at Apache Leap.

In support of prototype pore water extraction testing, four UZ core were cut and prepared for compression. Four core (2 welded, 2 nonwelded) with moisture contents ranging from 4.17 to 6.11 percent were compressed using the high pressure one-D compression cell. Water obtained from the tests ranged from 0 to 5.1 ml and the degree of success ranged from 0 to 36.7 percent. This phase of testing using the high pressure cell was completed on April 27. To develop the compression method for extracting pore-water, tests were performed on chips and cores of the same composition and water content. Nitrogen gas was used to purge the cell of atmospheric gas contained in the voids between chips so that CO<sub>2</sub> gas collected during squeezing is known to be from pore gas. This testing was completed April 30.

In support of site potentiometric level evaluations, the effect on the water level of the April 22 earthquake in southern California was investigated. The water level in the upper zone fluctuated less than a foot. Pressure changes were recorded in the lower interval, but the total range could not be determined.

Staff from the multiple-well interference testing project wrote a contract to drill six more wells at the Raymond Quarry site, near Oakhurst, California. It is intended that the hydraulic and tracer tests planned for the c-holes be prototyped at the Raymond site. The six wells are laid out to allow for the study of the dependence of the hydraulic parameters (obtained from the cross-hole testing) on "scale", or the distance between pumped and observed wells.

Staff from the stratigraphic studies project analyzed a suite of samples from G-4 drill core for Sr initial isotopic ratios in order to substantiate the isotope composition vs. depth variations observed previously in samples from UE-25a drill core. Data have not yet received final reduction and interpretation; however, the large range of present-day Sr isotopic ratios offers encouragement for use of this technique as a stratigraphic tool in the Topopah Springs welded and lithophysal units cooperative study of the potential repository horizon with LANL).

In support of surface based geophysics activities, compilation and technical review of previously acquired gravity and magnetic data is complete. A manuscript, "Gravity and magnetic data of Fortymile Wash, Nevada Test Site, Nevada", was submitted for USGS Director's approval. This report shows a shallow-source magnetic anomaly directly over the Wash which does not appear to be related to topographic or magnetic terrain effects. The cause of the anomaly may be fluvial basalt debris carried downstream from the basalt flows at Dome Mountain.

In support of borehole geophysical surveys, an open-file report is in USGS review, which assesses logging results by Atlas Wireline and Schlumberger from borehole G-2. This report provides recommendations for use of specific logging tools in applications at Yucca Mountain. No appreciable differences were found between density and dielectric logs from the two suppliers. Induction logs continue to be difficult to obtain in the high-resistivity welded tuff, but Schlumberger's 40kHz tool offers a higher signal/noise ratio that should provide an operational advantage. Schlumberger's sidewall epithermal neutron technique provided good porosity estimates in both water and air-filled boreholes, with no offset as the tool moved through the water/air interface. This is a real advantage, as neither the Atlas nor Birdwell tools are calibrated to provide porosity estimates in air-filled boreholes. Neither supplier provided K, U, and Th estimates from spectral gamma-ray logging that agreed satisfactorily with core analyses.

Staff from the geologic mapping of zonal features project completed Sr isotopic analysis of five Hcl-leaches from playa samples collected in November, 1991.  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios ranged widely. Analysis of residues from these same samples is still pending. These samples also were resubmitted for acetic acid leach/residue chemistry to compare the effects of weak acid attack. This study is intended to investigate the links between Sr isotopic

compositions of rock units and the eolian component in soils. Mapping and measurement continued of fault characterization parameters along, and within, the Ghost Dance fault. More than 50 percent of the mapped area has some rock exposure, allowing very detailed mapping. Data acquired so far describe north-trending fractures associated with the Ghost Dance fault in a zone up to 200 m wide. A second set of fractures oriented 20 to 40 degrees west is present in some locations. The exposures have required differentiation of Quaternary colluvium into two subdivisions to better communicate the geological information being mapped. Field mapping is underway in Crater Flat, west of Yucca Mountain. Initial results suggest structure similar to Yucca Mountain, with northward-decreasing offsets on north-trending normal faults and northward increase in left-lateral oblique slip. Exposures of the wall of the Claim Canyon caldera segment have been located. A well-defined arch, separating the structural domains of the Bullfrog Hills and northern Crater Flat was identified.

In support of past discharge studies, ostracodes were picked from four sites in the Oasis Valley: Coffey Ranch, near house; Coffey Ranch picnic area; Goss Spring; and Bailey's Hot Springs (Burro Springs). Ostracodes were also present in samples from Red Rocks Park area from Whiterock Spring and Willow Spring. Ostracodes were collected from three springs in the Spring Mountains: Cave Spring, Grapevine Spring, and Deer Creek Spring. Ostracodes were present at the spring pond at Indian Springs, Nevada. Samples of material collected from JF-3 in the microorganism collector in early March were examined under the microscope. Sand grains, paint chips, and nylon rope slivers were found in the material. Unfortunately, no remains of living organisms were found in this sample, although 26,400 gallons of water passed through the microorganism collector. Small, dark, round, glassy, ball-like material, perhaps "tekites", were in the sample.

In support of regional paleoflood evaluation studies, work progressed on longitudinal stream profiles of the modern-day Amargosa River from upper Fortymile Wash to Bad Water in Death Valley, and on drainages in the Goodsprings, Nevada (Potosi Mountain) area that are sites of recent (1990) debris flows. When complete, these profiles will show the slope of different reaches of the drainages and any breaks in slope that might be related to changes in flow regime or climatic conditions. In the Potosi Mountain area, four debris flows that occurred along ephemeral streams may provide evidence of the influential effects of channel slope and surface geology. Each of the debris flows appears to have been generated along steep tributary streams, and to have flowed out onto older gentle sloping fans before coming to a stop. The relationship between debris flow processes and landscape characteristics are important to our understanding of regional paleoflooding and the development of alluvial surfaces. Reconnaissance continued of alluvial fans along the west margin of Las Vegas valley to determine if these landforms are remnants of

past environmental conditions, or if they are currently active. Initial analysis indicates that 1) recent floods have stripped parts of the older fan surface and soil prior to burial, and 2) fan building is an active and ongoing process in the Las Vegas valley today - hypotheses supported by observations of flooding, channel erosion, and debris transport and deposition that occurred along modern drainages during the heavy rains of March, 1992.

Staff working on the development of a geomorphic map of Yucca Mountain started an erosion rate study of dated colluvial boulder fields. An analytical stereoplotter is being used to calculate a planar surface on the boulder fields and to collect a digital terrain model from the channels that cut the fields. The difference between these two surfaces, along with dates for the rock varnish from the surface of the fields, will be used to calculate a long-term erosion rate for the mountain.

The site flood and debris hazards project reports runoff continued into the first week in April from the wet weather pattern in southern Nevada that began in mid-February and continued throughout March. The final storm of this wet weather episode occurred on March 30 in the Las Vegas valley and moderate flooding resulted. The southern part of the valley was hardest hit, as in previous storms. Serious environmental damage to the lower Las Vegas Wash occurred during this final phase of storms and runoff. The lake that had been forming in Death Valley as a result of Amargosa River flows during February and March had totally evaporated by April 23. This evaporation was documented by photographs taken from Dante's View. None of the accumulation of water in Death Valley was contributed from Yucca Mountain or Fortymile Wash. No runoff occurred in the Yucca Mountain area that was able to reach the Amargosa River drainage.

Staff from the current seismicity project report that the seismic network's computer detected 45 local earthquakes for the month of April, down from 64 for March, and 99 in February. April's seismicity includes diffusely distributed earthquakes in the southern Nevada Test Site area, some of which are associated with the Rock Valley left-lateral fault system; a few earthquakes in the Pahranaqat Shear Zone south-southwest of Alamo, Nevada; a few at Grapevine Mountains, Nevada and California; one southwest of Hiko, Nevada; two in the Amargosa Desert; several in the eastern part of the Panamint Range, California; and a few elsewhere in the southern great basin (SGB). The largest SGB earthquake occurred in the Reville Range, Nevada, on April 17. Few areas that had been previously aseismic exhibited seismicity in April. No SGB earthquake in April was large enough to provide good constraint of P-wave polarities for attempting focal mechanism solutions.

In support of Midway Valley studies, approximately 17 soil pits were excavated; soil horizon logs have been completed in 6 of the pits. An appendix was written to the Midway Valley criteria letter

requesting support for cleaning and logging Trench 17, excavating Trench A-3, and excavating a box trench on the Bow Ridge fault at Trench 14d.

Staff working on the evaluation of Quaternary geology and potential faults at Yucca mountain obtained previous mapping along the Solitario Canyon fault, the Fatigue Wash fault, and northern Windy Wash fault for compilation. A structure map of southern Yucca Mountain was prepared from unpublished geologic mapping. Data from these sources will be compiled on the final fault map.

Staff evaluating the age and recurrence of movement prepared a criteria letter requesting three new trenches on the Stagecoach Road fault and one new trench on the Solitario Canyon fault. Also requested were extensive cleaning of natural outcrops on Busted Butte and cleaning of Trench CF-1 on the Fatigue Wash fault. Trench localities were selected and flagged in the field.

**WBS 1.2.5 - REGULATORY & INSTITUTIONAL**

In support of water resource monitoring, ground water levels were measured at 27 sites, with ground water discharge measured at one flowing well. Conversion of well JF-3 to the final monitoring configuration was initiated on April 15 and monitoring strings were installed on April 20. Preliminary evaluation of data on ground water quality collected to date (with respect to constituent concentrations, variability of parameters, and areal coverage) began.

Sincerely,



*for* Larry R. Hayes  
Technical Project Officer  
Yucca Mountain Project  
U.S. Geological Survey

cc: D. Appel, USGS/Denver  
J. Blakey, USGS/CR  
T. Blejwas, SNL/Albuquerque  
M. Brodeur, SAIC/Las Vegas  
R. Bullock, RSN/Las Vegas  
D. Campbell, USBR/Denver  
J. Canepa, LANL/Los Alamos  
T. Chaney, USGS/Denver  
T. Conomos, USGS/WR  
J. Cook, USGS/SR  
R. Craig, USGS/Las Vegas  
J. Docka, Weston/Washington D.C.  
✓ R. Dyer, DOE/YMPO/Las Vegas  
L. Ducret, USGS/Denver  
W. Dudley, USGS/Denver  
D. Faust, TESS, Las Vegas  
D. Gillies, USGS/Denver  
R. Hirsch, USGS/Reston  
✓ V. Iorii, DOE/YMPO/Las Vegas  
C. Johnson, TESS/Las Vegas  
K. Krupka/PNL  
R. Lowder, MACTEC/Las Vegas  
R. Pritchett, REECO/Las Vegas  
R. Ritchey, USGS/Denver  
E. Roseboom, USGS/Reston  
D. Russ, USGS/  
J. Sauer, USGS/NR  
V. Schneider, USGS/Reston  
M. Siegel, SNL, Albuquerque  
✓ A. Simmons, DOE/YMPO/Las Vegas  
R. St. Clair, TESS, Las Vegas  
T. Statton, TESS, Las Vegas  
N. Trask, USGS/Reston  
B. Viani, LLNL/  
J. Weeks, USGS/Denver  
R. Wesson, USGS/  
YMP-USGS Local Records Center File 1.1.02



1-327029UP

# United States Department of the Interior



GEOLOGICAL SURVEY

MAY 8 2 20 PM '00

WATER RESOURCES DIVISION  
333 West Nye Lane  
Room # 203  
Carson City, NV 89706

May 5, 1992

Mr. Carl P. Gertz, Project Manager  
Attn: Ms. Wendy Dixon  
U. S. Department of Energy  
Yucca Mountain Project Office  
P.O. Box 98508  
Las Vegas, NV 89193-8608

Dear Ms. Dixon:

Enclosed is the monthly status report for the Water-Resources Monitoring Program. This report is for the period April 1 - April 30, 1992.

If any clarification or additional information is needed, please don't hesitate to call me (at 702-887-7600).

Sincerely,

Richard J. La Camera  
Hydrologist

Enclosure

cc/w enc:

- Kathleen Grassmeier, DOE/YMPO, Las Vegas, NV
- Gregg Fasano, SAIC, Las Vegas, NV
- Raye Ritchey, WRD, Denver, CO
- Dan Gillies, HIP, Denver, CO
- Dave Beck, WRD, Las Vegas, NV
- Craig Westenburg, WRD, Las Vegas, NV

- cc: DIXON
- cc: Grassmeier
- cc: Wilson
- cc: Dyer
- cc: Schnecko
- cc: R. White
- cc: Gertz - up
- cc: Jones
- cc: \_\_\_\_\_

REC'D: WRP

5/8/92

ENCLOSURE

**Yucca Mountain Project  
USGS Monthly Status Report  
March 1992**

**Project Title:** Water-Resources Monitoring

**WBS Number:** 1.2.5.4.8. G

**Summary Account #:** CG54892B

**Project Chief:** Richard J. La Camera, U.S. Geological Survey (USGS), Water Resources Division, Nevada District

**Reporting Period:** April 1-30, 1992

**Section I. LATEST REVISED FUNDING ESTIMATE FOR FY 92:** Not Revised.

Operating: \$ 529,000

Capital Equipment: \$ 27,000

**Section II. PROGRESS AGAINST PLANS/SCHEDULE:**

**A. Schedule Status:** See attachment 1.

**B. Narrative of Progress and Work Performed:**

**1. 3GWR011 Survey Monitoring Sites**

Land surveys of reference points at two monitoring sites were conducted to permit the calculation of water-surface altitudes. Surveys have now been conducted for twenty two of twenty four sites at which the need for surveys have been identified.

**2. 3GWR0001 Ground-Water Level/Springflow Monitoring FY-92**

Ground-water levels were measured at twenty seven sites. Ground-water discharge was measured at one flowing well. Water level and discharge data were checked and filed, and data entry into computerized USGS databases was initiated. Responses to technical-review comments on the procedure for measurement of discharge using flumes, weirs, and barrels (HP-54) were prepared as per QA requirements.

**3. 3GWR010 Aquifer Pump Test JF-3**

Checking, reviewing, and entering of data into computerized USGS databases was initiated. The data includes continuous water-level, periodic water-level, pump discharge, and water-quality data collected at wells J-12 and JF-3 before, during, and after drilling and pumping of well JF-3.

**4. 3GWR013 Instrument JF-3**

Conversion of well JF-3 to the final monitoring configuration was initiated by the DOE contractor on April 15. USGS personnel were onsite to observe pump removal on April 15 and 16, and monitoring strings were installed on April 20. Placement of a cement pad around the well by the DOE contractor and subsequent calibration and installation of water-level monitoring equipment by USGS are scheduled for early May.

5. **3GWR006 Ground-Water Monitoring Report, 2nd Quarter FY-92**

Water level and discharge data collected during the second quarter of FY 92 were reviewed and compiled, and report preparation was begun.

6. **3GWR014 Capital Equipment Procurement**

Monitoring equipment for well JF-3 was received. Development of specifications and selection of an appropriate mobile water-quality lab began.

7. **3GWR004 Ground-Water Quality Data Collection**

Water-quality measurements and samples were collected at three wells. Samples were shipped to the USGS National Water-Quality Laboratory. The scientific notebook for water-quality monitoring (HP 225T) was closed, as per QA requirements, following approval and implementation of HP 225 for water-quality measurements. The measurements and samples collected complete this activity, which entailed the first, semi-annual measurement of water quality at ten sites.

8. **3GWR016 Water-Quality Network Revision**

Preliminary evaluations of data on ground-water quality collected to date (with respect to constituent concentrations, variability of parameters, and areal coverage) began. Documentation of the network, and any revisions, will be based on such analyses and was not warranted at this time.

9. **3GWR017 Water-Level Monitoring Network Revision**

DOE is considering USGS recommendations to improve data-collection capabilities at several network sites. A revision of the water-level and springflow monitoring network was not warranted at this time.

10. **3GWR018 Consult on Revision to EFAP**

Based on discussions with SAIC personnel, there is a need for revision of the EFAP in FY 92. Also as per those discussions, USGS consultation regarding content of the EFAP will begin upon initiation of revisions by SAIC.

11. **3GWR015 Calibrate Water-Level Equipment**

Electric tapes were checked for accuracy against a reference steel tape tape utilized by site-characterization investigations in December 1991. Calibration checks of continuous water-level monitoring equipment installed in wells J-12 and JF-3 were conducted in December 1991 and February 1992.

**C. Variances/Problems/Notes:**

1. **3GWR011 Survey Monitoring Sites**

Activity has been limited due to priority of water-level and water-quality monitoring. Impact on project is minimal since water-level data are measured as depths below a specific measuring point (and can be converted to water-surface altitude after surveying is completed).

2. 3GWR0001 Ground-Water Level/Springflow Monitoring FY-92

Water-level data were not collected at Army Well 1 due to a lack of access to the water surface.

3. 3GWR010 Aquifer Pump Test JF-3

The actual pump-testing of well JF-3 is complete. This activity, however, will not be listed as completed until water level and well-discharge data have been checked, reviewed, and processed into computerized USGS databases. Completion of data processing is planned in July. Although relocation of USGS offices, priority data-collection activities, and complications related to data processing (such as reformatting of data and proper identification of data in the database) have delayed entry of the data collected into computerized databases, the delay will not impact monitoring activities.

4. 3GWR013 Instrument JF-3

Installation of an instrument shelter and calibration and installation of water-level monitoring equipment will occur after the placement of a cement pad around the well by the DOE contractor. Construction of the pad, installation of the shelter, and calibration and installation of water-level monitoring equipment are currently scheduled for completion by mid-May. In the interim, continual monitoring of water levels in well J-12 (which the NTS has cooperatively kept in a non-pumping status) has been maintained, and that well will provide for monitoring of water levels between pumping well J-13 and Amargosa Valley.

5. 3GWR006 Ground-Water Monitoring Report, 2nd Quarter FY-92

None.

6. 3GWR014 Capital Equipment Procurement

Selection and receipt of an Interior vehicle may not occur by the end of the fiscal year. Receipt of such a vehicle is a prerequisite to the design, selection, and procurement of modifications to provide for a mobile water-quality lab. Should delays in obtaining a vehicle which preclude procurement of the mobile lab before the end of the fiscal year occur, other USGS vehicles will be utilized to accomplish the collection of water-quality data and capital equipment funds will be reprogrammed to FY 93.

7. 3GWR004 Ground-Water Quality Data Collection

None.

8. 3GWR016 Water-Quality Network Revision

None.

9. 3GWR017 Water-Level Monitoring Network Revision

None.

10. 3GWR018 Consult on Revision to EFAP

Limited activity. Impact on the program is minimal, since the EFAP serves primarily to document plans and technical activities for the program. In the interim, plans and technical activities of the program will continue under the direction of the existing

EFAP, the ground-water level and springflow monitoring plan developed to address concerns of the NPS, and consultations with DOE. At this time, no delay in the scheduled completion date for this activity is anticipated.

**11. 3GWR015 Calibrate Water-Level Equipment**

Activity was initiated ahead of schedule to improve the accuracy of water-level measurements during testing of well JF-3 and routine monitoring. Subsequent calibration checks will occur periodically, as warranted by changes in equipment utilized and indicators of equipment performance.

**D. Plans For Next Month:**

**1. 3GWR011 Survey Monitoring Sites**

Complete the activity by conducting surveys of reference points at two remaining sites in the monitoring network for ground-water levels.

**2. 3GWR0001 Ground-Water Level/Springflow Monitoring FY-92**

Measure ground-water levels and springflows at all accessible sites in the monitoring network, and check and file the data collected.

**3. 3GWR010 Aquifer Pump Test JF-3**

Limited progress in data processing is anticipated due to priority of ground-water level monitoring, springflow monitoring, instrumenting of well JF-3, and preparation of the quarterly data report. Checking and reviewing of data collected will continue as time permits.

**4. 3GWR013 Instrument JF-3**

Complete the activity by installing a cement pad, instrument shelter, and calibrated water-level monitoring equipment.

**5. 3GWR006 Ground-Water Monitoring Report, 2nd Quarter FY-92**

Complete the activity by reviewing and compiling data, and delivering the data report to DOE..

**6. 3GWR014 Capital Equipment Procurement**

Select and initiate procurement of an Interior vehicle. Plan, design, and initiate procurement (to the extent possible) of modifications to the vehicle for water-quality monitoring.

**7. 3GWR004 Ground-Water Quality Data Collection**

None scheduled or planned.

**8. 3GWR016 Water-Quality Network Revision**

Limited progress is anticipated due to priority of ground-water level monitoring, springflow monitoring, instrumenting of well JF-3, and preparation of the quarterly data report. Evaluation of data on ground-water quality collected to date will continue as time permits.

**9. 3GWR017 Water-Level Monitoring Network Revision**

None scheduled or planned.

10. 3GMR018 Consult on Revision to EFAP

None scheduled or planned.

III. WORK PERFORMED WHICH WAS NOT DESCRIBED IN ORIGINAL SCHEDULE:

1. Changes to water applications for the support of site-characterization activities were discussed with DCE, NPS, USFWS, and USGS personnel. Preliminary data from the testing of well JF-3, and potential effects of increased withdrawals on Death Valley National Monument (DVNM) resources were evaluated.
2. As per a meeting in DVNM, the NPS will obtain and operate the redundant monitoring system, but would like USGS input and/or assistance on installation. Potential configurations for the installation of a redundant, water-level monitoring system at Devils Hole were evaluated.

USGS Monthly Status Report  
April, 1992

SA # OG54892B

SA Manager: LACAMERA

SA Title: 1.2.5.4.8 Water Resources Assessment (Ground Water)

P&S #: OG548

Type of Account: Discrete

(Please read and follow instructions for each item below)

I. Latest revised estimate (\$000.0) \_\_\_\_\_ hours \_\_\_\_\_

II. Progress Against Plans/Schedule

A. Schedule Status: Enter Actual Start, Planned Finish, and Actual Finish dates, as appropriate.

ACTIVITY ID	CODE	ACTIVITY TITLE	EARLY START	EARLY FINISH	ACTUAL START	PLANNED FINISH	ACTUAL FINISH
JGWR006M	OG54892B	GROUNOWATER REPORT SECOND QUARTER-FY92	/ /	05/15/92	/ /	/ /	/ /
JGWR007M	OG54892B	GROUND WATER REPORT THIRD QUARTER-FY92	/ /	08/14/92	/ /	/ /	/ /
JGWR009	OG54892B	locate design Well JF-3	/ /	/ /	10/01/91	/ /	11/20/91
JGWR011	OG54892B	survey monitoring network sites	/ /	/ /	10/01/91	<del>04/30/92</del> 05/19/92	/ /
JGWR001	OG54892B	ground water levels springflow monitoring FY-92	/ /	/ /	10/01/91	09/30/92	/ /
JGWR005	OG54892B	G-W monitoring report first quarter report FY92	/ /	/ /	11/15/91	/ /	02/13/92
JGWR010	OG54892B	aquifer pump test JF-3	/ /	/ /	11/16/91	<del>04/30/92</del> 07/31/92	/ /
JGWR013	OG54892B	Instrument JF-3	/ /	/ /	12/16/91	<del>04/30/92</del> 05/31/92	/ /
JGWR005M	OG54892B	GROUNOWATER REPORT FIRST QUARTER-FY92	/ /	/ /	02/13/92	/ /	02/13/92
JGWR006	OG54892B	G-W monitoring report second quarter-FY92	/ /	/ /	03/02/92	05/15/92	/ /
JGWR014	OG54892B	capital equipment procurement	/ /	/ /	03/02/92	06/30/92	/ /
JGWR004	OG54892B	ground water quality data collection	/ /	/ /	03/23/92	<del>04/27/92</del> 4/21/92	/ /

3GWR016	06548928 water quality network revision	<del>04/01/92</del> 07/30/92	04/01/92	1	1	1
3GWR017	06548928 water level monitoring network revision	<del>04/01/92</del> 07/30/92	04/01/92	1	1	1
3GWR018	06548928 consult on revision to environmental field plan	<del>04/01/92</del> 09/01/92	04/01/92	1	1	1
3GWR019	06548928 compile regional water resources data	05/15/92 09/01/92		1	1	1
3GWR007	06548928 C-V monitoring report third quarter-FY92	05/18/92 08/14/92		1	1	1
3GWR020	06548928 compile water-use data FY 91	06/15/92 09/30/92		1	1	1
3GWR012	06548928 instrument tracer well	07/01/92 09/14/92		1	1	1
3GWR015	06548928 calibrate water level equipment	<del>07/10/92</del> 09/14/92	12/15/91	1	1	1
3GWR006A	06548928 ground water quality data collection	08/03/92 09/30/92		1	1	1

- B. Narrative of Work Performed (What, When, Where, How, Why)  
 Reference activity ID and activity title; code each narrative bullet.  
 Ex: 3GSS111A Conduct Scoping Study for Mag. Est.:
- \* narrative bullet (T) - Technical Work
  - \* narrative bullet (Q) - Quality Assurance
  - \* narrative bullet (P) - Planning, Operations, Logistics

C. Variances: Describe any departures from original schedules. Address cause, impact (short- and long-term), and any planned or possible corrective action. Reference activity ID number and title.