



Department of Energy  
Washington, DC 20585

DEC 09 1991

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U.S. Nuclear Regulatory Commission  
Washington, DC 20555

Dear Mr. Linehan:

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

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

Enclosures:

- (1) Los Alamos National Laboratory Monthly Activity Report, July 1991
- (2) Los Alamos National Laboratory Monthly Activity Report, August 1991

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PDR WASTE  
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NH03

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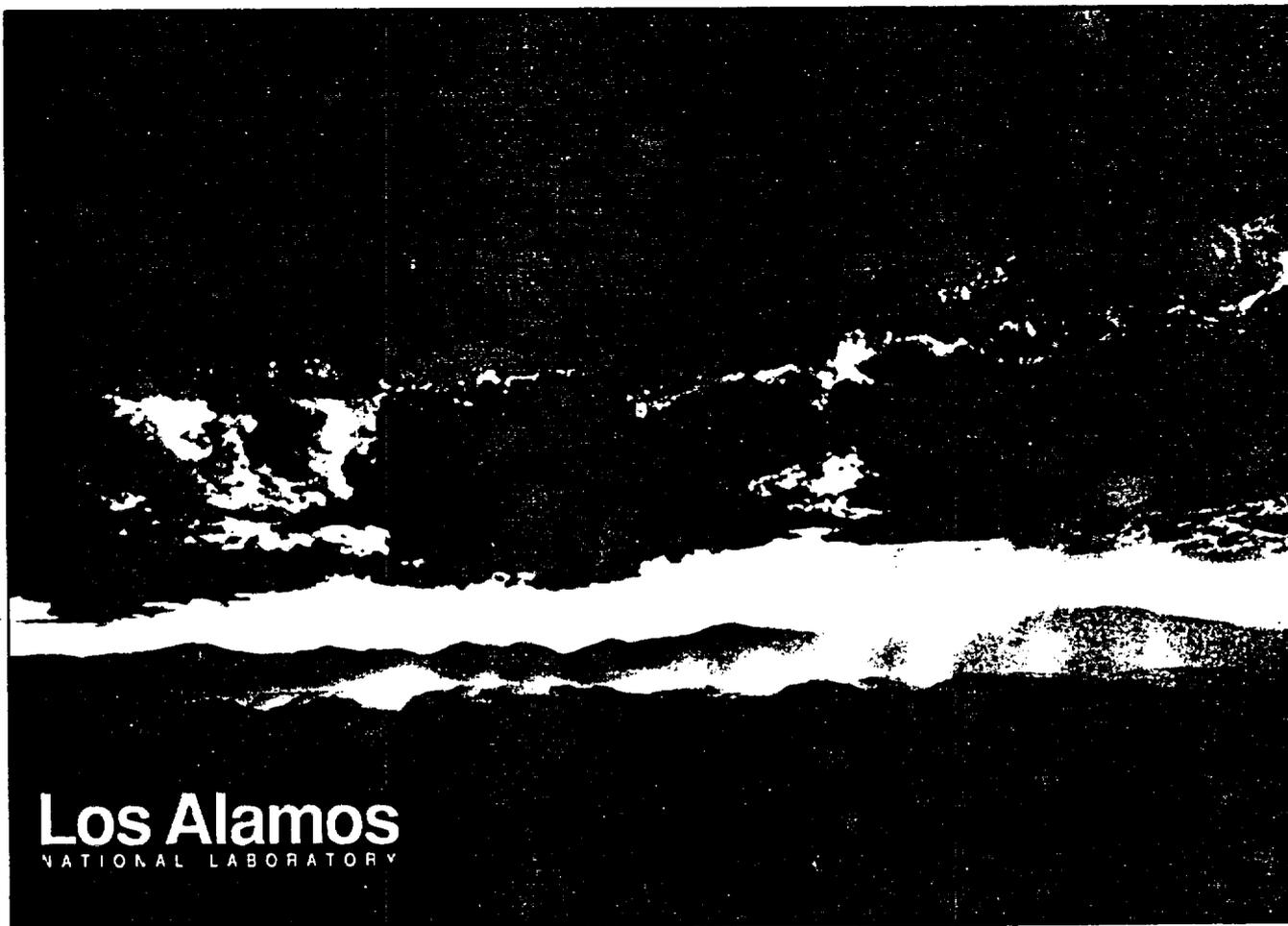
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# *Yucca Mountain Site Characterization Project*

## *Monthly Activity Report*

*July 1991*



*Attachment to TWS-EES-13-10-91-078*

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30 pp.*

**ENCLOSURE 1**

C. P. Gertz, DOE/YMP,  
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# CONTENTS

WBS 1.2.1 – Systems (Canepa) .....	1
WBS 1.2.3.2.1.1.1 – Mineralogy, Petrology, and Rock Chemistry of Transport Pathways (Vaniman) .....	1
WBS 1.2.3.2.1.1.2 - Mineralogic and Geochemical Alteration (Levy) .....	3
WBS 1.2.3.2.1.2 – Stability of Minerals and Glasses .....	5
WBS 1.2.3.2.5 – Postclosure Tectonics (Crowe) .....	6
WBS 1.2.3.3.1.2.2 – Water Movement Tracer Tests (Fabryka-Martin) .....	8
WBS 1.2.3.3.1.2.5 – Diffusion Tests in the ESF (Triay) .....	9
WBS 1.2.3.3.1.3.1 – Site Saturated Zone Ground-Water Flow System (Robinson) .....	9
WBS 1.2.3.4.1.1 – Ground-Water Chemistry Model (Ebinger) .....	11
WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 – Batch Sorption Studies and Sorption Models (Meijer) .....	12
WBS 1.2.3.4.1.2.2 – Biological Sorption and Transport (Hersman) .....	13
WBS 1.2.3.4.1.3 – Radionuclide Retardation by Precipitation Processes (Morris) .....	13
WBS 1.2.3.4.1.4 – Radionuclide Retardation by Dispersive, Diffusive, and Advective Processes (Triay) .....	15
WBS 1.2.3.4.1.5.1 – Retardation Sensitivity Analysis (Eggert) .....	17
WBS 1.2.3.4.1.5.2 – Demonstration of Applicability of Laboratory Data (Springer) .....	18
WBS 1.2.5 – Regulatory and Institutional (Canepa) .....	19
WBS 1.2.6 – Exploratory Studies Facility (Kalia) .....	20
WBS 1.2.6.8.4 – Integrated Data System (Oblad) .....	21
WBS 1.2.9.1.4 – Records Management (Sanders) .....	22
WBS 1.2.9.3 – Quality Assurance (Bolivar) .....	22

LOS ALAMOS NATIONAL LABORATORY  
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report  
July 1991

**WBS 1.2.1**

**PROJECT TITLE: SYSTEMS**

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**

**Caisson Experiment (WBS 1.2.1.4.6)**

A contract was established with the University of California at Berkeley to support stochastic analyses of the caisson experiment. The principal investigators are G. Dagan and Y. Rubin. Analyses conducted of earlier caisson experiments revealed that a stochastic model could be applied to describe the effluent behavior and the parameters derived for the response of the saturated experiment can be applied to the unsaturated experiments. For this contract, the sampling design to satisfy the stochastic model will be considered along with some analyses to examine the uncertainty in mass arrival and the effect of assumed probability density function and correlation scale of saturated conductivity on caisson response.

Final material selection for the caisson will require some simulations to assess the potential hydraulics. K. Birdsell has constructed a mesh for the caisson that can be used to support the material selection for the proposed experiment. The current design calls for using a silica sand; for the sorbing layer, the fine particle sizes will be removed from the sand and replaced with a zeolite. The modeling analyses are critical for examining the effects of the zeolites on hydraulic response.

**PA Calculational Support (WBS 1.2.1.4.7)**

G. Valentine contributed to a scenario-development manuscript on effects of volcanism on the repository. This report will be published as an SNL document. He also provided parameters for the total systems analysis due in October; these parameters relate to the possible release of radionuclides by volcanic eruption through the repository.

**PLANNED ACTIVITIES**

Select fill material with SNL personnel, and determine instrumentation requirements and sampler locations for stochastic and deterministic models.

**WBS 1.2.3.2.1.1.1**

**PROJECT TITLE: MINERALOGY, PETROLOGY, AND ROCK CHEMISTRY OF TRANSPORT PATHWAYS**

The purpose of this activity is to define the important mineralogic and geochemical variables along 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

The draft of milestone report 3135 (a review of Yucca Mountain mineralogy entitled *Mineralogic Framework of Altered Pyroclastic Rocks at Yucca Mountain, Nevada*) was revised to incorporate changes suggested by some of the authors.

B. Carlos examined core at the Sample Management Facility (SMF) on 9–10 July and 31 July. Additional samples of manganese coatings in Crater Flat tuff have been obtained from the SMF and submitted for x-ray diffraction analysis (XRD) and thin-section preparation. Lithiophorite, previously identified only in the Topopah Spring Member, has been identified in some of the Crater Flat samples. An additional manganese oxide is suspected, but chemical analyses will be required to confirm the tentative identification made from XRD patterns. These additional data will delay the completion of the paper on manganese-oxide minerals at Yucca Mountain.

B. Carlos presented results to date on fracture coatings and their interaction with groundwater at the Groundwater Geochemistry Exchange held at the Field Operations Center at NTS on 29–30 July. Most fracture coatings have overgrowths, etching, or other evidence of changes in conditions since their formation, but no dates can be assigned to most of the fracture coatings or to the modifications of these coatings.

## PLANNED ACTIVITIES

Analyze manganese-oxide fracture fillings, both in the Crater Flat tuff and in the Paintbrush tuff, to determine the distribution of the manganese minerals and define at least some of the factors controlling that distribution; work on image analysis methods for fracture and texture analysis; evaluate glass alteration features in saturated versus unsaturated environments; continue examination of fractures in the Crater Flat tuff in drill cores other than USW G-4; evaluate possible hazardous minerals at Yucca Mountain; and continue examination of fracture-coating minerals in the Topopah Spring Member using samples recently released by the SMF.

## PUBLICATIONS

D. Vaniman, D. Bish, S. Chipera, and M. Ebinger  
*Sepiolite at the Surface of Yucca Mountain, Nevada*  
Abstract, Clay Minerals Society Symposium  
Approved 12 July 1991.

B. Carlos, D. Bish, and S. Chipera  
*Fracture-Lining Minerals in Silicic Tuff at Yucca Mountain, Nevada*  
Abstract, GSA meeting  
Approved 15 July 1991.

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

D. Bish and S. Chipera  
*Detection of Trace Clays and Clay Minerals Amounts of Erionite Using X-ray Powder Diffraction: Erionite in Tuffs of Yucca Mountain, Nevada, and Central Turkey*  
Journal article, *Clay and Clay Minerals*  
In press.

D. Vaniman, D. Bish, D. Broxton, B. Carlos, S. Chipera, and S. Levy  
*Framework of Altered Pyroclastic Rocks at Yucca Mountain, Nevada*  
Journal article, *Jour. Geoph. Res.*  
In review.

#### MILESTONE PROGRESS

3120

*Calcite in Fractures*

Will be completed eight months after microprobe software approval.

3123

22 October 1991

*Mn Minerals in the Crater Flat Tuff*

Undergoing extensive revision.

3132

*Tiva Fracture Mineralogy in USW G-4*

Will be completed three months after microprobe software and standards are approved.

3135

January 1991 (revised date)

*Mineralogic Framework of Altered Pyroclastic Rocks at Yucca Mountain*

Draft revised.

3137

26 March 1992

*Mineralogy of Calico Hills for Adit Development*

Writing 66% complete; will be completed six months after XRD software approval.

T503

*Statistical Analysis, Topopah Spring Member*

Writing 5% complete; on hold pending software QA resolution

#### PROBLEM AREAS

Delays in obtaining software acceptance under the Los Alamos Software QA Plan are impacting fracture mineral studies. The report on manganese minerals in fractures (milestone 3123) cannot be completed for at least four months after approval of the scanning electron microscope operating software. Approval of software for quantitative XRD analysis will take longer than the electron microbeam software to gain approval.

#### WBS 1.2.3.2.1.1.2

#### PROJECT TITLE: MINERALOGIC AND GEOCHEMICAL ALTERATION

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

S. Levy and members of USGS, were present for the deepening of Trench 14 and collected several samples from the newly exposed walls. The fault zone in the deepened part of the trench bears a close resemblance to the same zone exposed in Trench 14A in that the Tiva Canyon tuff is juxtaposed (almost superimposed in the new exposures) against the younger Forty Mile Canyon tuff. Block rotation within the fault zone has moved the Tiva Canyon tuff locally above the younger unit. The main laminated calcite-silica fracture fillings become thinner with depth but do not disappear, the multiple fractures coalesce downward into a single fracture.

D. Bish participated in an NRC meeting to evaluate the use of natural analogue studies and their applicability to waste isolation. Bish joined the far-field working group for discussions.

D. Vaniman and S. Levy attended the YMP Geochemistry Integration Technical Exchange at the NTS. Vaniman gave a presentation on transport in the unsaturated zone at Yucca Mountain based on studies of opal, calcite, and chain-structure clays.

## PLANNED ACTIVITIES

Preparations are under way for the alteration history presentation at the October NWTRB meeting on repository thermal loading. Probable topics for presentation will include thermomechanical effects of mineral phase transitions, natural analogue studies of hydrothermal alteration centered in the Topopah Spring tuff, reconstruction of the paleogeothermal regime associated with Timber Mountain hydrothermal activity and its implications for mineral stability, and glass dehydration and rehydration studies.

D. Bish and D. Vaniman have been working with summer students on informal studies to delineate flow paths within unqualified Yucca Mountain cores. Cesium chloride and fluorescein dye were injected into the cores, and the results examined under ultraviolet illumination.

## PROBLEM AREAS

Electron microprobe analytical work continued to be delayed by software quality assurance certification requirements.

## PUBLICATIONS

S. Levy  
*Natural Gels in the Yucca Mountain Area, Nevada, USA*  
Abstract, Materials Research Society Symposium  
Approved 12 July 1991.

D. Vaniman  
*Calcite, Opal, Sepiolite, Ooids, Pellets, and Plant/Fungal Traces in Laminar-Fabric Fault Fillings at Yucca Mountain, Nevada*  
Abstract, Geological Society of America annual meeting  
Approved 12 July 1991.

D. Bish  
*Determination of Paleogeothermal and Paleohydrologic Conditions in Silicic Tuff from Illite/Smectite Mineralogy*  
Abstract, Clay Minerals Society Symposium  
Approved 22 July 1991.

S. Chipera and D. Bish  
*Rehydration Behavior of a Natural Analcime*  
Abstract, Clay Minerals Society Symposium  
Approved 28 July 1991.

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, *J. Geophys. Res.*  
Interim draft complete.

#### MILESTONE PROGRESS

3138  
26 March 1992  
*Chemical Transport in Zeolitic Alteration*  
Research is 55% complete; delayed by quality assurance stop work order.

3139  
30 November 1990  
*Progress in Calcite-Silica Breccia Studies*  
Los Alamos review complete; in USGS editorial review.

3141  
3 February 1992  
*Laminated Zone in Trench 14*  
Research is 37% complete; delayed to FY92.

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

3143  
30 September 1991  
*Experimental Dehydration of Volcanic Glasses*  
Interim draft complete.

#### WBS 1.2.3.2.1.2

#### PROJECT TITLE: STABILITY OF MINERALS AND GLASSES

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

## ACTIVITIES AND ACCOMPLISHMENTS

This activity has been deferred.

### WBS 1.2.3.2.5

## PROJECT TITLE: POSTCLOSURE TECTONICS

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

Final preparations were completed for beginning of surface-disturbing work (construction of soil pits) at the Lathrop Wells volcanic center. Test planning package 91-32 was completed and issued as a controlled document. We attended an informal readiness review meeting with YMPO.

The first surface-disturbing work was successfully completed on 9-10 July at the Lathrop Wells volcanic center. Several soil pits were dug on the north side of the main scoria cone. Highlights of this work are as follows.

1. Pyroclastic surge deposits were discovered beneath lobes of Q1<sub>4</sub> lavas at multiple localities. These deposits are inferred to be correlated with the pyroclastic surge deposits exposed northwest of the main cone. This relationship provides preliminary confirmation of previously developed stratigraphic models that suggest the growth of the main cone preceded and succeeded eruption of the Q1<sub>4</sub> lavas.
2. Eolian reworked surge and sand deposits form a mantle over all units on the north side of the cone. These deposits range in thickness from 0.5 m to beyond the digging depth of the backhoe.
3. Strombolian fall deposits were exposed that probably overlie the Q1<sub>4</sub> lava at one locality. These deposits are inferred to represent the Strombolian sequence of the growth of the main scoria cone. We could not dig to sufficient depths to expose the basal contact of the fall deposits.
4. The base of the Q1<sub>3</sub> lava was excavated on the south side of the Lathrop Wells center. The lavas overlie 3-cm-thick Strombolian fall deposits that rest on a pavement surface.

A letter presenting the first results of a formal review of the geochronology activity of the volcanism program was received from Donald DePaolo. Eight recommendations were presented in the review. The letter confirmed conclusions presented to the NWTRB that the chronology of the youngest volcanic activity in the Yucca Mountain region is still uncertain. The interpretation that the results of K-Ar age determinations and paleomagnetic data do not constrain conclusively the age of the Lathrop Wells volcanic center was supported. The letter from DePaolo and accompanying suggestions for implementing the recommendations were submitted to YMPO.

Samples of basaltic ash and bombs from scoria-fall and surge deposits were collected from the soil pits dug on the north side of the Lathrop Wells center. Three ash samples were submitted to the EES-1 sample-preparation laboratory for making petrographic grain mounts.

A duplicate sample of olivine from a bomb collected at the summit of the Lathrop Wells center was analyzed to evaluate the reproducibility of the cosmogenic <sup>3</sup>He method. Resulting data were within the estimated 15% analytical error.

A talk was presented on the use of analogues in volcanism studies for the disposal of high-level radioactive waste at the Workshop on the Role of Natural Analogues in Geologic Disposal of High-Level Nuclear Waste, sponsored by the Center for Nuclear Waste Regulatory Analyses and the Nuclear Regulatory Commission Office of Regulatory Research.

#### Work in Progress

Work began on writing a detailed technical procedure for isotopic analysis of cosmogenic noble gases.

Work resumed on the Issue Resolution Report for Volcanism. Informal review comments from co-authors were received, and sections of the report are being revised and discussed.

Discussions were held with participants from Raytheon and EG&G to obtain digitized topographic data for the volcanic centers of the Yucca Mountain region.

Minor changes in the techniques used to construct soil pits will be made as a result of the activities at the Lathrop Wells center. We will purchase a large bucket to speed pit construction and back-filling of holes. We will also purchase soil-coring equipment for selecting trench sites and to sample units below pit-construction depth.

#### PLANNED ACTIVITIES

A second phase of construction of soil pits at the Lathrop Wells volcanic center is scheduled for late August or early September.

#### PUBLICATIONS

R. Raymond, Jr., G. Guthrie, Jr., D. Bish, S. Reneau, and S. Chipera  
*Bio-mineralization of Manganese Within Rock Varnish*  
Catena Supplement, *Fel/Mn Bio-mineralization: Modern and Ancient Environments*  
Approved 22 July 1991.

S. Reneau, R. Raymond, Jr., and C. Harrington  
*The Elemental Composition of Rock Varnish Stratigraphic Layers, Cima Volcanic Field, Mojave Desert, California, and Implications of Varnish Stratigraphy*  
Journal article, *American Journal of Science*  
Approved 22 July 1991.

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

B. Crowe et al.  
*Methods for Assessing the Risk of Volcanism at the Yucca Mountain Site*  
Journal article  
In internal review.

B. Crowe et al.  
*Status of Geochronology Studies of the Lathrop Wells Volcanic Center*  
LA-series report  
In preparation.

July 1991

#### MILESTONE PROGRESS

3108

30 September 1992

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

3129

10 July 1992

*Petrology of Lathrop Wells Eruptive Sequences*  
Delayed.

#### WBS 1.2.3.3.1.2.2

#### PROJECT TITLE: WATER MOVEMENT TRACER TESTS

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

June Fabryka-Martin attended two workshops in July. The NRC and the Center for Nuclear Waste Regulatory Analyses sponsored a workshop, *The Role of Natural Analogues in Geologic Disposal of High-Level Nuclear Waste*, in San Antonio, Texas, on 23–25 July. Cosmogenic  $^{36}\text{Cl}$  in the unsaturated zone, for example, can be considered an analogue of water movement. YMPO and Los Alamos organized a workshop on Geochemistry Integration Technical Exchange at the NTS on 29–31 July.

Review comments were received from one of the technical reviewers of the study plan, and the plan was revised accordingly. Other technical reviews are continuing.

Three detailed technical procedures were submitted for technical review, and comments were received for two of them.

#### PLANNED WORK

Revise study plan; continue evaluating stable chloride ratios as tracer of meteoric chloride in rocks; complete documentation of YMP samples in possession of contractor; update core requests; prepare detailed technical procedures for processing of samples for  $^{36}\text{Cl}$  analysis; and process water samples received from USGS.

#### MILESTONE PROGRESS

3192

1 July 1991

*Water Movement Test Study Plan, Revision 1*  
Undergoing technical reviews.

**WBS 1.2.3.3.1.2.5****PROJECT TITLE: DIFFUSION TESTS IN THE ESF**

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**

After carefully considering the costs, we decided that it was far more economical to purchase a new trailer to fit the needs of the field experiments and salvage the existing Los Alamos YMP trailer. Consequently, the staff dismantled the equipment in the trailer, keeping the equipment in good condition, and inspected equipment and the trailer for potential contamination with radioactivity.

**PLANNED WORK**

Continue planning the diffusion prototype test.

**MILESTONE PROGRESS**

No level II milestones are planned this fiscal year.

**WBS 1.2.3.3.1.3.1****PROJECT TITLE: SITE SATURATED ZONE GROUND-WATER FLOW SYSTEM**

Experiments will be conducted at the C-Well complex (holes UE25c#1, UE25c#2, and UE25c#3) and in other wells near Yucca Mountain. Reactive tracers will be used to characterize retardation and transport properties on a scale larger than that currently used in laboratory experiments.

**ACTIVITIES AND ACCOMPLISHMENTS**

Corrective actions were initiated to resolve a deficiency report (DR) issued in June's audit, as well as a DR written because an employee lacked proper training.

**Software Qualification Efforts**

The design baseline for SORBEQ was submitted for an in-process review. The SRS for the FRACNET application was reviewed, the review comments (approximately 10 noneditorial and 104 editorial comments) were addressed, and the revised SRS was submitted.

The approach to qualifying FEHMN was changed with the decision to qualify the code by producing documentation rather than take an existing-documentation approach. The equation solver used in FEHMN, FRACNET, and TRACRN was broken-out as a reuse component so that it could be qualified once for all three codes (we will also take an existing-documentation approach for this software).

Calculations were initiated using FEHMN to provide field-test design information for the C-Wells conservative and reactive tracer experiments. The calculations are designed to provide preliminary design information related to tracer breakthrough times, peak time, and dispersion characteristics, so that we can pinpoint injection and sampling schedules for the test. Although the code is not qualified, many preliminary computations can be performed that can easily be rerun with a qualified version of the code before publishing or reporting the quantitative results of the simulations. For example, we are currently carrying out simulations to achieve the following goals: (1) determine an appropriate finite-

element mesh and time step parameters; (2) examine the effect of the permeability distribution on the transport characteristics; and (3) develop methods for synthesizing the information of a Monte Carlo simulation, a series of runs in which the permeability field is randomly generated.

Well water from J-13 was collected to supply the fluid for the batch sorption experiments. Problems were encountered with the ion chromatograph that need to be addressed before it can be used to performed cation analyses. The sorption experiments are on hold until it can be determined that the instrument is yielding accurate measurements of lithium ion concentration in solution.

#### PLANNED ACTIVITIES

Continue the effort to bring the computer codes FRACNET, FEHMN, and SORBEQ and other software into compliance with the Software Quality Assurance Plan by compiling existing documentation on these codes and writing new material as necessary.

Continue reviewing software submissions as required.

Complete the detailed technical procedure on the analytical balance.

Determine the problems with the ion chromatograph, repair the instrument, and begin the batch sorption tests.

#### PUBLICATIONS

W.L. Polzer and H.R. Fuentes

*The Use of the Modified Estimate Thermodynamic Equilibrium Properties of Ion Exchange Adsorption of Radionuclides on Volcanic Tuff. Part II. Experimental*

Journal article, *Environmental Science and Technology*

Submitted to Project Office 7 August 1990; resubmitted 22 March 1991 under AP-1.3.

B.A. Robinson

*FRACNET—Fracture Network Model for Water Flow and Solute Transport*

LA-series report

In preparation.

B.A. Robinson

*SORBEQ—A One-Dimensional Model for Simulating Column Transport Experiments*

LA-series report

In preparation.

#### MILESTONE PROGRESS

3047

November 1991

*Evaluation of Preliminary Application of FEHMN to Yucca Mountain*

Draft complete.

3196

26 September 1991

*FRACNET Documentation*

3193

23 July 1991

*Batch Sorption Experiments with Boron Using Single Crystals*

R529

*Evaluation of Preliminary Application of FEHMN to Yucca Mountain*

Undergoing Los Alamos/YMP policy review.

T112

22 October 1991

*Final Documentation for FEHMN*

Delayed.

## PROBLEM AREAS

The ion chromatograph must be repaired before the batch sorption experiments are started. If this will result in a major delay, we will seek another laboratory for performing the chemical analyses.

### WBS 1.2.3.4.1.1

## PROJECT TITLE: GROUND-WATER CHEMISTRY MODEL

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

## ACTIVITIES AND ACCOMPLISHMENTS

### Geochemistry Integration Technical Exchange

The Geochemistry Integration Technical Exchange was held at the NTS on 29–31 July. Technical presentations from Los Alamos, LLNL, and USGS were made 29–30 July, the Geochemistry Integration Group was established 30 July, and part of the group toured Yucca Mountain, Trench 14, the SMF, and the USGS Hydrologic Research Facility at Area 25. M. Ebinger presented a talk on pH and Eh of Yucca Mountain groundwater during the technical exchange and assisted DOE/YMP in planning the exchange. The proceedings will be summarized and distributed by YMPO and SAIC.

### Quality Assurance Activities

Disposition of DR-0153 was completed.

## PLANNED ACTIVITIES

Track Study Plan 8.3.1.3.1.1 during YMPO review.

Continue the collaboration with USGS. We will arrange to sample and analyze dissolved gases from USGS water samples. These data will be used to ascertain Eh conditions independently from Pt electrode measurements. Sampling of additional redox couples is under consideration.

## MILESTONE PROGRESS

No milestones are scheduled for the next three months.

### WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3

## PROJECT TITLE: BATCH SORPTION STUDIES AND SORPTION MODELS

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

Experiments designed to evaluate the effects of crushing on the sorption coefficients obtained by batch techniques have continued. The counting results for all the radionuclides used in the experiments (i.e., Cs, Sr, Np) are now available. The Np sorption coefficients obtained are all less than 1.0 ml/g for the devitrified tuff sample but are between 1.5-12.6 ml/g for the zeolitic tuff sample. Once the data on the change in the composition of the background electrolyte and the mineralogic composition of the reacted samples are available, all the data will be interpreted to assess the affect of crushing on the value measured for the sorption coefficient.

The Los Alamos Sorption task was internally audited this month.

A. Meijer attended an NRC workshop on the use of natural analogues in the repository program. He also attended a technical exchange meeting on groundwater chemistry held at the NTS.

The Stanford group continued work on experiments involving the adsorption of Np onto feldspar and silica phases. Additional adsorption experiments on the feldspar sample have included a longer pretreatment to test the possible influence of secondary phases formed on the feldspar surface on the sorption behavior of Np. No effect of longer pretreatment times was observed. These results are very important because Np is known to have a relatively small affinity for mineral surfaces in Yucca Mountain tuffs. If it can be shown that this affinity is due to a common mineral, such as feldspar, and not a trace mineral, such as hematite, it will be possible to predict Np sorption coefficients for a given unit in Yucca Mountain with greater confidence.

## PLANNED ACTIVITIES

Continue study of radionuclide sorption on pure mineral phases, write paper for Los Alamos Radionuclide Sorption Workshop proceedings, and complete study plan revisions.

## MILESTONE PROGRESS

3216

27 June 1991

*Mass Spectrometry as Applied to Americium Sorption*

3009

29 January 1992

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

## PUBLICATIONS

A. Meijer

*Sorption Studies Review and Strategy*

Conference paper, *Proceedings of the Radionuclide Adsorption Workshop*, Los Alamos, NM, 11–12 Sept. 1990

In preparation.

### WBS 1.2.3.4.1.2.2

## PROJECT TITLE: BIOLOGICAL SORPTION AND TRANSPORT

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 microorganisms capable of utilizing drilling fluids as growth substrates are of special interest.

## ACTIVITIES AND ACCOMPLISHMENTS

Experiments continued to characterize the siderophore isolated from *Pseudomonas* sp. 11c. Tests demonstrated that the siderophore strongly binds iron relative to the other siderophores, that the siderophore may not be a hydroxamic acid; and that the siderophore is fluorescent. All of this information is important in determining the structure of the siderophore. Experiments continued to determine the effects of microorganisms of the colloidal nature of bentonite clay (Fisher Scientific). Experiments were continued, in conjunction with the Groundwater Chemistry task, to investigate the pH stability of crushed tuff columns under vadose zone conditions.

L. Hasman attended and presented a talk at the Groundwater Chemistry Technical Exchange held at the NTS.

## PLANNED ACTIVITIES

Continue plutonium  $K_d$  and colloidal agglomeration experiments.

## MILESTONE PROGRESS

3176

22 October 1991

*Procedure for Determination of Formation Constants*

In progress.

3080

6 December 1991

*Report on Chelation*

### WBS 1.2.3.4.1.3

## PROJECT TITLE: RADIONUCLIDE RETARDATION BY PRECIPITATION PROCESSES

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

### Solubility and Speciation Studies

A Solubility Integration Meeting was held 22 July in Las Vegas. The purpose of this meeting was to facilitate integration between the Solubility task at Los Alamos and the counterpart task at LLNL. Participants at the meeting were R. Silva and C. Palmer from LLNL; D. Morris, D. Clark, D. Hobart, D. Tait, and H. Nitsche (of LBL) from the Los Alamos Solubility task; N. Patera and J. Canepa from Los Alamos; P. Cloke from SAIC; and A. Simmons from YMPO. Many action items were identified, but the most important one related to the urgent need for modeling support activities for both organizations. Specific modeling needs are being delineated and will be presented to A. Simmons.

D. Morris and D. Hobart represented the Solubility task at the recent Geochemistry Integration Technical Exchange held at the NTS. Morris presented a paper at this meeting entitled *The Role of Groundwater Chemistry in the Solubility/Speciation Task*, in which he described the strategy behind the Solubility study plan and presented some recent results from work at Los Alamos and LBL.

D. Morris' tenure as a rotating member of the Los Alamos YMP Software Quality Assurance (QA) Configuration Control Board began 1 July, and he serves as chair of the review committee for several software products.

Preliminary work continued on the photoacoustic spectroscopic investigation of the Pu<sup>4+</sup>/carbonate system. As noted previously, our results are markedly different from those reported by Kim *et al.* (*Radiochimica Acta* 1985, Vol. 38, pp. 197-201). We have demonstrated that our results are reproducible and that our solutions are stable with respect to speciation changes for periods of several weeks. The discrepancies between our results and those of Kim may be due to the presence of colloidal plutonium in Kim's experiments as a result of slightly different sample preparation and filtering schemes. We hope to test this hypothesis in the next period. Our results suggest that the Pu(IV) carbonate complex present in 1 M total carbonate at high pH (i.e., greater than ~9) is very stable towards subsequent hydrolysis as the pH is lowered. We are also continuing to work on the coding standards for QuickBASIC. Very little work remains here, and we hope to have the standards submitted to the CCB early in the period.

D. Hobart completed a letter report entitled *Plutonium(IV) Complexation by Carbonate, EDTA, and Siderophore Ligands: A Progress Report* and submitted it for review on 16 July. This report details some recent speciation studies related to competitive complexation of Pu(IV) by the title ligands.

LBL staff completed milestone report 3010, describing the solubility work that has been carried out for Np, Pu, and Am in J-13 water from oversaturation. Heino Nitsche is working on a detailed workplan for FY92 that will be completed next month. His experimental efforts have focused on preparing new Pu, Np, and Am/Nd stock solutions for solubility experiments at 60° C in UE25p#1 water from oversaturation.

S. Carpenter visited Los Alamos on 22 July to undergo training for records transmittal. S. Carpenter also met with G. Cort, D. Hines, and M. Clevenger to discuss withdrawing three Software Change Requests from the Los Alamos Software QA Plan consideration. They reached an agreement that withdrawal was an appropriate action.

### PLANNED ACTIVITIES

D. Clark will represent the Solubility task at the Gordon Conference on Inorganic Chemistry on 29 July-2 August.

## PUBLICATIONS

H. Nitsche

*The Importance of Transuranium Solids in Solubility Studies*

Abstract, *International Symposium on the Basis of Nuclear Waste Management XV*, Materials Resource Society Fall Meeting, France, 5-8 November 1991

Approved 22 July 1991.

## MILESTONE PROGRESS

3010

30 June 1991

*Report on Measured Solubilities of Pu, Am, and Np in J-13 Groundwater from Oversaturation Conditions*  
Complete.

3030

26 August 1991

*Carbonate Complexation of Pu(IV)*  
Complete.

31 August 1991

*Progress Report on PAS*  
In preparation.

### WBS 1.2.3.4.1.4

## PROJECT TITLE: RADIONUCLIDE RETARDATION BY DISPERSIVE, DIFFUSIVE, AND ADVECTIVE PROCESSES

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

We received the x-ray diffraction (XRD) analysis for the two samples selected for transport experiments from the core obtained from the Sample Management Facility. The Topopah Spring Member sample (G4 274.7' - 275.5') contains 68% feldspar, 19% tridymite, 12% cristobalite, 1% hematite, and 1% mica. The sample from the Calico Hills (G4 1530.3' - 1532.3') contains 63% clinoptilolite, 12% mordenite, 12% opal-CT, 4% feldspar, 3% quartz, and 1% smectite.

We continued to study the transport behavior of radionuclides as a function of mineralogy. The most likely reasons for the discrepancies between batch sorption coefficients and sorption coefficients obtained via column experiments (reported in May 1991) are pseudocolloid formation, precipitation, slow speciation kinetics, or slow mass transfer kinetics. This month, we concentrated on performing solubility experiments with Np and Pu solutions of the type used for the column transport experiments.

Solutions from well-characterized acidic Pu(IV), Pu(VI), and Np(V) were prepared in J-13 water. These solutions were allowed to settle, and aliquots from the solutions were obtained (without stirring) as a function of elapsed time. The results are given in the following table.

## Stability of Pu and Np Solutions in J-13

Species	Initial Concentration	% Tracer Falling Off in Solution After			
		3 days	7 days	14 days	19 days
Pu(IV)	$2.5 \times 10^{-7}$ M	35	53	56	
Pu(VI)	$2.5 \times 10^{-7}$ M	26	28	31	
Np(V)	$6.5 \times 10^{-6}$ M		3	13	18

These results indicate that some of the discrepancies reported could be the result of precipitation. The results with the Np solution in J-13 are particularly puzzling; the solubility of Np in J-13 should not be below  $10^{-5}$  M. A collaboration with the Sorption task is in progress to assess the reasons for unstable Np solutions in J-13.

We continued to analyze the data from the rock beaker experiments to determine the diffusion behavior of simple cations, pertechnetate, Am, and Np. This month, we concentrated on initiating sorption experiments in support of the diffusion data analysis.

The collaboration between J. Conca and Los Alamos is in place. This collaboration will enable Conca to assess the potential of his unsaturated flow apparatus to study unsaturated transport through consolidated tuff. Four solid rock columns (two made of tuff from the Topopah Spring Member and two made of tuff from the Calico Hills) have been prepared and sent to Conca for study.

We generated a presentation of the importance of the Los Alamos radionuclide migration work, based on the YMP Open House exhibit, and sent it to C. Hanlon in DOE/Washington D.C.

We participated in an audit of the Dynamic Transport and Diffusion studies.

## PLANNED ACTIVITIES

Continue transport work with pure minerals, and continue incorporating resolution to comments from YMP and DOE/HQ into the transport and diffusion study plans.

Initiate the study of actinide transport utilizing crushed and solid tuff.

## PUBLICATIONS

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

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

Conference paper, *Proceedings of the Radionuclide Adsorption Workshop*, Los Alamos, NM, 11–12 Sept. 1990

In internal review.

## MILESTONE PROGRESS

3025

9 September 1991

*Letter Report on Speciation and Transport in Pure Mineral Columns*

Delayed until 23 September 1991.

3061

9 December 1991

*Letter Report on Techniques to Study Kinetics of Sorption*

3234

9 December 1991

*Letter Report on Techniques of Studying Diffusion of Nuclides Through Saturated Tuff*

3236

9 December 1991

*Letter Report on Techniques of Studying Diffusion of Nuclides Through Unsaturated Tuff*

### **WBS 1.2.3.4.1.5.1**

#### **PROJECT TITLE: RETARDATION SENSITIVITY ANALYSIS**

The objectives of this task are to construct a geochemical/geophysical model of Yucca Mountain and to use this model to examine the physical and chemical controls on radionuclide transport along flow paths to the accessible environment.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

##### **Analysis of Physical/Chemical Processes**

Milestone report 3049, *Update Report on Coupled Phenomena*, by G. Zvoloski is undergoing internal technical review. The report describes the dual porosity/dual permeability model used to calculate flow in unsaturated fractured porous media. It also discusses calculations of flow in a discretely fractured medium that butts up against a fault zone. This problem was run as part of early site suitability.

E. Nuttall worked with I. Triay to develop the YMP colloid strategy that integrates data-gathering activities with modeling studies. They submitted a letter of intent to publish to R. Dyer (YMPO) for a Los Alamos/UNM/LLNL/SNL colloid paper. Nuttall also attended the three-day geochemistry meeting at NTS at which colloids were discussed frequently. At the meeting, USGS agreed to analyze for colloids as part of their water-sampling program.

##### **Geochemical/Geophysical Model of Yucca Mountain and Integrated Geochemical Calculations**

Milestone report R746, *Interim Report: Sensitivity Analysis of Integrated Radionuclide Transport Based on a Three-Dimensional Geochemical/Geophysical Model*, received YMPO approval and will be published as an LA-series report.

##### **QA and Programmatic**

After reviewing the Software Requirements Specification document for TRACRN, it was determined that there was not enough detail in the document to perform code verification. Since this is an in-process baseline, we will return to the requirements phase for TRACRN and redo the Software Requirements Specification document before proceeding further.

Responses to deficiency reports from Audit Report LANL-AR-91-05 were completed, and corrective action is underway.

At the Los Alamos PI meeting on 23 July, K. Eggert presented conceptual models for transport processes in the unsaturated zone.

Work to sanction CTCN continued. Two key commercial portions of the code, the graphics package NCSA and the solver LSODPK, were approved.

## PUBLICATIONS

K. Birdsell, K. Campbell, K. Eggert, and B. Travis

*Interim Report: Sensitivity Analysis of Integrated Radionuclide Transport Based on a Three-Dimensional Geochemical/Geophysical Model*

LA-series report

Approved 22 July 1991.

## MILESTONE PROGRESS

3049

27 June 1991

*Update Report on Coupled Phenomena*

Undergoing technical review.

3229

30 May 1991

*Report on FEHMNS Calculations*

Delayed until 27 June 1991.

3121

22 October 1991

*Baseline Documentation of CTCN Code*

Delayed until 20 November 1991.

3052

2 January 1992

*Baseline Documentation for TRACRN*

Delayed until 4 February 1992.

## WBS 1.2.3.4.1.5.2

### PROJECT TITLE: DEMONSTRATION OF APPLICABILITY OF LABORATORY DATA

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

## ACTIVITIES AND ACCOMPLISHMENTS

The text describing the change to this study for the four activities is being prepared.

E. Springer attended the Exploratory Studies Facility Test Coordination meeting held 11 July in Las Vegas. Two major issues that affect all tests were discussed at this meeting. The first was the performance assessment required to support the facility for test-to-test interferences, construction-to-test interferences, and the potential for tests to impact waste isolation. The first item, test-to-test interferences will be addressed by PIs. No resolution was presented on the second issue, construction-to-test interferences, although it was suggested that the Test Coordination Office may be able to address this issue. The impact on waste isolation will be addressed by SNL and must be addressed by the close of

Title II design activities. The second major topic discussed at the meeting was the close of Title I and the 91-5 Test Planning Package. The current information was preliminary, and it will have to be submitted with design controls. This process must be completed by 30 September 1991.

E. Springer was asked to make a technical presentation to support the Project's application for an injection permit at a public hearing on 16 July.

A meeting was held with the Geologic Repository Program at LBL on 17 July. The three areas of mutual interest were (1) use of the existing tunnels at NTS, (2) the caisson experiment, and (3) field experiments at Yucca Mountain. The first two topics were discussed in relatively brief conversations. The literature on the tunnels and their potential for hydrologic testing are being reviewed and will be presented in a report to YMPO. The design of the caisson experiment has proceeded without input from this group, and the late date does not allow much change. The field test provides an opportunity to use the diverse capabilities of this group, and there was discussion on the various facets of the test to which the members can contribute. Another meeting will be held in September or October to discuss study plan development, particularly for Chapter 3.

This activity was audited on 30 July as part of internal audit LANL-AR-91-07 of EES-13.

## PLANNED ACTIVITIES

Continue activity descriptions to support change request and develop the study plan.

## PUBLICATIONS

C. Woloshun

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

LA-series report

In review.

## WBS 1.2.5

### PROJECT TITLE: REGULATORY AND INSTITUTIONAL

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

## ACTIVITIES AND ACCOMPLISHMENTS

### Study Plans

**Water Movement Test, R3 (8.3.1.2.2.2).** Issued by DOE/HQ as a controlled document; sent to NRC and State of Nevada; revision is in progress.

**Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5).** A revision incorporating DOE/HQ and Project Office comments was submitted (11 June 1991).

**Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7).** Issued by DOE/HQ as a controlled document, and sent to the NRC (10 April 1990).

**Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1).** Accepted by the NRC 4 September 1990.

**History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2).** A revision incorporating SAIC comments was submitted (13 June 1991).

**Kinetics and Thermodynamics of Mineral Evolution and Conceptual Model of Mineral Evolution, R0 (8.3.1.3.3.2; 8.3.1.3.3.3).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 14–15 March 1990; revision activity has been deferred.

**Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3).** Comment resolution meeting for DOE/HQ and Project Office comments was held (February 1990); revision is in progress.

**Biological Sorption and Transport, R1 (8.3.1.3.4.2).** Revision, incorporating DOE/HQ and Project Office comments, was submitted to Project Office 20 May 1991.

**Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2).** Submitted to Project Office 17 August 1990.

**Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1).** Comment resolution meeting for DOE/HQ and Project Office comments was held 28–30 August 1990; revision is in progress.

**Diffusion, R0 (8.3.1.6.2).** Comment resolution meeting for DOE/HQ and Project Office comments was held 28–30 August 1990.

**Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1).** Revision incorporating DOE/HQ and Project Office comments was submitted 19 June 1990.

**Effects of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.2).** In preparation.

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

**Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1).** A revision incorporating DOE/HQ and Project Office comments was submitted (18 June 1991).

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

## **WBS 1.2.6**

### **PROJECT TITLE: EXPLORATORY STUDIES FACILITY**

These exploratory studies (ES) will address the issues and information needs associated with the feasibility of storing high-level nuclear waste in a geologic repository at Yucca Mountain.

## ACTIVITIES AND ACCOMPLISHMENTS

Staff involved with the Management Systems Improvement Strategy (MSIS) participated in resolving comments on the Physical Systems Requirements Document for the ESF prepared by OCRWM. Staff also attended the NWTRB meeting in Washington to discuss ESF-related topics and to finalize the ESF MSIS documentation.

Performed management and independent technical review of the ESF General Arrangement for the south portal of the ESF.

Work on the third group of test requirements for Test Planning Package (TPP) 91-5 was completed. Completion of this package will support Raytheon's effort to prepare general arrangements for the ESF. Work was also initiated to obtain QA-verified information from each test organization to prepare the consolidated TPP 91-5. Discussions were held with SNL and USGS PIs to obtain their test-design needs for incorporation, and a meeting was scheduled with PIs from LLNL and Los Alamos.

Initiated work to update the Preliminary Safety Analysis Report (PSAR) for ESF testing. This report with documents prepared by RSN, will be used to prepare the ESF PSAR.

Review comments on the Tracer, Fluids and Materials Management Plan were received from YMPO. Internal review comments on the Tracer Injection System report are being resolved.

Visited Dallas Flood Control Project to view the tunnel-boring machine and large roadheader.

## PLANNED ACTIVITIES

Continue to support the MSIS effort as required, to update ESF Requirements Document as needed, to prepare TPPs, and to prepare change requirements to update the ESFRD.

Resolve review comments and revise the Tracers, Fluids, and Materials Control Plan; resolve comments on the Tracer Injection System report; revise and update the PSAR; and update ESF Test Support Requirements Document.

Develop interfaces for testing and ESF design, new networks for ESF testing and testing prerequisites to start ESF design. Prepare SCPB changes to the ESF testing program to incorporate new ESF configuration.

### WBS 1.2.6.8.4

#### PROJECT TITLE: INTEGRATED DATA SYSTEM

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

Discussed IDS requirements with USGS in Denver for three of activities—Anisotropy Radial Boreholes, Contact Radial Boreholes, and Percolation (the first test supported by the IDS will be an anisotropy radial borehole in the north portal). The basic interface requirements for these activities were identified during the meeting. Additional details, including file formats, will be worked out during the next two months. Some common data requirements were also identified for inclusion in the IDS.

Discussed IDS architecture with the Raytheon design team to meet the USGS requirements identified at the Denver meeting.

Planning for test-specific support continued this month. A detailed schedule will be produced in August that will show when information is needed for IDS design and for each IDS-supported test at its earliest possible implementation, based on ESF construction.

Planning for operations of the IDS continued with emphasis on tasks and schedules.

#### **PLANNED ACTIVITIES**

Revisit the IDS conceptual design in light of a selected ESF alternative, and work with RSN to begin IDS design.

Continue developing IDS requirements by interfacing with participating organizations, and continue operations planning.

#### **WBS 1.2.9.1.4**

##### **PROJECT TITLE: RECORDS MANAGEMENT**

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

#### **ACTIVITIES AND ACCOMPLISHMENTS**

In July, 33 records were transmitted to the Central Records Facility, which rejected 3 records and 12 records were rejected by the Records Processing Center.

#### **WBS 1.2.9.3**

##### **PROJECT TITLE: QUALITY ASSURANCE**

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.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

##### **Software**

Three software Configuration Control Board (CCB) meetings were held. About 95 software change requests have been submitted, and 20 applications have been approved.

##### **Grading**

Of the 32 Los Alamos grading packages being prepared, 26 are approved, 3 have been withdrawn, and 3 are in YMP review.

### **Records/Document Control**

A meeting was held to discuss current issues, problems, and changes in Project requirements.

The following detailed technical procedures (DPs) were issued:

- DP-326, RO, Ion-chromatographic Determination of Constituent Concentrations in Solution
- DP-115, R2, Vaisala HMI-32 Humidity Probe
- DP-119, R1, Moisture Evolution Analyzer
- DP-121, R1, Long Term Sample heating Procedure
- DR-16, R5, Siemens X-ray Diffraction Procedure
- DR-24, R3, Calibration and Alignment of Siemens Diffractometer
- DP-25, R4, Clay Mineral Separation and Preparation for XRD Analysis
- DP-56, R3, Brinkman Automated Grinder
- DP-105, R2, Thermal Calibration Procedure
- DP-107, R2, Thermogravimetric and Differential Scanning Calorimetry Analyzer
- DP-110, R2, Zeolite Purification/Separation Procedure

### **Training**

Training classes for Root Cause Determination and Environmental Regulation Training Program were held.

Efforts continued on redesigning the training program. An orientation pilot class, using the new training concepts, will be held in August.

### **Program Development**

Revisions to quality administrative procedures QP-1.2 (stop work), QP-2.5 (personnel selection), QP-4.4 and QP-4.5 (procurement), QP-15.2 (deficiencies) are in draft stage.

### **Deficiencies**

A status report describing our efforts to resolve CAR-91-041 was sent to YMPO.

### **Audits**

Internal audits of INC-4, INC-7, INC-11, and EES-13 were undertaken. Audit reports LANL-AR-91-04 and LANL-AR-91-06 were approved and distributed.

The Project Office conducted a survey of criteria 16 and 17; there were no findings.

### **PLANNED ACTIVITIES**

Grading package revisions will continue. The internal audit of EES-13 and several open surveys will be completed. An amended response to CAP-YM-91-041 will be submitted.

Revisions to detailed technical procedures and QPs will continue.

An orientation pilot class using the new training concepts will be held in August.

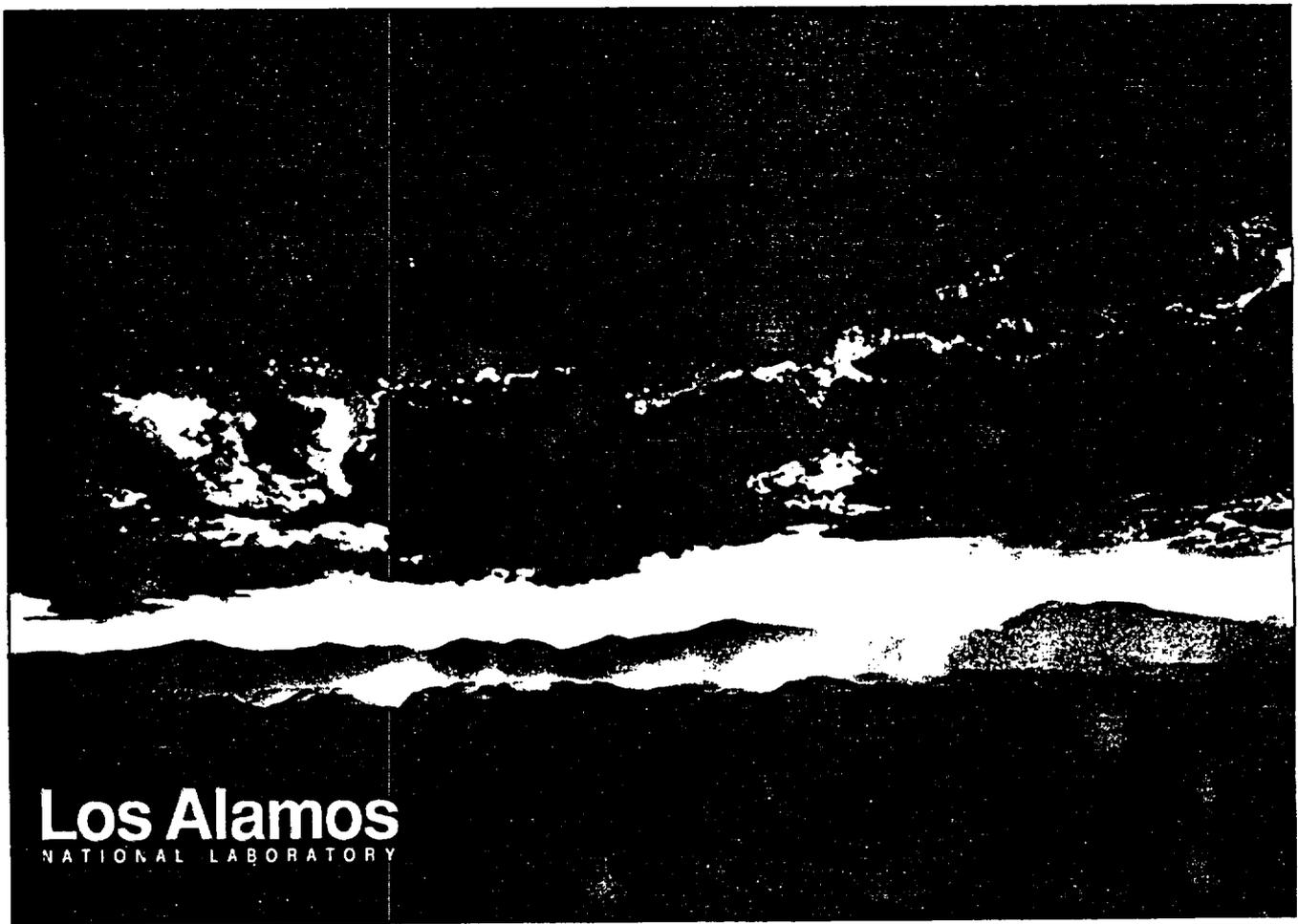
**PROBLEM AREAS**

The proposed new regulatory document (QARD) will affect our disposition of CAR-91-041 and will require us to amend our response. Resolution of this CAR will result in revision of several QPs. We are making a concerted effort to make sure that audit reports and other documentation are done in a timely manner.

# *Yucca Mountain Site Characterization Project*

## *Monthly Activity Report*

*August 1991*



*Attachment to TWS-EES-13-11-91-024*

9112100-225  
24812.

**ENCLOSURE 2**

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

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

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# CONTENTS

WBS 1.2.1 – Systems (Canepa) .....	1
WBS 1.2.3.2.1.1.1 – Mineralogy, Petrology, and Rock Chemistry of Transport Pathways (Vaniman) .....	1
WBS 1.2.3.2.1.1.2 - Mineralogic and Geochemical Alteration (Levy) .....	3
WBS 1.2.3.2.1.2 – Stability of Minerals and Glasses .....	5
WBS 1.2.3.2.5 – Postclosure Tectonics (Crowe) .....	5
WBS 1.2.3.3.1.2.2 – Water Movement Tracer Tests (Fabryka-Martin) .....	7
WBS 1.2.3.3.1.2.5 – Diffusion Tests in the ESF (Triay) .....	7
WBS 1.2.3.3.1.3.1 – Site Saturated Zone Ground-Water Flow System (Robinson) .....	8
WBS 1.2.3.4.1.1 – Ground-Water Chemistry Model (Ebinger) .....	10
WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 – Batch Sorption Studies and Sorption Models (Meijer) .....	10
WBS 1.2.3.4.1.2.2 – Biological Sorption and Transport (Hersman) .....	11
WBS 1.2.3.4.1.3 – Radionuclide Retardation by Precipitation Processes (Morris) .....	12
WBS 1.2.3.4.1.4 – Radionuclide Retardation by Dispersive, Diffusive, and Advective Processes (Triay) .....	13
WBS 1.2.3.4.1.5.1 – Retardation Sensitivity Analysis (Eggert) .....	14
WBS 1.2.3.4.1.5.2 – Demonstration of Applicability of Laboratory Data (Springer) .....	15
WBS 1.2.5 – Regulatory and Institutional (Canepa) .....	16
WBS 1.2.6 – Exploratory Studies Facility (Kalia) .....	17
WBS 1.2.6.8.4 – Integrated Data System (Oblad) .....	18
WBS 1.2.9.1.4 – Records Management (Sanders) .....	19
WBS 1.2.9.3 – Quality Assurance (Bolivar) .....	19

LOS ALAMOS NATIONAL LABORATORY  
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report  
August 1991

WBS 1.2.1  
SYSTEMS

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

Caisson Experiment (WBS 1.2.1.4.6)

A meeting was held with D. Ward (UNM/SNL) on 7 August to discuss time domain reflectometry (TDR) installations for the caisson experiment. The TDR equipment has been ordered.

The effort continues to identify the material for the caisson experiment. A letter from R. Glass (SNL) indicated the type of support that SNL can bring to this experiment. This expertise, in addition to the capabilities provide by M. Siegel (SNL), makes a more comprehensive effort, but these interactions increase preparation time by delaying decisions such as the fill material to be used in the experiment. However, the experiment is stronger, and working relationships between participants have been built. The cost is on time, and milestones are on schedule. It does not appear that the caisson will be filled in FY91 because analyses for hydraulic and geochemical properties for design are ongoing at SNL.

PA Computational Support (WBS 1.2.1.4.7)

Greg Valentine completed a draft version of letter report *Interfacing Site Characterization and Performance Assessment: Examples From the Volcanism Task*. This report discusses the philosophy of the integration of Site Characterization and Performance Assessment tasks and provides examples of how the work is proceeding under this philosophy for volcanism.

PLANNED ACTIVITIES

Resolve fill material with SNL personnel, and continue to obtain instrumentation for the experiment.

WBS 1.2.3.2.1.1.1

MINERALOGY, PETROLOGY, AND ROCK CHEMISTRY OF TRANSPORT PATHWAYS

The purpose of this activity is to define the important mineralogic and geochemical variables along 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

The draft of milestone report 3135 was further revised to incorporate new figures and comments; the new title is *Mineralogy as a Factor in Radioactive Waste Transport through Pyroclastic Rocks at Yucca Mountain, Nevada*. Mineral classifications used in the paper are now based on relative cation-exchange, surface complexation, or coprecipitation capacities known or inferred for minerals at Yucca Mountain.

B. Carlos examined and scraped manganese oxide coatings on fractures in core at the Sample Management Facility on 1 August. Scraped coatings were prepared for x-ray diffraction (XRD) analysis at Los Alamos.

During J. Bartlett's visit to Los Alamos on 6 August, D. Vaniman and B. Carlos met with him and discussed their work on transport pathways. Carlos and Vaniman also manned the Los Alamos display at the Field Operations Center during a tour for the miners and laborers on 24 August.

B. Carlos, D. Vaniman, and the Los Alamos Test Coordination Office discussed activities for transport pathways in the Exploratory Studies Facility (ESF). They prepared and submitted design requirements for the ESF and sections for the test planning package for pre-Title II Design Studies to cover studies of petrologic stratigraphy of the Topopah Spring Member, mineral distributions between the potential host rock and the accessible environment, and fracture mineralogy.

S. Craven, a Los Alamos Science and Engineering Research Semester student, arrived 26 August to work with B. Carlos for four months. She will be looking at the fracture coatings, especially Mn-oxides, in the Paintbrush Tuff in drill cores VH-1 and VH-2.

A presentation entitled *Fracture-Lining Manganese Oxide Minerals in Silicic Tuff at Yucca Mountain, Nevada* was accepted as a poster session to be presented by B. Carlos at the Geological Society of America annual meeting in San Diego on 22 Oct.

Considerable attention was given to preparing for the Tiger Team visit at Los Alamos. We anticipate further preparations in September, and work progress will be impacted in October and November while this group is at Los Alamos.

## PLANNED ACTIVITIES

Continue analysis of Mn-oxide fracture fillings in the Crater Flat and Paintbrush tuffs to determine their distribution and factors controlling that distribution; prepare poster session on Mn-oxide minerals for Geological Society of America Meeting in October; work on image analysis methods for fracture and texture analysis; evaluate glass alteration features in saturated versus unsaturated environments; continue examination of fractures in the Crater Flat Tuff in drill cores other than USW G-4; evaluate possible hazardous minerals at Yucca Mountain; continue examination of fracture-coating minerals in the Topopah Spring Member; and complete paper on Mn-oxides for publication in a refereed journal.

## PUBLICATIONS

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

D. Bish and S. Chipera  
*Detection of Trace Clays and Clay Minerals Amounts of Erionite Using X-ray Powder Diffraction: Erionite in Tuffs of Yucca Mountain, Nevada, and Central Turkey*  
Journal article, *Clay and Clay Minerals*  
In press.

D. Vaniman, D. Bish, D. Broxton, B. Carlos, S. Chipera, and S. Levy  
*Framework of Altered Pyroclastic Rocks at Yucca Mountain, Nevada*  
Journal article, *Jour. Geoph. Res.*  
In review.

## MILESTONE PROGRESS

3120

*Calcite in Fractures*

Will be completed eight months after microprobe software approval.

3123

22 October 1991

*Mn Minerals in the Crater Flat Tuff*

Undergoing extensive revision.

3132

*Tiva Fracture Mineralogy in USW G-4*

Will be completed three months after microprobe software and standards are approved.

3135

January 1991

*Review of Yucca Mountain Mineralogy*

Complete.

3137

26 March 1992

*Mineralogy of Calico Hills for Adit Development*

Writing 66% complete; will be completed six months after XRD software approval.

T503

*Statistical Analysis, Topopah Spring Member*

Writing 5% complete; on hold pending software QA resolution

## PROBLEM AREAS

Delays in obtaining software acceptance under the Los Alamos Software Quality Assurance Plan continue to impact all fracture mineral studies, particularly the studies of Mn-oxide mineralogy. The report on manganese minerals in fractures (milestone 3123) cannot be completed until at least four months after approval of the SEM operating software. Approval of software for quantitative XRD analysis will take longer than the electron microbeam software to gain approval.

### WBS 1.2.3.2.1.1.2

## MINERALOGIC AND GEOCHEMICAL ALTERATION

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

Major efforts this month were directed to providing input for Exploratory Studies Facility planning documents. Key design criteria concerns include the need for continuing access to excavated wall-rock surfaces so that preliminary sample characterization can be followed up by more detailed studies. Also identified was a need to coordinate with the perched-water test and the geologic-mapping test for collection of any gels observed in the Facility.

D. Bish and S. Levy attended a dry run for October's NWTRB presentation on repository thermal effects. Bish presented the results of his heating experiments on Yucca Mountain minerals.

J. Whelan of USGS, Denver, visited Los Alamos to consult with D. Vaniman and S. Levy on continuing joint research related to Trench 14 and drillhole samples. Vaniman and Whelan plan to do petrologic, chemical, and isotopic analyses on sets of Trench 14 materials prepared by Vaniman. Whelan and Levy discussed issues relating to the use of oxygen isotopic-fractionation factors for various forms of silica.

Preliminary x-ray fluorescence analyses of Trench 14 materials have been completed. The results indicate that aluminum may be a good indicator of approximate proportions of tuff-like materials in trench samples that are mixture of tuff and authigenic minerals.

#### PLANNED ACTIVITIES

Alteration history workers will travel to USGS next month to discuss revisions of drilling plans to allow deeper drillholes and possible additional holes. Calcite-silica studies in Trench 14 and elsewhere are continuing, as are heating and glass-rehydration experiments.

#### PROBLEM AREAS

Electron microprobe analytical work continues to be delayed by software quality assurance certification requirements. Work by G. WoldeGabriel on K/Ar studies of zeolites and clays will also be delayed about two months due to contract problems.

#### PUBLICATIONS

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, *J. Geophys. Res.*  
Interim draft complete.

#### MILESTONE PROGRESS

3138  
26 March 1992  
*Chemical Transport in Zeolitic Alteration*  
Research is 55% complete; delayed by quality assurance stop work order.

3141  
3 February 1992  
*Laminated Zone in Trench 14*  
Research is 46% complete; delayed to FY92.

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

3143  
30 September 1991  
*Experimental Dehydration of Volcanic Glasses*  
Interim draft complete.

### **WBS 1.2.3.2.1.2 STABILITY OF MINERALS AND GLASSES**

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

#### **ACTIVITIES AND ACCOMPLISHMENTS**

This activity has been deferred.

### **WBS 1.2.3.2.5 POSTCLOSURE TECTONICS**

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

#### **ACTIVITIES AND ACCOMPLISHMENTS**

A second phase of soil-pit digging was completed at the Lathrop Wells volcanic center. Seven new pits were dug on the north side of the volcanic center with the truck-mounted backhoe system. We were able to establish the stratigraphic relationships of several lava and pyroclastic units. Major conclusions of this work are as follows.

1. The buried lava (Ql<sub>5</sub>?) on the north side of the cone underlies the Ql<sub>4</sub> lava.
2. The two lava units are separated stratigraphically by up to two meters of fall, surge, and reworked tephra deposits.
3. There is a soil with significant horizon development (where not disrupted by bioturbation) between the two lava flow units.
4. The unconformity marked by the soil is probably correlative with a mapped erosional surface that is exposed beneath the scoria deposits of the north flank of the main scoria cone.

Sampling was completed for the 3.7-Ma basalt centers of Crater Flat for petrology and geochronology studies. Samples were collected from a feeder dike in cone scoria, a lava lake sequence ponded in the crater of a scoria cone, and two lava flow units.

The contract for additional thermoluminescence studies by S. Forman was placed with the Ohio State University.

A meeting on disruptive events with Golder Associates was attended in Seattle on 22-23 August.

#### **PLANNED ACTIVITIES**

We contacted M. Harrison, of the University of California at Los Angeles, concerning K/Ar and Ar/Ar dating of basalt of the Yucca Mountain region. He discussed the limitations of the method for analyzing fine-grained basaltic rocks and recommended contacting P. Zeitler of Lehigh University. This work responded to the geochronology review suggestions of D. DePaolo.

A literature search was started on the physical processes of magma generation, ascent, storage, and eruption in an extensional tectonic setting, in response to review recommendations for the geochronology program.

Sample processing and analyses have started of core collected from the Lathrop Wells center for paleomagnetic studies. We have placed a priority on obtaining data for the buried lava flow, for which there is neither K/Ar or paleomagnetic data. A literature search was started to evaluate information on the structural controls of Quaternary volcanic centers in the southwest United States.

Field work will commence in the Grand Canyon area of Arizona and Utah to examine the depth of derivation of lithic fragments in basalt scoria deposits.

A third phase of digging of soil pits at the Lathrop Wells center will be conducted in September. We will trace the soil and erosional unconformity identified in the August work toward the main scoria cone. We will also dig soil pits in the pyroclastic surge deposits northwest of the center.

## PUBLICATIONS

C. Harrington

*Quaternary Erosion Rates on Hillslopes in the Yucca Mountain Region, Nevada*

Abstract, GSA Annual Meeting

Approved 12 August 1991.

B. Crowe et al.

*Multiple Eruptive Events at Small Volume Basaltic Centers: Evidence From the Cima and Crater Flat Volcanic Fields*

Journal article

In preparation.

B. Crowe et al.

*Methods for Assessing the Risk of Volcanism at the Yucca Mountain Site*

Journal article

Revised draft in preparation.

B. Crowe et al.

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

LA-series report

In preparation.

## MILESTONE PROGRESS

3108

30 September 1992

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

Delayed.

3129

10 July 1992

*Petrology of Lathrop Wells Eruptive Sequences*

Delayed.

### WBS 1.2.3.3.1.2.2 WATER MOVEMENT TRACER TESTS

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 study plan was submitted to review.

Thus far, five detailed technical procedures (DPs) have been sent out for technical and QA review, and comments have been received and resolved for four of them. Additionally, five DPs remain to be submitted for review.

J. Fabryka-Martin met with A. Flint, USGS PI for Characterization of Unsaturated-Zone Infiltration, to discuss future data exchanges and to coordinate mutually beneficial field activities. Drilling of 12 neutron-access boreholes is to begin in October, and Flint agreed that the drilling procedure could be modified to provide QA-traceable samples for  $^{36}\text{Cl}$  analysis. After consultation with Sample Management Facility (SMF) staff, Fabryka-Martin and Flint submitted criteria letters to the SMF, and sample requests from Los Alamos were submitted to the Sample Overview Committee. Flint also agreed to Fabryka-Martin's participation in selecting locations for his artificial infiltration study plots, particularly with regard to the location of trenches providing access to sampling of soil profiles. Los Alamos also tentatively plans to sample these soil profiles for chlorine-36, chloride, and bromide.

A test planning package and Exploratory Studies Facility (ESF) Design Requirements were formally submitted to the Test Coordination Office for  $^{36}\text{Cl}$  sampling activities planned in the ESF.

#### PLANNED WORK

Continue evaluating stable chloride ratios as tracer of meteoric chloride in rocks; complete documenting YMP samples in possession of contractor; update core requests; prepare DPs for processing of samples for  $^{36}\text{Cl}$  analysis; and process water samples received from USGS.

#### MILESTONE PROGRESS

3192

1 July 1991

*Water Movement Test Study Plan, Revision 1*  
Complete.

### WBS 1.2.3.3.1.2.5 DIFFUSION TESTS IN THE ESF

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

I. Triay attended a meeting in Las Vegas to learn how to prepare a test planning package (TPP) and ESF Design Requirements (ESFDR) input for this task. The staff prepared input to the TPP and the ESFDR and initiated a review of the documents. The TPP review was completed.

## PLANNED ACTIVITIES

Continue planning the diffusion prototype test; complete the review cycle for the ESFDR input, and transmit both the TPP and ESFDR input to the Test Coordination Office.

## MILESTONE PROGRESS

No level II milestones are planned this fiscal year.

### WBS 1.2.3.3.1.3.1

## SITE SATURATED ZONE GROUND-WATER FLOW SYSTEM

### ACTIVITIES AND ACCOMPLISHMENTS

Core samples were selected for the batch sorption experiments, and preliminary sample preparation (visual examination, weighing, etc.) was completed.

The fluorimeter was repaired, and exploratory work was initiated with standard dye solutions to determine its suitability for use in measuring the microspheres. Next, the fluorescently labelled microspheres themselves will be used in the evaluation of this measurement technique.

The problems reported in June with the ion chromatograph have been corrected, and the instrument is now operational. The procedure for measuring cations in solution is being optimized. The key aspect of this work is to improve the chromatographic separation of the Li and Na cations so that each can be measured with adequate accuracy and precision.

#### Software Qualification

The review of the SORBEQ design baseline was completed, and the identified items addressed. The revised version of the SRS for FRACNET is being reviewed by the Change Control Authority. After this review is complete, the development will enter the design phase.

Preliminary FEHMN calculations are being performed to provide field-test design information for the C-Wells conservative and reactive tracer experiments. The calculations are designed to provide preliminary design information related to tracer breakthrough times, peak time, and dispersion characteristics so we can pinpoint the injection and sampling schedules for the test. None of the calculations will be submitted as quality-affecting data, but the work will be used to set the appropriate finite-difference parameters for the simulations. The runs will be repeated with a baselined version of the code when it becomes available, but no changes in the analysis are anticipated. So far, an appropriate finite-difference mesh and time-step parameters have been determined that minimize numerical dispersion and mass-balance inaccuracies.

#### Quality Assurance (QA)

The detailed technical procedure on the analytical balance was completed.

Several members attended a YMPO presentation at Los Alamos on Quality Concern Issues.

## PLANNED ACTIVITIES

Begin batch sorption experiments with lithium bromide. Continue to bring the computer codes FRACNET, FEHMN, and SORBEQ and other software into compliance with the Software QA Plan, compiling existing documentation and writing new material as necessary. Continue reviewing software submissions as required.

## PUBLICATIONS

W.L. Polzer and H.R. Fuentes

*The Use of the Modified Estimate Thermodynamic Equilibrium Properties of Ion Exchange Adsorption of Radionuclides on Volcanic Tuff. Part II. Experimental*

Journal article, *Environmental Science and Technology*

Submitted to Project Office 7 August 1990; resubmitted 22 March 1991 under AP-1.3.

B.A. Robinson

*FRACNET—Fracture Network Model for Water Flow and Solute Transport*

LA-series report

In preparation.

B.A. Robinson

*SORBEQ—A One-Dimensional Model for Simulating Column Transport Experiments*

LA-series report

In preparation.

## MILESTONE PROGRESS

3047

November 1991

*Evaluation of Preliminary Application of FEHMN to Yucca Mountain*

Complete.

3196

26 September 1991

*FRACNET Documentation*

3193

23 July 1991

*Batch Sorption Experiments with Boron Using Single Crystals*

R529

*Evaluation of Preliminary Application of FEHMN to Yucca Mountain*

Complete.

T112

22 October 1991

*Final Documentation for FEHMN*

Delayed.

## PROBLEM AREAS

The upcoming visit of the Tiger Team has forced our laboratory experimental team to focus on ES&H issues, but experimental work will commence in September.

### **WBS 1.2.3.4.1.1 GROUND-WATER CHEMISTRY MODEL**

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

#### **ACTIVITIES AND ACCOMPLISHMENTS**

This task will be updated in September.

#### **MILESTONE PROGRESS**

No milestones are scheduled for the next three months.

### **WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 BATCH SORPTION STUDIES AND SORPTION MODELS**

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**

Experiments designed to evaluate the effects of crushing on the sorption coefficients obtained by batch techniques were completed. We are waiting for mineralogic analyses from D. Bish before all the data can be properly interpreted.

Staff submitted a review to YMPO on the contract with PNL for groundwater analyses and responded to a request from SNL for sorption data.

The Stanford group continued work on experiments involving the adsorption of Np onto feldspar and silica phases. Currently, experiments are being designed to measure the adsorption of CO<sub>2</sub> onto feldspar and quartz. This component has considerable impact on the adsorption of Np onto these mineral phases. The experiments will allow quantification of this impact. These experiments are very important because Np is known to have a relatively small affinity for mineral surfaces in Yucca Mountain tuffs.

Significant effort this month was expended in addressing environment, safety, and health concerns in preparation for the DOE Tiger Team visit in September.

#### **PLANNED ACTIVITIES**

Complete paper for sorption workshop proceedings, revise study plan, and continue study of radionuclide sorption on pure mineral phases.

#### **MILESTONE PROGRESS**

3216

27 June 1991

*Mass Spectrometry as Applied to Americium Sorption*

3009

29 January 1992

*Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff*  
Delayed to 20 February 1991.

## PUBLICATIONS

A. Meijer

*Sorption Studies Review and Strategy*

Conference paper, *Proceedings of the Radionuclide Adsorption Workshop*, Los Alamos, NM, 11-12 Sept. 1990  
In preparation.

## WBS 1.2.3.4.1.2.2

### BIOLOGICAL SORPTION AND TRANSPORT

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 microorganisms capable of utilizing drilling fluids as growth substrates are of special interest.

### ACTIVITIES AND ACCOMPLISHMENTS

Work was completed on an experiment to determine the effects of microorganisms of the colloidal nature of bentonite clay (Fisher Scientific). A *Pseudomonas* sp. was tested for its ability to affect the agglomeration of colloidal particles. The experiment was performed with extracellular material only, without bacterial cells. The results of the experiment demonstrated clearly that the extracellular material accelerates colloidal agglomeration. In the presence of the extracellular material, clay particles formed agglomerates as compared with the controls where clay particles tended to remain as individual particles. These results suggest that in the presence of microorganisms the number of individual clay particles would be reduced, and thus, the effects of colloidal transport of radioactive materials would also be reduced.

### PLANNED ACTIVITIES

Continue plutonium  $K_d$  and colloidal agglomeration experiments.

### MILESTONE PROGRESS

3176

22 October 1991

*Procedure for Determination of Formation Constants*  
In progress.

3080

6 December 1991

*Report on Chelation*

### WBS 1.2.3.4.1.3

## RADIONUCLIDE RETARDATION BY PRECIPITATION PROCESSES

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

D. Morris met with M. Ebinger, PI for the Groundwater Chemistry Task, to plan joint experiments—in particular, modeling activities to address data needs and future directions for the Solubility task. They addressed a number of specific areas that were not previously considered in great detail, especially the role of redox buffering and inherent mineral redox capacity with respect to the speciation of the very redox sensitive actinide elements.

#### Solubility and Speciation Studies

LBL staff transmitted 3,000 pages of records to the Records Processing Center (RPC), bringing the total to more than 15,000 pages in the past two months.

LBL staff submitted Validation and Verification Review sheets, Software/Data Dissemination Requests, and TFL and AFL file lists for the following commercial software: Microsoft Disk Operating System (DOS), Microsoft Fortran, Microsoft Basic, Microsoft C, SigmaPlot Scientific Graph System, and Personal Computer Analyzer (PC:A) 4000.

H. Nitsche and coworkers continued working on detailed technical procedures: two new drafts, *Balance Operation and Calibration* and *Determination of Actinide Concentrations in Solubility Samples*, and one revision, *Operation and Calibration of Low Energy Gamma Counter*. The balance procedure cannot be completed until Los Alamos QP-12.1 is revised. The calibration weight set that was calibrated against a NIST-certified weight set is being calibrated by Los Alamos.

The internal technical reviews of two milestone reports were completed and returned to the authors for resolution. The reports are 3010, entitled *Measured Solubilities and Speciations of Neptunium, Plutonium, and Americium in Typical Groundwater (J-13) from the Yucca Mountain Region*, by H. Nitsche *et al.*, and 3030, a letter report entitled *Plutonium(IV) complexation by Carbonate, EDTA, and Siderophore Ligands: A Progress Report*, by D. Hobart *et al.*

#### Photoacoustic Spectroscopy (PAS) and Speciation

Experimental work continues on the speciation of Pu(IV) in carbonate media using PAS. Efforts have focussed on determining the origin of the pH drift seen in bicarbonate solutions at pH values below ~8.6. This behavior has been examined in a variety of different container materials, and the same behavior is seen in all cases. Experimental work also continued on the speciation of Pu(VI) carbonate complexes using Fourier-transform NMR, and preliminary work is nearly complete. Subsequent experiments will involve varying metal and carbonate concentrations to characterize equilibria for this oxidation state of plutonium.

Work continued in the preparation of new plutonium, neptunium, and americium/neodymium stock solutions for the UE25p#1 solubility experiment at 60°C. Difficulties were encountered with the preparation of the individual plutonium oxidation state solutions. The Pu(III) solution, which was prepared by electrolytic reduction, does not remain stable when the potential is switch off; it immediately changes the typical blue color to orange/red indicative for Pu(IV). This is a very unusual behavior because Pu(III) is stable for at least several hours (even days) under the given conditions. There is no clear explanation for this behavior, but the presence of a foreign, unidentified oxidizing substance is implicated. Therefore, this solution cannot be used for the experiments, and preparation of a new solution from plutonium dioxide has begun.

### Quality Assurance (QA)

D. Morris chaired software review committees for four products—SIEMGETPUT, MIEEQUA, CONAPS, and IFKSOLVE. The Software Configuration Manager and the Configuration Control Board are trying to find mechanisms to streamline the review process; however, experience as a reviewer has been valuable to developing software for this task.

### PLANNED ACTIVITIES

Efforts in all above mentioned areas will continue.

### MILESTONE PROGRESS

3010

30 June 1991

*Report on Measured Solubilities of Pu, Am, and Np in J-13 Groundwater from Oversaturation Conditions*  
Complete.

3030

26 August 1991

*Carbonate Complexation of Pu(IV)*  
Complete.

31 August 1991

*Progress Report on PAS*  
In preparation.

### PROBLEM AREAS

Preparation for the Tiger Team will require significant effort from all Solubility personnel at Los Alamos.

### WBS 1.2.3.4.1.4

### RADIONUCLIDE RETARDATION BY DISPERSIVE, DIFFUSIVE, AND ADVECTIVE PROCESSES

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

We prepared two waters in addition to J-13 for transport experiments, which entailed filtering available USW H-3 and UE25 P-1 waters through 0.05-micron filters.

Staff prepared an exhibit to present Los Alamos work on radionuclide migration.

We continue to analyze the data from the rock beaker experiments to determine the diffusion behavior of simple cations, pertechnetate, Am, and Np.

We purchased and set up the Soil Measurement Systems apparatus to study unsaturated transport through tuff utilizing vacuum. This effort, in conjunction with the collaboration established with J. Conca, will enable us to assess the potential of the available systems to perform unsaturated transport experiments.

#### PLANNED ACTIVITIES

Complete the analysis of the rock beaker experiments already performed; continue transport work with pure minerals; complete incorporating comment resolution from YMP and DOE/HQ into the transport and diffusion study plans; and initiate the study of actinide transport, utilizing crushed and solid tuff, under saturated and unsaturated conditions.

#### PUBLICATIONS

I.R. Triay, A.J. Mitchell, and M.A. Ott  
*Radionuclide Migration Studies for Validating Sorption Data—Past, Present, and Future*  
Conference paper, *Proceedings of the Radionuclide Adsorption Workshop*, Los Alamos, NM, 11–12 Sept. 1990  
In internal review.

#### MILESTONE PROGRESS

3025  
9 September 1991  
*Letter Report on Speciation and Transport in Pure Mineral Columns*  
Delayed.

3061  
9 December 1991  
*Letter Report on Techniques to Study Kinetics of Sorption*

3234  
9 December 1991  
*Letter Report on Techniques of Studying Diffusion of Nuclides Through Saturated Tuff*

3236  
9 December 1991  
*Letter Report on Techniques of Studying Diffusion of Nuclides Through Unsaturated Tuff*

#### WBS 1.2.3.4.1.5.1 RETARDATION SENSITIVITY ANALYSIS

The objectives of this task are to construct a geochemical/geophysical model of Yucca Mountain and to use this model to examine the physical and chemical controls on radionuclide transport along flow paths to the accessible environment.

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Analysis of Physical/Chemical Processes

Work continued on modifying FEHMN to include a dual porosity/dual permeability (DPDP) model. This model allows a fracture network to overlay a grid of matrix material. The fractures and matrix in a particular finite-element node can interact. Fracture-fracture interaction as well as matrix-matrix interaction may also occur between adjacent

nodes. This model can be used to better understand the effects of fracture flow on transport. The DPDP model is running and has been checked for some small problems, including liquid phase flow and unsaturated flow.

K. Eggert is working with G. Zyvoloski to complete milestone report 3049, *Update Report on Coupled Phenomena*. The report gives a description of the DPDP model used to calculate flow in unsaturated fractured porous media. It also discusses calculations of flow in a discretely fractured medium that butts-up against a fault zone. This problem was run as part of early site suitability.

E. Nuttall continued working with I. Triay to develop a YMP colloid strategy. As part of this work, they are meeting with USGS to ensure that colloid sampling of Yucca Mountain groundwaters is done over the next few years.

Three-dimensional calculations of colloid transport were run, based on the 3D flow field used for several dissolved species transport calculations run by our team.

#### MILESTONE PROGRESS

3049

27 June 1991

*Update Report on Coupled Phenomena*

Draft in preparation.

3229

30 May 1991

*Report on FEHMNS Calculations*

Delayed.

3121

22 October 1991

*Baseline Documentation of CTCN Code*

Delayed.

3052

2 January 1992

*Baseline Documentation for TRACRN*

Delayed.

#### PROBLEM AREAS

Environment, safety, and health preparations for the upcoming Tiger Team visit are significantly impacting our YMP work.

#### WBS 1.2.3.4.1.5.2

#### DEMONSTRATION OF APPLICABILITY OF LABORATORY DATA

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

## ACTIVITIES AND ACCOMPLISHMENTS

A meeting was held in Las Vegas on 14–15 August with the Test Coordination Office (TCO) to discuss required input for the 91-5 Test Planning Package and the Exploratory Studies Facility Design Requirements documents. The format, content, and review requirements for these documents, which are required to close out pre-Title II design activities for the ESF, were discussed. The documents are being finalized following review and are due to the TCO on 6 September.

A draft of the activity descriptions was completed and is undergoing internal review before submission to YMPO.

## PLANNED ACTIVITIES

Continue to support change requests and to develop study plan.

## PUBLICATIONS

C. Woloshun

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

LA-series report

Submitted to YMPO on 20 August 1991.

## WBS 1.2.5

### REGULATORY AND INSTITUTIONAL

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

## ACTIVITIES AND ACCOMPLISHMENTS

### Study Plans

**Water Movement Test, R3 (8.3.1.2.2.2).** Issued by DOE/HQ as a controlled document; sent to NRC and State of Nevada; revision is in progress.

**Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5).** A revision incorporating DOE/HQ and Project Office comments was submitted on 11 June 1991.

**Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7).** Issued by DOE/HQ as a controlled document, and sent to the NRC on 10 April 1990.

**Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1).** Accepted by the NRC on 4 September 1990. Responses to NRC comments were submitted on 19 August 1991.

**History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2).** A revision incorporating SAIC comments was submitted on 13 June 1991.

**Kinetics and Thermodynamics of Mineral Evolution and Conceptual Model of Mineral Evolution, R0 (8.3.1.3.3.2; 8.3.1.3.3.3).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 14–15 March 1990; revision activity has been deferred.

**Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3).** Comment resolution meeting for DOE/HQ and Project Office comments was held in February 1990; revision is in progress.

**Biological Sorption and Transport, R1 (8.3.1.3.4.2).** Revision, incorporating DOE/HQ and Project Office comments, was submitted to Project Office on 20 May 1991. Additional revised text was submitted to the Project Office on 28 August 1991.

**Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2).** Submitted to Project Office on 17 August 1990.

**Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 28–30 August 1990; revision is in progress.

**Diffusion, R0 (8.3.1.6.2).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 28–30 August 1990.

**Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1).** Revision incorporating DOE/HQ and Project Office comments was submitted on 19 June 1990.

**Effects of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.2).** In preparation.

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

**Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1).** A revision incorporating DOE/HQ and Project Office comments was submitted on 18 June 1991.

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

## **WBS 1.2.6**

### **EXPLORATORY STUDIES FACILITY**

These exploratory studies (ES) will address the issues and information needs associated with the feasibility of storing high-level nuclear waste in a geologic repository at Yucca Mountain.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

Performed independent technical review of the Exploratory Studies Facility (ESF) General Arrangement for the south portal of the ESF.

Resolved comments and verified that north and south portal comments have been adequately addressed.

Completed the third package of Test Planning Package (TPP) 91-5 for the design of the ESF, and started developing final, consolidated TPP 91-5.

Completed and submitted on schedule the updated Preliminary Safety Analysis Report (PSAR) for ESF testing. This submittal in addition to documents prepared by RSN, shall be used to prepare the ESF PSAR for the new General Arrangement.

Work has been initiated to obtain, from test organizations, QA-verified information to prepare consolidated TPP 91-5. Review comments on Tracer, Fluids, and Materials Management Plan were received from Yucca Mountain Site Characterization Project Office (YMPO). Comment resolution is in progress. Internal review comments on Tracer Injection System are being resolved and a revised document was submitted for policy review.

Regularly scheduled ESF design review meetings for Fridays were supported. These meetings have been cancelled because of the replanning of the Yucca Mountain Site Characterization Project (YMP) activities. We continue to support Test Integration Group (TIG) meetings and weekly ESF coordination meetings.

Participated in dry run for the NWTRB meeting. Presented material on Introduction of Foreign Materials into the ESF during ESF construction and site characterization activities.

We also worked with M&O (TRW) in developing the Construction Implementation Plan (CIP) to be presented to Dr. Bartlett. The construction plan takes a phased construction approach. Each subsequent construction step draws from earlier phases of the work.

Replanning of the ESF activities has been initiated to ensure that the resources allocated for FY 1992 and FY 1993 can be effectively deployed.

#### **PLANNED ACTIVITIES**

Resolve review comments and revise the Tracers, Fluids and Materials Control Plan. Initiate update to the ESF Test Support Requirements Document. Develop interfaces for testing and the ESF design. Prepare SCPB changes to the ESDF testing program to incorporate a new ESF configuration. Initiate work to develop new networks for ESF Testing. Participate in the NWTRB meeting.

The following work will continue: to work with M&O in finalizing the CIP, to develop plans for implementation during FY92 and FY93, to update ESF requirements document as needed, to prepare change requests for changes in testing needs to update the ESFDR (Project level document), to prepare test planning packages.

#### **WBS 1.2.6.8.4 INTEGRATED DATA SYSTEM**

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**

Planning for IDS operations continued with emphasis on deliverables, staffing requirements, and schedules.

Planning continued for implementing each test replication. A detailed schedule was developed for three classes of IDS-supported tests: new tests, replicated tests, and tests that will reuse existing IDS equipment. These schedules are being applied to each IDS-supported test replication, and this task should be completed in September. These schedules will show when information is needed for IDS design; indicate a schedule for implementing IDS (to support the test at its

earliest possible implementation, based on ESF construction); and will show integration of PI-directed activities prior to beginning the test.

#### **PLANNED ACTIVITIES**

Continue operations planning and development of test-specific IDS integration schedules.

#### **WBS 1.2.9.1.4**

#### **RECORDS MANAGEMENT**

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

#### **ACTIVITIES AND ACCOMPLISHMENTS**

In August, 46 records were transmitted to the Central Records Facility, and 18 records were rejected by the Records Processing Center.

#### **WBS 1.2.9.3**

#### **QUALITY ASSURANCE**

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.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

##### **Software**

Two software Configuration Control Board (CCB) meetings were held. Over 100 software change requests have been submitted; 27 applications have been approved.

##### **Grading**

Of the 32 Los Alamos grading packages being prepared, 27 are approved, 3 have been withdrawn, and 2 are in YMPO review.

##### **Records/Document Control**

Records personnel are converting all controlled documents to paper with the red "controlled" watermark.

##### **Training**

Training classes were held for Part II of the Environmental Training Program for YMP personnel. Efforts continued to redesign the training program; orientation trainers have been trained, and a video on responses to auditors was made. A pilot orientation class using the new training concepts will be held 5 September.

### Program Development

Revisions to the following quality administrative procedures (QPs) are in draft: QP-4.5 (procurement), QP-16.3 (deficiencies), QP-2.5 (personnel selection), and QP-1.2 (stop work).

S. Bolivar and J. Day attended the PQAC managers meeting at LLNL. J. Rusk is now the DOE QA contact for Los Alamos.

Group EES-13 hosted a visit by J. Bartlett, who spoke at a Laboratory-wide colloquium. In a separate visit, N. Voltura and J. Caldwell, YMPO, introduced the Quality Concerns Program.

### Deficiencies

An amended response for CAR-91-041 was sent to YMPO. Two stop work orders, SWO-05 and -06, were issued to stop work on selected portions of procedures. The stop work orders will be lifted when the procedures are revised.

### Audits

The internal audit of EES-13 was completed. Audit report LANL-AR-91-08 was approved and distributed.

DOE surveillance report YMP-SR-91-022 was issued; there were no findings.

### PLANNED ACTIVITIES

Grading package revisions will continue. The internal audits of Stanford University and LBL will be conducted. DOE will perform a surveillance on criterion 6 in September. Revisions to several QPs will continue.

### PROBLEM AREAS

The proposed QA Requirements Document affects our disposition of CAR-91-041; resolving this corrective action report will require revising several QPs.

We are making a concerted effort to make sure that all QA documentation is done in a timely manner.

M. B. Blanchard, DOE/YMP,  
Las Vegas, NV

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