Department of Energy
Washington, DC 20585

OCT 18 1993

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.

Also enclosed for your information are U.S. Department of Energy responses to State of Nevada comments on study plans.

If you have any questions on the enclosed reports, please contact Priscilla Bunton at (202) 586-8365.

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

Enclosures: Orig. & 1 cy
(1) EG&G/EM Progress Report, July 1993
(2) Los Alamos Monthly Activity Report Highlights, August 1993
(3) Los Alamos Monthly Activity Report, July 1993
(4) USGS Detailed Monthly Status Report, July 1993
(5) USGS Detailed Monthly Status Report, August 1993
(6) DOE Responses to State of Nevada Comments on Study Plan 8.3.1.2.1.3

170032

102.8
WM-11
NH03

cc:(w/out encl.)
R. Dyer, YMPO
(w/encl.)
Alice Cortinas, CNWRA
Ken Hooks, NRC
T. J. Hickey, Nevada Legislative Committee
R. Loux, State of Nevada
D. Bechtel, Las Vegas, NV
Eureka County, NV
Lander County, Battle Mountain, NV
P. Niedzielski-Eichner, Nye County, NV
W. Offutt, Nye County, NV
L. Bradshaw, Nye County, NV
C. Schank, Churchill County, NV
F. Mariani, White Pine County, NV
V. Poe, Mineral County, NV
J. Pitts, Lincoln County, NV
J. Hayes, Esmeralda County, NV
B. Mettam, Inyo County, CA

Mr. Dunn letter dtd. 10/18/93

YUCCA MOUNTAIN PROJECT
BIOLOGICAL RESOURCES PROGRAM
MONTHLY PROGRESS REPORT
JULY 1993

Summary of Work Accomplished During Report Period

EG&G Energy Measurements (EG&G/EM) conducted work for the Biological Resources task (WBS 1.2.13.4.11) 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.

KEY ISSUES and CONCERNS

- In late July, the presence of the hantavirus, the rodent borne virus suspected of causing deaths in the Four Corners area, was confirmed in Nevada north of Tonopah and suspected in another case near the California-Nevada border. Rodents have been trapped for four years in the Yucca Mountain area without incident, suggesting that there may not be a problem on the NTS. However, considering the seriousness of the illness, EG&G/EM has decided to submit blood samples from staff members who have trapped rodents this year to the Center for Disease Control (CDC) in Atlanta, Georgia to test for the presence of hantavirus antibodies. EG&G/EM also will assist CDC scientists in collecting rodent blood samples from Area 25 to determine the presence of antibodies in the different species at Yucca Mountain. Negative tests would indicate no exposure to the hantavirus. The results of these tests will be used guide decisions on recommended safety precautions for future trapping efforts. This process may preclude the small mammal trapping session scheduled for August. As long as the September trapping session is not affected, this should not seriously compromise the monitoring data.

MAJOR ACCOMPLISHMENTS

- A presentation was provided to the Nuclear Waste Technical Review Board on July 14 regarding impacts of thermal loading on the biological resources at Yucca Mountain.

PLANNED WORK NOT ACCOMPLISHED

- None.

1028

ENCLOSURE 1

MAJOR WORK IN PROGRESS

- EG&G/EM conducted four preactivity surveys for proposed activities to assess potential impacts on biological resources. Seven reclamation inventories were completed. Ten biological resource survey and six reclamation inventory reports were submitted to Project Office. Tortoise resurveys were conducted at two sites.

- EG&G/EM continued monitoring radiomarked tortoises. All female tortoises which are part of the reproduction study were x-rayed to determine if they were carrying eggs. At the end of July, no tortoises were carrying eggs. Nineteen tortoise nests were found through these efforts. These nests will be monitored until the eggs hatch.

- EG&G/EM continued monitoring animal populations and vegetation communities for the Radiological Monitoring (RMP) and Site Characterization Effects Programs (SCEP). Small mammal populations were monitored at eight ecological study plots and at three radiological monitoring locations by capturing, marking, and recapturing individual animals. The trapping of small mammals on the three radiological monitoring was terminated after the second of four planned days of trapping. Trapping was terminated after the first case of the rodent borne hantavirus was confirmed in central Nevada. Field data collection was completed for the vegetation production studies. Production samples still need to be dried and weighed.

- Data on microbial activity in the second topsoil collection from the borrow pit were received from Oregon State University.

- EG&G/EM received a new State of Nevada animal handling and collection permit. A new federal permit authorization list was received. This revised authorization list allows more staff members to handle desert tortoises.

Los Alamos
NATIONAL LABORATORY
Earth and Environmental Sciences Division
EES-13—Nuclear Waste Management R&D

SEP 28 2 59 PM '00

WBS 1.2.9.1
QA N/A

September 14, 1993

TWS-EES-13-09-93-020

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

I-347677

Dear Mr. Gertz:

Highlights of the Los Alamos Monthly Activity Report—August 1993

Attached are the highlights of the Los Alamos Monthly Activity Report for August 1993. This internal document describes our technical work; 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 constitute predecisional information, should not be referenced, and are not intended for release from the U.S. Department of Energy as referenceable information.

If you have changes to our distribution list, please call Susan Klein at (505) 667-0916.

Sincerely,

Julie A. Canepa

SHK/elm

Attachment: a/s

Cy w/att:
M. B. Blanchard, DOE/YMP, MS J900/523
W. L. Clarke, LLNL, Livermore, CA
W. R. Dixon, DOE/YMP, MS J900/523
J. R. Dyer, DOE/YMP, MS J900/523
N. Z. Elkins, EES-13/LV, MS J900/527
L. D. Foust, M&O/TRW, MS J900/423
L. R. Hayes, USGS, Denver, CO
V. F. Iorii, DOE/YMP, MS J900/523
S. H. Klein, EES-13, MS J521
M. Martin, M&O/TRW, MS J900/423
A. R. Pratt, EES-13, MS J521
L. Shephard, SNL, MS A904/6302
W. Simecka, DOE/YMP, MS J900/523
M. Voegele, SAIC, J900/517
RPC File (2), MS M321
TWS-EES-13 File, MS J521

Cy w/o att.:
CRM-4, MS A150

ENCLOSURE 2

August 1993 Highlights from Los Alamos

WBS 1.2.3.1.2/3 Site Planning/Test Management

A. Mitchell joined the Las Vegas-based Los Alamos staff. He will represent the principal investigators (PI's) on site during sample collection and testing activities. Staff attended several surface-based borehole consolidation meetings. Staff developed input for Los Alamos test sample collection for all site deep boreholes. Staff submitted input for several USW-SD and USW-NRG sites.

Staff provided multi-shift field coordination and PI support for ESF north-ramp starter tunnel tests. Staff finalized planning packages for ESF north-ramp starter tunnel alcove ESF tests (hydrochemistry and radial boreholes). Staff revised north-ramp starter tunnel ESF tests to support possible activities relating to a ramp extension.

Staff coordinated the development of design information for geologic mapping, which will be used in conjunction with tunnel construction monitoring and sample collection activities.

WBS 1.2.3.2.1.1.1 Mineralogy/Petrology

Petrographic analysis of thin-sections for microautoradiography was completed. The thin sections studied include specimens from the following: (1) the devitrified Topopah Spring Member in USW G-4, (2) the zeolitized Calico Hills Formation in USW G-4, (3) the vitric Calico Hills Formation in USW GU-3, (4 the zeolitized Prow Pass Member in USW G-4, and (5) the devitrified Prow Pass Member in USW GU-3. This suite of specimens includes primary oxide minerals and biotites that are both unaltered and variably altered, as well as grains of secondary hematite and secondary-oxide alteration coronas. This variety of trace minerals will allow a thorough examination of the potential interactions of trace minerals with radionuclides. Petrographic data will be compared with the results of microautoradiography, as well as with quantitative X-ray diffraction and batch sorption results. If the results suggest that any members of this trace-mineral suite have significantly enhanced retardation properties, then more quantitative data will be obtained.

WBS 1.2.3.2.1.1.2 Alteration History

The paper, "ESR Dating of Quartz From Exile Hill, Nevada," by D. Cowan, V. Priest, and S. Levy, was published in *Applied Radiation and Isotopes*. Drusy quartz from the Tiva Canyon tuff in Trench 14 was dated using a technique that used the gradual accumulation of paramagnetic defects produced by alpha recoil in the quartz. The calculated age of 8.7 + 2.6

million years has a large uncertainty, but is clearly not a Quaternary age. This paper was not supported by YMP, but the PI believes the results to be very relevant.

S. Levy examined drill core from holes NRG-2, NRG-3, and NRG-4 at the Sample Management Facility. Features of interest in these cores include the tuff units between the Tiva Canyon and Rainier Mesa tuffs, which will be compared with brecciated fault fragments in Trench 14 and zeolitic alteration in the tuffs between the Tiva Canyon and Topopah Spring Members of the Paintbrush Tuff. Levy and G. Turlington of USBR designated locations on the tunnel wall where wall mappers will take samples for the Mineralogy-Petrology task during the next mapping session. Their goal was to see how well this process works and how we can improve it. Following discussions with TCO representatives, they modified their initial plans to designate sample locations with spray paint, and used metal plates. Since the plates are only permitted to be attached to wire mesh on the tunnel walls, and the portion of wall they were investigating hadn't had any mesh installed, they had to affix the plates to the nearest mesh, about 10 to 15 feet from the desired sampling sites, and then measure over to the sites. This method doesn't allow for pinpoint accuracy; an additional problem is whether the designated sites will survive additional blasting, mucking, bolting, and grouting rounds before the mapping team is able to sample them.

WBS 1.2.3.2.5 Volcanism

A two-day field trip was held with participants from the volcanism program and the USGS. We examined trench sites along the Paintbrush and Stagecoach faults that expose basaltic ash. The trench site on the Stagecoach fault exposed, in a narrow-fault graben, two-ash units that appear on the basis of megascopic examination of ash morphology to correspond to the two major eruptive events at the Lathrop Wells center.

Field trips were made to the Lathrop Wells volcanic center to examine exposures of the scoria-fall units on the south side of the center. Fifteen trenches were dug, and they were described for stratigraphic studies. Samples were collected for geochemistry studies. A revised geologic map of the lava sequence (initiating eruptive event) of the Lathrop Wells center was completed. This sequence was mapped on a newly obtained color and infrared aerial photographs (scale 1:12000).

Staff continued to revise the "Volcanism Status Report." Written review comments were transmitted by the NRC.

WBS 1.2.3.3.1.2.5 Diffusion
The study plan for this task was approved by YMPO on 6 August.

WBS 1.2.3.4.1.2.1 Batch Sorption Studies.
Staff completed experiments to investigate the effect of organic coatings on Np sorption onto tuffs. Our results suggest that the presence of 3-(3,4-dihydroxypheny)-DL-alanine (DOPA) does not influence Np sorption onto the surface of tuffaceous materials.

We also completed Np sorption experiments onto tuffs from various hydrologic units. These experiments seem to suggest that: (1) iron oxide minerals in tuffs are passivated and do not contribute significantly to the observed Np sorption, (2) a measurable sorption of Np occurs in tuffs with a high zeolitic content, and (3) formation of Np-carbonato complexes in the ground-water decreases Np sorption onto tuff.

WBS 1.2.3.4.1.3 Speciation/Solubility.
Speciation. Using the thermodynamic binding constants for the U(VI) carbonate system that were validated by carbon-13 NMR, we performed a series of calculations to examine the extent and stability of fields for U(VI) speciation in J-13 and UE-25p #1 waters. The presence of small amounts of carbonate has a dramatic influence on the U(VI) speciation in solution, and the calculations indicate J-13 and UE-25p #1 waters will contain $UO_2(CO_3)$, $UO_2(CO_3)_2^{2-}$, $UO_2(CO_3)_3^{4-}$, and $(UO_2)_3(CO_3)_6^{6-}$ in ratios which depend on the metal concentration. Metal concentration ranged from 1×10^{-6} M through 1×10^{-2} M in both waters. It is significant that both $UO_2(CO_3)_3^{4-}$ and $(UO_2)_3(CO_3)_6^{6-}$ species have been directly observed and confirmed by carbon-13 and oxygen-17 NMR spectroscopy. Preliminary calculations suggest that when we examine carbon-13 NMR data as a function of metal concentration, we will be able to unequivocally rule out the formation of a dimer of formula $(UO_2)_2(CO_3)_4^{4-}$.

Photoacoustic spectroscopic studies of Pu(IV) in carbonate media continued. Previous studies in bicarbonate solutions at 500 nM Pu(IV) concentration as a function of total carbonate suggested that the presence of some polynuclear Pu species were required to account for the observed behavior. A new series of experiments at 100 nM Pu(IV) concentration were conducted to look for differences that might further indicate the presence of polynuclear species. However, the behavior at 100 nM total Pu(IV) was the same as that observed at 500 nM total Pu(IV), suggesting that polynuclear species may not be important in this regime.

WBS 1.2.3.4.1.5.1 Retardation Sensitivity Analysis

Integrated Transport. Using the FEHM computer code, we obtained solutions for several large Yucca Mountain three-dimensional flow simulation problems. The data set consisted of 56,600 nodes defined from the Sandia database. One simulation is on 250 ft by 250 ft centers, with approximately 17 cells in the vertical direction. Another simulation is on 250 ft by 500 ft centers, with 34 cells in the vertical direction; this is the preferred model because of the resolution in the vertical direction. The runs took approximately 20 hours on the Sun Sparc 10 . We ran conservative tracers as a test and will use Cs and Tc tracers in the run following. These first runs used uniform infiltration rates . With the geometry of Yucca Mountain represented in the model, a run with the best USGS-distributed infiltration rates would also be appropriate. The data generated by these runs is large, and we estimate that over a Gbyte of storage is necessary to save the 200 frames necessary for a simulation video.

Code optimization. The memory managed version of FEHM is complete, but is still being tested. L. Trease led this effort, with help from B. Robinson and Z. Dash. This code is a major improvement because it allows one code to be used for solving both very large and very small problems in a Unix environment. It differs from the run-of-the-mill memory managed codes in that for optimum system performance, it dynamically deallocates memory during a run. This work is necessary for moving the code to a parallel computing environment.

WBS 1.2.5.4.7 Performance Assessment

H. Trease is working with fracture representations generated by Golder and Associates in an effort to produce well-conditioned meshes that will work on unsaturated flow problems. Their original meshes will work on the mildly nonlinear fully saturated problems but not on ones that deal with vadose-zone flow.

WBS 1.2.6.1.1. ESF Management

Staff provided design input to support field changes related to north-portal construction and developing Title II design packages. Staff provided field test coordination and administrative support for ESF north-portal construction. Staff implemented site cleaning and preparation activities planned for the LLNL large-block test.

WBS 1.2.6.8.4 Integrated Data System

The TCO staff reviewed two design documents and conducted several meetings with the M&O IDS design team. F. Homuth joined the Las Vegas-based Los Alamos TCO staff and will serve as the IDS and ESF data coordinator.

Los Alamos documents published in August

B. Carlos, S. Chipera, D. Bish, and S. Craven, "Fracture-lining Manganese Oxide Manganese Oxide Minerals in Silicic Tuff, Yucca Mountain, Nevada" in *Chemical Geology*, Vol. 107, pp. 47-69.

Whitney, J.W. and Harrington, C.D. "Relict colluvial boulder deposits as paleoclimatic indicators in the Yucca Mountain region, southern Nevada" in *Geological Society of America Bulletin* V. 105, pp. 1008-1018.

Los Alamos milestones completed in August

Milestone 3365
"Equilibrium Modeling of the formation of zeolites in fractures at Yucca Mountain, Nevada" by Steven Chipera et al.
Full paper for Zeolite '93 proceedings

Los Alamos papers approved for publication by YMPO in August

Milestone 3031
"Actinide (IV) and Actinide (VI) Carbonate Speciation Studies by PAS and NMR Spectroscopies" by David Clark et al.
To be published as a Los Alamos report.

Milestone 3044
"Measurement of Unsaturated Hyrdraulic Conductivity in Yucca Mountain Tuff" by James Conca
To be published as a Los Alamos report.

Milestone 3188
"SORBEQ - A One-Dimensional Model for Simulating Column Transport Experiments" by Bruce Robinson
To be published as a Los Alamos report.

"Effects of Humidity on Clay and Zeolite Quantitative XRD Analyses" by Steven Chipera. Abstract of a paper to be presented at the Clay Mineral Society meeting.

Los Alamos
NATIONAL LABORATORY

WBS 1.2.9.1
QA N/A

September 21, 1993

TWS-EES-13-09-93-025

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

I-347792

Dear Mr. Gertz:

Los Alamos Monthly Activity Report—July 1993

Attached is the Los Alamos Monthly Activity Report for July 1993. 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 constitute predecisional information, should not be referenced, and are not intended for release from the U.S. Department of Energy as referenceable information.

If you have changes to our distribution list, please call Susan Klein at (505) 667-0916.

Sincerely,

for Julie A. Canepa

Julie A. Canepa

Attachment: a/s

Cy w/att:

M. B. Blanchard, YMPO, Las Vegas, NV
J. M. Boak, YMPO, Las Vegas, NV
R. L. Bullock, RSN, Las Vegas, NV
V. J. Cassella, HQ/Washington, DC
W. L. Clarke, LLNL, Livermore, CA
P. L. Cloke, SAIC, Las Vegas, NV
R. W. Conner, RW-133, HQ/Washington, DC
J. L. Cooper, YMPO, Las Vegas, NV
J. Docka, Weston, Washington, DC
J. R. Dyer, YMPO, Las Vegas, NV
L. D. Foust, CRWMS, M&O/TRW, Las Vegas, NV
L. R. Hayes, USGS, Denver, CO
C. Johnson, M&O/WCC, Las Vegas, NV
N. Jones, M&O/TRW, Las Vegas, NV
P. Justus, NRC, Las Vegas, NV
K. Krupka, PNL, Richland, WA
M. Martin, M&O/TRW, Las Vegas, NV
C. W. Myers, EES-DO, MS D446
S. Nelson, M&O/WCFS, Las Vegas, NV
C. M. Newbury, YMPO, Las Vegas, NV
R. F. Pritchett, REECo, Las Vegas, NV
R. L. Robertson, CRWMS, M&O, Fairfax, VA
L. E. Shephard, SNL, Albuquerque, NM
W. B. Simecka, YMPO, Las Vegas, NV
A. M. Simmons, YMPO, Las Vegas, NV
R. K. St. Clair, M&O/TRW, Las Vegas, NV
J. T. Sullivan, YMPO, Las Vegas, NV
M. Voegele, SAIC, Las Vegas, NV
D. R. Williams, YMPO, Las Vegas, NV
RPC File (2), MS M321
TWS-EES-13-File, MS J521

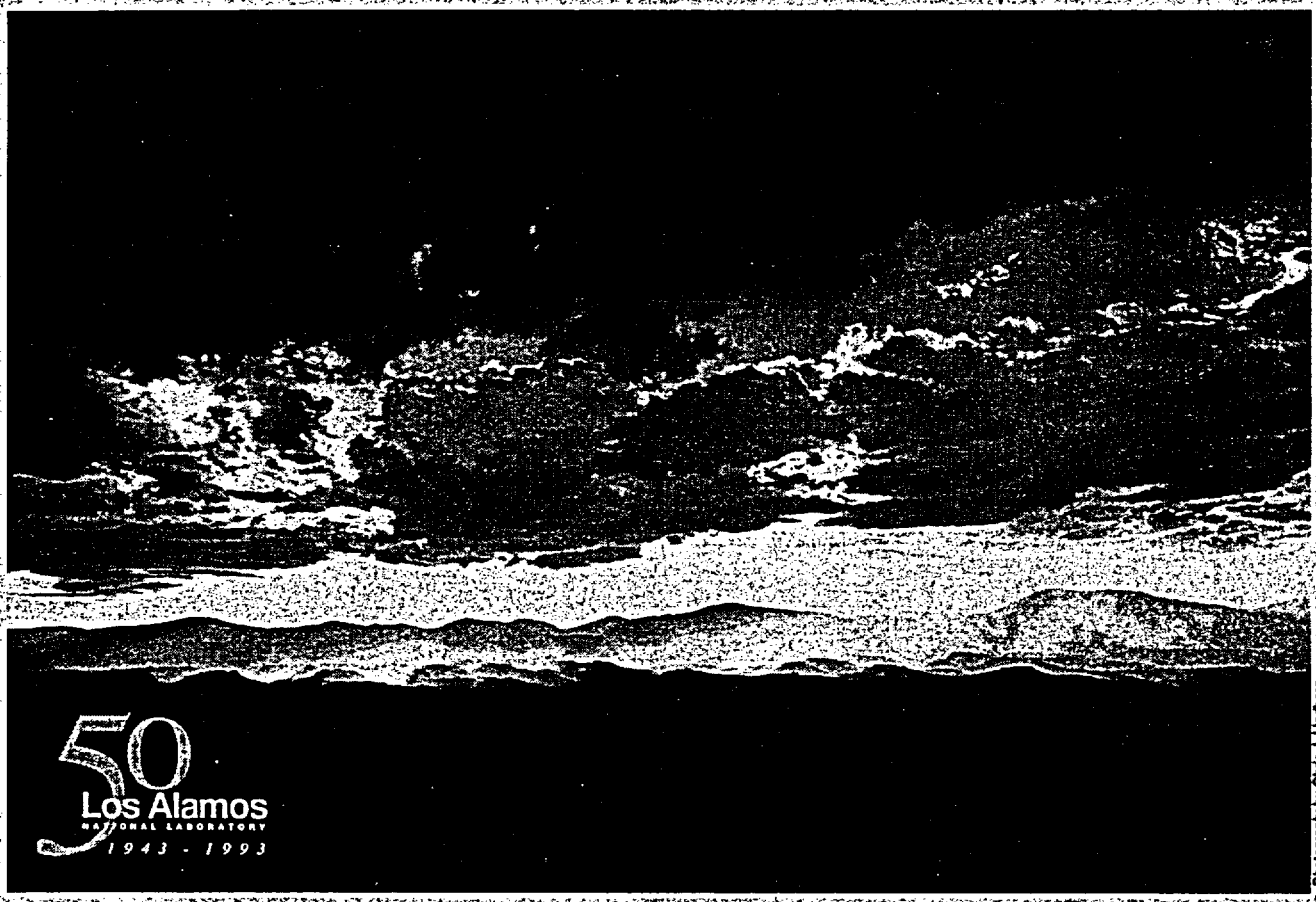
Cy w/o att.:
J. A. Canepa, EES-13, MS J521
S. H. Klein, IS-11, MS J521

ENCLOSURE 3

Yucca Mountain Site Characterization Project

Monthly Activity Report

July 1993



Photograph by Chris J. Lindberg

Attachment to TWS-EES-13-09-93-025

CONTENTS

LOS ALAMOS NATIONAL LABORATORY

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report

July 1993

WBS 1.2.1 Systems Engineering

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.

Activities and Accomplishments

S. Levy, D. Bish, and D. Vaniman met with S. Saterlie of the M&O to discuss possible geochemical and mineralogical assessments of various repository thermal load simulations. At this meeting, and in a follow-up conference call, they emphasized their concerns that such simulations should address how lithologic variability across the mountain might contribute to the extent and intensity of repository hydrothermal effects.

Staff will continue revising the paper reformulating SCP thermal goals. In August, they will hold discussions with the USGS and the M&O on research of mutual interest.

WBS 1.2.3.1.1 Site Investigation Coordination and Planning/ Site Management

Objective

The objective of this task is to manage and coordinate site characterization activities.

Activities and Accomplishments

Staff attended the following meetings and workshops: Nuclear Waste Technical Review Board meeting in Denver, 11-14 July; Natural Analog Workshop in Santa Fe, NM, 13-14 July; and Technical Advisory Group meeting, 15-16 July.

Interviews were completed for the vacant position of Project Leader for Site and Regulatory Investigations.

Staff attended a meeting hosted by DOE in Las Vegas with representatives of ENRESA, the Spanish Radioactive Waste Management company.

Staff supported continued development of the FY 1994 Annual Plan.

Staff held a meeting for principal investigators on 9 July. Site characterization activities were discussed, with particular emphasis on ESF and drilling schedules, thermal load Project initiatives, and the statusing of milestones and deliverables.

WBS 1.2.3.1.2/3 Site Investigation Coordination and Planning/ Test Management and Integration

Objective

The objective of this task is to manage and integrate Exploratory Studies Facility (ESF) and Los Alamos site characterization test activities and to provide coordination for Los Alamos surface-based test planning and package development.

Activities and Accomplishments

Surface-based Test Coordination. Staff represented the test coordination office at weekly surface-based testing meetings.

Staff continued to support activities pertaining to the use of tracers, fluids, and materials at Yucca Mountain.

B. Carlos and A. Mitchell represented the principal investigators (PI's) at the June SOC meeting on 2 June.

ESF Testing. Staff provided multi-shift field coordination and PI support for ESF north-ramp starter tunnel tests. Staff began formal planning for Phase 3 ESF tests (Hydrochemistry, Radial Boreholes, and Hydrologic Properties of Major Faults). Staff began to revise Phase 2 ESF tests to support potential starter tunnel activities.

Construction of the ESF starter tunnel continued. Geologic mapping, consolidated sampling, and construction monitoring activities proceeded as planned; no perched water was identified this month.

Planned Activities

Continue support of the Los Alamos surface-based and ESF activities in response to the Project program directives.

Problem Areas

None

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 mineralogical 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

Staff continued to prepare specimens from UE-25 UZ-16 for bulk-sample XRD analysis.

Staff used instrumental neutron activation analysis to obtain calcite chemistry data for samples from UE-25 UZ-16, USW G-1, USW GU-3, USW G-4, and UE-25A #7. These data will be added to their calcite database. The chemical characteristics are being studied to understand the distinctions between saturated-zone and unsaturated-zone calcite precipitation. Subsamples of the same calcites are being studied for isotopic composition, age, and fluid inclusion data at the USGS.

Chemical data were also obtained for two clay separates from drill cores USW GU-3 and USW G-4, and for a clay separate from the portal at the north-ramp starter tunnel. These clays are being studied for further evidence of transport within fracture networks at Yucca Mountain.

Staff began preparing approximately thirty UZ-16 core samples for XRD analysis. They also analyzed a number of fracture samples using the Siemens system. Procedures and software for the INEL position-sensitive diffractometer were approved, and the system was used to analyze six small fracture samples.

In May, D. Broxton collected outcrop samples to examine chemical and mineralogical variation in zeolitic tuffs in areas north and west of Yucca Mountain. This month, these samples were distributed for thin-section, XRD, and X-ray fluorescence analysis. Preliminary results were completed and they indicated that distribution of the zeolites and their chemistries reflect their proximity to hydrothermally altered areas.

The paper "Calcite Deposits in Drill Cores USW G-2 and USW GU-3/G-3 at Yucca Mountain, Nevada" was approved for publication by YMPO.

B. Carlos examined core from the top 650 ft of USW UZ-14 at the SMF on July 12-13 and has requested samples for further study of fracture-lining minerals.

G. Guthrie continued to investigate background dust mineralogy; he submitted samples for size separation and X-ray diffraction analysis. Preliminary analyses of these samples indicated that natural dusts can have mineralogies significantly different than in the surface outcrops. Guthrie also continued preparing for the Geological Society of America symposium entitled "Geochemical Aspects of Minerals in Physiological Fluids" and the Mineralogical Society of America short course entitled "Health Effects of Mineral Dusts."

Planned Activities

Staff will revise "Distribution and Chemistry of Fracture-Lining Zeolites at Yucca Mountain, Nevada." They will continue to prepare an LAMS report to be used as a field guide to fracture-lining minerals at Yucca Mountain.

Crushing and separation of magnetic minerals for characterization of the trace mineral contents of Yucca Mountain tuffs will continue, and microautoradiography experiments will begin.

Work planned within the next few months also includes the following activities: (1) continue analysis of calcites to understand transport and precipitation mechanisms; (2) examine drill core from USW UZ-14 as it becomes available at SMF; (3) sample UE-25 UZ-16 for studies of stratigraphic variability in bulk mineralogy; (4) continue statistical evaluation of XRD quantitative mineral analysis; and (5) continue analysis of background dust mineralogy around Yucca Mountain.

Problem Areas

None

Milestone Progress

3152
30 September 1993
Letter Report on Statistical Analysis of Chemical and Mineralogical Data
65 percent complete.

3352
31 March 1993
Distribution of Potentially Hazardous Phases in the Subsurface of Yucca Mountain
Completed on 27 April 1993.

3353
30 September 1993
Characterization of Airborne Minerals at UZ-16
40 percent complete.

3360
30 April 1993
Calcite Deposits in Fractures at Yucca Mountain, Nevada
Completed.

3364
30 September 1993
Distribution of Fracture-lining Zeolites at Yucca Mountain, Nevada
Draft completed.

3365
30 September 1993
Equilibrium Modeling of the Formation of Zeolites in Fractures at Yucca Mountain, Nevada

3369
30 September 1993
Field Guide to Fracture-lining Minerals at Yucca Mountain
25 percent complete.

3382
29 June 1993
The Importance of Zeolites in the Potential High-Level Waste Repository at Yucca Mountain
90 percent complete.

Milestone Progress (cont.)

4013
30 April 1993
Preliminary Description of Fracture-lining Minerals in Drill Cores UE-25 UZ-16
Completed.

Publications

D. L. Bish
The Importance of Zeolites in a Potential High-Level Waste Repository at Yucca Mountain, Nevada
Conference abstract, *Zeolites '93*
Published.

D. Broxton
Geological Evaluation of Six Nonweleded Tuff Sites in the Vicinity of Yucca Mountain, Nevada, for a Surface-based Test Facility for the Yucca Mountain Project. (3137)
LA-series report
In press.

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

B. Carlos, S. Chipera, and D. Bish
Distribution of Fracture-Lining Zeolites at Yucca Mountain, Nevada
Conference abstract, *Zeolite '93*
Published.

S. J. Chipera, D. L. Bish, and B. A. Carlos
Equilibrium Modeling of the Formation of Zeolites in Fractures at Yucca Mountain, Nevada
Conference abstract, *Zeolites '93*
Published.

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

D. T. 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, *Clay and Clay Minerals*
In revision.

D. T. Vaniman
Calcite Deposits in Drill Cores USW G-2 and USW GU-3/G-3 at Yucca Mountain, Nevada
LA-series report
In Los Alamos publication process.

D. T. Vaniman
Calcite Deposits in Fractures at Yucca Mountain, Nevada
Conference paper, *International High-Level Waste Management Conference*
Published.

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

D. Bish gave a presentation entitled "Alteration History of Yucca Mountain due to Thermal Effects: Analog for a Hot Repository?" to the 13 July Nuclear Waste Technical Review Board meeting on Thermal Loading: the Integration of Science and Engineering, held in Denver. He highlighted three types of alteration at Yucca Mountain:

(1) saturated-zone alteration related to the thermal effects of the Timber Mountain caldera, which provides insight into the long-term thermal stability of zeolites and clays under saturated conditions;

(2) alteration in the Topopah Spring tuff related to cooling of the pyroclastic unit, which offers an opportunity to assess the variability associated with fracture-dominated hydrothermal alteration in the unsaturated zone during a relatively short geologic time period; and

(3) comparisons of glassy and zeolitized nonwelded tuffs below the candidate host rock, which illustrate the changes in hydrologic properties of these rocks that would take place if a repository hydrothermal regime causes zeolitization of existing glassy nonwelded tuffs.

W. Carey and S. Chipera began installing a new thermal-analysis interface to the mass spectrometer that will permit gas collection closer to the sample; this system should improve high-temperature gas extractions. Staff will soon begin experiments using the new system to determine the evolution of gases from clinoptilolite as a function of temperature and relative humidity. They will also be using an improved method to control relative humidity, oversaturating air with water vapor at elevated temperature, and then mixing it with dry air.

S. Levy examined drill core from holes UZ-14, NRG-5, and NRG-6 at the Sample Management Facility and submitted requests for several samples of fractured and brecciated rock to the SOC. A report on surface exposures of breccias and other altered rock from several sites around Yucca Mountain (Milestone 3150) is almost complete.

G. WoldeGabriel continued his studies of zeolite chronology at Barstow and Tecopah, sites in California near Yucca Mountain, to help assess the reliability and significance of K/Ar zeolite dates. Work will begin soon on Ar/Ar dating of some of the largest available zeolite crystals from the Yucca Mountain area.

Planned Activities

Sample collection from the starter tunnel will continue on a periodic basis.

The steam-heating experiments with powdered samples of Yucca Mountain rocks will continue, and the samples will be examined for mineralogical changes on a periodic basis. Chemical and mineralogical characterization of samples of bedrock breccias and hydrothermal deposits exposed at the surface will continue, as will calcite-silica laminated-deposit studies. Studies on the evolution of water from zeolitic tuffs based on the development of characteristic T-pH_2O curves for clinoptilolite and mordenite, the zeolites of importance at Yucca Mountain, will continue.

Problem Areas

None

Milestone Progress

3138
30 September 1993
Chemical Transport in Zeolitic Alteration
Research 60 percent complete; delayed because TPO required Milestone 3381 for Focus '93 meeting.

3141
30 September 1992
Pedogenesis of Siliceous Calcretes at Yucca Mountain, Nevada
Completed.

3142
31 January 1993
K/Ar Dating of Clays and Zeolites
Completed.

3150
30 July 1993
Final Report on Bedrock
Research 60 percent complete; delayed because TPO required Milestone 3381 for Focus '93 meeting.

3343
30 September 1993
Zeolite Dating
Submitted to TPO on 16 June 1993.

3361
30 September 1993
Thermal Behavior of Natural Zeolites
On schedule

3381
30 September 1993
Natural Alteration in Topopah Spring Tuff as an Analog to Waste-Repository Hydrothermal Regime
On schedule

4012
30 September 1993
Chemical Alteration of Calico Hills Tuff during Zeolitization
(letter report, input to Milestone 3378, due 30 June 1994)
On schedule

Publications

D. L. Bish and D. T. Vaniman
Thermal Behavior of Natural Zeolites
Conference abstract, *Zeolites '93*
Published.

D. Bish and J. Aronson
Paleothermal and Paleohydrologic Conditions in Silicic Tuff from Yucca Mountain, Nevada
Journal article, *Clay and Clay Minerals*
Submitted.

S. Chipera
Effects of Humidity on Clay and Zeolite Quantitative XRD Analysis
Conference abstract, *Clay Minerals Society meeting*
Submitted to YMPO.

S. Levy
Surface-discharging hydrothermal systems at Yucca Mountain -- examining the evidence (3341)
Proceedings paper, *Materials Research Society Fall Meeting*
Published.

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* (3143)
Approved by YMPO.

D. Vaniman, S. Chipera, and D. Bish
Pedogenesis of Siliceous Calcretes at Yucca Mountain, Nevada (3141)
Journal article, *Geoderma*
Accepted for publication.

G. WoldeGabriel
K/Ar Dating of Clinoptilolites: Methods and Preliminary Results
Conference abstract, Zeolites '93
Published.

G. WoldeGabriel et al.
Preliminary Assessment of Clinoptilolite K-Ar Results from Yucca Mountain, Nevada
Los Alamos report
Approved by YMPO.

WBS 1.2.3.2.1.2 Stability of Minerals and Glasses

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

No activity in this task because the PI's time was spent preparing a presentation to the Nuclear Waste Technical Review Board meeting on thermal loading for Task 1.2.3.2.1.1.2. The study plan will be delayed.

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

Staff completed simulation modeling using 1000 iterations for subsets of E1 based on homogeneous Poisson assumptions. Multiple distribution sets were modeled including normal, triangle, modified triangle, and Poisson, for data from the "Volcanism Status Report." The modeling was divided into two sets, and probability distributions of E1 (10 percent step increments) were obtained for both modeling sets.

Volcanism task members attended a two-day field trip to field verify a geologic map of the northwest area of Yucca Mountain and eastern Crater Flat. Map research and production was sponsored by the State of Nevada, and the map has been submitted to the Nevada Bureau of Mines for publication.

Staff continued field studies at Cinder Cone, a scoria cone and lava complex in the northeastern part of Mt. Lassen National Park. This volcanic center is reported to have erupted in historic time (last eruption 1850). Moreover, episodic eruptions from the center (4 to 5 eruptive intervals) may have occurred over a span of three centuries; in support of this theory, they have found presence of local scoria-fall deposits directly overlain by lake-deposits, which in turn are overlain by blocky aa lava flows. This volcanic center provides an historic example of a small-volume basalt center that was thought to be a monogenetic center but actually exhibits polycyclic eruptive behavior. Additionally, the historic eruption is closely analogous to the inferred youngest stage of eruptive activity at the Lathrop Wells and Hidden Cone centers in the Yucca Mountain region.

Geologic mapping was completed at North Alkali Butte, a mixed hydrovolcanic-strombolian volcanic center in New Mexico.

Work in Progress. Staff completed final revisions to Section 1 of the "Volcanism Status Report" and continued to revised additional sections.

Staff began field studies to determine the distribution of lithic fragments in basaltic tephra at Alkali Butte and Grants Ridge in New Mexico began. They began reconstructing basement stratigraphy in preparation for analog field studies of eroded basalt centers in the Rio Puerco area of New Mexico.

Staff also began studies of scoria clast-size distributions and stratigraphy of fall events in trenches on the southwest flank of the Lathrop Wells volcanic center. These studies will provide data to model the dimensions of basalt eruption columns.

Planned Activities

B. Crowe, along with USGS staff, will meet with G. Thompson of Stanford University to discuss integrating Volcanism studies with the geophysics program at Stanford.

Problem Areas

The problem identified last month with regard to not receiving results of XRF sample analysis scheduling was resolved.

Milestone Progress

3075
30 September 1993
Preliminary Geologic Mapping of Volcanic Centers
On schedule.

3129
30 September 1993
Geochemistry of Lathrop Wells (part of 3252)
May be delayed because they have not been able to obtain XRF data.

3252
30 September 1993
Volcanism Status Report
First draft in technical review.

Publications

B. M. Crowe et al.
Volcanism Status Report
First draft in technical review.

B. M. Crowe et al.
Simulation Modeling of the Probability of Magmatic Disruption of the Potential Yucca Mountain Site
Conference paper, *Focus'93 proceedings*
In technical review.

G. Valentine et al.
Effects of Magmatic Processes on the Potential Yucca Mountain Repository: Field and Computational Studies
Conference paper, *Focus'93 proceedings*
In technical review.

WBS 1.2.3.2.8.1 Rock-Varnish Dating Support for USGS Neotectonic Studies

Objective

This activity will provide rock-varnish dating support in various areas of surface site characterization activities including erosion, neotectonics, and paleoclimate.

Activities and Accomplishments

Staff continued to map the extent and character of scarps and their associated geomorphic features along the Windy Wash and Solitario Canyon faults. The features of interest, including the presence of colluvial cover and drainage changes across the scarp, are being mapped because they may have contributed to the scarp's prominence or evolution.

Staff began sampling activities for the scoping study that will test the feasibility of cosmogenic dating of the scarps along the Solitario Canyon fault.

Planned Activities

Staff will continue mapping geomorphic features of scarps that may provide information about how and when they were formed. Staff will complete samples collection for the scoping study to test the feasibility of cosmogenic dating of the scarps under study.

Problem Areas

None

Milestone Progress

None

Publications

S. Reneau
Maganese Accumulation in Rock Varnish in a Desert Piedmont, Mojave Desert, California, and Application to Evaluating Varnish Development
Journal article, *Quaternary Research*
Anticipated publication date, September 1993.

J. W. Whitney and C. D. Harrington
Relict Colluvial Boulder Deposits as Paleoclimatic Indicators in the Yucca Mountain Region, Southern Nevada
Journal article, *Geological Society of America Bulletin*
Accepted for August publication.

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

The subcontractor, Hydro Geo Chem, completed chloride and bromide analyses of a soil profile collected to a depth of 70 cm in the vicinity of Test Cell C. These samples were collected to test the hypothesis that nuclear rocket tests conducted during Project Rover in the 1960's produced significant levels of chlorine-36, which may have subsequently contaminated the ream-bit cutting collection system used at UZ-N55.

J. Fabryka-Martin reported the current status of this activity at the TPO meeting on 30 July in Las Vegas. She presented a talk entitled "Preliminary Results from Chlorine-36 Studies."

Sufficient halide and chlorine-36 data have now been collected so that they may evaluate their reproducibility, precision, and accuracy; J. Fabryka-Martin began to organize and review this data in preparation for submitting it to the YMP Technical Database. Work also began on the design of an in-house database for organizing and manipulating this data.

Planned Activities

Complete thorough review of halide and chlorine-36 data by the end of FY93.

Revise existing DPs; prepare new DPs; process soil samples for Cl/Br and chlorine-36/Cl ratios; process cuttings samples from UZ-16 and neutron-access boreholes; participate in planning activities for sample collection from ESF; collect additional soil samples from Yucca Mountain area as opportunities arise.

Problem Areas

None

Milestone Progress

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

3362
Summary of Cl-36 Work
30 September 1993
On schedule.

Publications

Summary of Cl-36 work to be submitted to Focus '93.

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

This task has been deferred because of lack of funding.

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 (holes UE-25c #1, UE-25c #2, and UE-25c #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 QA. B. Robinson continued to serve as CCB Chair, and Z. Dash continued to serve as a member of the CCB. A draft of the FEHMN SRS is currently under review.

Colloid transport. Experiments were conducted in which two types of one-micron polystyrene microspheres (and an iodide tracer) were injected simultaneously into a Bandelier tuff fracture specimen. Both microspheres had significantly negative surface charges, which in theory should minimize hold-up on the negatively-charged rock surface; however, they found that one microsphere was hydrophilic and the other was not. The hydrophilic microsphere transported without filtration, as in previously reported tests, but the non-hydrophilic microsphere exhibited significant attachment to the rock surface. This suggests that in addition to surface charge, the hydrophilicity of the particle is an important factor in its ability to transport radionuclides through natural fractures.

Planned Activities

Staff will continue to contribute to the SQA effort by serving as CCB Chair and CCB member.

Staff will address review comments on the FEHMN SRS. Staff will continue modeling studies using FEHMN to support the design of field tests.

Staff will begin lithium column sorption experiments.

Staff will prepare DP's for measuring microsphere concentration using flow cytometry, and for measuring iodide using an ion-specific probe.

Staff will prepare equipment for use in C-Wells core experiments.

Problem Areas

None

Milestone Progress

3188
31 March 1993
Documentation for SORBEQ
Completed and submitted to YMPO on 27 July 1993.

3194
30 September 1992
Batch Sorption Experiments with Lithium
Submitted to TPO on 27 July 1993.

T112
22 June 1992
Final Documentation for FEHM
Rescheduled to June 1993 because of personnel reassignment.

3196
27 July 1992
FRACNET Documentation
Rescheduled to August 1993 because of personnel reassignment.

Milestone Progress (cont.)

3201
Preliminary Modeling Using FEHM
Completed.

3367
30 April 1993
Aperture Characteristics, Saturated Fluid Flow, and Tracer Transport Calculations for a Natural Fracture
Completed.

Publications

B. A. Robinson
FRACNET—Fracture Network Model for Water Flow and Solute Transport (3196)
LA-series report
In preparation.

B. A. Robinson
SORBEQ—A One-Dimensional Model for Simulating Column Transport Experiments (3188)
LA-series report
Submitted to YMPO on 27 July 1993.

B. A. Robinson
A Strategy for Validating a Conceptual Model for Radionuclide Migration in the Saturated Zone Beneath Yucca Mountain (3201)
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle - Special issue on the Yucca Mountain Project*
Approved by YMPO.

W. L. Polzer and E. H. Essington
The Use of Selectivity Coefficients to Estimate Modified Langmuir Isotherm Parameters as a Function of Experimental Conditions
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle - Special issue on the Yucca Mountain Project*
Approved by YMPO.

P. Reimus, R. Glass, and B. Robinson
Aperture Characteristics, Saturated Fluid Flow, and Tracer Transport Calculations for a Natural Fracture (3367)
Conference paper, *1993 High-Level Radioactive Waste Management Conference*
Published.

WBS 1.2.3.4.1.1 Ground-water Chemistry Model

Objective

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

Activities and Accomplishments

Revision of the Ground-water Chemistry Study Plan, R0, continued. Reviewers' comments are being addressed.

Modeling of different radionuclides using compositions of ground-waters from Yucca Mountain continued. Report on "most active ground-water" will not be completed until 30 September 1993.

Modeling of pH and Eh Stability continued. Tuffaceous and carbonate waters at Yucca Mountain appear well buffered by bicarbonate or carbonate, and Eh is well poised within oxidizing conditions. The pH stability is supported by modeling calculations that show little change when different minerals dissolve in Yucca Mountain ground-waters. Eh also appears to change little when different minerals are allowed to dissolve.

Planned Activities

Continue resolution of comments on study plan.

USGS collaboration will continue. Discussions continued concerning water chemistry, stable isotope constraints on water composition, and the ground-water chemistry model.

Continue support of QA efforts.

Problem Areas

None

Milestone Progress

3415
30 September 1993
Letter report on Most-Active Ground-water Chemistry
(input to Milestone 3349 [Dynamic Transport])

Publications

None

WBS 1.2.3.4.1.2.1 Batch Sorption Studies

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

Staff at Stanford University is currently studying uranyl and neptunyl surface complexation on monomineralic surfaces, such as iron oxides and oxyhydroxides, quartz, and feldspars. This month this report will focus on their work on uranyl interactions in the goethite/solution interface. They are building an empirical database, which will lead to the derivation of binding constants for uranium (U) adsorption onto goethite in the presence of CO_2 and ethylenediaminetetraacetic acid (EDTA).

Sorption experiments in individual polycarbonate centrifuge tubes (which do not adsorb U) were conducted on synthetic goethite with a specific surface area of 48.9 m^2/g; the appropriate quantity of goethite stock suspension, electrolyte ($NaClO_4$), U stock solution (10^{-4} M), and EDTA were added to each tube. Before initial pH adjustments with NaOH or $HClO_4$ solutions, the suspensions were bubbled at pH < 4 with argon to remove potentially adsorbed carbonate species. In CO_2-free systems, pH was adjusted and measured, keeping an argon atmosphere in the centrifuge tubes by bubbling the suspension. At atmospheric or increased $p(CO_2)$, the appropriate gas (either compressed air or CO_2/N_2 mixtures, respectively) was purged through the suspensions; using liquid scintillation counting, the solid and liquid phases were separated and the quantity of ^{14}C-labeled EDTA was measured. The U concentration of the supernatants was measured either electrochemically or radiometrically.

Fig. 1 indicates the quantity of U sorbed by goethite under CO_2-free conditions as a function of pH. The total U(VI) concentration $[U(VI)]_T$ was 1×10^{-6} M; the $NaClO_4$ concentration was 0.1 M; and the goethite concentration was 1 g/L. These results in combination with others in the literature indicate that the U adsorption edges (pH values at which 50 percent of the U is sorbed by a solid phase) fall in the pH range of 4–5, regardless of the nature of the solid phase.

Fig. 2 indicates that U adsorption onto goethite is independent of ionic strength (from 0.005 M to 0.1 M $NaClO_4$), which indicates the existence of inner-sphere surface complexes.

Fig. 3 shows the influence of different pCO_2 upon the adsorption of U, and up to pH 6, the sorption of U is not affected by CO_2. Aqueous carbonate species HCO_3^- and CO_3^{-2} are present at pH > 6.5 and 10.3, respectively, and their concentration increases with increasing $p(CO_2)$. The sharp decreases in the U adsorption at pH 8 and 9 for $p(CO_2)$ of 2×10^{-2} and 3.2×10^{-4}, respectively is caused by the formation of solution uranyl-carbonato complexes.

Fig. 4 shows U sorption by goethite in the presence of EDTA. At EDTA concentrations of 10^{-6} M, which correspond to low coverage of the goethite surface, U sorption is not affected. At EDTA concentrations of 5×10^{-5} M, enhanced sorption of U is observed. At higher EDTA concentrations (1 mM), the goethite sorption sites are fully covered with EDTA, leading to U complex formation with goethite at low pH values and lowering of U sorption at high pH values due to the formation of U-EDTA complexes in solution.

Activities and Accomplishments (cont.)

Our U sorption results indicate that a likely sorption reaction for the sorption of U onto goethite in the absence of CO_2 can be given by Reaction 1 where S represents the goethite surface. The equilibrium constant for this reaction is given by Equation 2.

$$SOH + UO_2^{2+} + H_2O = SOUO_2OH + 2H^+ \quad (1)$$

$$K = \frac{[SOUO_2OH]\,[H^+]^2}{[SOH]\,[UO_2^{2+}]} \quad (2)$$

The data shown in Figure 1 could be fitted by using log K = 2.4 - pH.

The U-goethite sorption experiments in the presence of CO_2, could be fitted using reaction 3. All surface uranyl-carbonato-complexes are postulated as outer-sphere complexes.

$$SOH + UO_2^{2+} + 2CO_3^{-2} + H^+ = SOH_2^+ \text{---} UO_2(CO_3)_2^{-2} \quad (3)$$

No attempts were made to model the system goethite-uranyl-EDTA which could possibly lead to ternary compounds.

J. Leckie and staff prepared a report detailing these results. It is in internal review.

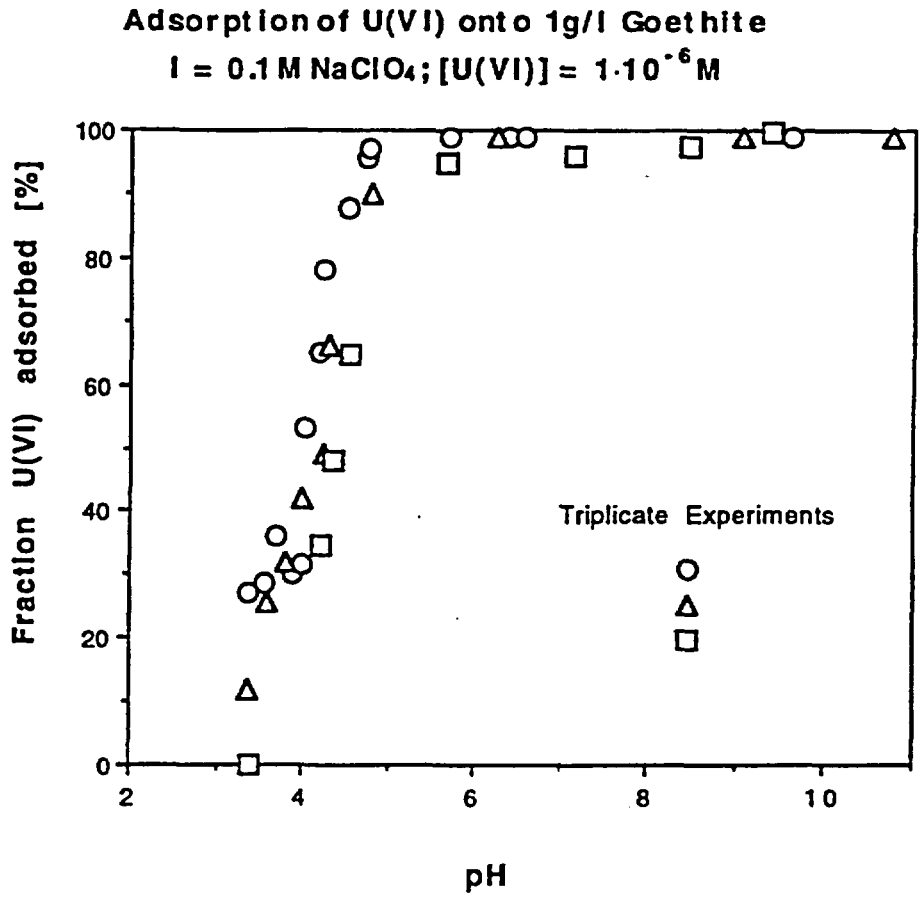


Fig. 1. Percent U(VI) sorbed as a function of pH at constant U(VI) and goethite concentration. Ionic strength, I = 0.1 M $NaClO_4$, U(VI)T=1x10^{-6} M, and the goethite mass concentration is 1g/L.

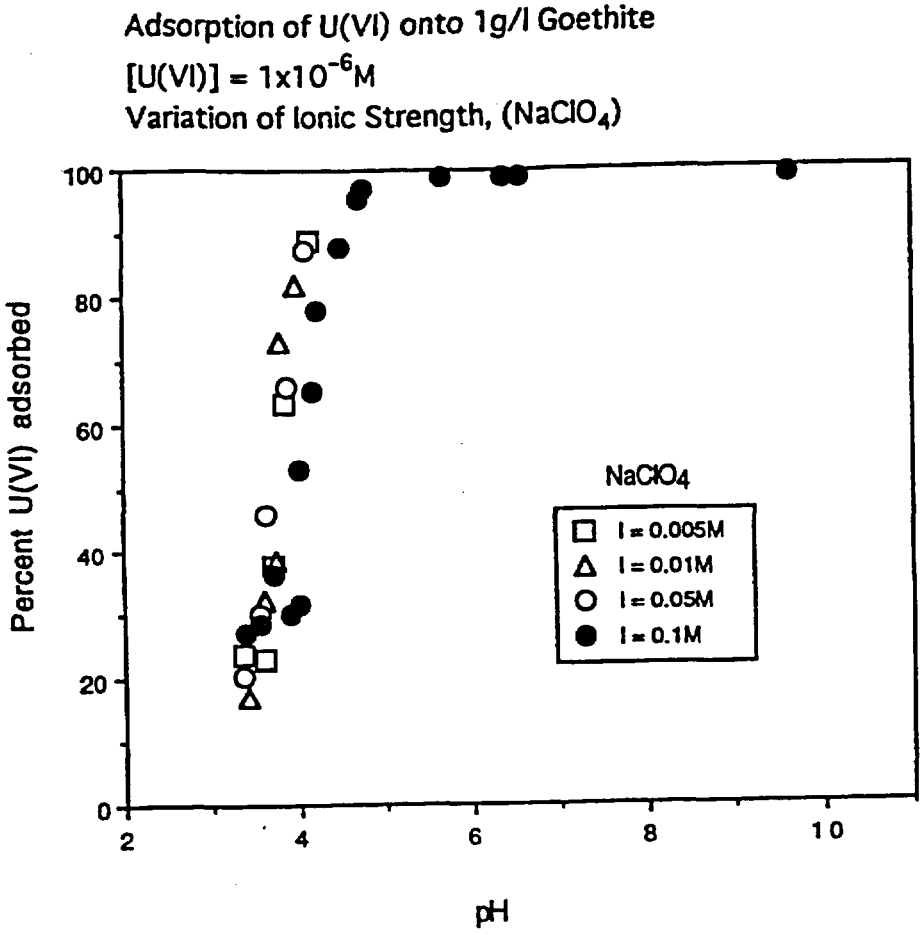


Figure 2. Percent U(VI) sorbed as a function of pH and ionic strength at constant $U(VI)_T$ and goethite concentration. $U(VI)_T = 1 \times 10^{-6}$ M and the goethite mass concentration is 1 g/L.

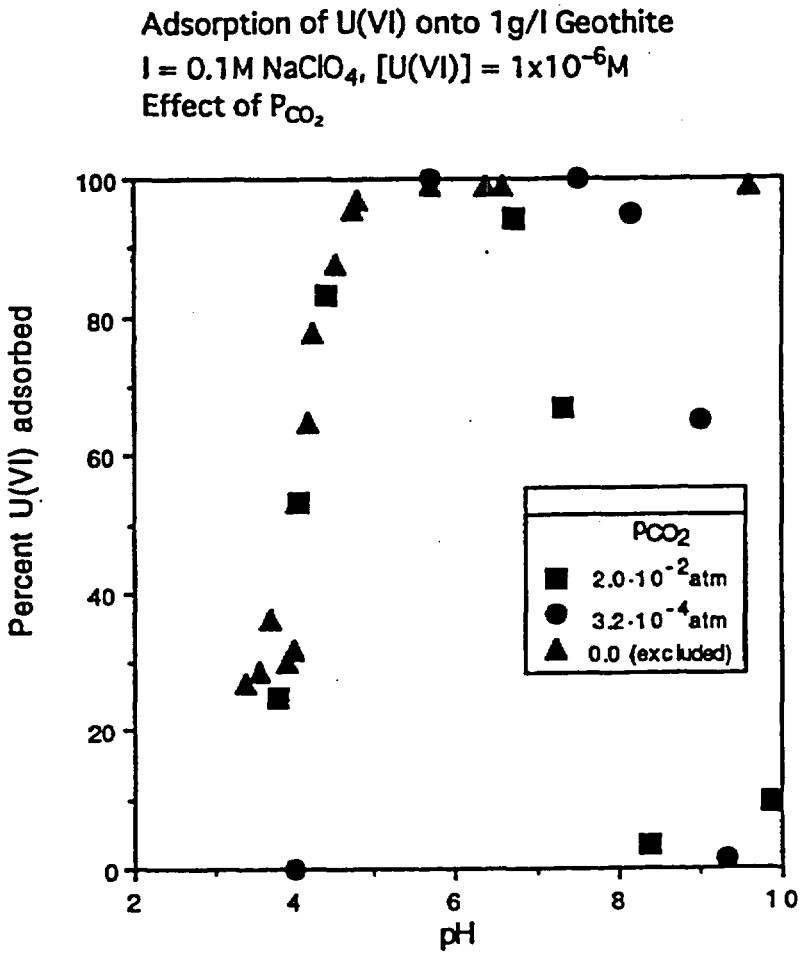


Figure 3. Percent U(VI) sorbed as a function of pH and pCO_2 at constant $U(VI)_T$ and goethite concentration. $U(VI)_T = 1 \times 10^{-6}$ M and the goethite mass concentration is 1 g/L.

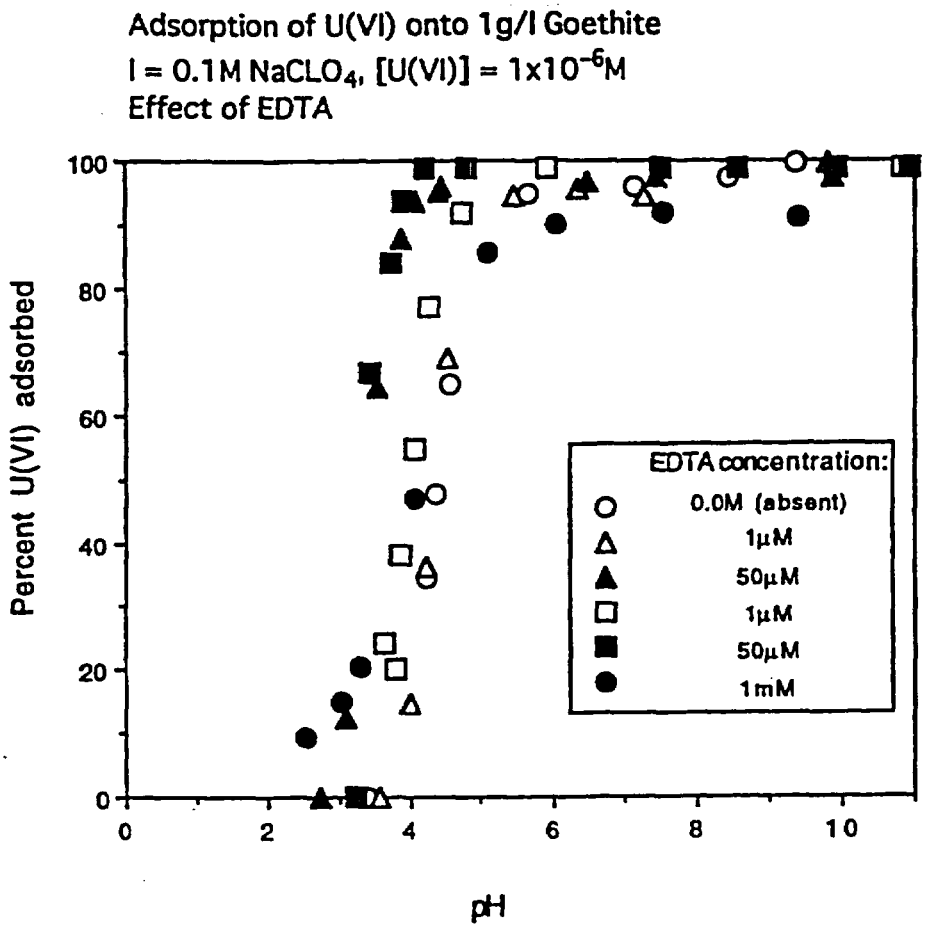


Figure 4. Percent U(VI) sorbed as a function of pH and EDTA concentration at constant $U(VI)_T$ and goethite concentration. Ionic strength, I = 0.1 M $NaClO_4$, $U(VI)_T = 1 \times 10^{-6}$ M and the goethite mass concentration is 1 g/L. EDTA concentration varies from 0.0 to 1×10^{-3} M.

Planned Activities

Continue work in all areas discussed above.

Problem Areas

None

Milestone Progress

3009
30 April 1993
Dependence of Radionuclide Sorption on Sample Grinding, Surface Area, and Water Composition
Completed.

3218
30 September 1993
Effects of Water-Rock Ratios on Sorption Coefficients
On schedule.

3345
30 June 1993
Neptunium Sorption onto Feldspar
In internal technical review; (summary presented in this monthly).

3346
30 September 1993
Sorption as a Function of Temperature
On schedule.

Publications

P. S. Z. Rogers and A. Meijer
Dependence of Radionuclide Sorption on Sample Grinding, Surface Area, and Water Composition (3009)
Conference paper, *1993 International High-Level Waste Management Conference*
Published.

WBS 1.2.3.4.1.2.3 Sorption Models

Objective

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

Activities and Accomplishments

Previous work on goethite crystal #9 had shown that this particular crystal exhibited a variety of surface features. This month the crystal was mounted in the AFM wet cell in preparation for imaging under water. An area that contained an ordered array of crystallites was characterized; water was introduced into the wet-cell and images became sharper immediately. A number of images were taken, and within a trapezoidal clear area, atomic resolution imaging was possible. The sample was allowed to sit under water for 2 1/2 days, the water was removed from the wet cell, and the crystal surface reexamined. After exposure to water and drying, there appeared to be: a greater abundance of larger, ordered nanocrystalline surface arrays, ordered texturing of the bare crystal surface, nano size holes, and 1 to 2 unit high (010) pits. Additionally, the areas covered by large crystallites (microns), observed before the addition of water, appeared to be unchanged. The surface roughening and pitting were observed everywhere else on the crystal's top surfaces.

Their results indicate that goethite surface reactions with water, especially pitting and roughening, are essentially instantaneous. This raises the question of whether highly sorbing surfaces are created during typical batch sorption experiments, leading to higher estimates of adsorption than might be observed under natural conditions. During the next two months, they will try to repeat these experiments using large hematite crystals. In future experiments, surfaces of this type will be reacted with various sorbers, and they will attempt to image the location and relative coverage of the adsorbed species.

Planned Activities

Staff plans AFM characterization of the surfaces of hematite crystals separated from Topopah Spring tuff, as soon as the complicated sample separation by D. Broxton and staff is complete. These will be examined for the presence of natural surface coatings, then their reaction with water, J-13 water, and hopefully various sorbers will be observed.

Problem Areas

None

Milestone Progress

3347
30 September 1993
AFM Analysis of Hematite and Goethite
On schedule.

Publications

None

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 mineral dissolution experiments. Reductase assays have demonstrated that Pseudomonas sp. produces reductases when grown in the presence of ferric chloride, hematite, and, to a lesser extent, in the controls that do not contain iron.

Staff began experiments to investigate the role of siderophores in mineral dissolution. The staff is following well-recognized procedures to measure ligand-promoted dissolution. The results of these two experiments will be used to determine the relative use of reductases and siderophores by microorganisms in mineral dissolution.

Planned Activities

Continue dissolution experiments.

Problem Areas

None

Milestone Progress

3092
30 September 1992
Report on Colloidal Agglomeration
Draft completed. Will be submitted to YMPO when PI returns from sabbatical leave.

Publications

L. E. Hersman, P. D. Palmer, and D. E. Hobart
Preliminary Evidence of a Siderphore Plutonium Complex
Conference proceedings, *Proceedings of the Fall Meeting of the Materials Research Society*
Published.

L. E. Hersman
Report on Colloidal Agglomeration
LA-series report.
In preparation.

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 report on the second meeting of the Radionuclide Solubility Working Group (16 June) was completed. Twelve major action items and the champion(s) for each item were identified in the report. A full report of this meeting is included in the Appendix to this monthly.

Two sections in the study plan for this task were revised to address concerns of an external reviewer, and the study plan was forwarded to YMPO for transmittal to the NRC.

D. Morris represented this task at the Technical Database Dictionary Parameter Review meeting at Los Alamos on 27 July. A number of substantive problems were identified for the five activities encompassing this study. Staff revised the parameter list and submitted it to the Los Alamos management for consideration.

Speciation. Using carbon-13 enriched carbonate, the staff prepared new carbon-13 NMR samples for the Np(VI) carbonate system (pH 9.5–5.7). NMR measurements were taken at 0 and 23°C. They prepared buffer solutions using analyzed gas mixtures of 0.3, 3, 30, and 100 percent CO_2, with known concentrations of carbonate/bicarbonate at a fixed ionic strength. The solutions were allowed to come to equilibrium, and the actual hydrogen ion concentration was calculated. (These samples were used to calibrate their commercial buffer solutions for accurate measurement of p[H] instead of the more common pH.) Their studies will allow for curve-fitting of experimental thermodynamic binding constants for the Np systems.

Oxidation-state pure ultra-high-purity Np(V) was prepared and shipped to the Sorption Task (WBS 1.2.3.4.1.2.1) to be used in sorption experiments.

Staff continued to study the temperature dependence of the NpO_2^+ carbonate system using Vis/NIR absorption spectroscopy. Temperature data at 30, 50 and 90°C was collected for Np. The interference of the H_2O overtones in the region of the strong Np(V) absorbance (950 to 1000 nm) was mitigated by careful background correction and temperature regulation of both the sample and the reference cells. At room temperature, the equilibrium between "$NpO_2CO_3^-$" (characterized by a 992 nm peak) and "$NpO_2(CO_3)_2^{3-}$" (997 nm peak) at pH 8.5 occurred between 0.15 and 0.25 M total carbonate. The following table summarizes these data at elevated temperature for a 40 micromolar Np solution:

Table I. Temperature Dependence of the NpO_2^+ Carbonate System using Vis/NIR Absorption Spectroscopy.

[NaHCO3]	T (°C)	Peak (nm)	Width (nm)	Intensity
.250 M	30	997	23.8	.0039
	55	997	11.0	.0016
	80	997	14.0	.0018
.210 M	30	994	13.5	.0041
	55	994	15.0	.0041
	80	994	13.5	.0041
.170 M	30	992	12.5	.0049
	55	993	15.0	.0042
	80	992	15.0	.0042
.100 M	30	993	12.0	.0031
	55	993	20.3	.0034
	80	993	15.0	.0033

It is clear that some inconsistencies still exist in their results and further work is required, but the staff believes that it is quite possible that this equilibrium is not temperature dependent.

Solubility. Preparation for the solubility experiments in 0.1 M $NaClO_4$ at pH 6, 7, and 8.5 continued. The pH 6 and 7 solutions equilibrated at the target pH values quickly, but the pH 8.5 solution was much slower to equilibrate, probably because of the very low partial pressure of CO_2 required to meet this target value. The Np solubility experiments have now been started at all three pH values. The americium/neodymium experiments will start the first week in August, and the Pu experiments will begin the following week.

Milestone 3329 will be completed shortly. Following this, staff will begin Milestone 3344. Regarding the LBL QA effort, final drafts of two detailed technical procedures were submitted to the QA liaison.

Planned Activities

Efforts in all above mentioned areas will continue.

Problem Areas

None

Milestone Progress

3031
30 October 1992
Actinide(IV) and Actinide(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies
Completed.

3329
30 September 1992
Measured Solubilities and Speciations from Oversaturation Experiments of Neptunium, Plutonium, and Americium in UE-25p #1 Well Water from the Yucca Mountain Region
Technical review completed; reviewer comments returned to LBL.

Milestone Progress (cont.)

3330
30 January 1993
Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy
Completed.

3344
30 September 1993
Report on Comparison of Solubilities of Np, Am, and Pu Between J-13 and UE-25p #1 Waters
On schedule.

3350
30 September 1993
PAS Analysis of Pu(IV) Carbonate Systems
On schedule.

3351
30 September 1993
NMR Analysis of Np(V) and Pu(IV) Carbonate Systems
On schedule.

3363
30 April 1993
Radionuclide Solubility and Speciation Studies for the Yucca Mountain Site Characterization Project
Completed.

Publications

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. L. Clark, C. D. Tait, D. E. Morris, D. E. Hobart, S. A. Ekberg, and P. D. *Palmer*
Actinide(IV) and Actinide(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies (3031)
LA-series report
Submitted to YMPO.

D. L. Clark, J. G. Watkin, D. E. Morris, and J. M. Berg
Molecular Models for Actinide Speciation
LA-series report
In preparation.

D. L. Clark et al.
Carbon-13 NMR Kinetics and Ligand Exchange Dynamics of Actinyl(VI) Carbonate Complexes in Aqueous Solution
Conference abstract, *Actinides '93*
Approved by YMPO.

D. L. Clark et al.
Carbon-13 NMR Kinetics and Ligand Exchange Dynamics of Actinyl(VI) Carbonate Complexes in Aqueous Solution
Conference abstract, *Fourth International Conference on Chemical and Migration Behavior*
Approved by YMPO.

Publications (cont.)

D. L. Clark and P. Palmer
Oxygen-17 and Carbon-13 NMR Studies of Uranyl and Neptunyl Carbonate Complexes in Near-neutral Solution
Conference abstract, *Fourth International Conference on Chemical and Migration Behavior*
Approved by YMPO.

D. L. Clark et al.
Oxygen-17 and Carbon-13 NMR Studies of Uranyl and Neptunyl Carbonate Complexes in Near-neutral Solution
Conference abstract, *Actinides '93*
Approved by YMPO.

H. Nitsche et al.
Radionuclide Solubility and Speciation Studies for the Yucca Mountain Site Characterization Project
Conference paper, *1993 International High-Level Waste Management Conference* (3363)
Published.

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 Ground-water (J-13) from the Yucca Mountain Region (3010)
LA-series report (LA 12562 MS)
Published.

C. D. Tait, D. E. Morris, J. M. Berg and W. H. Woodruff
Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy
Journal article, *Analytical Chemistry* or *Reviews of Scientific Instrumentation* (3330)
Approved by YMPO.

C. D. Tait, S. A. Ekberg, P. D. Palmer, and D. E. Morris
Plutonium (IV) Carbonate Speciation Changes (3350)
Journal article, *Inorganic Chemistry*
In internal review.

C. D. Tait et al.
Speciation of Neptunium(V) Carbonate as a Function of Temperature Using Absorption Spectroscopies
Conference abstract, *Actinides '93*
Approved by YMPO.

C. D. Tait et al.
Speciation of Neptunium(V) Carbonate as a Function of Temperature Using Absorption Spectroscopies
Conference abstract, *Fourth International Conference on Chemical and Migration Behavior*
Approved by YMPO.

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 completed solid-tuff wafer diffusion experiments in which the kinetics of sorption onto solid tuff was studied. They are now able to address determining the K_d for crushed vs. solid tuff.

Each wafer was suspended in an Np solution prepared with J-13 or UE-25p #1 water; to determine Np concentration as a function of time, 0.1-g aliquots of liquid were removed from the solution at specific intervals. The experiments were conducted for more than 100 hours. The equilibrium Np concentration remaining in solution was used to calculate the Np K_ds in Tables I and II.

Table I. Tuff Wafers in J-13 water with an Np concentration of 3.8×10^{-5} M

Tuff	G4-270	G4-1532
Diameter (mm)	13.4	13.1
Length (mm)	5.8	6.5
Weight of tuff Wafer (g)	1.5	1.3
Np solution added (g)	40.0	40.0
Kd (ml/g)	2.0	5.0

Table II. Tuff Wafers in UE-25 p#1 water with an Np concentration of 6.6×10^{-6} M

Tuff	G4-270	G4-1532
Diameter (mm)	13.4	12.8
Length (mm)	6.0	6.0
Weight of tuff Wafer (g)	1.8	1.2
Np solution added (g)	40.0	40.0
Kd (ml/g)	4.0	6.0

Their results indicate that the kinetics of Np sorption are very fast. After 30 minutes, the solution concentration of Np in contact with the wafer reaches steady-state. This is important because the use of K_ds in performance assessment calculations implies instantaneous sorption (as seems to be the case for Np). In addition, their results indicate that the zeolitic-rich tuff (G4-1532) seems to sorb Np better than the non-zeolitized tuff units.

Staff submitted a technical data transfer package that describes the diffusion of non-sorbing radionuclides through Yucca Mountain tuffs. These data indicate that the diffusion coefficient of non-sorbing radionuclides is approximately 10^{-6} cm^2/s. Radionuclides that exist in solution (such as pertechnetate) exhibit coefficients on the order of 10^{-7} cm^2/s, which is caused by charge and size exclusion.

Planned Activities

Work in all the above mentioned areas will continue.

Problem Areas

None

Milestone Progress

3040
30 January 1993
Kinetics of Sorption on Columns of Pure Minerals
Completed.

3044
30 October 1993
Measurement of Unsaturated Hydraulic Conductivity in Yucca Mountain Tuff
(Completed as Level IV Milestone in 1992; TPO requested that it be published; a TIP review was completed and the TIP was submitted to YMPO.)
Completed.

3212
Far-Field Transport of Carbon Dioxide: Retardation Mechanisms and Possible Validation Experiments
Completed.

3065
Techniques to Study Diffusion in Saturated Tuffs
30 October 1992
Completed.

3348
30 September 1993
Colloid Workshop Report
On schedule.

3349
30 September 1993
Summary Report on Np Transport through Yucca Mountain Tuffs
On schedule.

Publications

J. Conca
Measurement of Unsaturated Hydraulic Conductivity in Yucca Mountain Tuff (3044)
Conference paper, *Focus '93 Site Characterization and Validation*
Submitted to YMPO.

A. Meijer
Far-Field Transport of Carbon Dioxide: Retardation Mechanisms and Possible Validation Experiments
Conference paper, *Focus '93 Site Characterization and Validation*
Approved by YMPO.

I. R. Triay, K. H. Birdsell, A. J. Mitchell , and M. A. Ott
Diffusion of Sorbing and Nonsorbing Radionuclides in Tuff (3065)
Conference paper, *1993 International High-Level Waste Management Conference*
Published.

I. R. Triay, M. A. Ott, A. J. Mitchell, and C. M. Overly
Transport of Np through Yucca Mountain Tuffs
Conference paper, *Proceedings of the fall meeting of the Materials Research Society, November 30 - December 4, 1992*
Published.

Publications (cont.)

I. R. Triay, B. A. Robinson, R. M. Lopez, A. J. Mitchell, and C. M. Overly
Neptunium Retardation with Tuffs and Ground-waters from Yucca Mountain (3040)
Conference paper, *1993 International High-Level Waste Management Conference*
Published.

WBS 1.2.3.4.1.5.1 Retardation Sensitivity Analysis

Objective

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.

Activities and Accomplishments

Physical/Chemical Processes Affecting Transport. Staff continued to develop software for automated finite-element grid generation. The most recent development has be the addition of software modules that ensure that the final mesh is a Delaunay-type mesh, which improves the accuracy of numerical flow and transport calculations. Using this capability, they are producing meshes that are representative of the stratigraphy at Yucca Mountain. They are being used for preliminary flow studies that will eventually be extended to complete three-dimensional flow calculations that include the entire volume of the proposed repository.

Three dimensional simulations of the Yucca Mountain flow field are underway. After several preliminary calculations, a large-scale, three-dimensional simulation using a 55,000-node mesh is being evaluated. Preliminary studies have indicated that convergence will be 10–100 times faster for the steady state flow problem than their 32,000 node simulation run in 1989. The calculations are being run on the SUN network, and storage capacity is adequate, although they are experiencing some problems with just manipulating the files involved. After the flow solution is obtained, transport calculations using the K_d values used in the simulation conducted in 1989 will be run. The results of the simulations will be reported in Milestone 3355 and in video format.

QA and Programmatic. The staff is investigating several configuration management software packages and will report their findings in the near future.

Planned Activities

Staff will continue to perform simulations described above.

Problem Areas

None

Milestone Progress

3052
30 January 1993
Baseline Documentation for TRACRN
Received conditional certification; documentation is available from the Los Alamos Software Manager.
Completed.

3355
30 September 1993
Interim report—Update of Geophysical/Geochemical Models

Publications

K. Birdsell, K. Eggert, and B. Travis
Three-Dimensional Simulations of Radionuclide Transport at Yucca Mountain
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle - Special issue on the Yucca Mountain Project*
Approved by YMPO.

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

This task has been deferred because of lack of funds.

WBS 1.2.5.2.2 Site Characterization Program

Objective

The purpose of this task is to coordinate the regulatory 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 framework.

Management and Integration

Following the NRC Volcanism Technical Exchange held in June, staff worked on revisions to the "Volcanism Status Report." The "Calcite-Silica Topical Report" continues to be supported by the Los Alamos staff.

Study Plans

Water Movement Test, R1 (8.3.1.2.2.2). Review comments on Rev. 1 of the Study Plan were received from the YMPO in May 1992; they were addressed and returned to YMPO in December 1992. This study plan was approved on 10 February 1993 by the DOE. It was submitted to the NRC for a Phase I review and accepted on 8 April 1993.

Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5). In April 1992, this study plan was accepted by DOE. In June 1992 it was submitted to the NRC for review. It was accepted by the NRC on 19 January 1993.

Testing of the C-Hole Sites With Reactive Tracers, R0 (8.3.1.2.3.1.7). In February 1990, DOE/HQ issued the study plan (8.3.1.2.3.1) as a controlled document; it was then sent to the NRC for comments. The Los Alamos study plan (8.3.1.2.3.1.7) was approved. Staff reviewed NRC comments on the USGS study plan related to the first six C-wells activities and notified the DOE that they agreed with all NRC comments.

Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1). This study plan was returned in May 1992 from YMPO review; comments are now being addressed.

Mineralogy, Petrology, and Chemistry of Transport Pathways, R0 (8.3.1.3.2.1). In January 1992, they submitted revised NRC comments to T. Bjerstedt. In August 1992, YMPO requested that they word process the changes to be incorporated in the revision. That revision is in progress and staff is also responding to review comments from the State of Nevada received in January 1993.

History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2). The YMPO approved the study plan on 18 December 1991 and submitted it to the NRC on 31 January 1992. No further action has been required.

Natural Analog 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). No progress during the recording period because of funding.

Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3). A new draft of the study plan combining studies 8.3.1.3.4.1 and 8.3.1.3.4.3 was submitted to YMPO for review in October 1992. Review comments were returned to Los Alamos in February 1993; these comments are being incorporated in the study plan.

Biological Sorption and Transport, R0 (8.3.1.3.4.2). A revision addressing the Exploratory Shaft Design was submitted in September 1992. The study plan was approved by YMPO on 25 November 1992 and accepted by the NRC on 25 March 1993.

Study Plans (cont.)

Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2). All YMPO comments on the study plan were resolved by the principal investigator in September 1992. Rev. 0 was submitted to YMPO for comment resolution, verification, and approval on 9 October 1992. In preparation for forwarding to the NRC, the study plan was sent to YMPO on 28 July 1993 with all review comments addressed .

Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1). All YMPO comments on the study plan were resolved by the principal investigator in September 1992. This study plan was revised, incorporating YMPO and DOE review comments. It was returned to YMPO in March 1993 for technical review. YMPO comments were completed in June 1993.

Diffusion, R0 (8.3.1.3.6.2). All YMPO comments on the study plan were resolved by the principal investigator in September 1992. The study plan was revised in response to YMPO comments and returned to YMPO in April 1993. Verification of comment resolution was completed on 28 June 1993. A separate list of technical procedures was sent to YMPO on 13 July 1993 in preparation for forwarding the study plan to the NRC.

Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1). This study plan was approved by the DOE and sent to the NRC for review in July 1992. It was accepted by the NRC on 19 January 1993.

Demonstration of the Applicability of Laboratory Data to Repository Transport Calculations, R0 (8.3.1.3.7.2). This study plan is deferred because no funds were allocated.

Gaseous Radionuclide Transport Calculations and Measurements, (8.3.1.3.8.1). This study plan is deferred because no funds were allocated.

Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1). A detailed technical review was completed in July 1992 by the NRC. In August 1992, a one-day video conference was held with the NRC to discuss their technical review comments. In response to those comments, this study plan was revised and submitted to YMPO for review in February 1993. It was accepted and sent to the NRC in March 1993 for review.

Physical Processes of Magmatism and the Effects on the Repository, R0 (8.3.1.8.1.2). A draft study plan was submitted to DOE for review in October 1992. The review comments were returned in January 1993 for comment resolution. Those comments have now been addressed, and the study plan was sent to YMPO in May 1993.

Characterization of Volcanic Features, R0 (8.3.1.8.5.1). This study plan was accepted by NRC on 4 September 1990. A minor revision was added in March 1993, which does not require a review by YMPO and the DOE.

WBS 1.2.5.3.5 Technical Database Input

Objective

The objective of this task is to coordinate input of technical data to the Project Technical Database (TDB) and the Automatic Technical Data Tracking System (ATDT).

Activities and Accomplishments

Staff set up a 27 July meeting between Los Alamos staff, the M&O, and DOE representatives to review parameters for Technical Data Parameter Dictionary. This all-day review resulted in considerable input by Los Alamos PI's into the composition and format of the dictionary. Further review by some Los Alamos researchers continued after the meeting, and their comments will be forwarded to the M&O.

Staff submitted "Diffusion of Sorbing and Non-sorbing Radionuclides" (LA000000000034.002) to the Technical Data Base and sent complete data record package (LA000000000034.001 and .002) to the RPC.

Staff made several corrections to records for "Dehydration and Rehydration of a Tuff Vitrophyre" (LA000000000017.002) to bring records into agreement with information in the ATDT. The corrected package was and then submitted to the RPC.

Staff entered information into ATDT and completed TDIF forms on the following:

- "Distribution of Potentially Hazardous Phases in the Subsurface at Yucca Mountain, Nevada," which was given the data tracking number LA000000000054.001 and TDIF #301780.

- "Equilibrium Modeling of the Formation of Zeolites in Fractures at Yucca Mountain, Nevada," which was given the data tracking number LA000000000055.001 and TDIF #301779.

- "Minerals in Fractures of the Unsaturated Zone from Drill Core USW G-4, Yucca Mountain, Nye County, Nevada," which was given the data tracking number LA000000000056.001 and TDIF #301781. This report represents backlog data.

Staff participated in audit of EES-13 YMP quality-affecting activities. Deficiencies were noted, and they were corrected during the audit. Procedures currently being put in place by DOE/YMP, which will combine two parallel record paths (one to the TDB and one to the CRF) into one, will improve the inefficiencies noted in the audit.

Planned Activities

Staff will continue to determine what technical data should be logged into the ATDT for current work on zeolites, saturated fluid flow, and other ongoing work of various PI's, and what work needs to be submitted to TDB.

Problem Areas

None

WBS 1.2.5.4.6 Development and Validation of Flow and Transport Models

Objective

Model testing is necessary to assess performance at Yucca Mountain. This task will conduct an experiment in a caisson facility to provide a baseline of confidence in models for transport.

Activities and Accomplishments

The steady-state flow field is being established in the caisson. A problem developed with the lower-boundary condition during thei attempt to saturate the caisson, and sand was discharged, causing a shift in the plate. As a result, approximately 40 percent of the porous cups are no longer functional because the lines have been clogged with sand. The lower boundary will be used to sample, but there are insufficient cups to control the pressure head. The staff will use instruments to measure steady-state flow and thus determine when to inject the tracers.

Planned Activities

Establish steady-state flow, prepare tracer input device, and inject tracers.

Problem Areas

None

Milestone Progress

3357
30 September 1993
Caisson Experiments to Test Flow and Transport Models

3368
30 April 1993
Testing models of flow and transport in unsaturated porous media
Completed.

Publications

E. P. Springer, M. D. Siegel, P. L. Hopkins, and R. J. Glass
Testing models of flow and transport in unsaturated porous media
Conference paper, *1993 High-Level Radioactive Waste Management Conference*
Published.

WBS 1.2.5.4.7 Supporting Calculations for Postclosure Performance Analyses

Objective

This task will provide documentation and results of calculations used in analyses of postclosure performance that supports design of repository, seals, and waste package and perform calculations of postclosure performance needed to support activities carried out under other performance assessment WBS elements.

Activities and Accomplishments

G. Zyvoloski met with G. Lee of Golder Associates of Seattle, Washington, on 22 July regarding a project involving a software interface using their FRACMAN code and the FEHM technology developed at Los Alamos.

Planned Activities

No planned activities reported.

Problem Areas

None

Milestone Progress

4004
30 September 1993
Letter Report on Thermal Repository Calculations

Publications

None

WBS 1.2.6 Exploratory Studies Facility

Objective

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.

Activities and Accomplishments

Staff attended weekly design and construction meetings and provided design input to support field changes related to north-portal construction and developing of Title II design packages. Staff developed weekly and monthly administrative management reports for testing activities and facilitated Job Package record development. Staff provided field test coordination and administrative support for north-portal construction.

Staff finalized the planning for the LLNL large-block test. The program will be implemented with a series of test planning and job package records developed under DOE procedures.

Additional information may be found in the Appendix to this monthly report.

Planned Activities

In preparation for the 90 percent design review, staff will support the finalizing of Title II design packages for the north-portal surface facility and starter tunnel extension .

Staff will meet with the testing organization to consolidate thermal/mechanical testing in the ESF.

Staff will continue to coordinate field tests relating to the Fran Ridge engineered barrier test activity. They will revise construction monitoring test records to include activities to be conducted in the north-portal starter tunnel alcove and extension.

Publications

N. Elkins
Planning and Implementation of Underground Testing in the ESF
Conference paper, *Rock Mechanics Conference*
Approved by YMPO.

N. Elkins
Prioritization of ESF Testing and Integration with Design and Construction
Conference paper, *1993 International High-Level Radioactive Waste Management Conference*
Published.

H. Kalia
Control of Tracers, Fluids, and Materials for the Yucca Mountain Site Characterization Project
Conference paper, *1993 International High-Level Radioactive Waste Management Conference*
Published.

Problem Areas

None

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

IDS design and development oversight continued on schedule. Staff was briefed by the M&O on the current status of the IDS design and procurement actions.

Planned Activities

Staff will continue to oversee M&O design and development of the IDS. Staff will develop IDS technical requirements documents as a source of information for the IDS designers. Meetings are planned to discuss the IDS requirements of various PI's and the current IDS design status. Staff will continue to review design documents as they are developed by the M&O.

Publications

H. Kalia
Acquisition of Test Data from the Exploratory Studies Facility for the Yucca Mountain Site Characterization Project
Conference paper, *Second International Symposium on Mine Mechanization and Automation*
Approved by YMPO.

Problem Areas

None

WBS 1.2.9.1.2 Technical Project Office Management

Objective

The objective of this task is to manage the Los Alamos Yucca Mountain Project Site Characterization Program.

Activities and Accomplishments

On 27 July, the TPO hosted the Technical Data Parameter Dictionary meeting between DOE staff and Los Alamos principal investigators.

The TPO met with representatives of the Spanish Radioactive Waste Management company, ENRESA. She presented an overview of Los Alamos YMP activities and initiated possible future technical exchanges with key Spanish research personnel.

The TPO hosted Project Management and Project Control staff from the DOE and the M&O. They discussed project control management philosophies and the TPO's concerns about DOE's efforts in continuous quality improvement of the Planning and Control System.

The TPO was named to the Los Alamos National Laboratory (Los Alamos) Middle Management Council.

The TPO attended the Technical Advisory Group meeting in Denver 15-16 July.

WBS 1.2.9.2.2 Project Control

Objective

The objective of this task is to support management's efforts in planning, scheduling, and controlling the technical work. This task will develop, implement, and maintain computerized cost, schedule, and technical milestone databases and develop strategies to meet management information requirements.

Activities and Accomplishments

Staff attended the initial Scheduling Users Group meeting in Las Vegas on 2 July. This meeting gave us a great deal of insight into the upcoming FY 1994 planning process.

Staff attended the PACS orientation training class in Las Vegas on 29 July.

Staff toured the Yucca Mountain Site on 30 July.

The PACS June status was submitted on 14 July.

Planned Activities

Download software will continue to be used during the status period. Further refinements to Los Alamos internal estimating and cost performance reporting methods will be implemented.

Staff will attend the second course in the George Washington University Project Management Master Certificate Program in August.

Staff will continue to prepare for the DOE/OIG audit of Los Alamos procurements and expenses for FY91, FY92, and FY93 year-to-date.

Problem Areas

None

WBS 1.2.11.2/.3/.5 Quality Assurance Program Development, Verification, and Engineering

Objective

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.

Program Development (WBS 1.2.11.2)

The major focus of this task continues to be on revising documents to satisfy the new QA description document. Of the 48 affected documents, only 10 procedures are still being prepared for review. All others documents have been through the review cycle at least once. The revisions will probably be completed in 60-90 days. Budget updates for FY94 were submitted to DOE.

Personnel. C. Martinez was appointed as verification coordinator, and J. Day was selected as Project Office liaison. They will assume the duties of the former records coordinator.

Procedure Revisions. Ten procedures are currently being revised. An additional nineteen are in formal review. Five procedures were completed and await entry into the RTN system.

Training. Efforts continued to finalize the new class on records management. It is scheduled to be given at the Lawrence Berkeley Laboratory audit in September. S. Bolivar and M. Clevenger attended a four-hour class on 5700.6C and guidebook preparation. The training database is still being tested.

Audits and Surveys (WBS 1.2.11.3)

Final reports for audits of EES-13/LV Volcanism (AR-93-04) and the University of New Mexico (AR-93-05) were issued. The report for Ohio State University (AR-93-06) audit is in process. Audit plan AR-93-07 (EES-13) was approved and issued. The DOE issued corrective action reports YM-93-049, -050, and -051, which were identified during YMP audit YM-93-11. Responses were submitted and accepted for CAR-YM-50 and -51. An amended response was submitted for CAR-YM-049. Corrective actions for stop work order SWO-03 are being examined by verification personnel. The second quarter trend report and the M&TE status report were issued. Revision 3 of the audit schedule was issued.

Quality Engineering (WBS 1.2.11.5)

The draft software procedures are in the comment resolution process. C. Mechels will recompile the SQAP into a software guidebook. The software quarterly status report was issued.

Planned Activities

Revisions on the QP-17.6 class will continue. The majority of efforts will be directed at revising procedures to satisfy the new QARD. Corrective actions on stop work order SWO-03 will be verified. The audit report for Ohio State University will be completed, and the EES-13 audit will be conducted. Compilation of the 1992 QA status report will continue.

Problem Areas

None

WBS 1.2.12.2 1.2.12.5 1.2.13 Local Records Center Operations/Records Management and Document Control

Objective

The objective of this task is to satisfy the records management requirements of the YMP and NQA-1.

Activities and Accomplishments

Forty-nine records and/or record packages were received by the RPC; seven of these were rejected and returned to their originators for corrections.

Forty-eight records and/or record packages were submitted to the CRF, and all of these were accepted.

On 20-21 July, staff attended a RIDS seminar in Las Vegas, Nevada. Participants reviewed the draft RIDS, which must be submitted to YMPO by 1 October.

Planned Activities

No planned activities reported.

Problem Areas

None

WBS 1.2.15.2 Administrative Support

Objective

The objective of this task is to provide administrative support for the Los Alamos YMP and the YMPO.

Activities and Accomplishments

S. Klein, Los Alamos editor, reviewed and edited six technical information products (TIPs); following TPO review and approval, she forwarded the TIPs to YMPO. She also prepared YMP weekly reports each week and monthly highlights for June. All reports were transmitted to the M&O and YMPO.

The May YMP Monthly Activity Report was published and distributed. The editor completed the first draft of the June YMP Monthly Activity Report.

The FY 1993 TIP database was updated and distributed to Los Alamos YMP management.

S. Klein met with a member of the Los Alamos YMP Project Control staff to exchange information about FY93 milestones.

Planned Activities

Continue work in all areas discussed above.

Problem Areas

None

WBS 1.2.15.3 Training

Objective

The objective of this task is to fulfill the training requirements of the Yucca Mountain Project and maintain appropriate training records.

Activities and Accomplishments

No activity reported this month because the training coordinator was on medical leave.

Planned Activities

No planned activities reported.

Problem Areas

None

Appendix

WBS 1.2.6.1.1, 1.2.3.1
"QA N/A"

Los Alamos
Los Alamos National Laboratory
P.O. Box O Mercury, Nev. 89023

memorandum

TWS-EES-13-LV-08-93-05

August 5, 1993
702/794-7095
M/S 527

TO: J. Russell Dyer, DOE/YMPO
W. Simecka, DOE/YMPO

FROM: R. Oliver, LANL

SUBJECT: EXPLORATORY STUDIES FACILITY TESTING ACTIVITIES - JULY 1993 - MONTHLY PROGRESS REPORT

GENERAL EXPLORATORY STUDIES FACILITY (ESF) ACTIVITIES

SITE CONSTRUCTION

Job Package (JP) 92-20 ESF North Portal Pad and Facilities

Construction of the ESF Starter Tunnel continued through the month of July, 1993, with the face of the pilot drift and side slashes being extended to CS 1+97. Rock bolting, wire mesh, and extensive shotcreting has continued from the portal to the face. Miscellaneous final rockbolting and shotcreting remains to be accomplished on the top bench.

Equipment has arrived and is being set up to commence rock sawing activities in support of the Engineered Barrier - Large Block Experiment.

TEST PROGRAM

A summary of ongoing ESF testing activities is provided as Table I. The general strategy for test planning and implementation is a function of starter tunnel construction progress, a general ESF test working schedule and supporting illustrations are provided as Attachment 1. Geologic mapping, consolidated sampling, and construction monitoring activities are proceeding as planned, no perched water was identified during the period. Sites at Fran Ridge were identified and flagged for Engineered Barrier - Large Block Experiment site preparation activities. Test support trailers and site configuration illustrations are provided in Attachment 2.

AUG 12 93

TABLE I
ESF Testing Field Activity
North Ramp Starter Tunnel

SCP PROGRAM	STUDY NAME	SCP Study PLAN NUMBER	TEST NAME	TPP #	JP #	CONTROL LED	FIELD START
Rock Characteristic Program	Characterization of Structural Features in the Site Area	8.3.1.4.2.2	Geologic Mapping of the ESF	TPP 92-10	JP 92-20A	4/2/93	4/8/93
Geohydrology Program	Characterization of YM Percolation in the Unsaturated-Zone ESF Investigation	8.3.1.2.2.4	Perched Water Testing in the ESF	TPP 92-11	JP 92-20B	4/2/93	4/8/93
Thermal and Mechanical Rock Properties Program	In Situ Design Verification	8.3.1.15.1.8	Construction Monitoring in the ESF	TPP T-93-2	JP 92-20D	4/2/93	4/8/93
Geohydrology Program &	Water Movement Tests, Rev. 0 Water Movement Tests, Rev. 1 Characterization of the Percolation in the Unsaturated-Zone Surface-Based Study	8.3.1.2.2.2 8.3.1.2.2.3	Consolidated Sampling in the ESF	TPP 92-14	JP 92-20C	5/19/93	5/27/93
Geochemistry Program	History of Mineralogic and Geochemical Alteration of YM	8.3.1.3.2.2					

ENVIRONMENTAL, SAFETY, AND HEALTH (ES&H) ACTIVITIES

No unusual ES&H Testing activities occurred during the period. A safety analysis review of the test Engineered Barrier - Large Block Experiment at Fran Ridge was completed. No actions were identified.

TRACERS, FLUIDS, AND MATERIALS (TFM)

Approximately 98,000 gallons of water with lithium-bromide tracer was reported used during the period by the constructor. The total construction water used to date is approximately 226,700 gallons. A previous usage limit for traced water had been set at 112,000 gallons. Explosives and tunnel support materials were consumed and/or installed during tunnel construction. No other significant TFM usage was reported by test organizations during the period.

TEST EXCLUSION AREAS AND TCO TURN OVER

A total of 19 samples have been collected for the Principal Investigators (PIs) in conjunction with the consolidated sampling program. The geologic mapping investigator also established numerous mapping targets that were surveyed and recorded.

None of the target areas or sample locations are considered permanent testing exclusion areas.

Four "Tests Released to Construction" forms were submitted for geologic mapping activities in conjunction with starter tunnel construction during the period (Attachment 3).

TEST SPECIFIC ESF ACTIVITIES

Appendix I - Underground Geologic Mapping (JP 92-20A)
Appendix II - Perched Water (JP 92-20B)
Appendix III - Consolidated Sampling (JP 92-20C)
Appendix IV - Construction Monitoring (JP 92-20D)
Appendix V - Fran Ridge - Engineered Barrier - Large Block Site Preparation (work order)

Attachments "Limited Value Material"

RDO:RK:jp58

Cy w/o attachment 3:
D. Williams, DOE/YMPO, MS 523
D. Harrison, DOE/YMPO, MS 523
W. Girdley, DOE/FOC, MS 717
W. Wilson, DOE/FOC, MS 717
R. Crawley, DOE/YMPO, MS 532
K. Skipper, DOE/YMPO, MS 523
E. Petrie, DOE/YMPO, MS 523
V. Iorii, DOE/YMPO, MS 523
W. Kopatich, RSN, MS 403
B. Gardella, REECo, MS 408
R. McDonald, CRWMS/M&O, MS 423
L. Hayes, USGS, Denver, CO
D. Edwards, USGS/LV, MS 509
L. Shephard, SNL, Dept. 6302, Albuquerque, NM
D. Kessel, SNL/LV, MS 509
W. Clarke, LLNL, Livermore, CA
J. Blink, LLNL/LV, MS 527
J. Canepa, LANL, EES-13, MS J521
N. Elkins, LANL, EES-13/LV, MS 527
D. Boak, LANL, EES-13/LV, MS 527
D. Weaver, LANL, EES-13/LV, MS 527

F. Homuth, LANL, EES-13/LV, MS 527
A. Mitchell, LANL, EES-13/LV, MS 527
D. Rashid, LANL, EES-13/LV, MS 527
J. Berry, LANL, EES-13/FOC, MS 735
K. Dye, LANL/FOC, MS 735
R. Kovach, LANL/FOC, MS 735
EES-13/LV, LANL, MS 527
CRMO, LANL, MS A150

TEST SPECIFIC ESF ACTIVITIES

UNDERGROUND GEOLOGIC MAPPING (JP 92-20A)

PROGRESS - MILESTONES AND DELIVERABLES

The geologic mapping data collection activity started with starter tunnel construction.

SUMMARY OF FIELD ACTIVITIES

The United States Bureau of Reclamation (USBR) continued the geologic mapping of the starter tunnel through the month of July. To date, the geological mapping has been completed to CS 1+97 and site characterization to CS 1+97 (see attachment). Present ground conditions are producing large blocks and associated joints which have reduced the mapping interval to 16 - 20 feet. Construction, due to safety concerns, has requested that geological maps produced from the current USBR mapping activities be made available to them for rock bolt location assessment. This has been approved and will be handled through the Los Alamos National Laboratory Test Coordination Office.

DATA FLOW INFORMATION

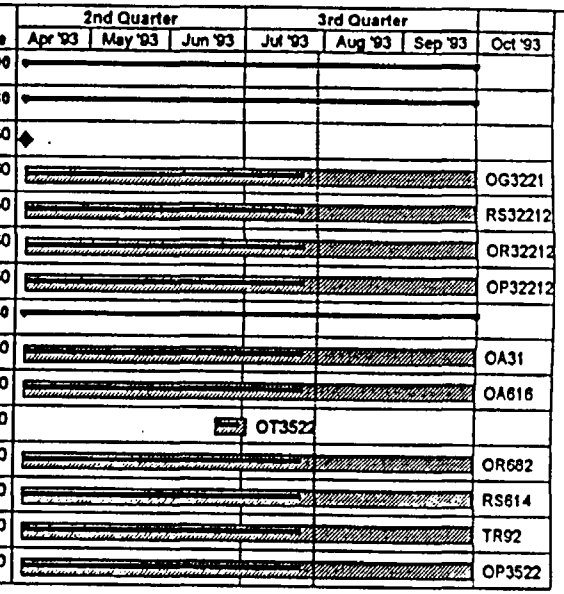
Geologic mapping data is being recorded in scientific notebooks. Test-related photo and survey mission data is being submitted to the JP record file and the PIs.

COST AND SCHEDULE SUMMARY

See attached illustrations for detailed cost and schedule information. The costs and progress estimates on this activity are within the scope set by JP 92-20A.

Geologic Mapping (TPP 92-10/JP 92-20A)
Field Activity Working Schedule
LANL ESF Test Coordination Office

ID	Name	Dur	Start	Summary Acct.	Cost Estimate	Estimated Prior Month Cost	Estimated Cost to Date
1	TEST IMPLEMENTATION - GEOLOGIC MAPPING	129d	4/5/93		$584,000	$62,830	$382,800
2	Test Implementation - Discreet	129d	4/5/93		$448,000	$34,760	$277,760
3	Start of Field Testing Activities	0d	4/5/93		$0	$0	$0
4	USGS/USBR Test Implementation (*1)	129d	4/5/93	OG32212D93	$448,000	$56,240	$277,760
5	RSN Field Survey & Processing	129d	4/5/93		$0	$0	$0
6	REECo Test Construction & Procurement	129d	4/5/93		$0	$0	$0
7	JC Photography & Process	129d	4/5/93		$0	$0	$0
8	Test Implementation - Matrix Support Elements	129d	4/5/93		$136,000	$28,070	$85,040
9	Los Alamos TCO Coordination & Planning (Field Test Coordination Support)	129d	4/5/93	OA310BL3	$32,000	$3,200	$19,840
10	Los Alamos TCO Test Management (Project Engineer Support)	129d	4/5/93	OA616AL3	$16,000	$1,600	$9,920
11	T&MSS Direct Support Services (Photo Support)	10d	6/20/93	OT3522DL	$4,000	$400	$3,200
12	REECo Construction & Operations Support (Interim WBS) - (*1)	129d	4/5/93	OR682L3	$40,000	$14,521	$24,800
13	RSN Survey Support / Capital Procurement (Interim WBS)	129d	4/5/93	RS614P92	$25,000	$2,500	$15,500
14	CRWMS M&O Networking & Baseline Planning Support (Network & Progress Rpt	129d	4/5/93	TR9228A	$8,000	$800	$4,960
15	JC Photo Support (Interim WBS)	129d	4/5/93	OP3522L93	$11,000	$560	$6,820



Preliminary data—do not reference

(*1) Changes based on participant input.

Project: I-92-10
Date:7/29/93
Revision #3

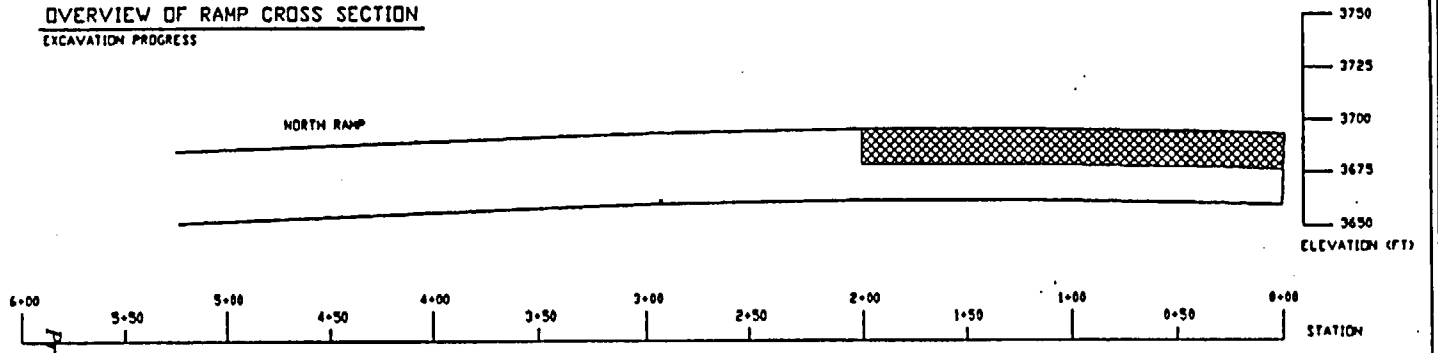
Critical ▭ Progress ——— Summary ▼
Activity ▭ Milestone ◆ Rolled Up ◇

T9210TI.MPP

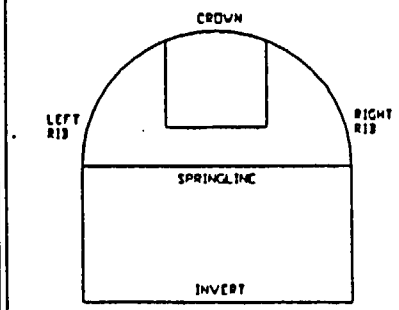
ADMINISTRATIVE USE ONLY

OVERVIEW OF RAMP CROSS SECTION

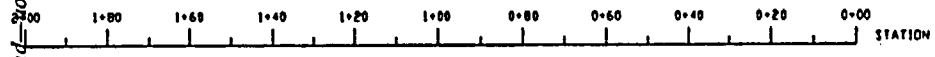
EXCAVATION PROGRESS



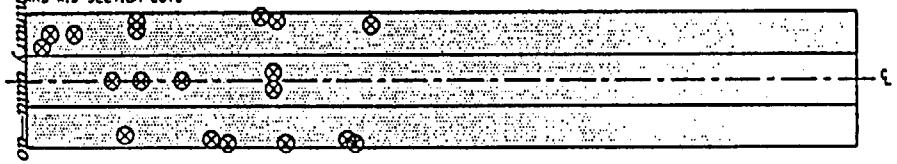
TUNNEL SECTION PROFILE



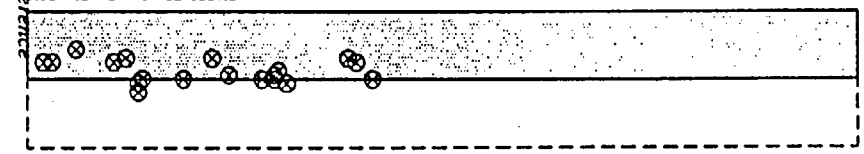
DETAILED RAMP SECTION



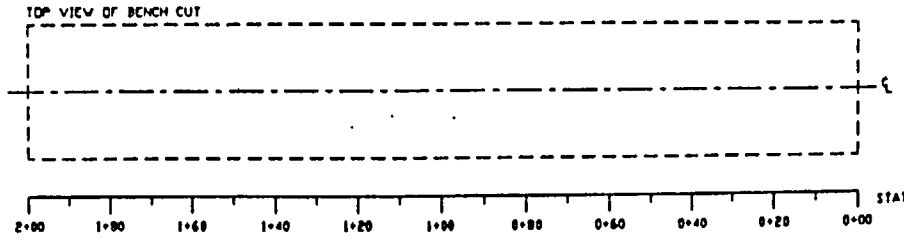
TOP VIEW OF CROWN DRIFT AND RIB SECTION CUTS



SIDE VIEW OF TUNNEL SECTION



TOP VIEW OF BENCH CUT



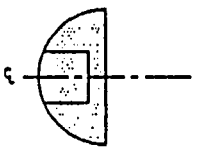
COMMENTS:

ALL SAMPLES TAKEN BY THE USBR DURING GEOLOGIC MAPPING

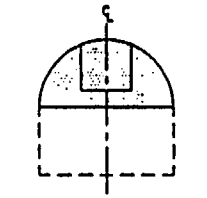
GEOLOGIC COMMENTS: ROCK APPEARS MORE COMPETENT MORE SINGLE FRACTURES AND FEWER FRACTURE ZONES

NORTH PORTAL BOX CUT FACE AT CS 0+00

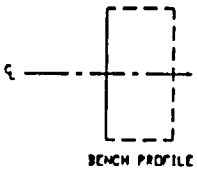
GRAPHIC SCALE
1" = 30'
20 (6.1) 0 20 (6.1) 40 FT. (12.2 m)



CROWN DRIFT AND RIB SECTIONS PROFILE



TUNNEL SECTION PROFILE



BENCH PROFILE

LEGEND:

- CENTER LINE OF RAMP
- UNEXCAVATED MATERIAL
- EXCAVATED RAMP
- SAMPLE LOCATION
- CONVERGENCE PINS
- LOAD CELLS
- PHOTOGRAMMETRY TARGET LOCATIONS
- MAPPING PROGRESS
- EXCAVATION PROGRESS

SAMPLE BAR CODE #	DATE COLLECTED	LOCATION
SPC00100498	7/1/93	TUNNEL HEADING, CS 1+40
SPC00100499	7/1/93	TUNNEL HEADING, CS 1+40
SPC00100497	7/1/93	RIGHT RIB, CS 1+16, SPRINGLINE
SPC00100495	7/1/93	LEFT RIB, CS 1+20, 4' ABOVE SPRINGLINE
SPC00100496	7/1/93	LEFT RIB, CS 1+22, 5' ABOVE SPRINGLINE
SPC00009485	7/8/93	LEFT RIB, CS 1+37, 1' BELOW SPRINGLINE
SPC00009486	7/8/93	RIGHT RIB, CS 1+39, 2' ABOVE SPRINGLINE
SPC00100438	7/9/93	CENTERLINE, CS 1+62 TO CS 1+72
SPC00100494	7/10/93	FACE, CS 1+72
SPC00100493	7/10/93	RIGHT RIB, CS 1+436
SPC00009487	7/13/93	CENTERLINE, CS 1+79 TO CS 1+89, PILOT DRIFT
SPC00500993	7/16/93	LEFT RIB, CS 1+51, 1' ABOVE SPRINGLINE
SPC00100492	7/16/93	RIGHT RIB, CS 1+73, 3' BELOW SPRINGLINE
SPC00500991	7/16/93	LEFT RIB, CS 1+55, 5' ABOVE SPRINGLINE
SPC00100490	7/16/93	RIGHT RIB, CS 1+94, 5' ABOVE SPRINGLINE
SPC00100489	7/16/93	RIGHT RIB, CS 1+88, 8' ABOVE SPRINGLINE
SPC00100491	7/16/93	FACE, CS 1+96, 5' ABOVE SPRINGLINE
SPC00500992	7/16/93	RIGHT RIB, CS 1+73, 1' BELOW SPRINGLINE
SPC00500994	7/16/93	LEFT RIB, CS 1+76, 6' ABOVE SPRINGLINE

LOS ALAMOS NATIONAL LABORATORY
TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT

PROJECT: GEOLOGIC MAPPING/CONSOLIDATED SAMPLING IN THE NORTH RAMP STARTER TUNNEL

CAD FILE: BENCHGL.DVG | AUTOCAD R12 | SIZE A | SCALE NOTED

DRN. BY: B.J. WEAVER | DATE: 8-3-93

NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY

Predecisional information—preliminary data—do not reference

PERCHED WATER (JP 92-20B)

PROGRESS - MILESTONES AND DELIVERABLES

The perched water data collection contingency activity was started with starter tunnel construction.

SUMMARY OF FIELD ACTIVITIES

No water or samples were collected during the period. Equipment to collect samples, if identified, is on station.

DATA FLOW INFORMATION

Perched water sample data and observations will be recorded in a scientific notebook if encountered.

COST AND SCHEDULE SUMMARY

See attached illustration for detailed cost and scheduling information. The costs and progress estimates on this activity are within the scope set by JP 92-20B.

Perched Water (TPP 92-11/JP 92-20B)

Field Activity Working Schedule

LANL ESF Test Coordination Office

ID	Name	Dur	Start	Summary Acct.	Cost Estimate	Estimated Prior Month Cost	Estimated Cost to Date	2nd Quarter			3rd Quarter			
								Apr '93	May '93	Jun '93	Jul '93	Aug '93	Sep '93	Oct '93
1	TEST IMPLEMENTATION - PERCHED WATER	95d	4/5/93		$3,500	$600	$1,580							
2	Test Implementation - Discreet	95d	4/5/93		$2,000	$400	$1,140							
3	USGS Test Implementation	95d	4/5/93	OG33124G93	$2,000	$740	$1,140						OG33124	
4	Test Implementation - Matrix Support	95d	4/5/93		$1,500	$100	$440							
5	Los Alamos TCO Coordination & Planning (Field Test Coordination Support)	2d	8/1/93	OA3108L3	$500	$0	$0						OA31	
6	Los Alamos TCO Test Management (Project Engineer Support)	95d	4/5/93	OA616AL3	$0	$0	$0						OA616	
7	T&MSS Direct Support Services (Photo Support)	2d	8/1/93	OT3522DL	$500	$0	$0						OT3552	
8	REECo Construction & Operations Support (Contingency) - (*1)	2d	8/1/93	OR682L3	$0	$0	$0						OR682	
9	RSN Survey Support / Survey Procurement (Contingency)	1d	8/1/93	RS614P92	$0	$0	$0						RS614	
10	CRWMS M&O Networking & Baseline Planning Support (Monthly Cost & Progress	95d	4/5/93	TR922BA	$500	$340	$440						TR92	

(*1) Changes based on participant input.

Project: t-92-11
Date:7/29/93
Revision #3

Critical — Progress — Summary

Activity — Milestone ◆ — Rolled Up ◇

T9211TI.MPP

ADMINISTRATIVE USE ONLY

JP 92-20C CONSOLIDATED SAMPLING

PROGRESS - MILESTONES AND DELIVERABLES

The consolidated sampling data collection and observation activity began when the starter tunnel construction exposed suitable rock.

SUMMARY OF FIELD ACTIVITIES

The geologic mapping investigator continued to observe formation exposed by tunnel construction for potential sample collection. The sample plan SP 92-20C provides the working criteria and instruction for sample selections, collection, and correction. All samples were photographed and bar coded. Table II provides a summary of sampling dates by tests.

Table II "Starter Tunnel Sample Bar Code ID's"

TEST	Bar Code	Date Taken
History of Mineralogic and Geochemical Alteration of Yucca Mountain	SPC 00009486	July 8, 1993
	SPC 00500991	July 16, 1993
	SPC 00500994	July 16, 1993
Fracture Mineralogy	SPC 00100495	July 1, 1993
	SPC 00100496	July 1, 1993
	SPC 00100497	July 1, 1993
	SPC 00100498	July 1, 1993
	SPC 00100499	July 1, 1993
	SPC 00009485	July 8, 1993
	SPC 00100493	July 10, 1993
	SPC 00009487	July 13, 1993
	SPC 00500993	July 16, 1993
	SPC 00100489	July 16, 1993
	SPC 00100490	July 16, 1993
	SPC 00100491	July 16, 1993
The Mineral Distribution Between Host Rock and Accessible Environment	SPC 00100492	July 16, 1993
	SPC 00500992	July 16, 1993
Chloride and Chlorine-36 Measurements of Percolation	SPC 00100488	July 8, 1993
	SPC 00100494	July 10, 1993

DATA FLOW INFORMATION

Consolidated sampling data and sample collection activities are controlled by the JP Document and Records Center files, scientific notebooks, and by AP-6.26Q, sample collection report records and bar codes. Test-related photo and survey mission data is being submitted to the JP record file and the PIs.

COST & SCHEDULE SUMMARY

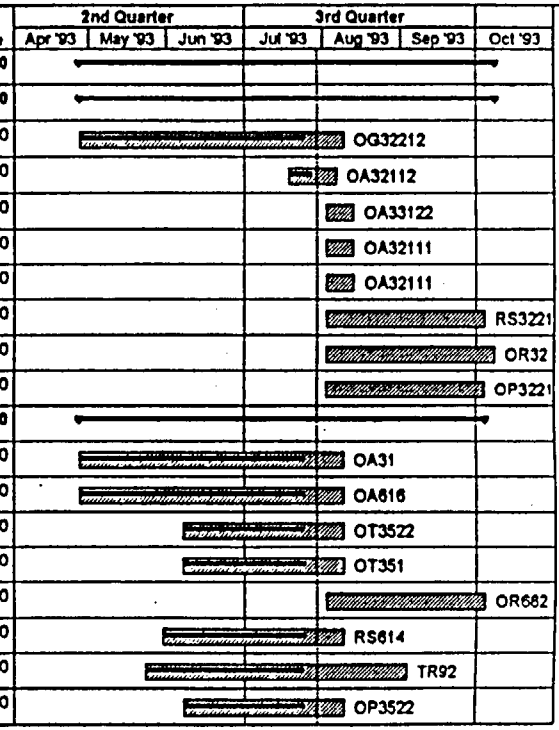
See attached illustrations for detailed cost and schedule information. The costs and progress estimates on this activity are within the scope set by JP 92-20C.

Consolidated Sampling (TPP 92-14/JP 92-20C)

Field Activity Working Schedule

LANL ESF Test Coordination Office

ID	Name	Dur	Start	Summary Acct.	Cost Estimate	Estimated Prior Month Cost	Estimated Cost to Date
1	TEST IMPLEMENTATION - CONSOLIDATED SAMPLING	119d	4/27/93		$63,000	$0	$19,800
2	Test Implementation - Discrete	119d	4/27/93		$12,000	$0	$4,380
3	USGS/USBR Test Implementation	75d	4/27/93	OG3212D93	$4,000	$1,040	$3,400
4	History of Mineralogic & Geochemical Alteration at YM	15d	7/18/93	OA32112C02	$2,000	$780	$960
5	Chloride and Chlorine-36 Measurements of Percolation at YM	10d	8/2/93	OA33122HA3	$2,000	$0	$0
6	Fracture Mineralogy Studies	10d	8/2/93	OA32111BA2	$2,000	$0	$0
7	Mineral Distribution Between Host Rock and Accessible Environment	10d	8/2/93	OA32111B17	$2,000	$0	$0
8	RSN Field Survey & Processing	46d	8/2/93		$0	$0	$0
9	REECo Test Construction & Procurement	50d	8/2/93		$0	$0	$0
10	JC Photography & Process	46d	8/2/93		$0	$0	$0
11	Test Implementation - Matrix Support Elements	116d	4/27/93		$51,000	$1,760	$15,420
12	Los Alamos TCO Coordination & Planning (Field Test Coordination Support)	75d	4/27/93	OA310BL3	$2,000	$500	$1,700
13	Los Alamos TCO Test Management (Project Engineer Support)	75d	4/27/93	OA616AL3	$1,000	$250	$650
14	T&MSS Direct Support Services (Photo Support)	46d	6/7/93	OT3522PL	$5,000	$2,300	$3,750
15	T&MSS Sample Management Facility	46d	6/7/93	OT351DL	$3,000	$1,410	$2,280
16	REECo Construction & Operations Support (Interim WBS)	46d	8/2/93	OR662L3	$31,000	$0	$0
17	Engineering Survey Support / Survey Processing (Interim WBS)	51d	5/30/93	RS614P92	$6,000	$2,940	$4,740
18	CRWMS M&O Networking & Baseline Planning Support (Monthly Cost & Progress	75d	5/23/93	TR922BA	$1,000	$250	$600
19	JC Photography & Process (Interim WBS)	46d	6/7/93	OP3522L93	$2,000	$920	$1,500



Predecisional information—preliminary, data—do not reference

(*1) Changes based on participant input.

Project: I-92-14
Date:7/29/93
Revision #2

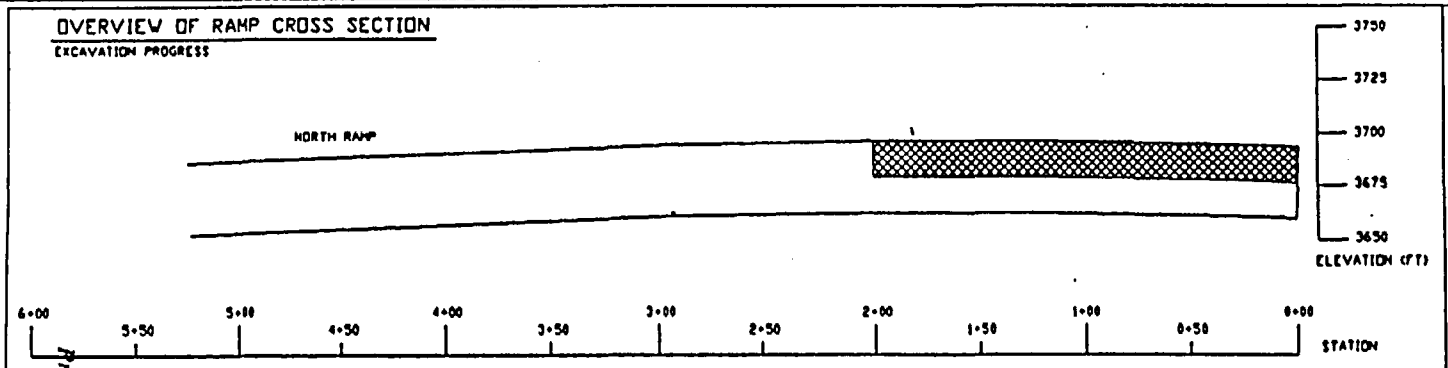
Critical Activity Progress Milestone ◆ Summary Rolled Up ◇

T9214TI.MPP

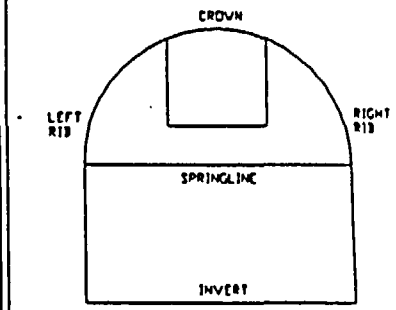
ADMINISTRATIVE USE ONLY

OVERVIEW OF RAMP CROSS SECTION

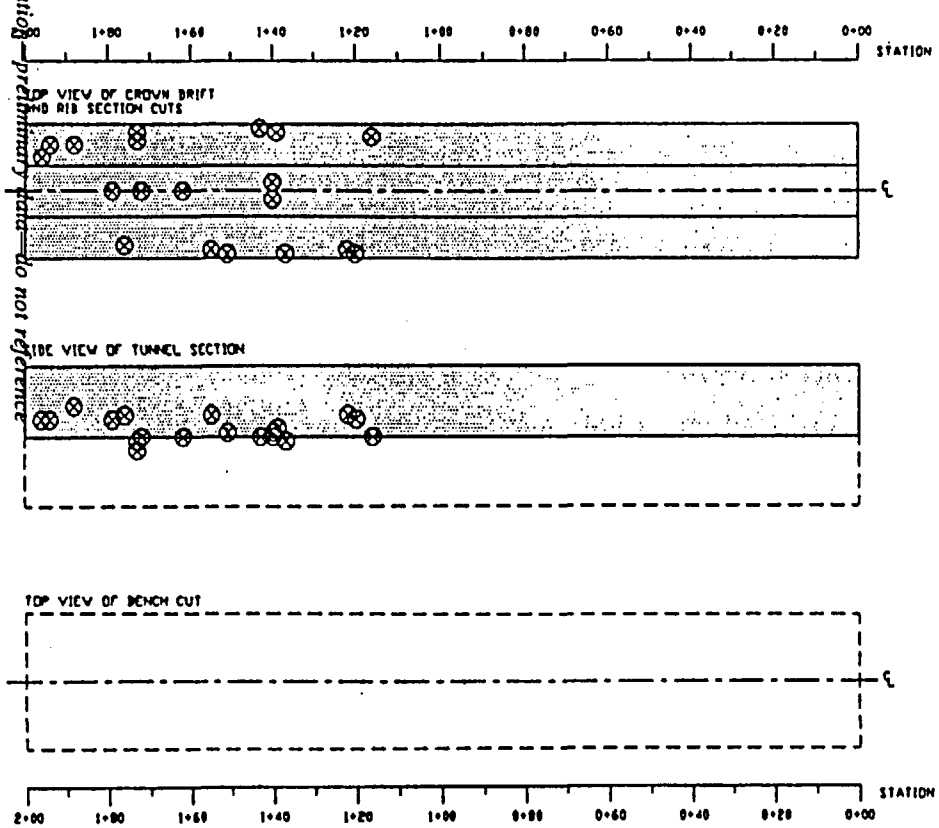
EXCAVATION PROGRESS

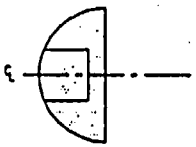


TUNNEL SECTION PROFILE

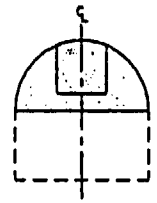


DETAILED RAMP SECTION

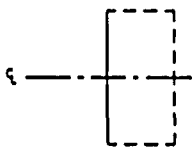




CROWN DRIFT AND RIB SECTIONS PROFILE



TUNNEL SECTION PROFILE



BENCH PROFILE

COMMENTS:

ALL SAMPLES TAKEN BY THE USBR DURING GEOLOGIC MAPPING

GEOLOGIC COMMENTS: ROCK APPEARS MORE COMPETENT MORE SINGLE FRACTURES AND FEWER FRACTURE ZONES

NORTH PORTAL BOX CUT FACE AT CS 0+00

GRAPHIC SCALE

1" = 30'

20 (6.1) 0 20 (6.1) 40 FT. (12.2 M)

LEGEND:

- CENTER LINE OF RAMP
- UNEXCAVATED MATERIAL
- EXCAVATED RAMP
- SAMPLE LOCATION
- CONVERGENCE PINS
- LOAD CELLS
- PHOTOGRAMMETRY TARGET LOCATIONS
- MAPPING PROGRESS
- EXCAVATION PROGRESS

SAMPLE BAR CODE #	DATE COLLECTED	LOCATION
SPC00100498	7/1/93	TUNNEL HEADING, CS 1+40
SPC00100499	7/1/93	TUNNEL HEADING, CS 1+40
SPC00100497	7/1/93	RIGHT RIB, CS 1+16, SPRINGLINE
SPC00100495	7/1/93	LEFT RIB, CS 1+20, 4' ABOVE SPRINGLINE
SPC00100496	7/1/93	LEFT RIB, CS 1+22, 5' ABOVE SPRINGLINE
SPC00009485	7/8/93	LEFT RIB, CS 1+37, 1' BELOW SPRINGLINE
SPC00009486	7/8/93	RIGHT RIB, CS 1+39, 2' ABOVE SPRINGLINE
SPC00100438	7/9/93	CENTERLINE, CS 1+62 TO CS 1+72
SPC00100494	7/10/93	FACE, CS 1+72
SPC00100493	7/10/93	RIGHT RIB, CS 1+436
SPC00009487	7/13/93	CENTERLINE, CS 1+79 TO CS 1+89, PILOT DRIFT
SPC00500993	7/16/93	LEFT RIB, CS 1+51, 1' ABOVE SPRINGLINE
SPC00100492	7/16/93	RIGHT RIB, CS 1+73, 3' BELOW SPRINGLINE
SPC00500991	7/16/93	LEFT RIB, CS 1+55, 5' ABOVE SPRINGLINE
SPC00100490	7/16/93	RIGHT RIB, CS 1+94, 5' ABOVE SPRINGLINE
SPC00100489	7/16/93	RIGHT RIB, CS 1+88, 8' ABOVE SPRINGLINE
SPC00100491	7/16/93	FACE, CS 1+96, 5' ABOVE SPRINGLINE
SPC00500992	7/16/93	RIGHT RIB, CS 1+73, 1' BELOW SPRINGLINE
SPC00500994	7/16/93	LEFT RIB, CS 1+76, 6' ABOVE SPRINGLINE

LOS ALAMOS NATIONAL LABORATORY

TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT

PROJECT: GEOLOGIC MAPPING/CONSOLIDATED SAMPLING IN THE NORTH RAMP STARTER TUNNEL

CAD FILE: BENCHGM.DVG | AUTOCAD R12 | SIZE: A | SCALE: NOTED

DRN. BY: D.J. WEAVER | DATE: 8-3-93

NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY

Predecisional information - preliminary data - do not reference

CONSTRUCTION MONITORING (JP 92-20D)

PROGRESS - MILESTONES AND DELIVERABLES

The construction monitoring data collection and observation activity began with starter tunnel construction.

SUMMARY OF FIELD ACTIVITIES

The PIs have continued monitoring the blasting activity and recording peak particle velocity removal. The geophones have been located at GM #3 and GM #4, or GM #4 and GM #5 dependent on activity in the tunnel (see Attachment 3 for all geophone locations).

To date, five locations for load cells have been identified at approximately CS 0+50, 0+90, 1+15, 1+45, and 1+90. At CS 0+50 all three rock bolts exist and cans for two load cells have been installed. At CS 0+90 the three rock bolts exist but further installation has not been completed due to ongoing tunnel construction in the area. At CS 1+15, CS 1+45, and CS 1+90, the load cells will be installed upon removal of the bench.

Five locations have been identified for extensometer installation, CS 0+16, 0+30, 0+60, 0+86, and 1+15. These locations are used by the Civilian Radioactive Waste Management System Management & Operating Contractor for monitoring drift stability.

Convergence pins have been installed at CS 1+50 and CS 1+90. The pins are in support of the Construction Monitoring Testing Program.

DATA FLOW INFORMATION

Construction monitoring data was recorded in a scientific notebook. Test-related photo and survey mission data is being submitted to the JP record file and the PIs.

COST AND SCHEDULE SUMMARY

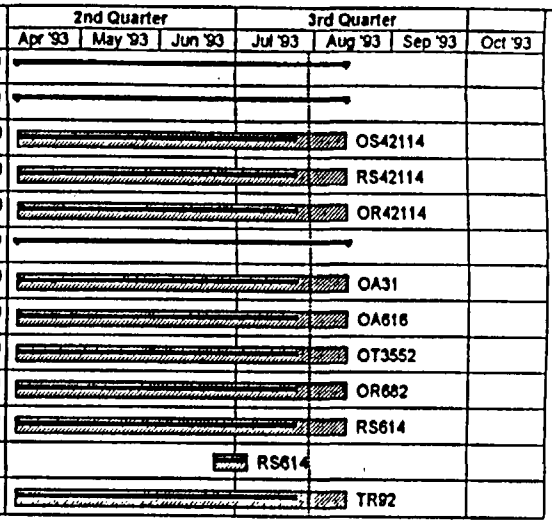
See attached illustrations for detailed cost and schedule information. The costs and progress estimates on this activity are within the scope set by JP 92-20D.

Construction Monitoring (TPP 93-2/JP 92-20D)

Field Activity Working Schedule

LANL ESF Test Coordination Office

ID	Name	Dur	Start	Summary Acct.	Cost Estimate	Estimated Prior Month Cost	Estimated Cost to Date
1	TEST IMPLEMENTATION - CONSTRUCTION MONITORING	96d	4/5/93		$446,000	$89,000	$378,390
2	Test Implementation - Discrete	95d	4/5/93		$280,000	$56,000	$238,000
3	SNL Test Implementation	95d	4/5/93	OS42114L93	$280,000	$56,000	$238,000
4	RSN Field Survey & Processing	95d	4/5/93		$0	$0	$0
5	REECo Test Construction & Procurement	95d	4/5/93	OR42114L3	$0	$0	$0
6	Test Implementation - Matrix Support	95d	4/5/93		$166,000	$33,000	$140,390
7	Los Alamos TCO Coordination & Planning (Field Test Coordination Support)	95d	4/5/93	OA310BL3	$56,000	$11,200	$47,600
8	Los Alamos TCO Test Management (Project Engineer Support)	95d	4/5/93	OA616AL3	$28,000	$5,600	$23,800
9	T&MSS Direct Support Services (Photo Support)	95d	4/5/93	OT3522DL	$5,000	$1,000	$4,250
10	REECo Construction & Operations Support (Contingency) - (*1)	95d	4/5/93	OR682L3	$55,000	$11,000	$46,750
11	RSN Survey Support / Survey Procurement (Contingency)	95d	4/5/93	RS614P92	$5,000	$1,000	$4,250
12	Engineering Verification	10d	6/22/93	RS614P92	$2,000	$560	$1,840
13	CRWMS M&O Networking & Baseline Planning Support (Monthly Cost & Progress	95d	4/5/93	TR922BA	$14,000	$2,800	$11,900



Predecisional information—preliminary data—do not reference

(*1) Changes based on participant input.

Project: T-93-2
Date:7/29/93
Revision #3

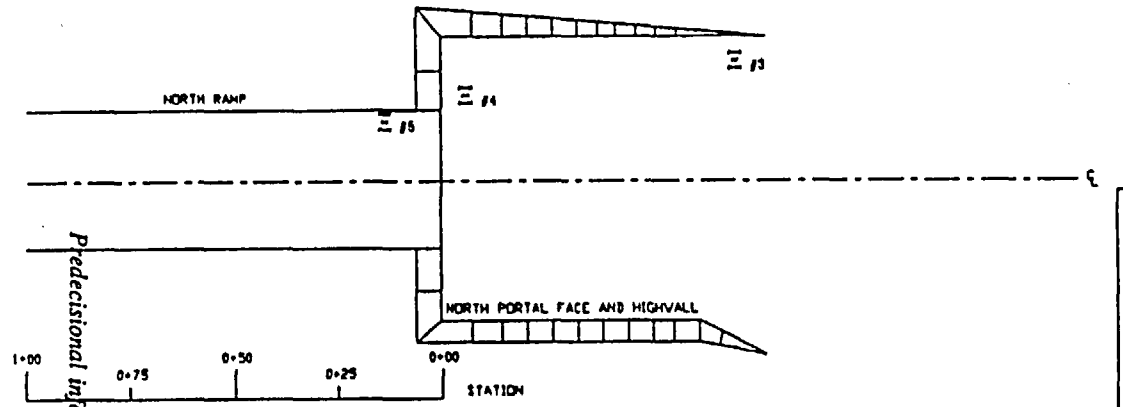
Critical | Progress | Summary
Activity | Milestone ◆ | Rolled Up ◇

T932TI.MPP

ADMINISTRATIVE USE ONLY

OVERVIEW OF RAMP CROSS SECTION AND PAD

TOP VIEW
GEOPHONE LOCATIONS ON NORTH PAD



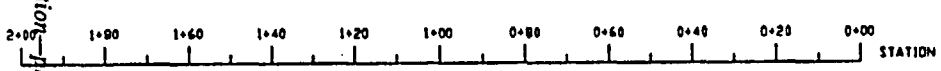
COMMENTS:
NORTH PORTAL BOX CUT FACE AT CS 0+00

GEOPHONE STATION
- #1 (ELIMINATED) 196.44' FROM FACE OF HIGHWALL
- #2 (ELIMINATED) (NOT SHOWN) 396.44' FROM FACE OF HIGHWALL
- #3 82.50' FROM FACE OF HIGHWALL
- #4 32 ' FROM RAMP CENTERLINE AT FACE OF HIGHWALL
- #5 14' INSIDE DRIFT AGAINST RIGHT RIB

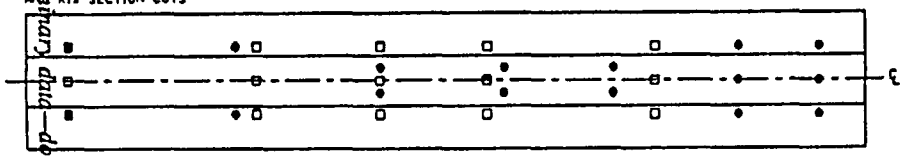
MONITORING INSTRUMENTS AND LOCATIONS

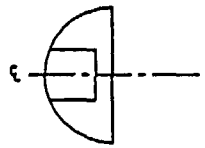
INSTRUMENT DESCRIPTION	STATION	QUANTITY	LOCATION	ACTIVITY
ROCK BOLT LOAD CELLS	0+50	3 CELLS	CL - 2L - 2R	PULL-TEST, HANG CAN
	0+90	3 CELLS	CL - 2L - 2R	PULL-TEST, HANG CAN
	1+15	3 CELLS	CL - 2L - 2R	PULL-TEST, HANG CAN
	1+45	3 CELLS	CL - 2L - 2R	PULL-TEST, HANG CAN
	1+90	3 CELLS	CL - 2L - 2R	PULL-TEST, HANG CAN
MPBX	1+45	1 EACH	VERT. CL	DRILL HOLES
	1+90	2 EACH	VERT. CL. - HORZ. SPRINGLINE S	DRILL HOLES (VERT)
CONVERGENCE PINS	1+50	2 PAIR	VERT. @ SOUTH OF CL - HORZ. @ ABOVE SILL	INSTALL
	1+90	2 PAIR	VERT. @ SOUTH OF CL - HORZ. @ ABOVE SILL	INSTALL

DETAILED RAMP SECTION



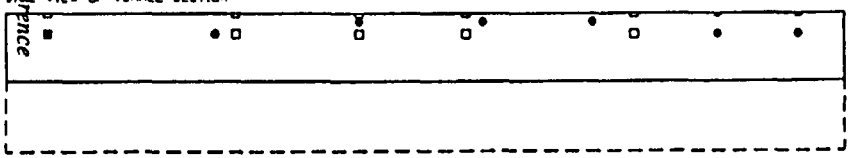
TOP VIEW OF CROWN DRIFT AND RIB SECTION CUTS

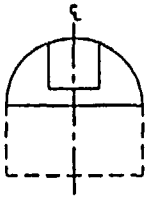




CROWN DRIFT AND RIB SECTIONS PROFILE

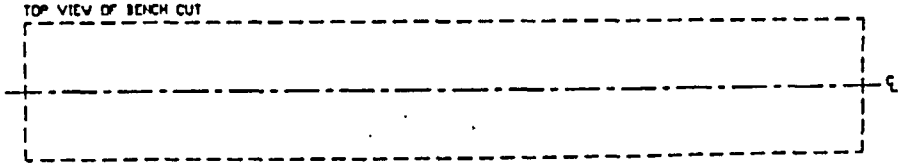
SIDE VIEW OF TUNNEL SECTION

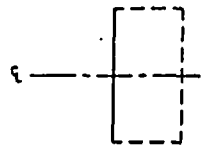




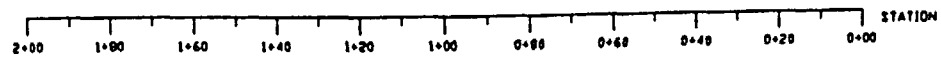
TUNNEL SECTION PROFILE

TOP VIEW OF BENCH CUT





BENCH PROFILE



GRAPHIC SCALE
1" = 20'
20 (6.1) 0 20 (6.1) 40 FT. (12.2 m)

LEGEND:
- CENTER LINE OF RAMP
- UNEXCAVATED MATERIAL
- EXCAVATED RAMP
- SAMPLE LOCATION
- CONVERGENCE PINS
- LOAD CELLS
- PHOTOGRAMMETRY TARGET LOCATIONS
- GEOPHONE LOCATION
- MAPPING PROGRESS
- EXCAVATION PROGRESS

COMMENTS:
NORTH PORTAL BOX CUT FACE AT CS 0+00

CONVERGENCE PINS BETWEEN CS 0+00 AND CS 1+15 WERE USED BY THE M&O FOR MONITORING. THE REMAINING PINS ARE FOR TESTING (SP 92-20D)

TRACED WATER USED FROM 6/28/93 TO 7/30/93 = 97,979 GAL. TOTAL USED TO DATE = 226,655 GAL.

LOS ALAMOS NATIONAL LABORATORY
TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT

PROJECT: CONSTRUCTION MONITORING ILLUSTRATION - NORTH RAMP AND PAD

CAD FILE: BENCHCN.DWG	AUTOCAD R12	SIZE: A	SCALE: NOTED

DRN. BY: D.J. WEAVER
DATE: 8-3-93

NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY

Predecisional information—preliminary data—do not reference

FRAN RIDGE CONSTRUCTION - ENGINEERED BARRIER SITE PREPARATION

PROGRESS - MILESTONES AND DELIVERABLES

The Engineered Barrier - Large Block Experiment Site Preparation activity began with site cleaning and selection activities.

SUMMARY OF FIELD ACTIVITIES

During the month the PI has made several trips to the site. The location of the block has been identified and site selection pavement mapping has been completed. The sighting of the engine generator, ground mat, support trailer, and a small circulating pond was accomplished. Numerous pieces of equipment was delivered to the site and cutting test blocks will commence as funding becomes available.

DATA FLOW INFORMATION

Construction monitoring data was recorded in a scientific notebook. Test-related photo and survey mission data is being submitted to DRC 059 and to the PI's.

COST AND SCHEDULE SUMMARY

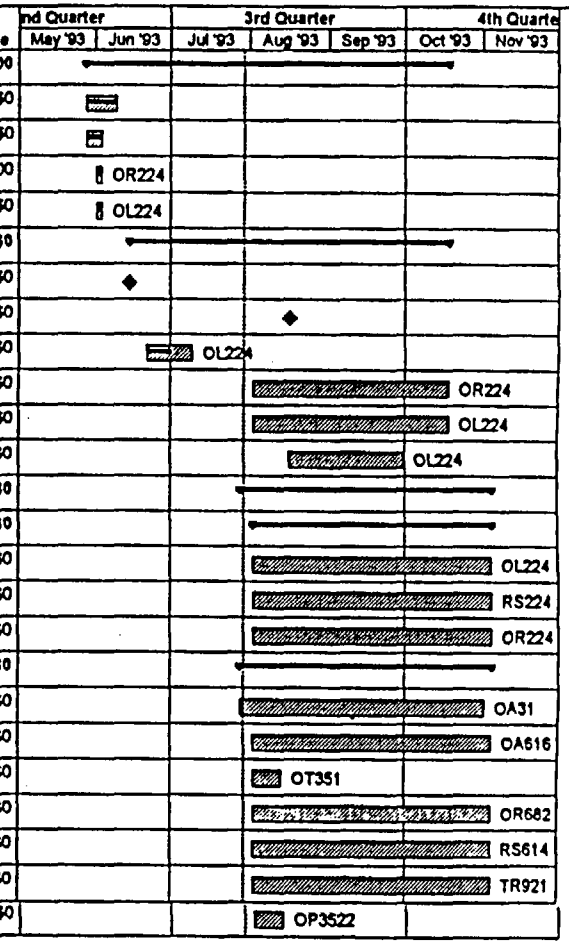
See attached illustrations for detailed cost and schedule information. The costs and progress estimates on this activity are within the scope set by the Work Breakdown Structure participant accounts.

Engineered Barrier - Large Block Experiment - (JP 93-10)

Field Activity Working Schedule -- Site Preparation - Fran Ridge

LANL ESF Test Coordination Office

ID	Name	Dur	Start	Summary Acct.	Cost Estimate	Estimated Prior Month Cost	Estimated Cost to Date
1	PHASE I - SITE SELECTION - ENGINEERED BARRIER	102d	6/28/93		$390,000	$0	$24,000
2	Project Manager Authorization Letter	9d	5/28/93		$0	$0	$0
3	Environmental Clearance for Site Confirmed	5d	5/28/93		$0	$0	$0
4	Clean Site North of Pits (*1)	3d	6/1/93	OR224 (TBD)	$25,000	$24,000	$24,000
5	Select Large Block Location	3d	6/1/93	OL224HXC	$0	$0	$0
6	Phase IA - Demonstration of Saw Cuts	90d	6/14/93		$365,000	$0	$0
7	Project Manager Authorization Letter	0d	6/14/93		$0	$0	$0
8	Start Large Block Saw Demonstration Cuts	0d	8/16/93		$0	$0	$0
9	Saw Shipped to Site	15d	6/21/93	OL224KGB	$0	$0	$0
10	Construction Support	56d	8/2/93	OR224 (TBD)	$365,000	$0	$0
11	Demonstration Block Cuts - Prototype Saw	56d	8/2/93	OL224KGB	$0	$0	$0
12	Demonstration Cuts - Large Block Saw	34d	8/16/93	OL224KGB	$0	$0	$0
13	SITE PREPARATION - EB LRG. BLOCK TEST (JP 93-10)	72d	7/28/93		$361,000	$0	$0
14	Site Preparation - Discreet	69d	8/2/93		$361,000	$0	$0
15	LLNL Site Preparation Monitoring	69d	8/2/93	OL224KGB	$0	$0	$0
16	RSN Field Survey & Processing	69d	8/2/93	RS224 (TBD)	$46,000	$0	$0
17	REECo Test Construction & Procurement	69d	8/2/93	OR224(TBD)	$305,000	$0	$0
18	Construction Implementation - Matrix Support Elements	72d	7/28/93		$0	$0	$0
19	Los Alamos TCO Coord. & Planning (Field Test Coord)	69d	7/28/93	OA310BL3	$0	$0	$0
20	Los Alamos TCO Test Mgt. (Project Engineer Support)	69d	8/2/93	OA616AL3	$0	$0	$0
21	T&MSS Sample Management Facility	10d	8/2/93	OT3522DL	$0	$0	$0
22	REECo Construction & Operations Support - Interim WBS	69d	8/2/93	OR682L3	$0	$0	$0
23	Engineering & Survey Support/Survey Processing - Interim WBS	69d	8/2/93	RS614P92	$0	$0	$0
24	CRWMS M&O Network & Baseline Plan Support (Mo Cost/ Progress Rpt)	69d	8/2/93	TR9228A	$0	$0	$0
25	JC Photo & Processing	10d	8/2/93	OP3522L93	$0	$0	$0



(*1) Changes based on participant input.

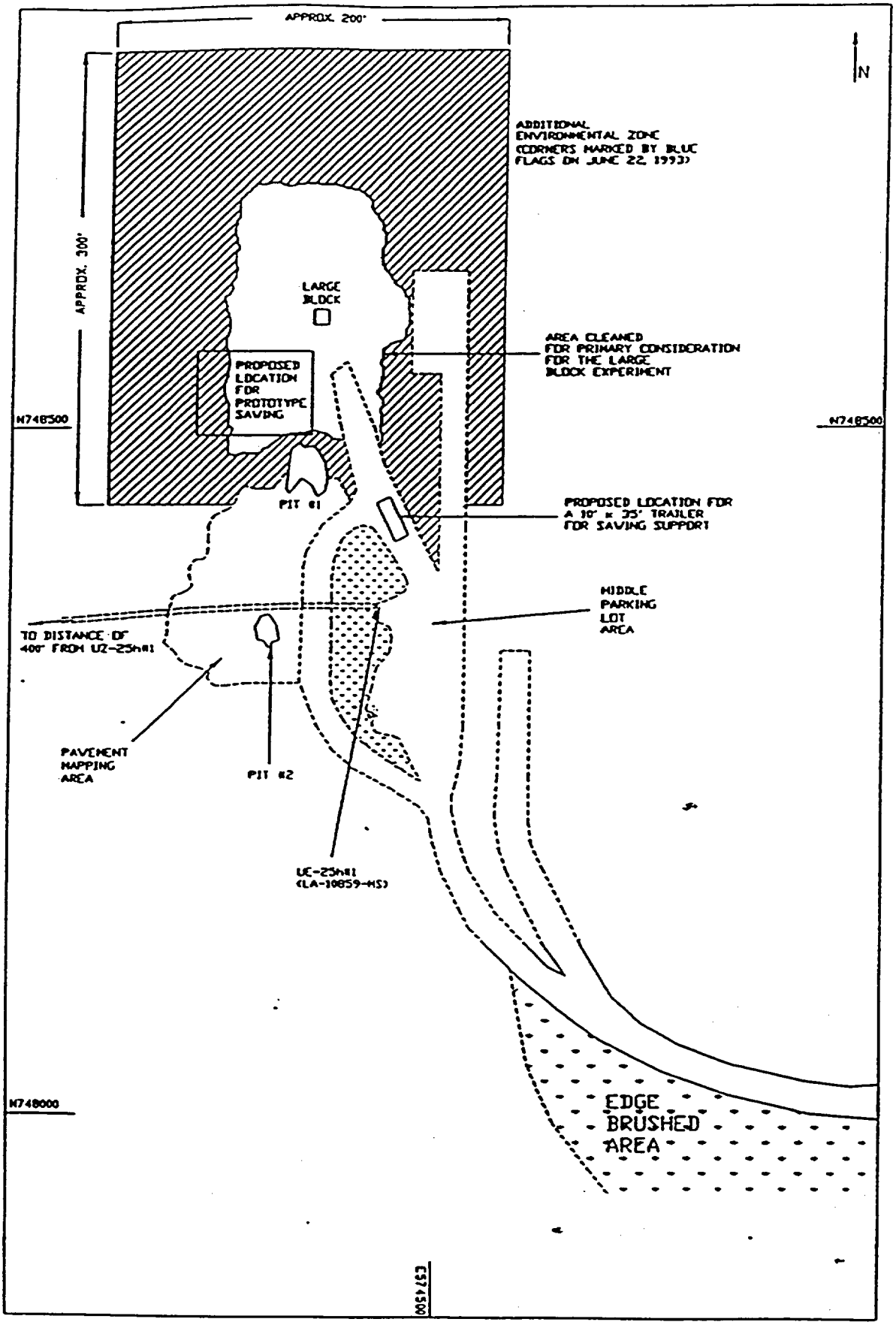
Project: T-93-3
Date:7/29/93
Revision #3

Critical Activity — Progress — Milestone ◆ — Summary — Rolled Up ◇

T933TI.MPP

ADMINISTRATIVE USE ONLY

ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT
SITE PREPARATION ILLUSTRATION
FRAN RIDGE SITE



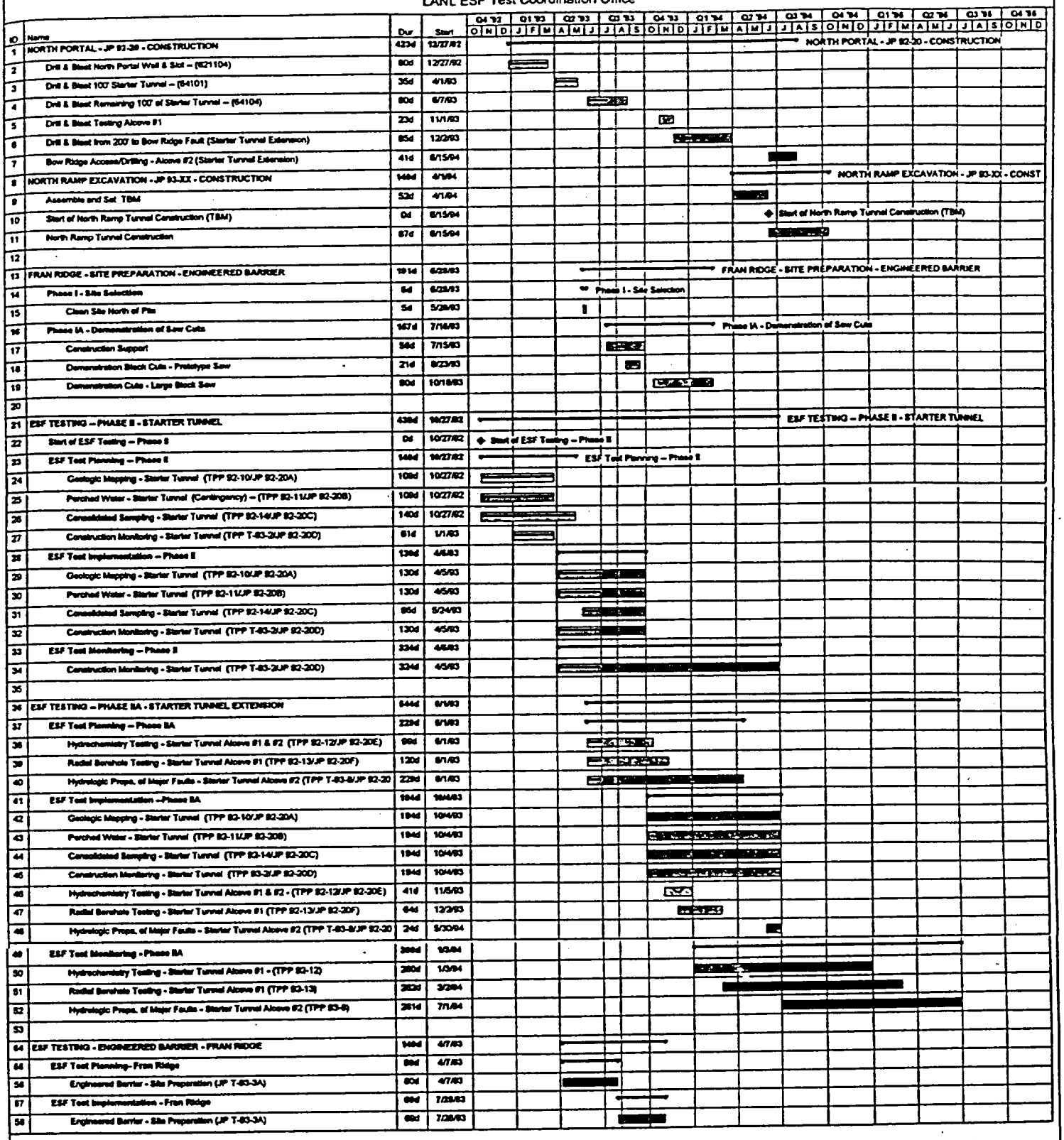
ADMINISTRATIVE USE ONLY

DRN. BY
D.J. WEAVER

FRLBENV2.DWG
6/25/93

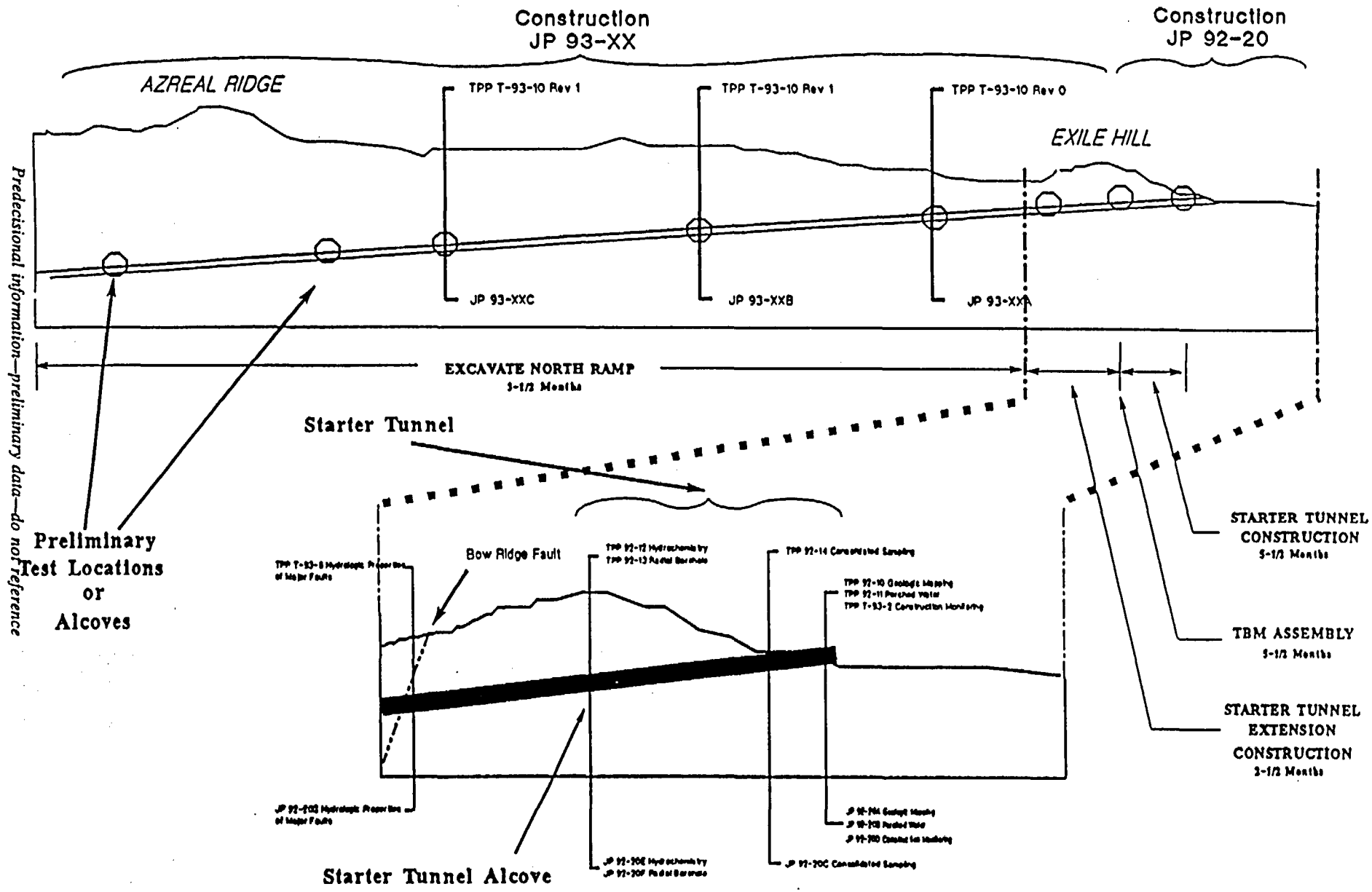
Predecisional information—preliminary data—do not reference

ESF Working Test Schedule
Planning and Field Activities
LANL ESF Test Coordination Office



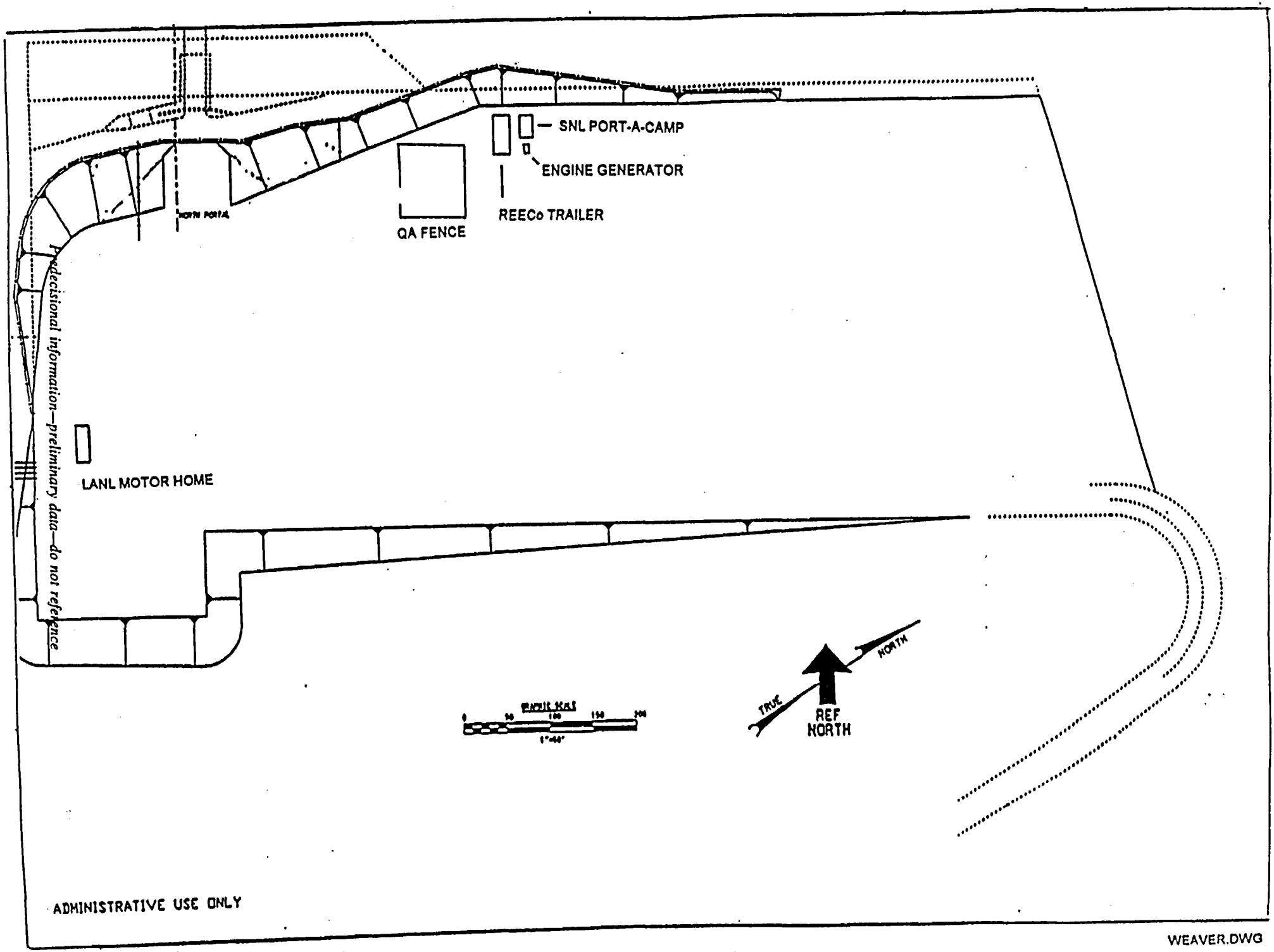
Predecisional information—preliminary data—do not reference

ESF TESTING - NORTH RAMP
JP & TPP Interactions

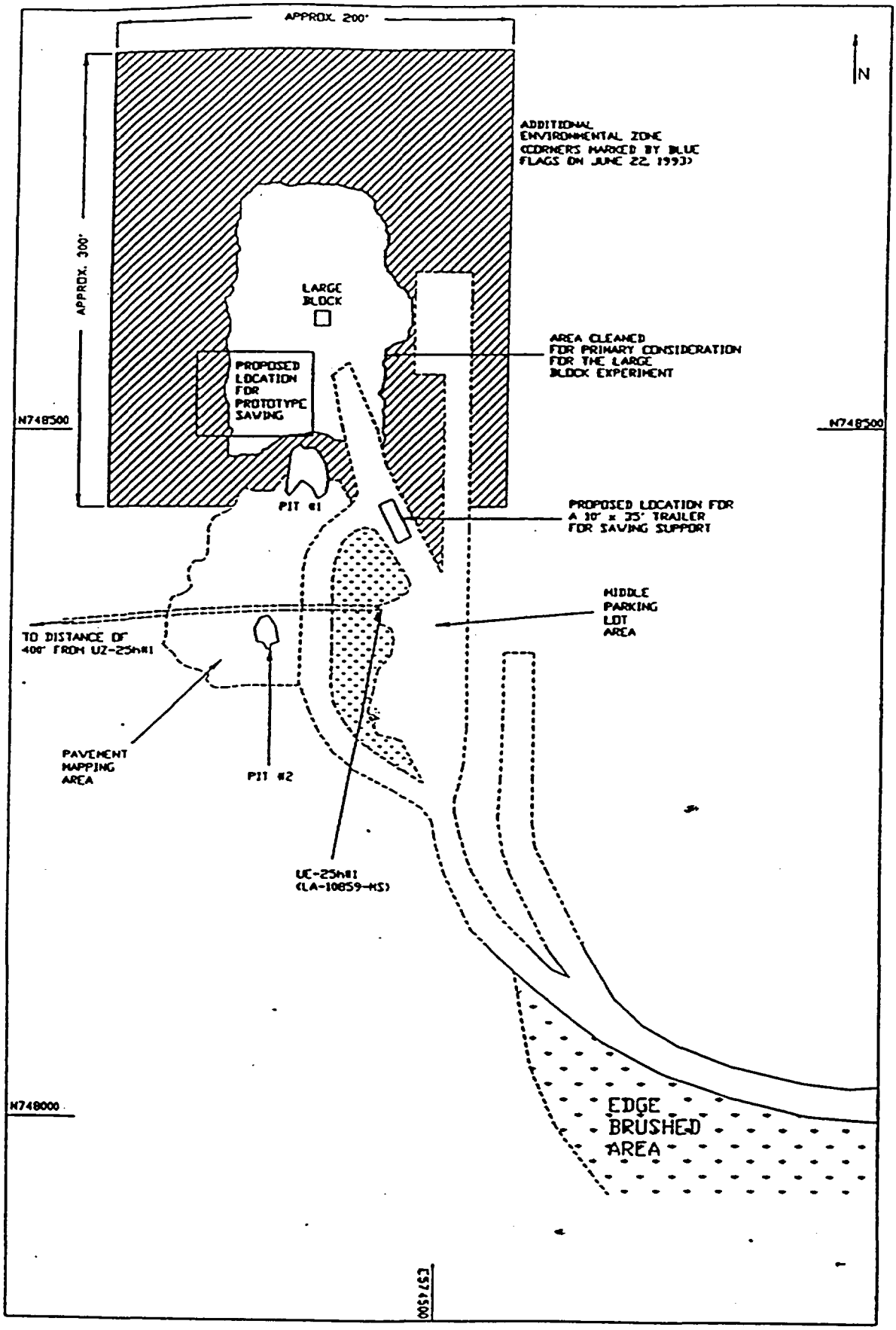


Predecisional information—preliminary data—do not reference

LOCATION OF TEST SUPPORT TRAILERS ON THE NORTH PAD



ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT
SITE PREPARATION ILLUSTRATION
FRAN RIDGE SITE



ADMINISTRATIVE USE ONLY

DRN. BY D.J. WEAVER

FRLBENV2.DWG 6/25/93

Predecisional information—preliminary data—do not reference

Los Alamos
NATIONAL LABORATORY
1943 - 1993

Isotope and Nuclear Chemistry Division
Spectroscopy and Biochemistry

David E. Morris, INC-14, MS C345
Los Alamos, New Mexico 87545
Office: (505) 665-6487
Fax: (505) 665-3166

Date: July 27, 1993
Refer to: TWS-INC-07-93-08

Dr. Ardyth Simmons
U.S. Department of Energy
101 Convention Center Drive
Las Vegas, Nevada 89109

Dear Dr. Simmons,

Enclosed please find the meeting report from the recent second meeting of the Radionuclide Solubility Working Group. The report has been reviewed by all meeting participants and changes have been incorporated. Please disseminate this report to any and all parties you deem appropriate. Thank you for your assistance.

Sincerely,

David E. Morris
Team Leader for Environmental Chemistry
Spectroscopy and Biochemistry Group

enc. a/s

xc: Julie Canepa, EES-13
Ines Triay, INC-9
Heino Nitsche, LBL
Robert Silva, LLNL
James Johnson, LLNL
David Clark, INC-1
Drew Tait, INC-14
Mike Ebinger, EES-15
TWS File

JUL 28 '93

SUMMARY
Yucca Mountain Site Characterization Program
SOLUBILITY WORKING GROUP MEETING
JUNE 16, 1993

The second meeting of the Radionuclide Solubility Working Group (SolWOG) took place on Wednesday, June 16, 1993 at the DOE Offices in Las Vegas, NV. The agenda for this meeting is included in this report as Attachment 1. The participants included personnel from the DOE/Yucca Mountain Site Characterization Program (YMP or Project), Los Alamos National Laboratory (LANL), Lawrence Berkeley Laboratory (LBL), and Lawrence Livermore National Laboratory (LLNL). A complete list of participants is included as Attachment 2. It should be noted that in addition to the core members of the SolWOG and technical specialists in radionuclide solubility and speciation, this meeting also had a representative from the GEMBOCHS data base management, Dr. Jim Johnson of LLNL. A deliberate attempt was made to maintain flexibility in the meeting agenda so that exchange of information and ideas would be facilitated and no forced resolution of issues or artificially terminated discussion would occur. However, within this informal structure, the group was successful in addressing all scheduled agenda items and coming to agreement / closure or clearly identifying action plans on all important issues. The following is a brief summary of the discussion and identified action items organized according to agenda topic.

Agenda Topic #1: Discussion of SolWOG Work Scope and Purpose

To initiate this discussion, Dr. Simmons (YMP) distributed the original charter for the SolWOG. This document is included as Attachment 3. It was noted and generally agreed that it is not the purpose of the SolWOG to duplicate the ongoing work of the OECD/NEA to review critically the thermodynamic data for uranium, neptunium, plutonium, americium, and technetium. Because the Project has already agreed to accept these reviewed data, they will be incorporated directly into the GEMBOCHS data base as they become available.

The issue of the current scheduling of solubility and speciation work vis a vis the strategy for solubility and speciation as captured in the "flow chart" (see

Attachment 3, Fig. 4) was raised. It was noted that the solubility study plan does not contain sufficient flexibility, particularly with respect to solubility experiments, to accomplish the proposed strategy. For example, the strategy allows experimental iterations if calculated and measured solubilities disagree to some significant extent whereas the study plan only lays out a very linear set of experiments. There was general agreement that it is unrealistic to make wholesale changes to the LANL study plan for solubility and speciation (Dissolved Species Concentration Limits, SCP No. 8.3.1.3.5.1) at this point. Dr. Simmons noted that the Nuclear Regulatory Commission (NRC) is requesting written clarification from LANL on several aspects of their site-characterization effort. It was suggested that this is a potential opportunity to introduce the Strategy for Dissolved Species Concentration Limits Studies (Attachment 3) in a formal manner for acceptance as a complementary guidance document to the existing study plan. *This is Action Item #1 taken by Dr. Morris.*

The emerging synergistic interactions between Solubility personnel and the Performance Assessment (PA) group was raised. It was noted that PA is ultimately one of the most important customers for solubility and speciation data. Therefore, they need to be explicitly incorporated into the flow chart for the Strategy for Dissolved Species Concentration Limits Studies. Furthermore, PA may potentially serve an important feedback role for identifying and prioritizing solubility and speciation studies if Total System Performance Assessment (TSPA) calculations can be done on solubility-related issues in near-real time. (The timeliness is important because if TSPA calculations related to solubility are only carried out at long time intervals the feedback would not be of significant value for planning experiments.) If there is general agreement with PA personnel with regard to establishing such a feedback process, then a PA member should be identified to serve as a liaison to the SolWOG. *This is Action Item #2 taken by Dr. Morris.*

An update of the status of the OECD/NEA reviews of the thermodynamic data for radionuclides was provided by Drs. Silva and Nitsche. Note that both are serving as members of review panels, Dr. Silva for americium data and Dr. Nitsche for neptunium and plutonium data. The uranium data base report is now in print. These data have been incorporated into GEMBOCHS. The first draft of the report on the americium data is presently out for internal review by

the panel. The external review by non-panel members should be initiated in several months. For the neptunium and plutonium data rough drafts are expected to be ready in the fall of 1993. The present schedule is thought to call for both reports to be ready for internal review by the panels at the end of calendar year 1994. It is the opinion of both Drs. Silva and Nitsche that no new reviews (i.e., of the second tier radionuclides such as Th, Zr, Ni, and Ra) will be initiated until all existing reviews are completed, and the probability is high that none will be started even after completion of the existing reviews. Dr. Nitsche expressed the opinion that the NEA might be willing to review data for other radionuclides if money were available and the United States demonstrated a greater interest in the process. As soon as it is feasible an attempt will be made to make available to the SolWOG draft versions of the NEA reports with the understanding that these data will only be used for trial purposes in GEMBOCHS and no results will be published or cited at meetings suggesting that the results were derived from accepted NEA data. *This is Action Item #3 taken by Drs. Silva and Nitsche.*

Because the SolWOG will ultimately be called upon to review data that has not been formally reviewed by the NEA, the issue of sanctioning such a review process by the SolWOG was raised. It was noted that the NRC has an existing set of criteria for a data quality assurance review. The NRC will be reviewing the radionuclide migration effort October 13-15, 1993 at Los Alamos. The issue of sanctioning the SolWOG for the purpose of qualified data review will be introduced as an agenda item at that meeting. *This is Action Item #4 taken by Dr. Simmons.* It was also agreed by the group that a clearly delineated set of criteria must be established for selection and prioritization of non-NEA reviewed radionuclides. These criteria will constitute the basis by which the SolWOG chooses radionuclide thermodynamic data for review. Dr. Silva has already considered this problem in some detail, and has prepared several reports related to it. He will forward these to Dr. Morris for distribution to the group. *This is Action Item #5 taken by Drs. Silva and Morris.* The SolWOG members will review Dr. Silva's reports and discuss the selection criteria at the next meeting. Finally, the Project currently has an Administrative Procedure pertaining to the qualification of data (AP 5.9 Qualification of Data). This procedure will be reviewed to determine if the SolWOG can be sanctioned to qualify data. *This is Action Item #6 taken by Drs. Simmons and Morris.*

Agenda Topic #2: Update / Discussion of Recent Work

Recent experimental data on the solubility and speciation of uranium, neptunium, plutonium, and americium were presented by the four technical specialists listed below. A detailed summary of these presentations is outside the scope of this report. However, additional details can be found in project milestone reports and monthly reports or the technical personnel can be contacted directly for further information (see Attachment #1).

A. Solubility

Dr. Nitsche provided a review of recent solubility data, oxidation-state distributions, and solid-phase characterization data that he and his team at LBL have acquired recently for neptunium, plutonium, and americium/neodymium in UE25p#1 well water at 25 and 60 °C and pH 6, 7, and 8.5 from both over- and undersaturation.

B. NMR Speciation

Dr. Clark presented recent multi-nuclear (^{13}C, ^{17}O) nuclear magnetic resonance data on the speciation of uranium, neptunium, and plutonium in the penta- and hexavalent oxidation states in carbonate solutions. He focused in particular on the $UO_2(CO_3)_3^{4-}$ / $(UO_2)_3(CO_3)_6^{6-}$ equilibrium and compared these results to those predicted from calculations using the NEA data base values, finding an extremely good agreement.

C. PAS / UV-Visible Speciation

Dr. Tait presented recent photoacoustic spectroscopy (PAS) data on the plutonium(IV) system in carbonate media and conventional UV-visible spectroscopy data on the neptunium(V) system in carbonate media. The PAS data specifically addressed the question of oxidation-state redistribution in dilute solution. The neptunium work is intended to confirm the stability field (in pH and carbonate concentration) of the aquo- and monocarbonato-complexes of Np(V).

D. Most Active Groundwater Modeling

Dr. Ebinger presented some preliminary results from an attempt to model Dr. Nitsche's published solubility data for neptunium in J-13 well water using the thermodynamic code EQ3/6 and existing GEMBOCHS data. The trends are reasonable, but the absolute values are off by a significant amount. Dr. Simmons raised a question about the level of uncertainty that PA can tolerate in the solubility data that is input into their calculations and the impact of uncertainty on their results. Appropriate PA personnel will be contacted to answer this question. *This is Action Item #7 taken by Dr. Morris.*

Agenda Topic #3: Discussion of Pu Oxidation State Disparity

This topic was raised by LANL personnel because of their inability to detect oxidation states other than 4^+ for plutonium in their dilute experiments using PAS (see above) while LBL solubility results have consistently found mixtures of 4^+, 5^+, and 6^+ in their equilibrated solutions. It was suggested that a possible reason for this apparent discrepancy in the two experiments is that the LBL solubility experiments are allowed to equilibrate for several hundred days while the LANL PAS experimental solutions usually only age for several days. Given the poorly defined kinetics associated with radiolytic oxidation / reduction processes, the difference in time-scale between the experiments could account for this difference. Two additional experiments were identified to address this issue. The first is a LANL experiment in which dilute solutions of $^{239}Pu(IV)$ will be aged for several hundred days prior to collection of PAS spectral data. The second is a joint LBL / LANL or LBL / LLNL experiment in which aliquots from Dr. Nitsche's forthcoming solubility experiment for plutonium in neutral electrolyte at 25 °C will be assayed for oxidation-state distribution directly using PAS. *This is Action Item #8 taken by Drs. Tait, Nitsche, and possibly Silva.*

Agenda Topic #4: Discussion of Performance Assessment Data Elicitation and Results

Drs. Morris and Ebinger described the solubility data elicitation exercise that took place at Sandia National Laboratory on April 13, 1993 between LANL

geochemistry personnel and Sandia PA personnel. Dr. Morris then presented the preliminary results that derived from the elicitation and opened the floor for discussion and modification of these results. The group as a whole strongly agreed that existing solubility data that form the basis for the solubility bounds provided to PA will not be valid under a proposed high thermal load repository concept. Therefore, data that have been elicited are only valid under the original SCP repository design concept. There was also uniform agreement that the SolWOG was not comfortable addressing data for radionuclides other than the actinides. Table 1 presents a summary of the SolWOG consensus for the actinides. (Definitions of terms in this table can be found in Barnard et al. *TSPA-1991: An Initial Total-System Performance Assessment for Yucca Mountain*, SAND91-2795, Sandia National Laboratories, Albuquerque, NM, 1992.) Note that changes have been made for both plutonium and neptunium relative to the initial data elicitation values. For those numbers which have been changed, the original value is given in parentheses. The impact of the change in minimum value for neptunium on the value for the coefficient of variation is unknown. These new values will be conveyed to PA personnel as soon as possible. *This is Action Item #9 taken by Dr. Morris.*

Table 1. SolWOG Consensus Values for the Potential Range of Actinide Solubilities at Yucca Mountain and Environs

Radionuclide	Minimum Value	Maximum Value	Expected Value	Coefficient of Variation	Distribution
Uranium	10^{-8}	10^{-2}	$10^{-4.5}$	0.20	log beta
Neptunium	$5x10^{-6}$ (10^{-8})	10^{-2}	10^{-4}	? (0.20)	log beta
Plutonium	10^{-8} (10^{-10})	10^{-6}	-	-	uniform
Americium	10^{-10}	10^{-6}	-	-	uniform

All concentration values are in molarity units.

Agenda Topic #5: Long-range Planning for Solubility / Speciation Experimental and Modeling Efforts in YMP

To begin the discussion of this topic Dr. Johnson was given the floor to describe data needs for GEMBOCHS. He indicated that any and all thermodynamic data would be valuable. He is particularly interested in amassing the data necessary to make corrections for ionic strength effects (e.g., ion interaction constants) and temperature-dependent data so that results can be expressed with the most complete thermodynamic rigor. He indicated that GEMBOCHS already has some data for the actinides of interest. In fact, he had with him a compilation of some of these data. It was agreed that as a stop gap measure until all NEA reviews are complete the SolWOG would review these existing GEMBOCHS data for the elements thorium through americium and technetium. The existing data will be made available to LANL, and LANL personnel will ensure that it is distributed to SolWOG members. *This is Action Item #10 taken by Drs. Johnson and Clark.* The time frame for this examination of existing data is ~ 6 months with the intent of beginning discussion of the data at the next SolWOG meeting. The existing data for actinide phosphate complexation have been shown by Dr. Silva and others to be an apparent obvious problem. These data will serve as the starting point for the review by the SolWOG.

Dr. Clark indicated his concern over the seemingly widely-held view that technetium will only exist as the pertechnetate anion (TcO_4^-) under environmental conditions, and therefore it is not expected to be retarded by sorption processes. Dr. Clark noted that the other Group VII metals (manganese and rhenium) can exist in a variety of different, lower oxidation states, and simple binary complexes of these metals (e.g., carbonates) are known. In fact, Los Alamos has a very active program in synthetic technetium chemistry that takes advantage of these other accessible oxidation states. Dr. Clark is a member of the Los Alamos team studying technetium chemistry. He will conduct some simple scoping experiments to determine if technetium might be stable in lower oxidation states under environmental conditions, and convey these results to the Project. *This is Action Item # 11 taken by Dr. Clark.*

Finally, it was agreed that much better coordination of experimental and modeling effort is needed between LANL and LLNL. It was noted that efforts at

LANL and LBL are presently well defined by the Dissolved Species Concentration Limits Study Plan and constrained by the existing schedules for task completion. Therefore, these organizations perhaps have less flexibility to pursue "gaps" in the thermodynamic data bases that are identified by NEA and the SolWOG. It was suggested that a possible means of better coordinating efforts between the various laboratories would be to have LLNL serve in the capacity of the "gap" filler. The need for additional discussions and efforts to facilitate more and better interactions was noted. *This is Action Item #12 taken by Drs. Simmons, Silva, and Morris.*

Dr. Nitsche announced his intention to leave the Project to assume a new position in Germany in September, but he indicated his interest and willingness to continue to interact with the SolWOG in particular and the Project in general to assist us in meeting our objectives.

It was agreed that the next meeting of the SolWOG will take place in January 1994. The exact date, location, and the specifics of the agenda will be determined later.

ATTACHMENT 1

Yucca Mountain Site Characterization Project Solubility Working Group Meeting

Wednesday, June 16, 1993
Small Conference Room
DOE Offices
101 Convention Center Dr
Las Vegas, NV
8:30 AM - 4:00 PM

Agenda

8:30 - 9:30 Discussion of SolWOG Work Scope and Purpose

9:30 - 11:30 Update / Discussion of Recent Work

- Solubility
- NMR Speciation
- PAS / UV-Vis Speciation
- Most Active Groundwater Modeling

11:30 - 12:00 Discussion of Pu Oxidation State Disparity

1:00 - 2:30 Discussion of Performance Assessment Data Elicitation and Results

2:30 - 4:00 Long-range Planning for Solubility / Speciation Experimental and Modeling Efforts in YMP

To facilitate a free exchange of information, ideas, etc., I would like to keep the "presentations" as informal as possible. I will attempt to send all meeting participants copies of the solubility probability distributions for radionuclides that resulted from the data elicitation meeting with Sandia in April. These will serve as the basis for initiating the discussion of agenda item #4. Additions, deletions, or other suggestions to this agenda are welcome.

ATTACHMENT 2

Solubility Working Group (Sol WG(r)

June 16, 1993

NAME	AFFILIATION	PHONE	FAX
Ardyth Simmons	DOE/YMP	(702) 794-7658	(702) 794-7907
David Morris	LANL	505 665 6487	5056653166
HEINO NITSCHE	LBL	510 486-6509	510 486-5799
Bob Silva	LLNL.	(510)423-1977	(510)422-3160
Michael Ebinger	LANL	505-667-3147	505-665-3866
David Clark	LANL	(505)665-4622	(505) 665-462[illegible]
Drew Tait	LANL	(505)665-0008	(505)6653166
Jim Johnson	LLNL	510-423-7352	510-422-0208

ATTACHMENT 3

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, contraints, 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

July 1993

Strategy for Dissolved Species Concentration Limit Studies

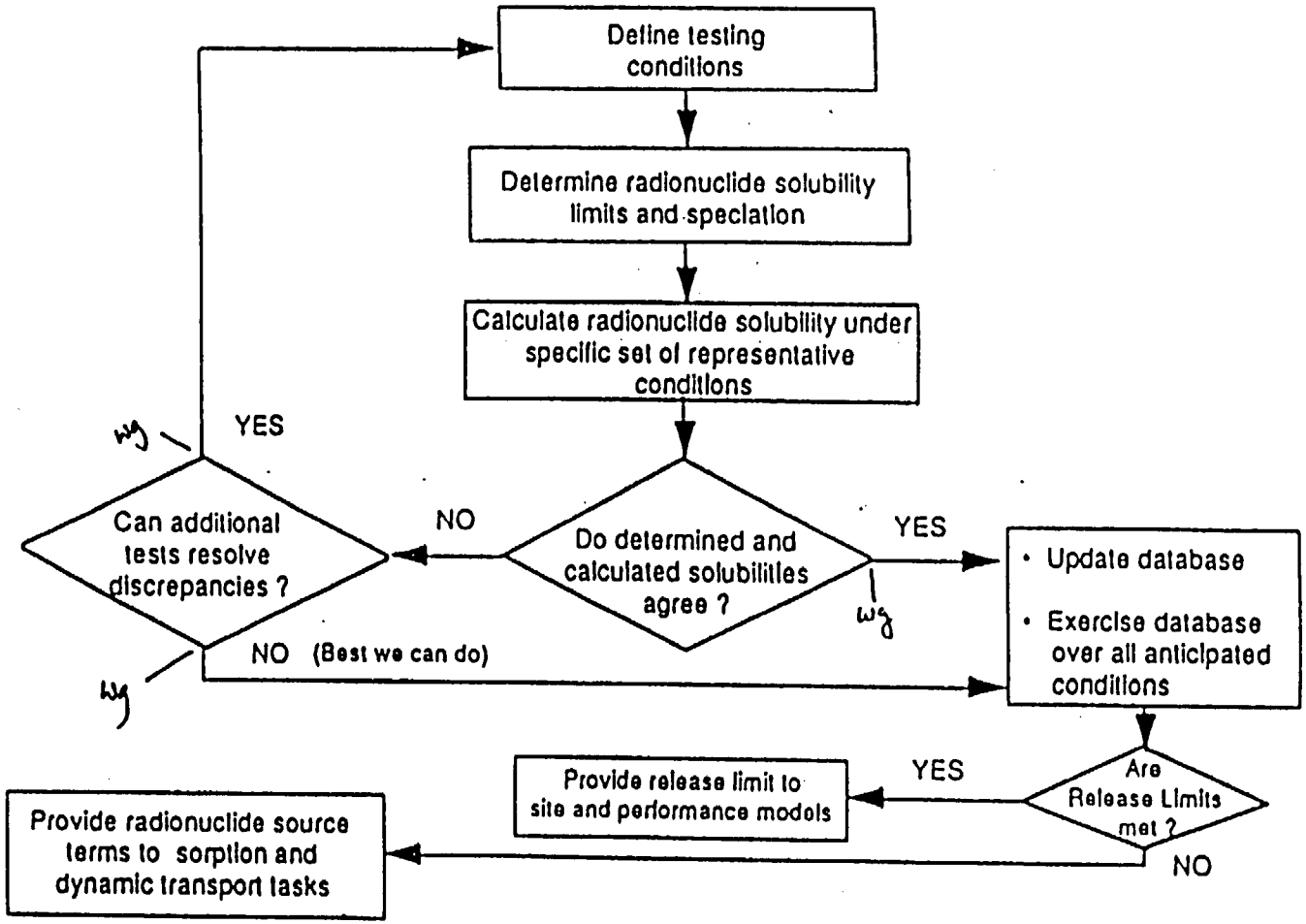


Figure 4

A. M. Simmons, DOE/YMP, Las Vegas, NV

Los Alamos
NATIONAL LABORATORY
Los Alamos, New Mexico 87545