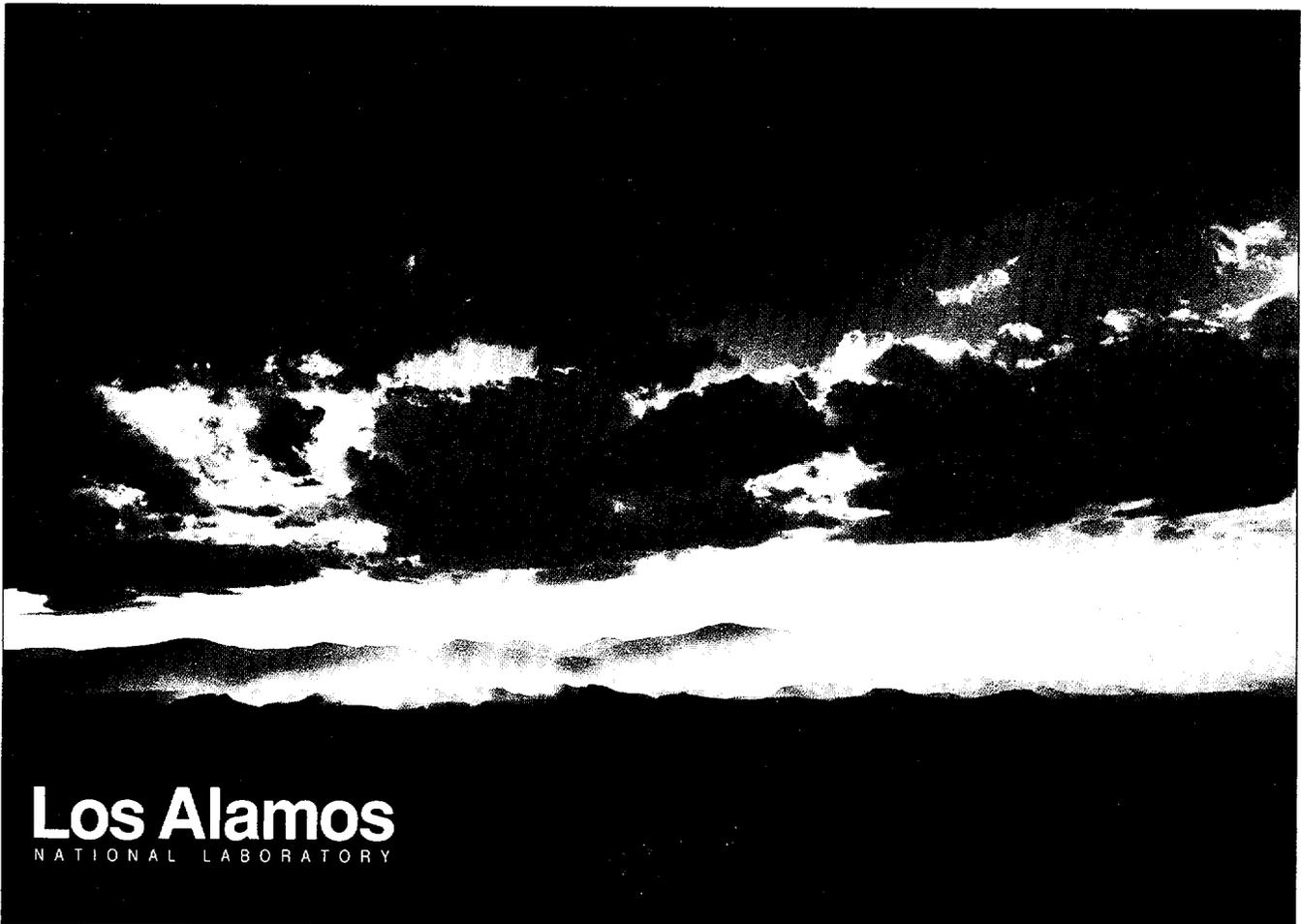


5/21/92

Yucca Mountain Site Characterization Project Monthly Activity Report

March 1992



Los Alamos
NATIONAL LABORATORY

Photograph by Chris J. Lindberg

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<u>Date</u>	<u>Event</u>	<u>Escorts</u>
H. <u>Tours Scheduled</u> (Continued)		
Saturday, September 26	Public Open House (P)	Various Escorts
Saturday, October 17	Public Open House (P)	Various Escorts

IRM:DLH-3394


Carl P. Gertz
Project Manager

CONTENTS

WBS 1.2.1	Systems (Canepa)	1
WBS 1.2.1.3.5	Technical Data (Lopez)	1
WBS 1.2.1.4.6	Caisson Experiment (Springer)	1
WBS 1.2.1.4.7	Performance Assessment Computational Support (Valentine)	2
WBS 1.2.3.1	Site Management and Integration	3
WBS 1.2.3.1.1	Site Management (Canepa)	3
	Surface-Based Test Management and Integration (Oliver)	3
WBS 1.2.3.2.1.1.1	Mineralogy, Petrology, and Rock Chemistry of Transport Pathways (Vaniman)	4
WBS 1.2.3.2.1.1.2	Mineralogic and Geochemical Alteration (Levy)	6
WBS 1.2.3.2.1.2	Stability of Minerals and Gases	8
WBS 1.2.3.2.5	Postclosure Tectonics (Crowe)	9
WBS 1.2.3.3.1.2.2	Water-Movement Tracer Tests (Fabryka-Martin)	12
WBS 1.2.3.3.1.2.5	Diffusion Tests in the ESF (Triay)	13
WBS 1.2.3.3.1.3.1	Site Saturated Zone Ground-Water Flow System (Robinson)	14
WBS 1.2.3.4.1.1	Groundwater Chemistry Model (Ebinger)	16
WBS 1.2.3.4.1.2.1/3	Batch Sorption Studies and Sorption Models (Rogers)	18
WBS 1.2.3.4.1.2.2	Biological Sorption and Transport (Hersman)	20
WBS 1.2.3.4.1.3	Radionuclide Retardation by Precipitation Processes (Morris)	21
WBS 1.2.3.4.1.4	Radionuclide Retardation by Dispersive, Diffusive, and Advective Process (Triay)	24
WBS 1.2.3.4.1.5.1	Retardation Sensitivity Analysis (Eggert)	33
WBS 1.2.3.4.1.5.2	Demonstration of Applicability of Laboratory Data (Springer)	34
WBS 1.2.5	Regulatory and Institutional (Canepa)	35
WBS 1.2.6	Exploratory Studies Facility (Kalia)	37
WBS 1.2.6.8.4	Integrated Data System	38
WBS 1.2.9.1.2.4	Technical Software Management (Cort)	39
WBS 1.2.9.1.4	Records Management (Sanders)	41
WBS 1.2.9.3	Quality Assurance (Bolivar)	42
APPENDIX	44

LOS ALAMOS NATIONAL LABORATORY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report
March 1992

WBS 1.2.1 Systems

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

Technical Data (WBS 1.2.1.3.5)

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

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

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

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

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

Work on parameter screens for the Technical Database.

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

Caisson Experiment (WBS 1.2.1.4.6)

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

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

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

Continued on next page

March 1992

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

Prepare the caisson for filling with sand.

Revise SOP as indicated by reviewers.

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

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

Performance Assessment Computational Support (WBS 1.2.1.4.7)

Activities and Accomplishments No activity to report.

WBS 1.2.3.1 Site Management and Integration

Site Management (WBS 1.2.3.1.1)

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

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

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

Project orientation on site characterization was presented on 13 March.

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

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

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

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

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

Activities and Accomplishments No significant accomplishments this month.

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

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

Continued on next page

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

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

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

WBS 1.2.3.2.1.1.2 Mineralogic and Geochemical Alteration

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

Continued on next page

Publications

G. WoldeGabriel, *et. al.*

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

Conference paper, *Proceedings of the 7th Water-Rock Interactions Symposium*, July 1992

Approved by YMPO.

S. Levy and C. Naeser

Bedrock Breccias Along Fault Zones near Yucca Mountain, Nevada

Chapter in USGS Bulletin on Yucca Mountain studies

In USGS editorial review.

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

Dehydration and Rehydration of a Tuff Vitrophyre

Journal article, *Journal of Geophysical Research*

Interim draft complete.

D. Vaniman, *et. al*

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

Conference paper, *Proceedings of the 7th Water-Rock Interactions Symposium*, July 1992

Approved by YMPO.

March 1992

WBS 1.2.3.2.1.2 Stability of Minerals and Gases

Objective

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

**Activities and
Accomplishments**

This activity has been deferred.

WBS 1.2.3.2.5 Postclosure Tectonics

Objective	The objective of these volcanism studies is to determine the hazards of future volcanic activities with respect to siting a high-level radioactive waste repository at Yucca Mountain.
Activities and Accomplishments	<p>A comment by Wells, Crowe, and McFadden on the paper by Turrin <i>et.al.</i>, "⁴⁰Ar/³⁹Ar Age of the Lathrop Wells Volcanic Center, Yucca Mountain, Nevada," has been accepted by <i>Science</i> for publication. The comment summarizes alternative interpretations of the radiometric ages for the Lathrop Wells Center.</p> <p>An additional phase of trenching was completed at the Lathrop Wells Volcanic Center and the "A" cone of the Cima Volcanic Center. Five trenches were dug in the pyroclastic surge unit, northwest of the Lathrop Wells cone. The exposures were described for soil, petrology, and tephra studies, and samples were collected. A fourth trench was excavated in eolian and tephra deposits above the buried lava flow, north of the main cone; this section was also described for soil studies, and samples were collected. Four soil pits were excavated in the tephra-fall sheet, directly west of the main cone; these pits were sampled for petrology studies, but there was insufficient time to describe the soils and tephra sections. The pits will be re-excavated and described in the next trenching phase. A total of 29 soil pits have been excavated at the Lathrop Wells Volcanic Center.</p> <p>A poster session that summarized the progress of volcanism studies for the Yucca Mountain Site Characterization Project was presented at the Waste Management '92 Conference in Tucson, Arizona in March.</p> <p>Paleomagnetic data have been obtained and analyzed for the QI₅, QI₆, and buried lava flow at the Lathrop Wells Volcanic Center.</p> <p>An internal audit of the volcanism program began; it will completed during the first week of April.</p> <p>Five samples were collected from surface clinker for the QI₅ lava flow south of the main cone. They will be used for ³He cosmogenic dating of the lava flow. A sample was also collected for dating using the U-Th disequilibrium method.</p> <p>Geologic mapping and sampling for petrological studies continued for the 3.7 Ma centers in Crater Flat. We found that the geometry of the major vent zones for these units are different from the younger basalt centers: the vents are elongate (north-south) along fissures marked by accumulations of vent scoria and local sites of lava that was ponded in vent craters. Extrusive lava flows from these centers are of aa type and have sheet-like distributions. The flows tend to be relatively thin (3-5 meters). These flow features are consistent with higher magma effusion rates when compared with the flow features of the younger basalt centers.</p> <p>Isotope-dilution data were examined for Rb and Nd for units of the Lathrop Wells volcanic center. The data strongly support the theory that the individual units were formed by different degrees of partial melting and represent temporally and spatially distinct magmas, which is consistent with a polycyclic classification of the center. We have begun to model geochemical constraints of melt processes to evaluate the geochemical variations. We are comparing the Lathrop Wells geochemical data set with geochemical data from established monogenetic volcanic centers.</p>

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

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

Planned Activities

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

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

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

Milestone Progress

3174

8 January 1992

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

3071

September 1992, expected completion April 1992

Status of Geochronology Studies at the Lathrop Wells Volcanic Center

3129

10 July 1992, expected completion April 1992

Geochemistry of Lathrop Wells Eruptive Sequences

3034

30 September 1992

Report on Magma System Dynamics

3035

30 September 1992, expected completion April 1992

Effects of Strombolian Eruption

3109

30 September 1992

Report of Subsurface Effects

Continued on next page

3111
30 September 1992
Preliminary Geologic Mapping of Volcanic Centers

3164
30 September 1992
Progress Report on Thermoluminescence

Publications

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

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

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

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

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

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

March 1992

WBS 1.2.3.3.1.2.2 Water-Movement Tracer Tests

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

WBS 1.2.3.3.1.2.5 Diffusion Tests in the ESF

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

Activities and Accomplishments No significant activity in this study.

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

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

Objective	Experiments will be conducted at the C-Well complex (holes UE25 C#1, UE25 C#2, and UE25 C#3) and other wells in the vicinity of Yucca Mountain using reactive tracers to characterize retardation and transport properties at a larger scale than currently used in laboratory experiments.
Activities and Accomplishments	<p>Software Certification. The requirements and design phases of the SORBEQ application have been completed, and the final review of the implementation phase will take place when software that SORBEQ accesses is certified.</p> <p>The requirements review of the FEHMN application was completed, and the review comments are being addressed.</p> <p>The final iteration of the review of the cdftools application (tools for using the netCDF software more easily) is in process.</p> <p>Work continued on the GZSOLVE and genplot (general-purpose plotting routine using DISSPLA graphics software) applications; however, no new baselines have been completed.</p> <p>Lithium Bromide Studies. Error statistics have been compiled for the analyses of all dissolved species being measured by ion chromatography. A significant amount of adjustment was required to bring the errors down to acceptable levels as specified by the ion chromatography DP.</p>
Planned Activities	<p>Continue the effort to bring the computer codes FRACNET, FEHMN, GZSOLVE, and SORBEQ and other software into compliance with the SQAP. This consists of compiling existing documentation on these codes and writing new material required by the SQAP where necessary.</p> <p>Begin batch sorption experiments using lithium bromide.</p> <p>Continue developing techniques for measuring the concentration of polystyrene microspheres in solution.</p>
Problem Areas	None
Publications	<p>W. L. Polzer, W. L., M. G. Rao, H. R. Fuentes, and R. J. Beckman <i>Thermodynamically Derived Relationships Between the Modified Langmuir Isotherm and Experimental Parameters</i> Journal article, <i>Environmental Science and Technology</i> Undergoing revision.</p> <p>B. A. Robinson <i>FRACNET-Fracture Network Model for Water Flow and Solute Transport</i> LA-series report In preparation.</p>

Continued on next page

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

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

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

Milestone Progress

3188
16 January 1992
Documentation for SORBEQ

3194
1 April 1992
Batch Sorption Experiments with Lithium

T112
22 June 1992
Final Documentation for FEHMN

3196
27 July 1992
FRACNET Documentation

WBS 1.2.3.4.1.1 Groundwater Chemistry Model

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

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

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

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

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

Planned Activities Track Study Plan 8.3.1.3.1.1 during YMPO review.

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

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

Problem Areas None

Milestones Progress 3006
31 May 1992
Eh and pH Buffering Capacity

3415
30 September 1992
Letter Report: *Most Active Groundwater Chemistry*

Continued on next page

Publications

M. Ebinger

Water-Rock Interactions and the pH Stability of Ground waters from Yucca Mountain, Nevada

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

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

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

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

WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 Batch Sorption Studies and Sorption Models

Objective	The objective of this task is to provide sorption coefficients for elements of interest to predict radionuclide movements from the repository to the accessible environment.
Activities and Accomplishments	<p>P. Rogers replaced A. Meijer as principal investigator for the sorption task. Appropriate QA paperwork, equipment transfers, and responsibility transfer for laboratory space have been completed.</p> <p>P. Rogers and I. Triay participated in the technical audit of the sorption task held 17 March.</p> <p>An important priority of the new PI will be to improve communication and integration between the sorption and dynamic transfer tasks. To this end, an extensive series of experiments to measure the batch sorption coefficients of neptunium under varying conditions was planned jointly with I. Triay of WBS 1.2.3.4.1.4. These experiments will begin when the new sorption staff member, K. Kung, begins work in June. K. Birdsell has also begun a series of calculations to test the applicability of the minimum K_d approach under various flow scenarios. Improved interaction with this task will provide valuable information on the validity of this approach for broad classes of radionuclides.</p> <p>Over 80 x-ray diffraction (XRD) quantitative analyses, for samples used in experiments to determine the effect of particle size on sorption, were received from D. Bish and S. Chipera. The analyses provide important information for interpreting the results of those experiments because the analyses show that significant compositional changes were caused by the extensive grinding and washing of the samples, which must be corrected before final data interpretation. The precise content of hematite in these samples is important for comparing the results of neptunium batch sorption with column experiments carried out by the dynamic transport task. D. Bish has agreed to try to improve the precision of hematite analysis in two samples that currently are yielding results of 1 +/- 1% hematite.</p> <p>Research at the atomic-force microscope (AFM) has been redirected to emphasize experiments that are technologically feasible at this time. Previous work targeted obtaining atomic-resolution AFM scans of hematite; however, researchers from Stanford, Berkeley, and Switzerland have indicated that they have not been successful in obtaining atomic-resolution scans of hematite, presumably because of the strong electrostatic field due to Fe(III). These researchers also report problems similar to those we have encountered in preparing smooth surfaces on hematite and have suggested one promising alternative method for surface preparation, which we will try. We are currently looking into significant alterations of the experimental conditions under which we could scan hematite samples to determine if improved resolution is possible as obtaining high-resolution scans of hematite is a prerequisite to studying sorption behavior of this mineral.</p>
Milestone Progress	<p>3009 20 February 1992 <i>Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff</i></p> <p>3212 30 September 1992 <i>Progress Report on Single Mineral Experiments</i></p>

Continued on next page

Publications

A. Meijer

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

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

In preparation.

WBS 1.2.3.4.1.2.2 Biological Sorption and Transport

Objective	The purpose of this research is to determine whether microbial activity can influence the movement of plutonium in tuff. Because fluids are used extensively in the exploration of locations for a nuclear repository, those micro-organisms capable of utilizing drilling fluids as growth substrates are of special interest.
Activities and Accomplishments	<p>Work continued on the characterization of the siderophore(s) produced by micro-organism 11c. Specifically, a bioassay of the siderophore, using ethylenediamine di(o-hydroxyphenyl) acetic acid (EDDA) is being performed.</p> <p>A review of the chelation chemistry of mineral dissolution literature was completed.</p> <p>Work continued on writing Milestones 3080, Report on Chelation, and 3092, Report on Colloidal Agglomeration.</p>
Planned Activities	<p>Continue plutonium K_d experiments.</p> <p>Continue colloidal agglomeration experiments.</p>
Problem Areas	None
Milestone Progress	<p>3080 30 September 1992 <i>Report on Chelation</i> In preparation.</p> <p>3092 30 September 1992 <i>Report on Colloidal Agglomeration</i> In preparation.</p> <p>3176 30 September 1992 <i>Procedure for Determination of Formation Constants</i> In progress.</p> <p>3177 30 September 1992 <i>Procedure for Determination of Effects on Colloidal Agglomeration</i> In preparation.</p>
Publications	<p>L. R. Hersman, D. E. Hobart, and T. W. Newton <i>Preliminary Evidence of Siderophore/Plutonium Complexation</i> Journal article, <i>Journal of Applied and Environmental Microbiology</i> Resubmitted.</p>

WBS 1.2.3.4.1.3 Radionuclide Retardation by Precipitation Processes

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

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

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

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

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

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

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

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

Continued on next page

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

Solubility Studies. The solubility determinations for Np, Pu, and Am in UE-25p#1 water continue. The Np undersaturation experiment at pH 8.5 was started during the past reporting period. Exactly 24 hours before stopping the oversaturation experiment, a fresh sample of UE-25 water at 60°C was saturated with a CO₂/Ar mixture, and the sample from the oversaturation experiment was centrifuged to isolate the Np solids. Small portions of the solids were retained for structural analysis, and the remaining portion was taken up in the CO₂-saturated solution. Samples from this experiment have now been taken at intervals of 3 hours, 1 day, and 6 days. Similar undersaturation experiments for Np at pH 6 and 7 will begin this month.

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

Planned Activities

Efforts in all above mentioned areas will continue.

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

Problem Areas

None

Milestone Progress

3031

30 September 1992

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

On schedule.

3329

30 September 1992

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

On schedule.

3330

Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy

Early completion anticipated.

Letter Report

Spectroscopic Studies of the Hydrolysis of UCl₄, Spectral Effects of Ligand Exchange

In preparation.

Continued on next page

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

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

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

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

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

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

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

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

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

D. E. Morris and D. L. Clark
Spectroscopic Studies of the Hydrolysis of UCl_4 , Spectral Effects of Ligand Exchange
 LA-series report.
 In preparation.

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

Objective

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

Activities and Accomplishments

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

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

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

I. Triay participated in a technical data workshop.

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

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

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

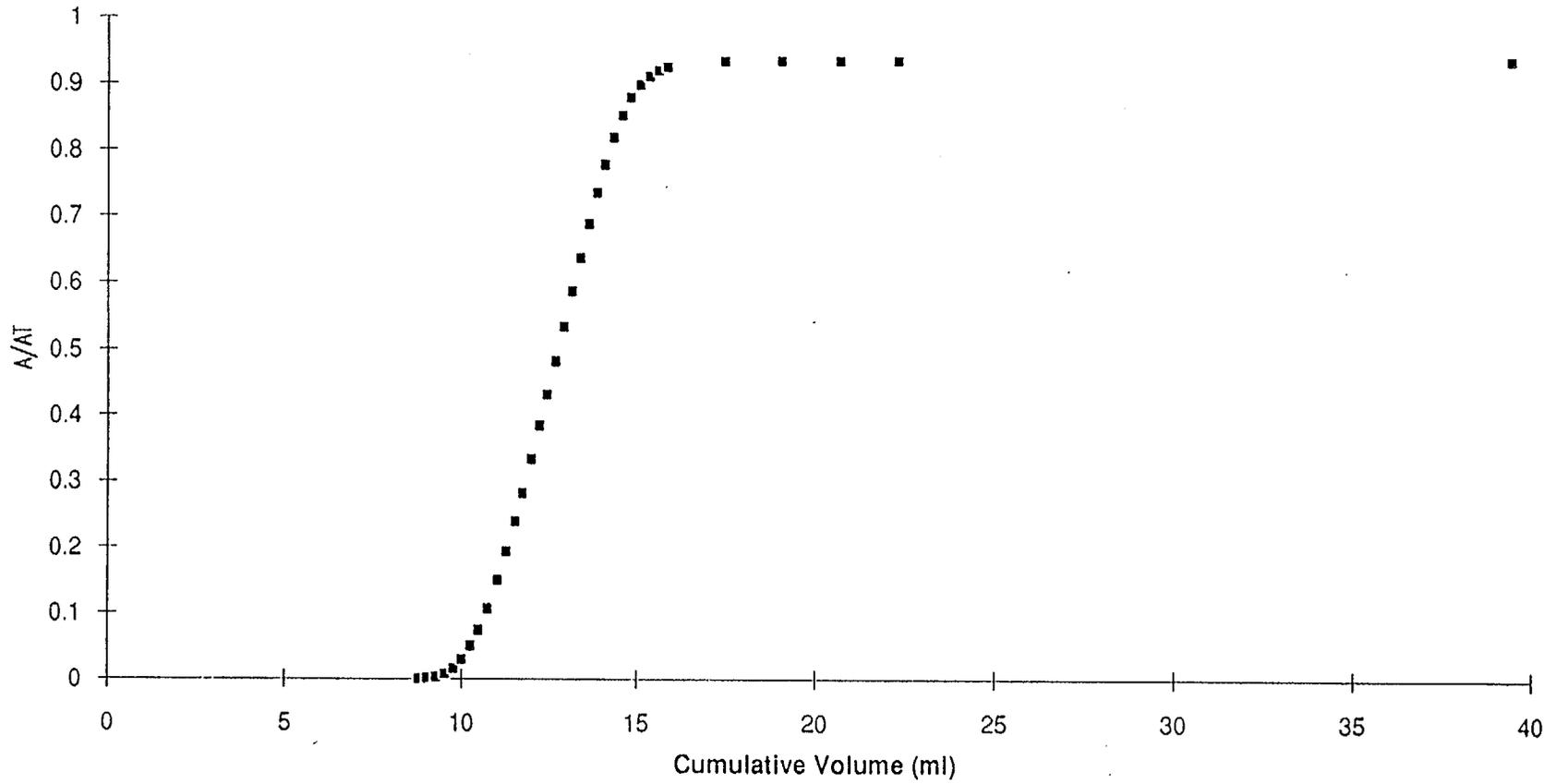
Table 1

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

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

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Fig. 1 HTO elution through G4-1530.3A



Preliminary Data—Do Not Reference

Fig. 2 HTO elution through G4-1530.3B

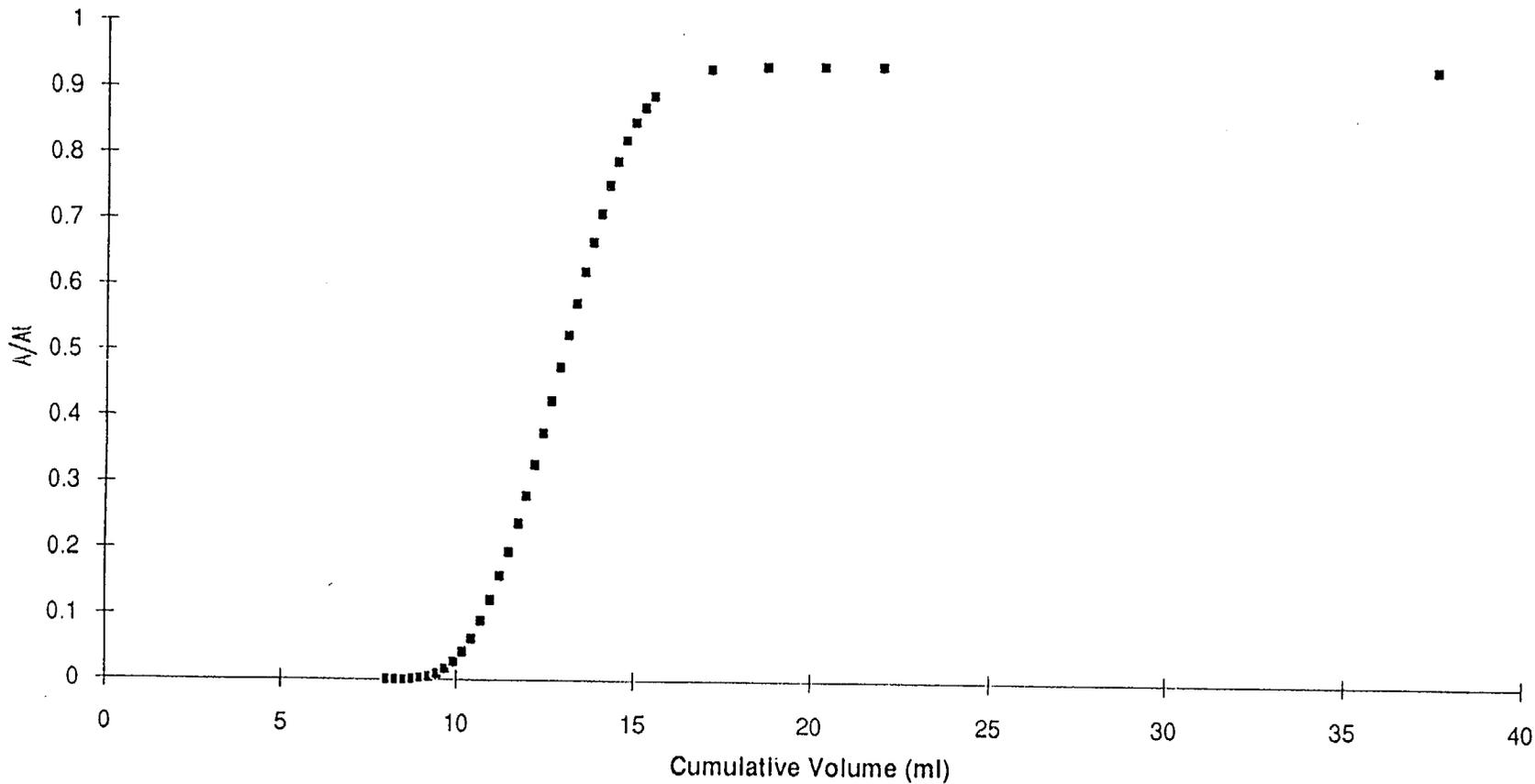
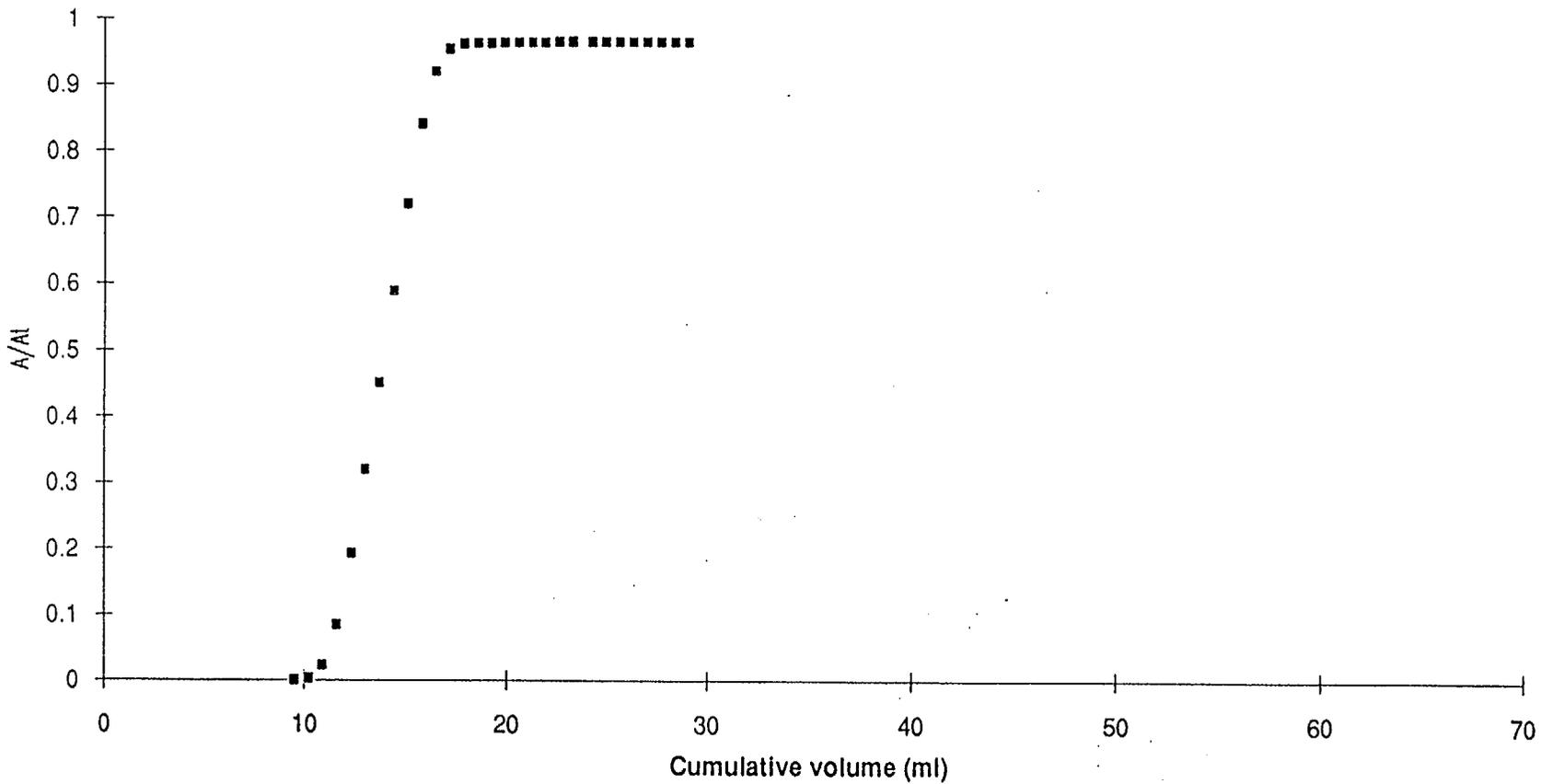
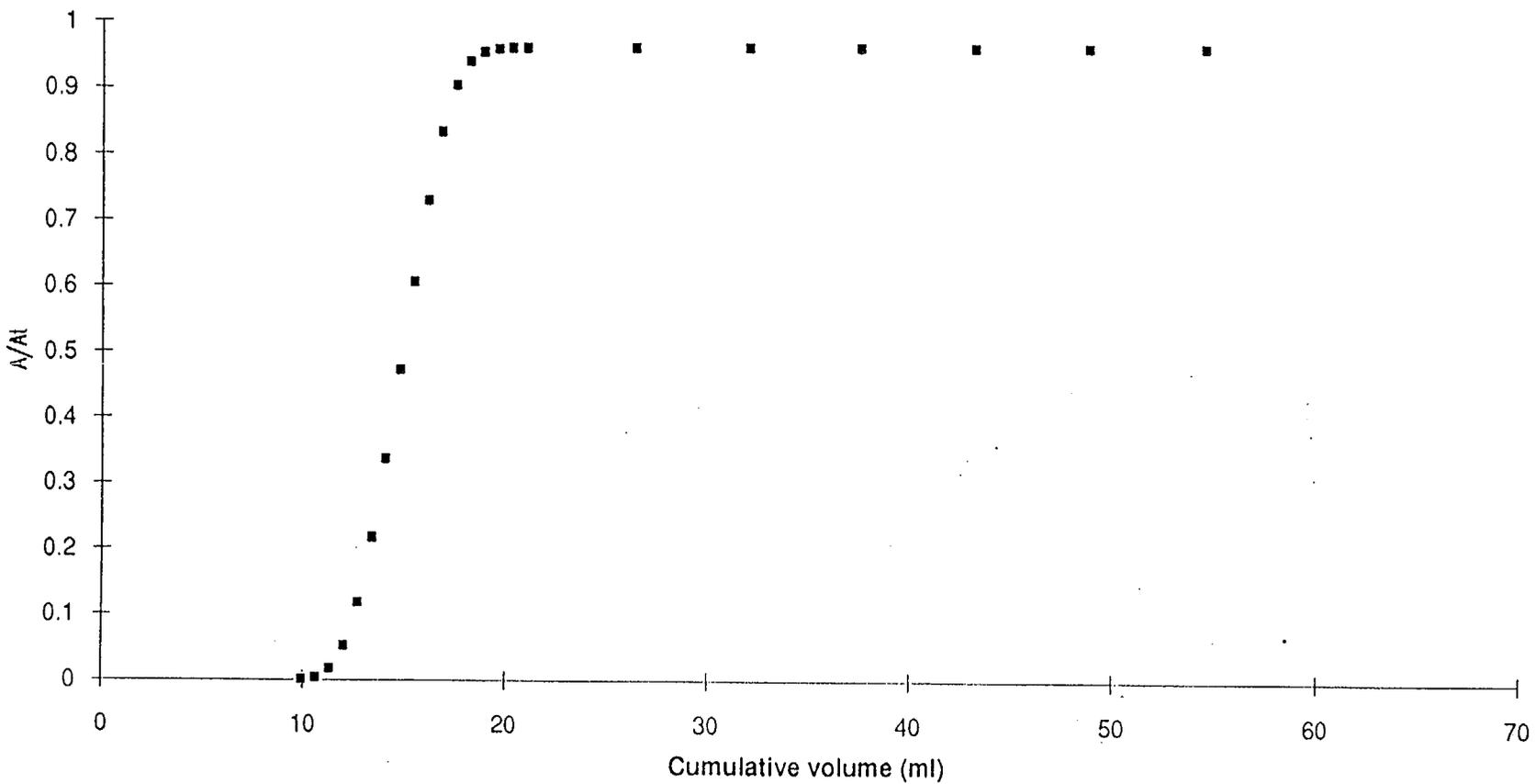


Fig. 3 HTO elution through G4-1530.3C



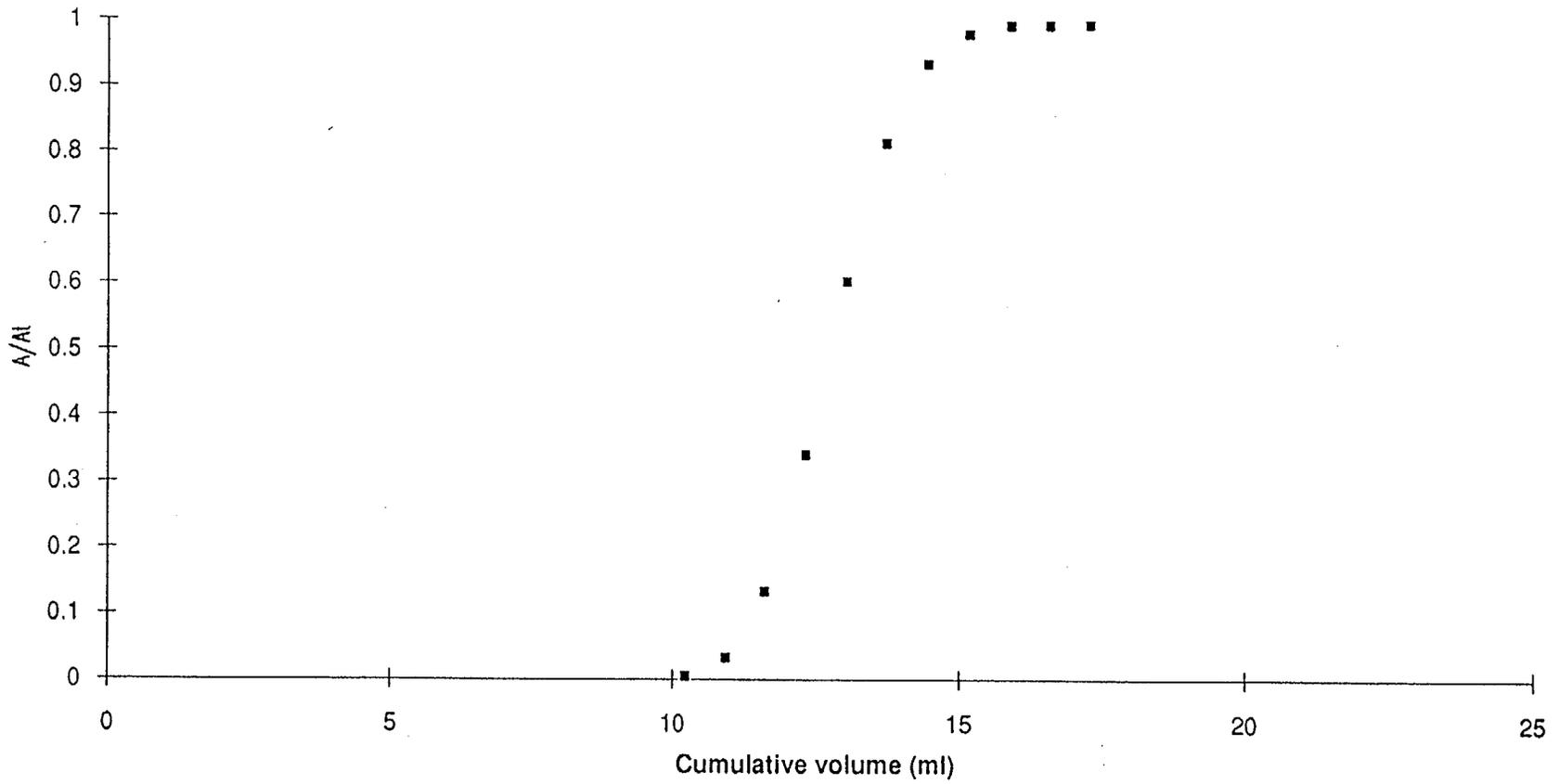
Preliminary Data—Do Not Reference

Fig. 4 HTO elution through G4-1530.3E



Preliminary Data—Do Not Reference

Fig. 5 HTO elution through G4-1530.3F



Preliminary Data—Do Not Reference

Fig. 6 HTO elution through G4-275A

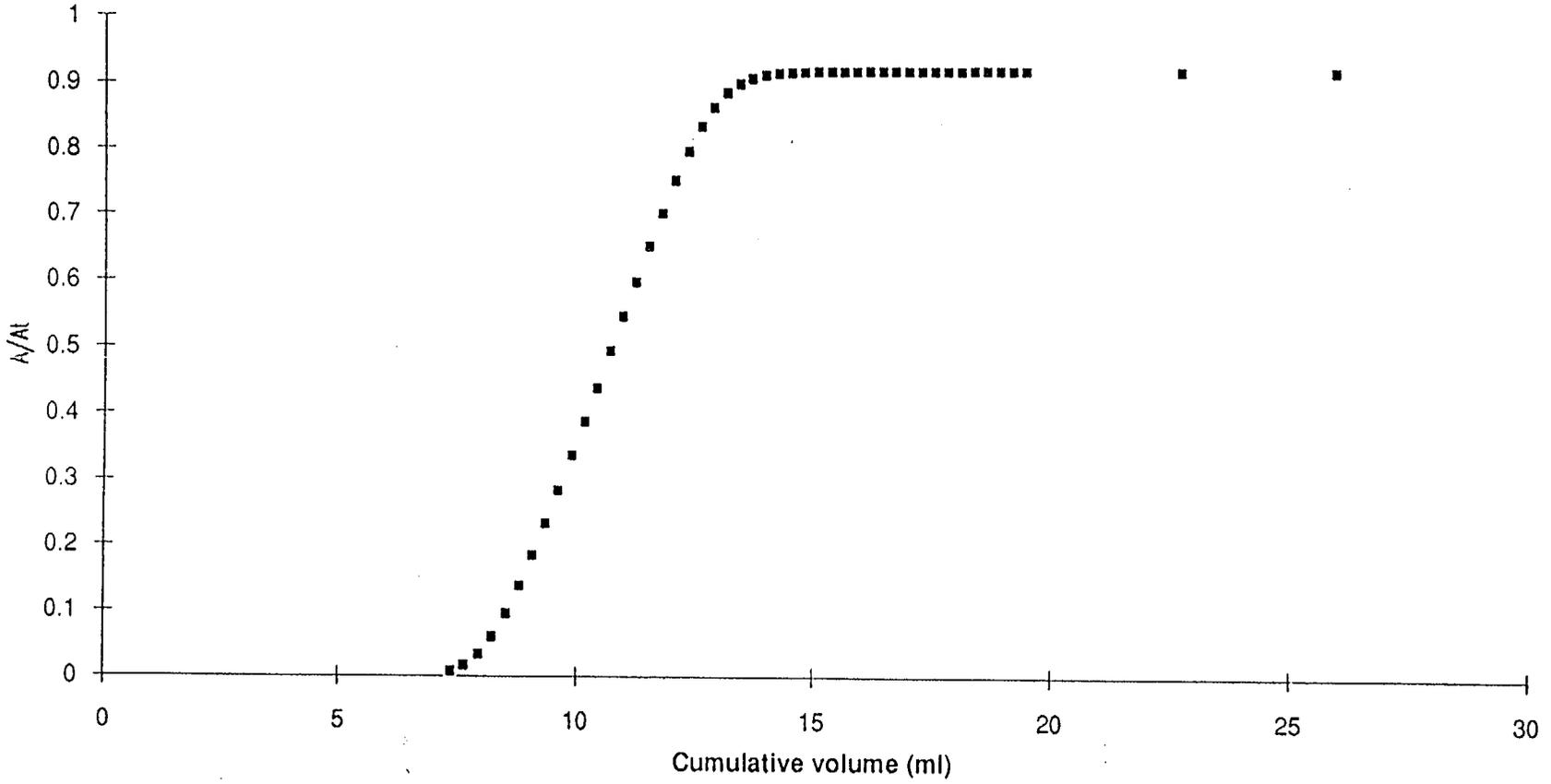
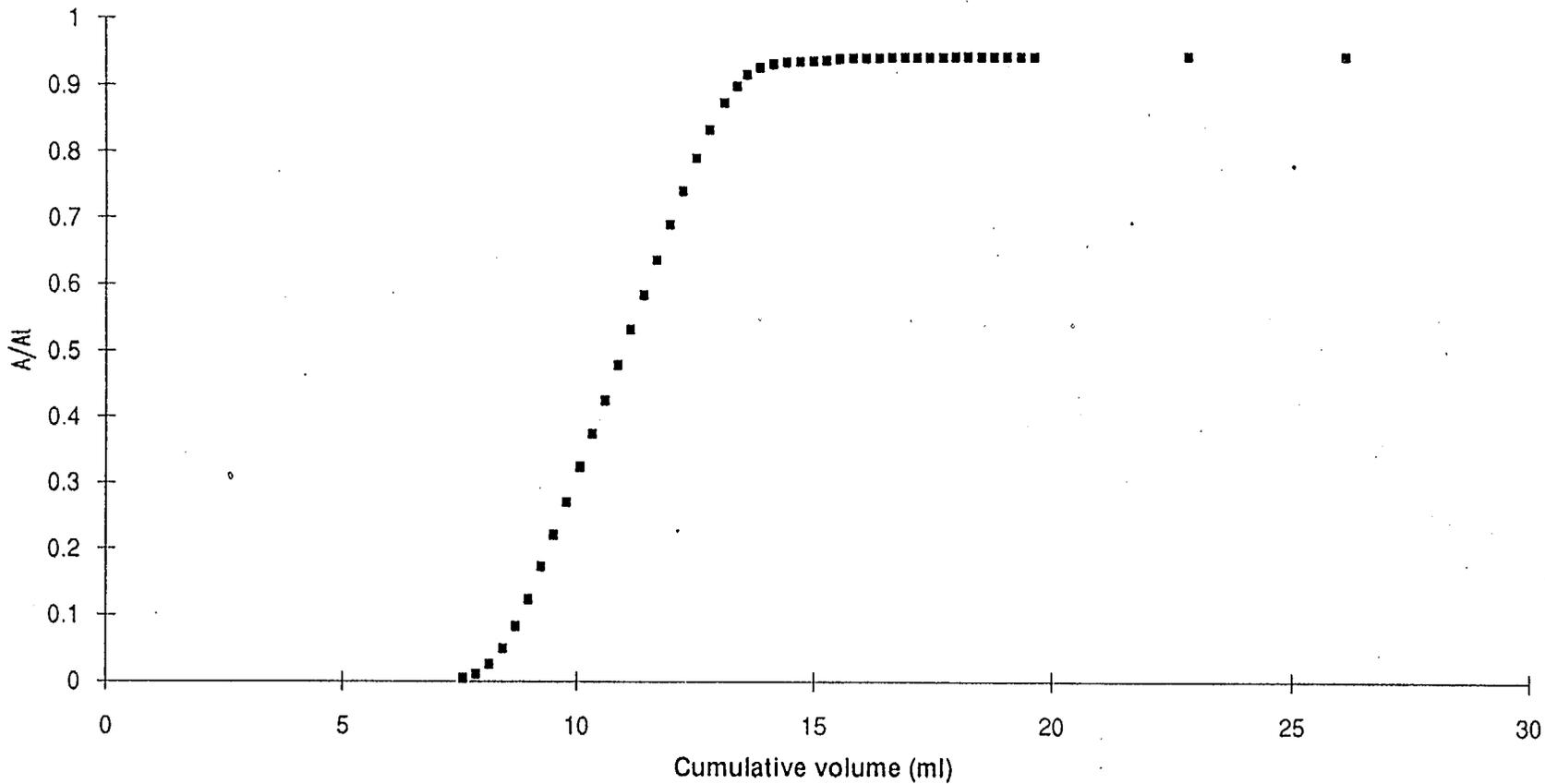


Fig. 7 HTO elution through G4-275B



Preliminary Data—Do Not Reference

March 1992

Planned Activities

Continue work described above.

Milestone Progress

3040

30 September 1992

Kinetics of Sorption on Columns of Pure Minerals

3044

31 August 1992

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

In preparation.

3027

31 March 1992

Report on Sorption by Batch and Column Techniques

Publications

I. R. Triay

Radionuclide Migration in Tuff under Diffusive Conditions

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

In preparation.

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

Radionuclide Migration Studies for Validating Sorption Data—Past, Present, and Future
Conference paper, *Proceedings of the DOE/Yucca Mountain Site Characterization Project Radionuclide Adsorption Workshop* at Los Alamos National Laboratory September 11-12, 1990.

Submitted to YMPO.

WBS 1.2.3.4.1.5.1 Retardation Sensitivity Analysis

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

WBS 1.2.3.4.1.5.2 Demonstration of Applicability of Laboratory Data

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

Continued on next page

WBS 1.2.5 Regulatory and Institutional

- Objective** The purpose of this task is to coordinate the regulatory and institutional Project requirements within the Los Alamos programmatic structure. The focus of this coordination effort is on the integration of the technical work within the regulatory and institutional framework.
- Management and Integration** Significant effort was made to put forth changes to the SCP Baseline. In particular, the rock-varnish work to support volcanism, erosion, and neotectonic studies was identified discretely. PACs changes were initiated. Work began to evaluate rock-varnish data in support of the erosion issue resolution.
- Study Plans**
- Water Movement Test, R1 (8.3.1.2.2.2).** R1 has been approved by DOE but not by NRC. A revision incorporating NRC and State of Nevada comments was submitted to the YMPO on 17 October 1991.
- Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5).** A revision incorporating DOE/HQ and Project Office comments was submitted to Dr. Dobson in June 1991.
- Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7).** In February 1990 DOE//HQ issued this study plan as a controlled document; it was then sent to the NRC for comments. In January 1992 we were requested by DOE to revise NRC comments. The revision is in progress.
- Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1).** In March 1991 this study plan was submitted to the project office for review .
- Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1).** In August 1990 the NRC approved the study plan. In October 1991 we were asked to revise the study plan; in January 1992 we submitted revised comments to T. Bjerstedt.
- History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2).** The Project Office approved the study plan in December 1991 and submitted it to the NRC in January 1992 for comments.
- Natural Analogue Hydrothermal System in Tuff (8.3.1.3.3.1).** This is an out-year activity.
- Kinetics and Thermodynamics of Mineral Evolution and Conceptual Model of Mineral Evolution, R0 (8.3.1.3.3.2; 8.3.1.3.3.3).** A comment resolution meeting for DOE/HQ and Project Office comments was held in March 1990; revision on this activity has been deferred because funds have not been allocated.

Continued on next page

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

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

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

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

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

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

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

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

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

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

WBS 1.2.6 Exploratory Studies Facility

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

March 1992

WBS 1.2.6.8.4 Integrated Data System

Objective

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

Activities and Accomplishments

This activity has been deferred.

WBS 1.2.9.1.2.4 Technical Software Management

Objective

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

Activities and Accomplishments

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

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

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

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

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

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

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

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

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

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

Continued on next page

March 1992

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

Planned Activities

Configuration Management:

- Continued management of submitted baselines and change requests.

Software Engineering:

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

Problem Areas

None

WBS 1.2.9.1.4 Records Management

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

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

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

WBS 1.2.9.3 Quality Assurance

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

Continued on next page

Publications

S. L. Bolivar

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

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

In internal review.

APPENDIX

ATTACHMENTS AND LEVEL III MILESTONE REPORTS



Lawrence Berkeley Laboratory

1 Cyclotron Road Berkeley, California 94720

(415) 486-4000 • FTS 451-4000

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

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

March 3, 1992

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

RE: Letter Report for February 1992

Dear Dave:

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

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

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

Figure 3 shows that the Am/Nd solubility experiments require much more work. The low americium solubility in UE25p#1 at 60° C leads to assays with very low count rates. Neptunium and plutonium samples usually have enough activity that results can be obtained with relatively short counting times. The rather irregular approach-to-equilibrium plots for the americium experiments are probably caused by the relative concentration inaccuracy due to too short counting times and the non-consideration of the low-level counter background. To avoid extra long counting times for the gamma pulse height analysis of each sample, we tried to use alpha liquid scintillation counting because of its high efficiency. We found, however, that this method will not work for the following reason: Am/Nd has a very low solubility in UE25p#1, while ^{237}Np , the daughter of ^{241}Am , has a rather high solubility relative to Am/Nd. Even though the daughter impurity is very small in the initial stock solution, we have enriched the Am/Nd/UE25p#1 solution with ^{237}Np to a significant degree with regard to gross alpha activity. Liquid scintillation counting does not have the resolution to distinguish between these alphas, and is, therefore, unsuitable for this situation. We must now perform low-level gamma pulse height analysis of all Am/Nd samples, which necessitates the use of very long counting times as well as periodic background counts.

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

Dr. David E. Hobart

Page 3

3/3/92

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

If you have any questions, please call me.

Best regards,



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

cc: Dr. David E. Morris

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

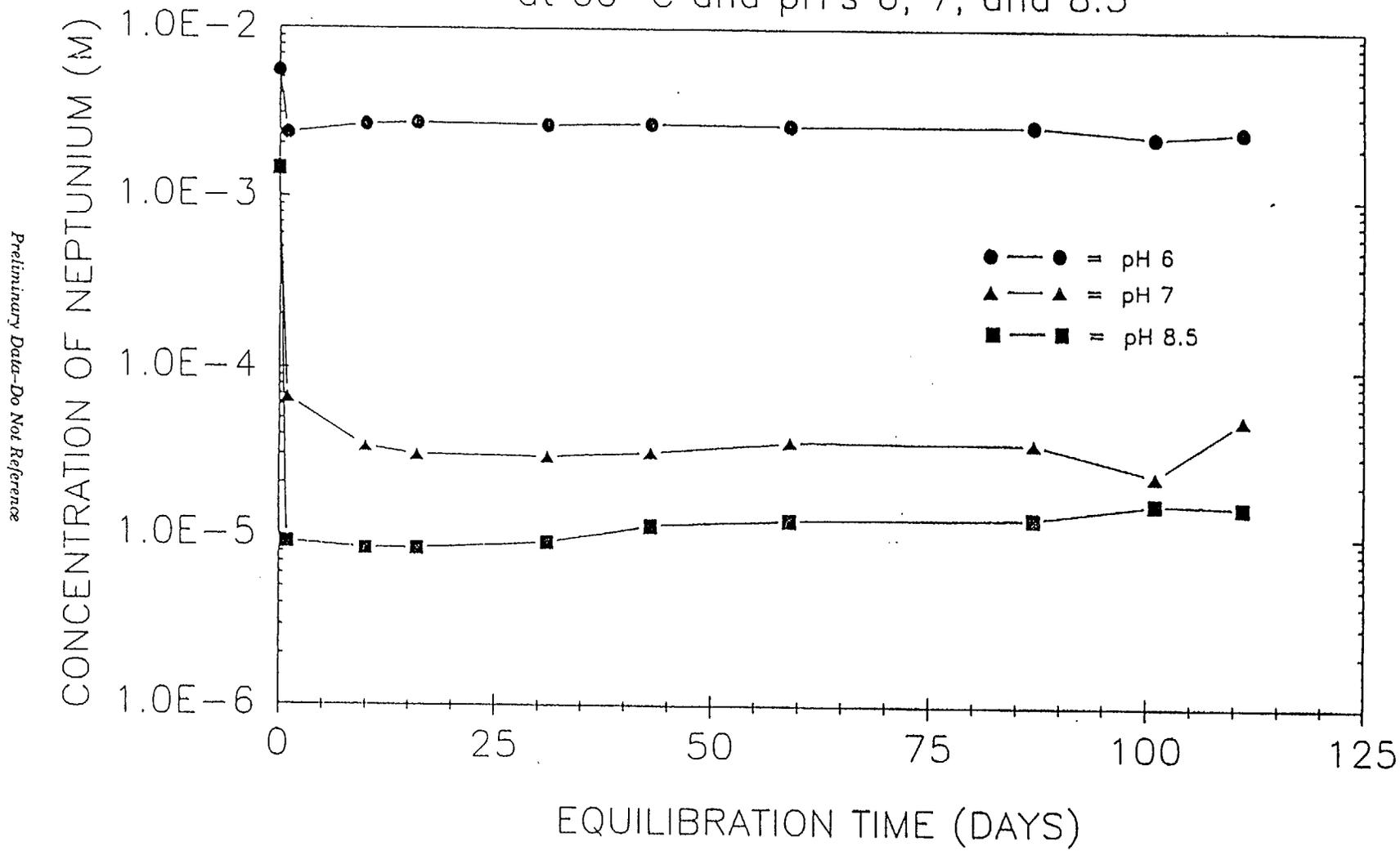


Figure 1

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

Preliminary Data-Do Not Reference

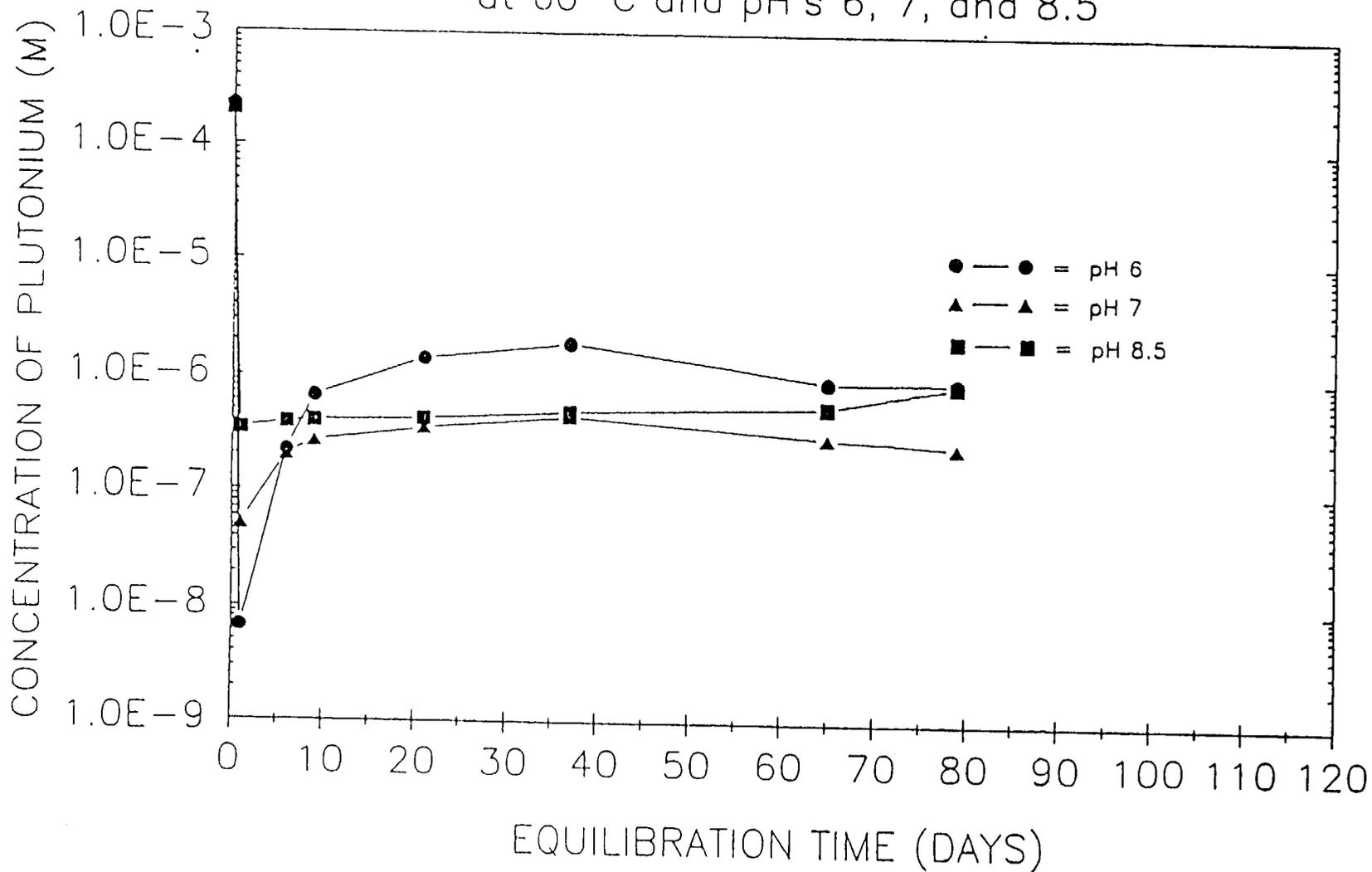
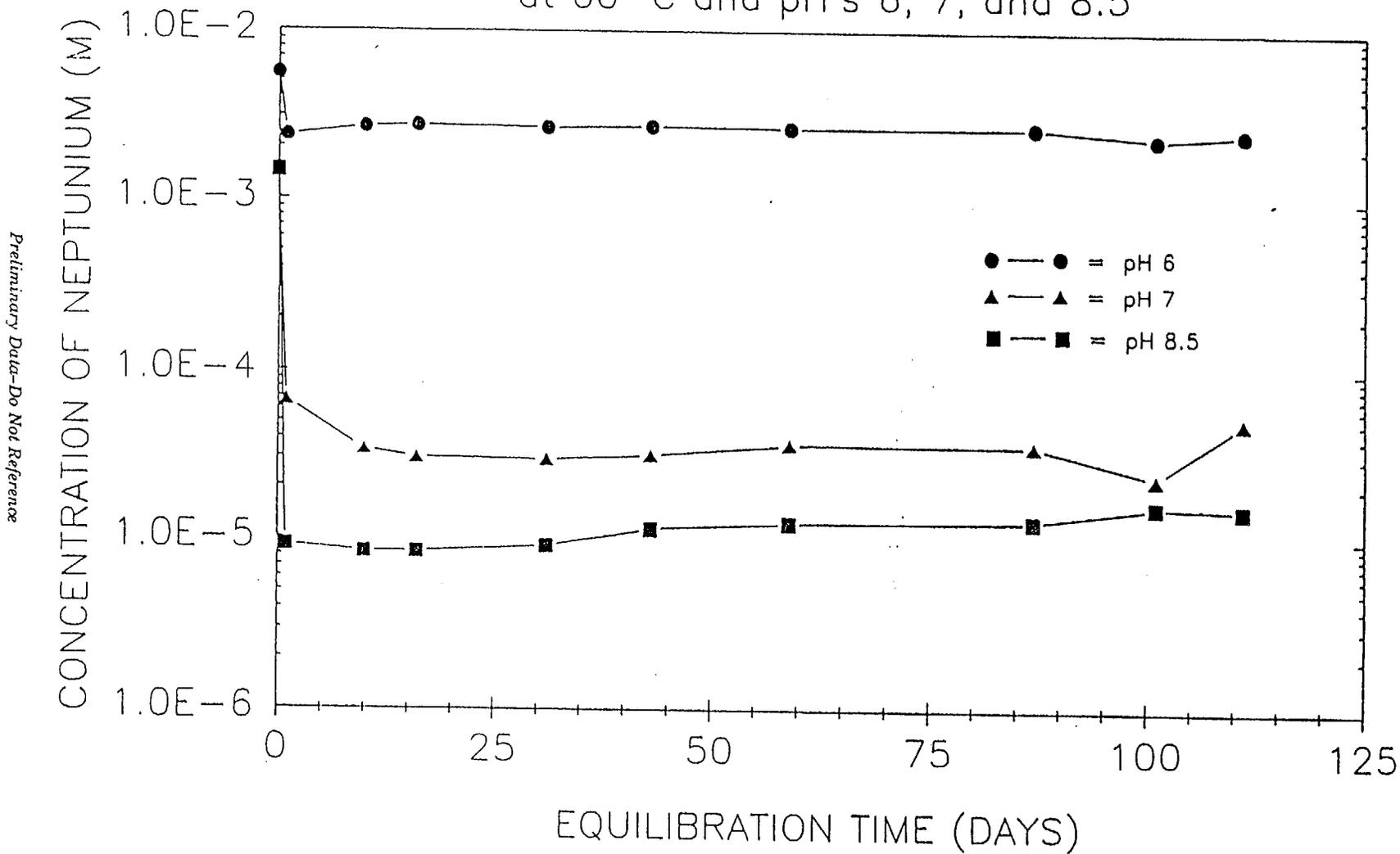


Figure 2

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



NPAEQE6.GRA
24 FEBRUARY 1992

Figure 3

P. T. Prestholt, NRC, Las Vegas, NV

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

Los Alamos National Laboratory, an affirmative action/equal opportunity employer,
is operated by the University of California under contract W-7405-ENG-36 for the U.S. Department of Energy.



Reynolds Electrical & Engineering Co., Inc.

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

IN REPLY REFER TO:
580-01-400

May 14, 1992

WBS 1.2.9.1
QA: N/A

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

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP) STATUS REPORT

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

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

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

RFP:SLH:mab

Enclosure
Status Report (3 pages)

cy: See page 2

REECO

AN  **E&G** COMPANY



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

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)

APRIL 1992 - STATUS REPORT

SITE (1.2.3)

WBS 1.2.3.5

Task: LM-300 Drill Rig and Pipe Handling System

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

Task: Capital Equipment to Support Drilling Programs

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

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

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

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

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

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

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

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

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

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

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

Limited activity. Moved shoring for geologists.

EXPLORATORY STUDIES (1.2.6)

WBS 1.2.6.1

Task: Exploratory Studies Facility (ESF)

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

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

FIELD OPERATIONS (1.2.7.4)

Task: Administrative & Maintenance Support

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

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

PROJECT MANAGEMENT (1.2.9)

WBS 1.2.9.1

Task: Management and Administrative Support

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

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

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

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

Task: Site Characterization Plan (SCP) Distribution

Distributed five SCP sets during this period.

Task: Hazardous Materials Coordination

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

Task: Long Range Planning (LRP)

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

WBS 1.2.9.3

Task: Quality Assurance (QA)

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

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

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

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

General

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



Lawrence Livermore National Laboratory

LLYMP92050032
May 11, 1992

WBS 1.2.9
"QA: N/A"

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

SUBJECT: Yucca Mountain Project Status Report - April 1992

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

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

Sincerely,

W. L. Clarke
LLNL Technical Project Officer
for YMP

WC/EC

cc:
Distribution

DISCLAIMER

The LLNL Yucca Mountain Project cautions that any information is preliminary and subject to change as further analyses are performed or as an enlarged and perhaps more representative data base is accumulated. These data and interpretations should be used accordingly.

LAWRENCE LIVERMORE NATIONAL LABORATORY YUCCA MOUNTAIN PROJECT

APRIL 1992 TECHNICAL HIGHLIGHTS AND STATUS REPORT

TABLE OF CONTENTS

1.2.1 Systems

- WBS 1.2.1.1 Management and Integration
- WBS 1.2.1.2.4 Systems Engineering Implementation (Revelli)
- WBS 1.2.1.2.6 YMP Support to MSIS (Ruffner)
- WBS 1.2.1.3.5 Technical Database Input (Revelli)

Performance Analyses (Halsey)

- WBS 1.2.1.4.2 Waste Package Performance Assessment (Halsey)

Geochemical Modeling

- WBS 1.2.1.4.5 Geochemical Modeling & Database Development (Wolery/Johnson)
- WBS 1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses

1.2.2 Waste Package

- WBS 1.2.2.1 Management and Integration

Waste Package Environment (Wilder)

- WBS 1.2.2.2.1 Chemical & Mineralogical Properties of the Waste Package (Glassley)
- WBS 1.2.2.2.2 Hydrologic Properties of Waste Package Environment (Buscheck)
- WBS 1.2.2.2.3 Mechanical Attributes of the Waste Package Environment (Blair)
- WBS 1.2.2.2.4 EBS Field Tests (Lin)

Waste Form & Materials Testing (Stout/Clarke)

- WBS 1.2.2.3.1.1 Waste Form Testing - Spent Fuel (Stout)
- WBS 1.2.2.3.1.2 Waste Form Testing - Glass (Bourcier)
- WBS 1.2.2.3.2 Metal Barriers (Clarke)
- WBS 1.2.2.3.4.1 Integrated Radionuclide Release: Tests and Models (Viani)
- WBS 1.2.2.3.4.2 Thermodynamic Data Determination (Silva)

Engineering & Systems Analyses (Ruffner/Clarke)

- WBS 1.2.2.4.1 Waste Package Design (Ruffner)
- WBS 1.2.2.4.2 Container Fabrication & Closure Development (Clarke)
- WBS 1.2.2.4.3 Container/Waste Package Interface Analysis (Ruffner)

1.2.5 Regulatory and Institutional

- WBS 1.2.5.2.1 NRC Interaction Support (Blink)
- WBS 1.2.5.2.2 Site Characterization Program (Blink)
- WBS 1.2.5.2.4 Technical Support Documentation (Blink)
- WBS 1.2.5.2.5 Study Plan Coordination (Blink)
- WBS 1.2.5.2.6 Semi-Annual Progress Reports (Campbell)

1.2.9 Project Management

- WBS 1.2.9.1.1 Management (Clarke)
- WBS 1.2.9.1.4 Records Management (Bryan)
- WBS 1.2.9.2 Project Control (Podobnik)
- WBS 1.2.9.3 Quality Assurance (Wolfe)

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

APRIL 1992

EXECUTIVE SUMMARY
(Items Proposed for Reporting in YMPO or OGD Reports)

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

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

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

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

- 1) high burnup fuel (>60 MWd/kgM) with strong rim effect,
- 2) low fission gas release (<10%), high burnup fuel,
- 3) low fission gas release (<10%), low burnup fuel,
- 4) burnable poison fuel (5 to 8 wt% Gd₂O₃) with relatively high burnup, and
- 5) high fission gas release BWR fuel.

1.2.1 SYSTEMS

1.2.1.1 Management and Integration

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

1.2.1.2 Systems Engineering

1.2.1.2.4 Systems Engineering Implementation

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

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

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

1.2.1.2.6 YMP Support to Management Systems Improvement Strategy

No significant activities.

1.2.1.3 Technical Data Base Management

1.2.1.3.5 Technical Data Base Input

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

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

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

1.2.1.4 Performance Assessment

1.2.1.4.2 Waste Package Performance Assessment

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

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

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

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

1.2.1.4.5 Geochemical Modeling and Data Base Development

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

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

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

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

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

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

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

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

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

1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses

This WBS element has not been funded in FY92.

1.2.2 WASTE PACKAGE

1.2.2.1 Management and Integration

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

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

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

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

1.2.2.2 Waste Package Environment

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

1.2.2.2.1 Chemical and Mineralogical Properties of the Waste Package Environment

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

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

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

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

1.2.2.2 Hydrologic Properties of the Waste Package Environment

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

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

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

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

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

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

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

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

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

1.2.2.2.3 Mechanical Attributes of the Waste Package Environment

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

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

1.2.2.2.4 Engineered Barrier System (EBS) Field Tests

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

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

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

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

1.2.2.3 Waste Form and Materials Testing

1.2.2.3.1 Waste Form

1.2.2.3.1.1 Waste Form Testing - Spent Fuel

Spent Fuel Oxidation

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

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

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

Spent Fuel Dissolution

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

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

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

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

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

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

Material Characterization Center (MCC) Support

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

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

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

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

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

Increased MCC Hot Cell Costs

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

1.2.2.3.1.2 Waste Form Testing - Glass

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

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

1.2.2.3.2 Metal Barriers

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

1.2.2.3.3 Other Materials

This WBS element has not been funded in FY92.

1.2.2.3.4 Integrated Testing

1.2.2.3.4.1 Integrated Radionuclide Release

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

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

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

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

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

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

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

Preliminary Transmission Electron Microscopy (TEM) analysis of the particles in fluids from the UO₂ leaching experiment indicated that some of these particles may be contaminants. Work is continuing on identifying the source of contamination.

G-20-6 Source Term Development

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

1.2.2.3.4.2 Thermodynamic Data Determination

This WBS element has not been funded in FY92.

1.2.2.3.5 Nonmetallic Barrier Concepts

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

1.2.2.4. Design, Fabrication, and Prototype Testing

1.2.2.4.1 Waste Package Design

This WBS element has not been funded in FY92.

1.2.2.4.2 Container Fabrication and Closure Development

This WBS element has not been funded in FY92.

1.2.2.4.3 Container/Waste Package Interface Analysis

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

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

1.2.5 REGULATORY AND INSTITUTIONAL

1.2.5.2 Licensing

1.2.5.2.1 NRC Interaction Support

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

1.2.5.2.2 Site Characterization Program

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

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

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

1.2.5.2.4 Technical Support Documentation

No significant activities.

1.2.5.2.5 Study Plan Coordination

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

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

1.2.5.2.6 Semi-Annual Progress Reports

No significant activities.

1.2.9 PROJECT MANAGEMENT

1.2.9.1 Management and Integration

1.2.9.1.1 Management

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

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

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

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

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

1.2.9.1.4 Records Management

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

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

1.2.9.2 Project Control

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

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

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

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

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

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

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

committee in FY93 project planning, budgeting and scheduling procedures; subcommittee roles; and transition of tasks to the M&O.

1.2.9.3 Quality Assurance

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

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

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

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

Activity Plan D-20-53b-0-3 Change Notice, Flow Through Dissolution Tests on UO₂, was finalized and distributed on April 3.

Quality Procedure Change Notice 1.0-2-2, Organization, was completed and distributed.

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

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