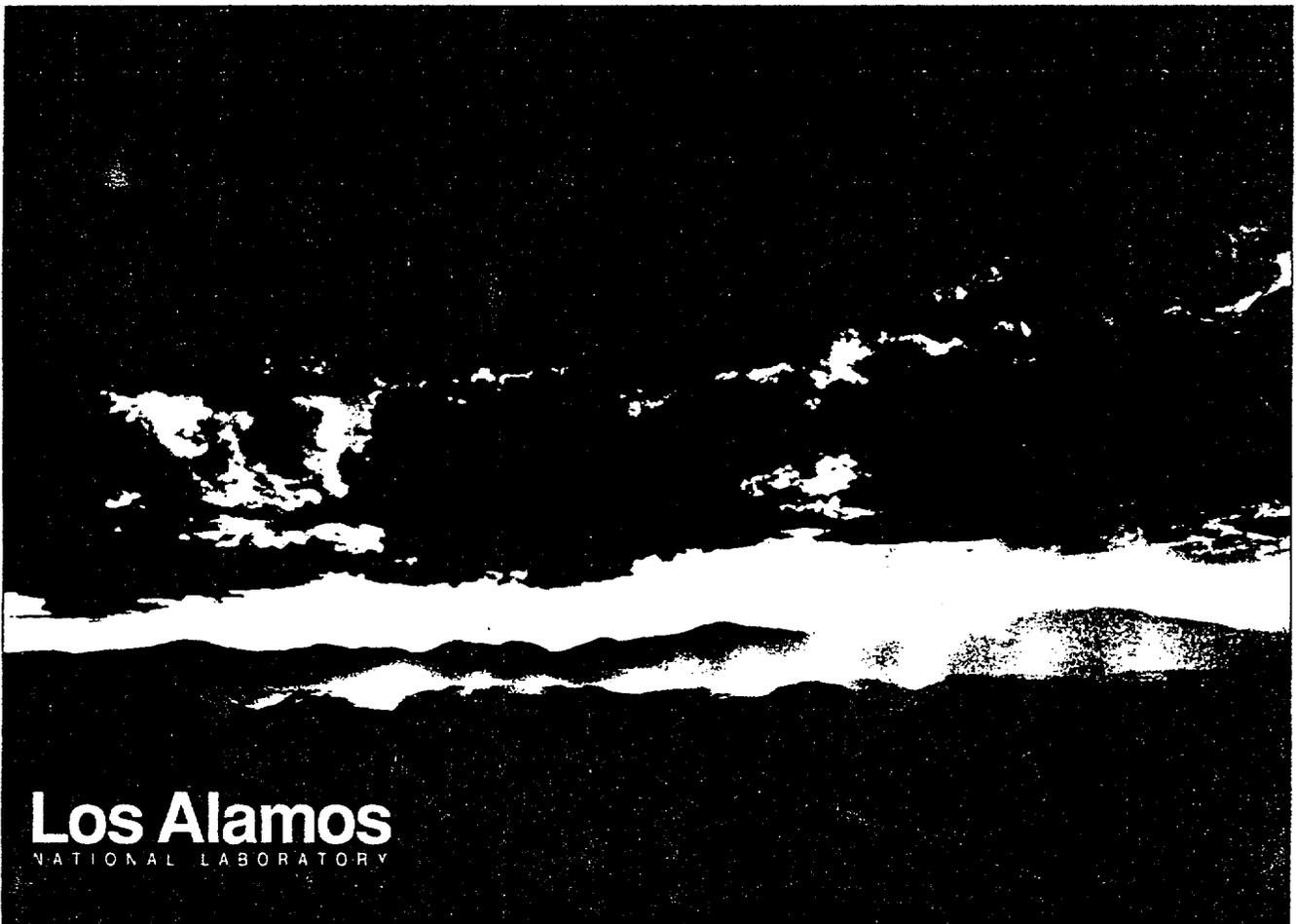


*Approved and letter
dated 12/13/91*

Yucca Mountain Site Characterization Project

Monthly Activity Report

July 1991



Los Alamos
NATIONAL LABORATORY

Photograph by Chris J. Lindberg

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

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ENCLOSURE 1

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

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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 Q1₄ 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 Q1₄ 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 Q1₄ 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 Q1₅ 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 ³He 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
Biominalization of Manganese Within Rock Varnish
Catena Supplement, *Fe/Mn Biominalization: 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.

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}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}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

RS29

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 Pu⁴⁺/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)	2.5×10^{-7} M	35	53	56	
Pu(VI)	2.5×10^{-7} M	26	28	31	
Np(V)	6.5×10^{-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. Zivoloski 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.

July 1991

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).

July 1991

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.

July 1991

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.

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

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